PRG

MBOX® MEDIA SERVER

USER MANUAL (rev. N)

Mbox® Media Server v4.4.3 User Manual
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Notable changes from Mbox v3.x

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REVISION HISTORY

This manual has been revised as follows:

Version	Release Date	Notes
4.1 (revA)	February 14, 2017	Initial Release
4.1 (revB)	February 28, 2017	Rework Image Remapping, add .mblk & activerect
4.1 (revC)	March 2, 2017	Fix errors in parameter default values
4.2 (revD)	June 19, 2017	Mbox v4.2 release, multichannel audio, new effects, edit MediaTimeCodes.plist info, fix errors with Out Frame and Play Speed parameter values
4.2.1 (revE)	October 26, 2017	Fix typos in Image Remap section, mix property editing
4.2.2 (revF)	December 5, 2017	Fix network timecode input omissions
4.3 (revG)	August 31, 2018	Mbox v4.3 release, add Studio+, add multi-mix, add image remap pos/tex center, add NDI®, remove shutter blob mode, enhanced frame blend, more script info
4.3.2 (revH)	November 30, 2018	Clarify Blackmagic audio in/out, Mojave compatibility
4.3.3 (revJ)	April 8, 2019	Fix Mini patch layout, rework embedded audio, pixmap constant update
4.4 (revK)	July 11, 2019	Mbox v4.4 release, new licensing, prefs, playmodes, effects, transitions, blend modes, image remap controls
4.4.1 (revL)	October 14, 2019	New Mbox content folder location, audio in/out OS Default option, Adobe AAC caution, Control Channel HUD changes
4.4.2 (revM)	February 12, 2020	Remove reference to shutter blob mode, Active Silicon compatibility note
4.4.3 (revN)	January 15, 2021	Apple Silicon warning, Auto-sidecar, new FX, Image Seq. info, GS max size, NDI Output, Preferences tab reorder

INTRODUCTION

About This Guide

This user manual provides necessary information regarding the operation of the Mbox v4 Media Server software. This guide is provided to explain the features in the Mbox v4 software in detail. This manual covers all three versions of the Mbox application - Designer, Studio/Studio+, and Mini. Differences between the operation of the three versions of software are noted wherever applicable.

Studio+

Beginning with Mbox v4.3, the Mbox Studio software has an available feature upgrade package called "Studio+" in this manual and others. The Studio+ feature upgrade adds:

+ Additional video output pixels to a maximum of 8192x2160 (from 4096x2160)
+ Additional Pixel Mapping pixels to a maximum of 16,000 (from 8000)
+ Syphon output from layers (in addition to Syphon output from the Global Surface and outputs)
+ Additional Image Remapping configurations to a maximum of 16 (from 8)

Important Note About Control

The Mbox v4 software is designed to work with either the Mbox Director software or moving-light consoles. There is a new version of the Mbox Director software (v4) for controlling the Mbox v4 software. Mbox v4 will work with moving-light consoles having compatible profiles, including: PRG Vx76®, MA Lighting grandMA, High End Systems Hog® 4, Jands Vista, Compulite Vector, ETC EOS and Ion, and Elation M-Series.

Additional Documentation

For more information about DMX512 and sACN protocols, refer to the following documents available from the American National Standards Institute (ANSI) at www.ansi.org:

+ ANSI E1.11 - 2008 (R2013): Entertainment Technology - USITT DMX512-A, Asynchronous Serial Digital Data Transmission Standard for Controlling Lighting Equipment and Accessories
+ ANSI E1.31 - 2009: Entertainment Technology - Lightweight streaming protocol for transport of DMX512 using ACN

The above documents are also available in electronic format free for PLASA members at www.plasa.org

For more information about Art-Net, refer to the following document available from Artistic Licence Engineering at www.artisticlicence.com:

+ Specification for the Art-Net Ethernet Protocol

Customer Service

For technical assistance, contact the nearest PRG office. Contact information for all PRG offices can be found on our website at: www.prg.com

For Mbox support, contact: mboxsupport@prg.com For additional resources and documentation, please visit the Mbox website at: mbox.prg.com

Notes

1.

OVERVIEW

This chapter provides an overview of Mbox features and operations

+ **GENERAL OVERVIEW**
+ **MBOX ENVIRONMENT**
+ **FIXTURE AND LAYER OVERVIEW**
+ **FIXTURE DESCRIPTIONS**

GENERAL OVERVIEW

Features

Mbox allows advanced video playback and effects to be integrated into an automated lighting system. Powerful real time rendering, built-in effects, and interactive 3D objects provide tools for combining pre-recorded movies and still images to create visual imagery, which can be displayed by any projector, LED wall, plasma screen or LED lighting fixture.

The Mbox software can be programmed and operated from a moving light console, allowing ease of coordination between movie/image effects and lighting cues. Intricate Mbox sequences can be generated on site without the need for offline video processing, rendering, or editing. Media files are easy to add to the server for playback on demand.

The Mbox software runs on an Apple® Mac® computer controlled by Art-Net or sACN. All movies, still images and 3D objects are stored directly on the hard drive, allowing instant access to any file.

Mbox Software Features

+ Flexible output configurations, up to 32 outputs (Number of outputs is affected by connected hardware.)

+ Accepts live video input with optional PCIe cards, Blackmagic UltraStudio Thunderbolt, and USB/Firewire devices.

+ 4K HD Video playback. (Playback resolutions are limited only by the capability of the computer hardware.)

+ Adjustable camera perspective for 3D objects. (Designer only). Adjustable lighting for 3D objects. (Designer and Studio)

+ Up to twenty-four interactive, scalable layers that can be configured as backgrounds or 3D objects.

+ Digital gobos that can be used as backgrounds, masks, or for advanced layer blending effects.

+ Pixel mapping with Group Mastering and Merging.

+ Mapping of textures (movies or still images) to 3D objects and digital gobos.

+ Real-time crossfades and transitions between movies or images on the same layer.

+ Over 125 Effects that can be used in combination.

+ User-configurable output aspect ratio and resolution control.

+ Control by Art-Net, sACN, or Mbox Director.

Version Comparison - Designer/Studio/Mini

	Mbox Designer	**Mbox Studio**	**Mbox Studio+**	**Mbox Mini**
Playback Layers	24	12	12	6
Outputs/Output Masters	32/32	32/8	32/8	32/6
Maximum Output Size*	Unlimited	8.8 million pixels	17.6 million pixels	4.6 million pixels
Video Inputs	8	4	4	2
Syphon In/Out	12/Layers & Outputs	4/Outputs Only	4/Layers & Outputs	2/Outputs Only
Pixel Mapping Pixels	Unlimited	8000	16,000	3600
Effects: Master/Layer	2/4	1/2	1/2	1/1
Image Remapping	255 Configurations	8 Configurations	16 Configurations	2 Configurations
2D/3D Content	65535/65535	65535/255	65535/255	65535/255

* Actual output size limit depends on hardware performance

Concepts of Operation

Basic Function

The basic function of Mbox is to control dynamic media - such as movie clips, still images and 3D objects - during a visual production. The resulting visual imagery is output to a display device such as a projector, LED wall, LCD screen, or lighting fixture. Media can be manipulated on the fly, allowing changes to be made during the actual performance and immediately seen. This eliminates the need to modify media in advance, which can take considerable time.

Control

Mbox can be controlled by either a lighting console or a personal computer running Mbox Director software. The console or computer can be used to configure and control all aspects of the Mbox media and playback parameters.

+ **Console** - Since a lighting console would typically be used in a stage production, this method is a convenient and logical way to consolidate all stage control elements into a single device.

+ **Mbox Director** - Mbox Director is a software application that allows control of Mbox from either another Macintosh computer or optionally from the same computer running Mbox - depending on the required performance of the Mbox software.

For instructions on using Mbox Director, refer to the separate Mbox Director User Manual (02.9800.0002.xx).

Primary Components

A typical Mbox system is made up of several different components that work together to achieve the final result. The following simplified diagram illustrates how the components work together:
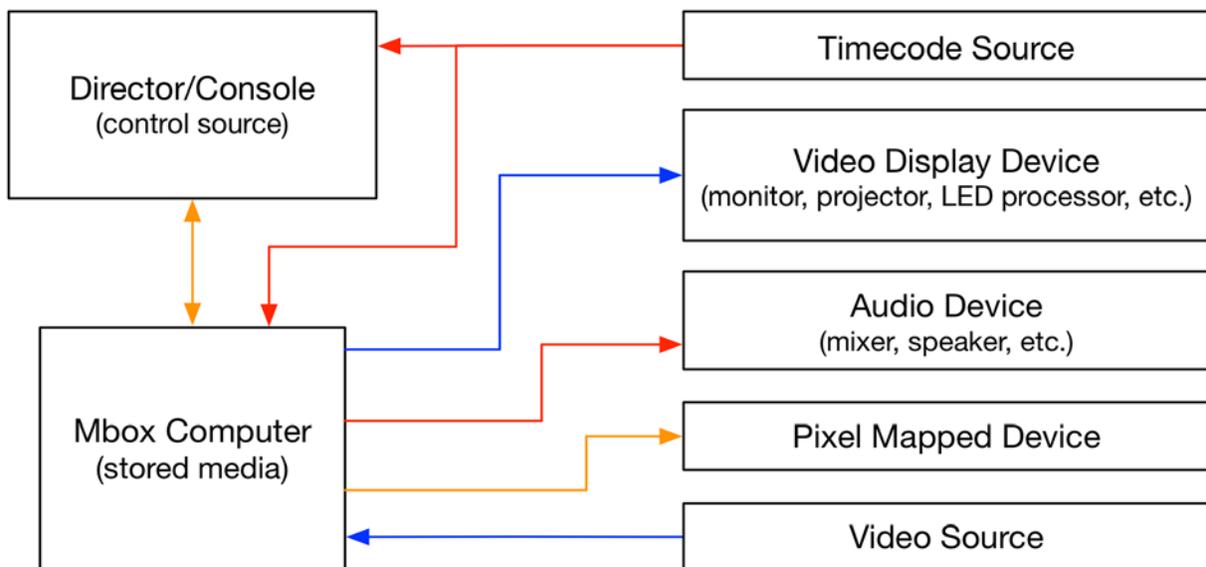
Mbox is a software product that requires a suitable Mac computer to achieve desired performance levels. The following items should be considered:

+ Operating System: Mac OS X 10.10 Yosemite or newer, 10.13 High Sierra and 10.14 Mojave are recommended.

+ Video Card (GPU): Better GPUs will allow for higher content/output resolutions without performance issues.

+ Hard Drive Configuration: Flash-based storage or SSDs (in RAID 0 configuration) provide the best performance. Rotational drives (e.g. 5400/7200rpm) should be avoided in all cases!

+ Processor Type, Number of Cores, and Speed: Mbox requires an Intel 64-bit processor (Intel Core 2 or better). For best results, the processor(s) should have at least six cores total, running at a speed of 2.5GHz or better.

MBOX ENVIRONMENT

Environment

In order to get the most from Mbox, it is important to understand the overall concept of the Mbox environment, which is essentially a building platform for "virtual scenery." The final "look" of this virtual scenery is comprised of multiple layers. These layers can be made up of backgrounds and 3D objects, all of which are controllable elements within the Mbox environment. Likewise, each of these elements has a set of controllable parameters such as color, texture, size, and rotation. When all combined, it provides an infinite number of possibilities for the virtual scenery.

At first, the interaction of these elements may seem complicated, but as they are broken down into individual components, they become similar to automated lighting parameters which should already be familiar. The only difference is that luminaire parameters coincide with physical hardware - e.g. a motor that controls an iris - while the Mbox parameters coincide with software elements. For example, just as a console would control a luminaire's beam color from a console encoder or keypad, it can control the color of an Mbox 3D object.

Once configured, the entire Mbox environment (i.e. the virtual scenery) can be output to any compatible video device connected to the machine.

The following illustration is a virtual representation of the elements within the Mbox environment. More detailed descriptions of each element are provided on subsequent pages.
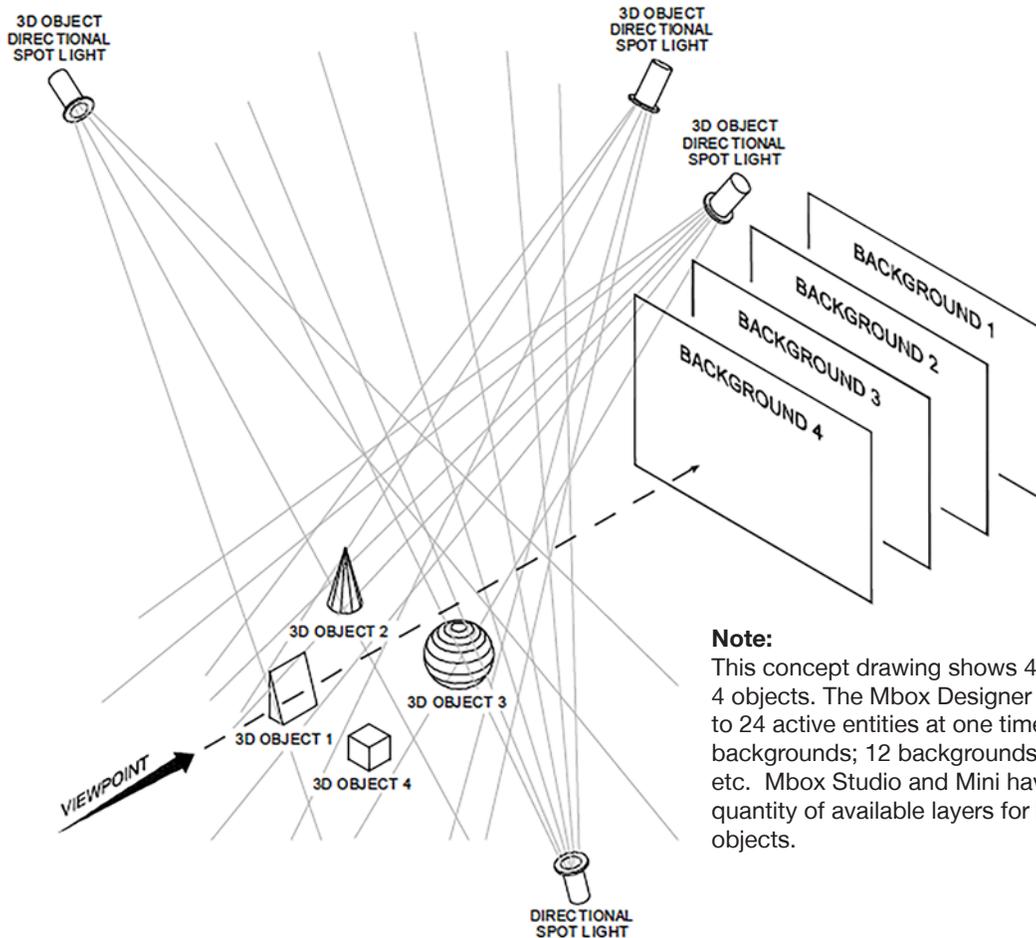
Note:
This concept drawing shows 4 backgrounds and 4 objects. The Mbox Designer system allows up to 24 active entities at one time. For example, 24 backgrounds; 12 backgrounds and 12 objects; etc. Mbox Studio and Mini have a different quantity of available layers for backgrounds and objects.
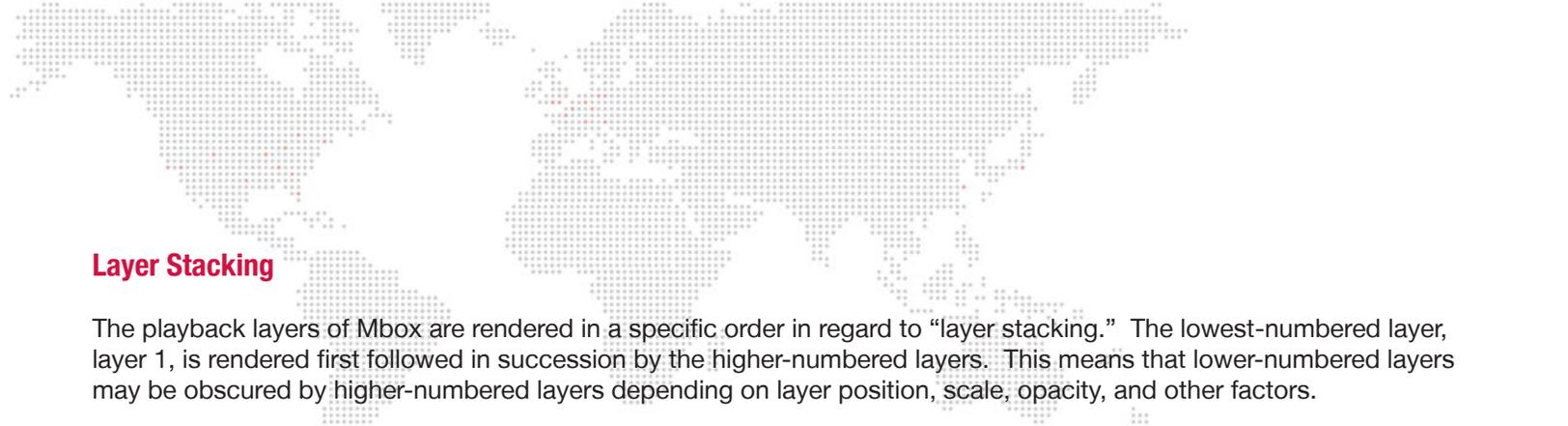
Layer Stacking

The playback layers of Mbox are rendered in a specific order in regard to "layer stacking." The lowest-numbered layer, layer 1, is rendered first followed in succession by the higher-numbered layers. This means that lower-numbered layers may be obscured by higher-numbered layers depending on layer position, scale, opacity, and other factors.

The layer stacking order in Mbox is fixed and unless a 3D object is used on a layer, the layer is considered to be a "background." If an object is used on a layer, that layer may be moved backwards and forwards along the Z axis in 3D space, allowing it to be moved in front of 3D objects on other layers. However, 3D objects cannot be moved behind layers that are acting as backgrounds, and likewise layers that are backgrounds cannot be moved in front of 3D objects.

If a layer is acting as a background and it becomes necessary to move it along the Z axis to place it in front of an object, then the layer must have an object selected. There are various ways of creating planar objects for such purposes.

Layer = Texture + Object

Each of the playback layers incorporates both Texture (2D) and Object (3D) functionality. The Texture element displays 2D elements such as still images and movies. The Object element displays 3D objects or digital gobos. The combination of the Texture and Object elements make up the final composition of each layer.

Effects and Transitions

Mbox Rendering Environment

Mbox loads each layer's raw imagery frame-by-frame onto an individual rendering context. After a frame of imagery has been loaded onto the context, applying an effect and/or transition can modify it. Layer effects are applied in sequential order, with Effect 2 being applied to the result of Effect 1 and so on. Transitions are applied at the final point in layer rendering as a mix between the outgoing and incoming content. All layers are then composited into a single context called the Global Surface, using the stacking order explained above, and then individual outputs are generated from designated areas of the Global Surface.

Effects

There are two types of effects in Mbox - Shaders (1-220) and Object Effects (221 and above). Both the shaders and object effects are available to be used on layers, but only the shaders work on output masters.

Shaders

When applied to a layer, Shaders only work within the original pixel boundaries of the content that has been selected on the layer. This means that a layer's shader-based effect cannot modify pixels on other layers, or beyond the original boundaries of the content. Therefore, the result of the shader will only be visible on content on that layer. As a result, some shader-based effects (e.g. wobble) will appear to have an invisible cropping frame around them.

+ When applied to the Master, shaders work within the boundaries of the entire screen and will affect everything visible on the screen.

+ Shaders are written as mathematical expressions that modify the properties of individual pixels in the source content. There are three basic manipulations (with infinite possibilities) that shaders can make: color, opacity, and position.

+ Shaders can be created by anyone and compiled for use on the Mac platform. They can then be imported for use with Mbox.
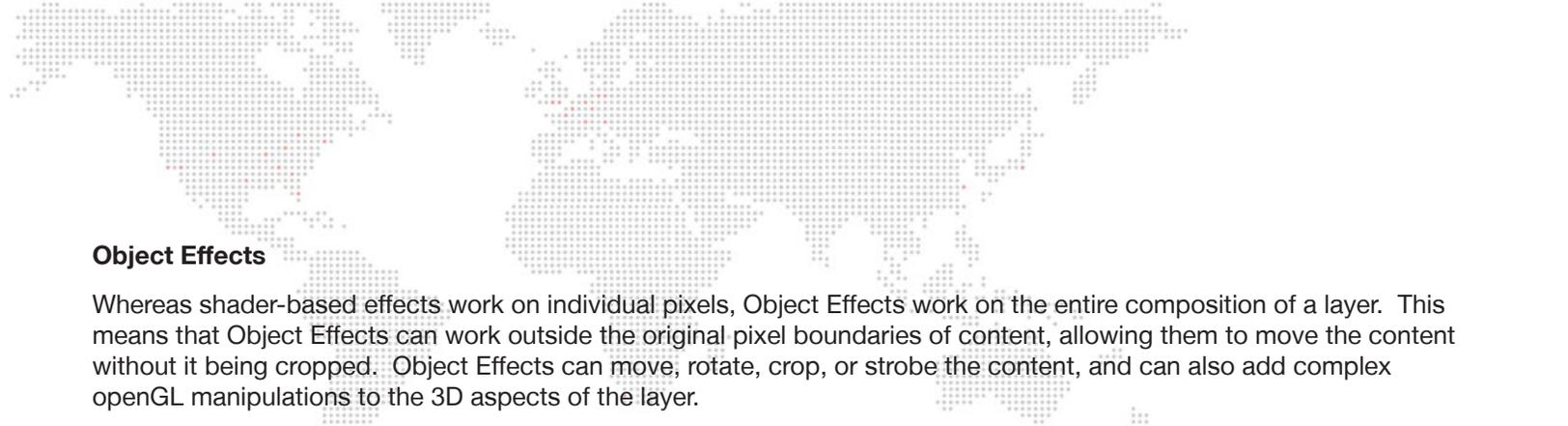
Object Effects

Whereas shader-based effects work on individual pixels, Object Effects work on the entire composition of a layer. This means that Object Effects can work outside the original pixel boundaries of content, allowing them to move the content without it being cropped. Object Effects can move, rotate, crop, or strobe the content, and can also add complex openGL manipulations to the 3D aspects of the layer.

Note: Object Effects must be created by PRG's Mbox Development Team.

Transitions

One of Mbox's most powerful features is its ability to perform a timed transition from one piece of content to another on the same layer. There are two types of transitions within Mbox - Built-in and Object Dissolve. There are about 60 different built-in transitions, but only one Object Dissolve. The built-in transitions are based on shaders, just like the majority of the layer effects.

Built-In

As with the shader-based Layer effects, the built-in transitions can only work within the original pixel boundaries of the layer's content. What this means is that if the outgoing and incoming content share the exact same pixel size the transition can work seamlessly. However, if the two pieces of content are different sizes, the transition will happen in a frame whose size is defined by that of the larger piece of content. In most cases this should be fine, as the majority of the built-in transitions still work well like this.

One consideration is that the built-in transitions may not work as desired when other parameters such as position, rotation, scale, etc. are modified at the same time as the content is changed. In such cases, the other parameters will change based on the cue timing, while the transition uses the transition timing parameter. This can mean that parameter changes can precede or lag behind the content transition.

Like effect shaders, built-in transitions can be created by anyone and imported for use in Mbox.

Note: Built-in transitions between different sizes of content will likely produce unexpected results when used with 3D objects.

Object Dissolve

The Object Dissolve transition type is special within Mbox. These transitions are not built-in shader-based transitions, but rather use Mbox's ability to support two playback/rendering engines on each layer. When an Object Dissolve transition is initiated, Mbox automatically begins an opacity crossfade between the two pieces of content, just like what might be performed manually using two different layers.

Because they work like a two-layer opacity crossfade, the Object Dissolve transitions can seamlessly move between content of different sizes and with different values for parameters like position, scale, rotation, and so on.

FIXTURE AND LAYER OVERVIEW

The Mbox environment is based on the concept of output masters and layers. Mbox supports up to 32 output masters and 24 active layers at a time (Studio and Mini have fewer layers and output masters), each having its own particular parameters. The parameters include settings such as opacity, texture, intensity, color, blending, rotation, and many more. The manner in which all playback layers are combined across one or more outputs results in the final "look" of the server's output.

For typical control purposes, component parts of Mbox are grouped into "fixtures" and patched on the console. Profiles for some consoles may choose to group the fixtures listed below differently. Each fixture is made up of one or more parameters which are then controlled by mapping them to channels on the console. An appendix at the end of this manual contains tables for all parameters used with the Mbox software.

The standard fixtures and their controllable parameters are outlined below. To help illustrate these concepts, an image of the corresponding Patch tab feedback data is shown. The Patch tab provides feedback regarding the values assigned to individual control parameters. The Patch tab will be covered in more detail later in this manual.

Note: The tables below show features and parameters that are not supported by all versions of the Mbox software. Refer to "Appendix C: Fixture Profile Reference" on page 183 for information on supported parameters.

GLOBAL

+ Fixture: Global Master

  - Global Intensity

  - HUD/Macro Control

  - Control Selector

  - Pixel Map Intensity

  - Global Volume

+ Fixture: Lighting (Designer/Studio only)

  - Intensity

  - Red

  - Green

  - Blue

  - Ambience

  - Horizontal Bearing

  - Vertical Bearing

Fixture Patch

▼Global Master	Univ: 0	Addr: 1 to 50	Source IP: 127.0.0.1 (Local)

parameter	address offset	master 0.1
Global Intensity	0	255
HUD / Ctrl	1	0
Ctrl Selector	2	0
Pix Intensity	3	255
Global Volume	4	255
Ints	5	0
Red	6	255
Green	7	255
Blue	8	255
Ambience	9	0
H Bearing	10	32767
V Bearing	12	32767
Ints	14	0
Red	15	255
Green	16	255
Blue	17	255
Ambience	18	0
H Bearing	19	32767
V Bearing	21	32767
Ints	23	0
Red	24	255
Green	25	255
Blue	26	255
Ambience	27	0
H Bearing	28	32767
V Bearing	30	32767
Ints	32	0
Red	33	255
Green	34	255
Blue	35	255
Ambience	36	0
H Bearing	37	32767
V Bearing	39	32767
Ints	41	0
Red	42	255
Green	43	255
Blue	44	255
Ambience	45	0
H Bearing	46	32767
V Bearing	48	32767

Color Indications:

+ Green - at default value

+ Yellow - not at default value

OUTPUT MASTER

+ **Fixture:** Output Master
  - Output Intensity
  - Color Mix - Red, Green, Blue
  - Brightness and Contrast

+ **Sub-Fixture:** Output Effect
  - Effect Selector
  - Modifiers - A, B, C, D, E

+ **Fixture:** Output Camera (Designer only)
  - Enable Projection Camera
  - Camera Position X, Y, Z
  - Lookat Position X, Y, Z
  - Field of View
  - Roll

+ **Fixture:** Output Geometry (Designer/Studio only)
  - Output Position X, Y
  - Output Scale
  - Output Rotation
  - Mix Offset X, Y

+ **Fixture:** Output Keystone (Limited in Studio/Mini)
  - Keystone Mode/Curve
  - Gamma
  - Edge - Top, Bottom, Right, Left
  - Keystone Corners (8)
  - Linearity X, Y

+ **Fixture:** Output Shutter (Limited in Studio/Mini)
  - Shutter Mode/Shape
  - Shutter Color - Red, Green, Blue
  - Shutter Controls (8)
  - Shutter X, Y
  - Shutter Scale
  - Shutter Rotation
  - Shutter Damping

▼Outputs 1	Univ: 0	Addr: 51 to 143	Source IP: 127.0.0.1 (Local)
parameter	address offset	output 1 0.51	
Intensity	0	255	
Red	1	127	
Green	2	127	
Blue	3	127	
Brightness	4	127	
Contrast	5	127	
Effect 1	6	0	
FX1 Ctrl a	7	0	
FX1 Ctrl b	8	0	
FX1 Ctrl c	9	0	
FX1 Ctrl d	10	0	
FX1 Ctrl e	11	0	
Effect 2	12	0	
FX2 Ctrl a	13	0	
FX2 Ctrl b	14	0	
FX2 Ctrl c	15	0	
FX2 Ctrl d	16	0	
FX2 Ctrl e	17	0	
Use Proj Cmra	18	0	
Position X	19	32767	
Position Y	21	32767	
Position Z	23	42767	
LookAt X	25	32767	
LookAt Y	27	32767	
LookAt Z	29	32767	
Field of View	31	71	
Roll	32	32767	
Output Posn X	34	32767	
Output Posn Y	36	32767	
Output Scale	38	32767	
Output Rot	40	32767	
Mix Offset X	42	32767	
Mix Offset Y	44	32767	
Curve	46	0	
Gamma	47	127	
Edge Top	48	0	
Edge Right	49	0	
Edge Bottom	50	0	
Edge Left	51	0	
Key 1x	52	32767	
Key 1y	54	32767	
Key 2x	56	32767	
Key 2y	58	32767	
Key 3x	60	32767	
Key 3y	62	32767	
Key 4x	64	32767	
Key 4y	66	32767	
Linearity X	68	32767	
Linearity Y	70	32767	
Shape	72	0	
Red	73	0	
Green	74	0	
Blue	75	0	
Edge	76	0	
Shutter 1a	77	0	
Shutter 1b	78	0	
Shutter 2a	79	0	
Shutter 2b	80	0	
Shutter 3a	81	0	
Shutter 3b	82	0	
Shutter 4a	83	0	
Shutter 4b	84	0	
Shutter X	85	32767	
Shutter Y	87	32767	
Scale	89	65535	
Shutter Rot	91	127	
Shutter Damp	92	0	

LAYER

+ **Fixture:** Layer (Limited in Studio/Mini)

  - Opacity

  - Color Mix - Red, Green, Blue

  - Brightness and Contrast

  - 2D Texture Folder and File

  - Play Mode and Speed

  - In and Out Frame

  - Sync Stream and Offset

  - Aspect

  - Frame Blending

  - Texture Xfade Type and Time

  - 3D Object Folder and File

  - Position X, Y, Z

  - Scale (overall)

  - Scale X, Y, Z

  - Rotation X, Y, Z

  - Spin X, Y, Z

  - Mix Select and Mode

  - Blend Mode

  - Draw Mode

  - Image Remapping Configuration

+ **Sub-Fixture:** Layer Effect

  - Effect Selector

  - Modifiers - A, B, C, D, E

+ **Sub-Fixture:** Layer Volume

  - Volume

+ **Sub-Fixture:** Layer DMX Timecode

  - Hours

  - Minutes

  - Seconds

  - Frames

Layers 1-6	Univ: 1	Addr: 1 to 486		Source IP: 127.0.0.1 (Local)			
parameter	address offset	layer 1 1.1	layer 2 1.82	layer 3 1.163	layer 4 1.244	layer 5 1.325	layer 6 1.406
Opacity	0	255	0	0	0	0	0
Red	1	127	127	127	127	127	127
Green	2	127	127	127	127	127	127
Blue	3	127	127	127	127	127	127
Brightness	4	127	127	127	127	127	127
Contrast	5	127	127	127	127	127	127
Library	6	1	0	0	0	0	0
File	7	1	0	0	0	0	0
Play Mode	8	0	0	0	0	0	0
Play Speed	9	127	127	127	127	127	127
In Frame	10	0	0	0	0	0	0
Out Frame	12	65535	65535	65535	65535	65535	65535
Sync Stream	14	0	0	0	0	0	0
Sync Offset	15	127	127	127	127	127	127
Aspect	16	0	0	0	0	0	0
Frame Blend	17	255	255	255	255	255	255
xFade Type	18	0	0	0	0	0	0
xFade Time	19	0	0	0	0	0	0
Obj Library	20	0	0	0	0	0	0
Object	21	0	0	0	0	0	0
Object xFade	22	0	0	0	0	0	0
Obj xFade Time	23	0	0	0	0	0	0
X Position	24	32767	32767	32767	32767	32767	32767
Y Position	26	32767	32767	32767	32767	32767	32767
Z Position	28	32767	32767	32767	32767	32767	32767
Scale	30	32767	32767	32767	32767	32767	32767
X Scale	32	32767	32767	32767	32767	32767	32767
Y Scale	34	32767	32767	32767	32767	32767	32767
Z Scale	36	32767	32767	32767	32767	32767	32767
Z Rotate	38	32767	32767	32767	32767	32767	32767
X Rotate	40	32767	32767	32767	32767	32767	32767
Y Rotate	42	32767	32767	32767	32767	32767	32767
Z Spin	44	127	127	127	127	127	127
X Spin	45	127	127	127	127	127	127
Y Spin	46	127	127	127	127	127	127
Mix Select	47	0	0	0	0	0	0
Mix Mode	48	0	0	0	0	0	0
Blend Mode	49	0	0	0	0	0	0
Draw Mode	50	0	0	0	0	0	0
Image Remap	51	0	0	0	0	0	0
Effect 1	52	0	0	0	0	0	0
FX1 Ctrl a	53	0	0	0	0	0	0
FX1 Ctrl b	54	0	0	0	0	0	0
FX1 Ctrl c	55	0	0	0	0	0	0
FX1 Ctrl d	56	0	0	0	0	0	0
FX1 Ctrl e	57	0	0	0	0	0	0
Effect 2	58	0	0	0	0	0	0
FX2 Ctrl a	59	0	0	0	0	0	0
FX2 Ctrl b	60	0	0	0	0	0	0
FX2 Ctrl c	61	0	0	0	0	0	0
FX2 Ctrl d	62	0	0	0	0	0	0
FX2 Ctrl e	63	0	0	0	0	0	0
Effect 3	64	0	0	0	0	0	0
FX3 Ctrl a	65	0	0	0	0	0	0
FX3 Ctrl b	66	0	0	0	0	0	0
FX3 Ctrl c	67	0	0	0	0	0	0
FX3 Ctrl d	68	0	0	0	0	0	0
FX3 Ctrl e	69	0	0	0	0	0	0
Effect 4	70	0	0	0	0	0	0
FX4 Ctrl a	71	0	0	0	0	0	0
FX4 Ctrl b	72	0	0	0	0	0	0
FX4 Ctrl c	73	0	0	0	0	0	0
FX4 Ctrl d	74	0	0	0	0	0	0
FX4 Ctrl e	75	0	0	0	0	0	0
Layer Volume	76	255	255	255	255	255	255
Hours	77	24	0	0	0	0	0
Minutes	78	0	0	0	0	0	0
Seconds	79	0	0	0	0	0	0
Frames	80	0	0	0	0	0	0

For complete parameter maps, refer to "Fixture Parameter Data" on page 192.
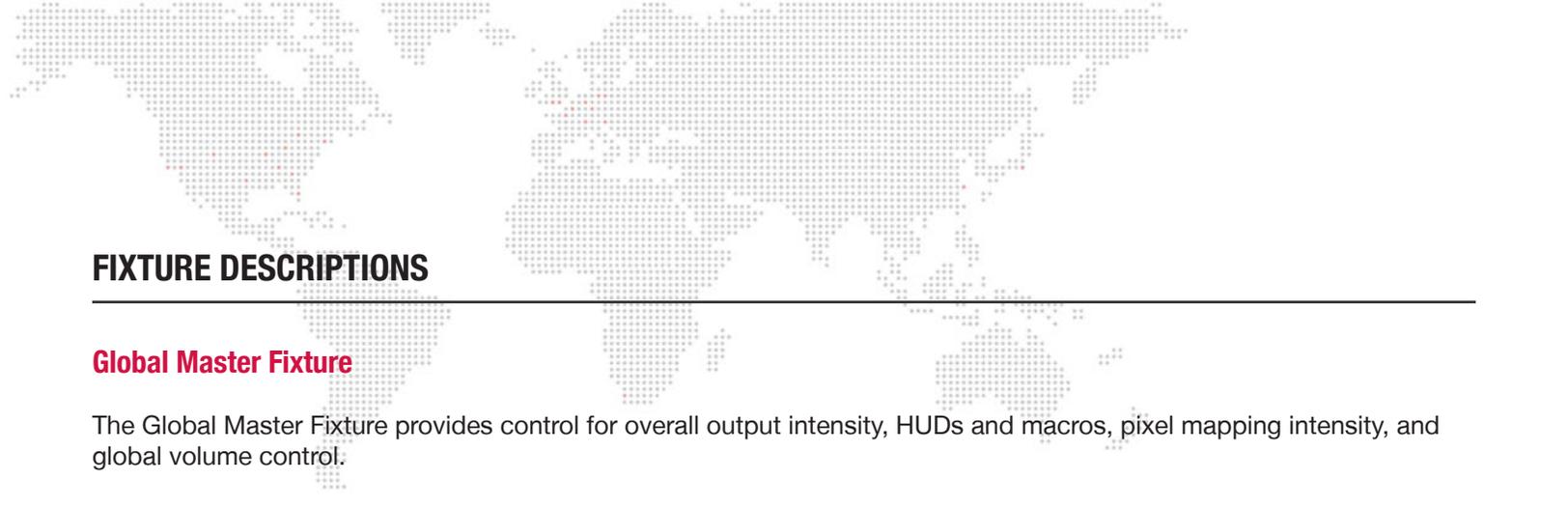
FIXTURE DESCRIPTIONS

Global Master Fixture

The Global Master Fixture provides control for overall output intensity, HUDs and macros, pixel mapping intensity, and global volume control.

Intensity

The Global Master Intensity masters the intensity of all outputs from the Mbox software, regardless of Output Master Intensity. The Global Master Intensity will affect the hardware dimming state if an Mbox Dual IO Module is connected to the computer. If no IO Module is connected, or if the Software Dimming preference is enabled, the Global Master Intensity will perform the dimming inside the Mbox rendering. In Window Mode, the Global Master Intensity has no effect.

HUD/Macro Control and Control Selector

The Global Master's HUD/Macro Control parameter allows for the selection of various HUDs to display on-screen and for macros to be run. The Control Selector is used with the Control parameter to apply a modifying value to specific macros.

Pixel Mapping Intensity

The Pixel Mapping Intensity parameter masters the output levels of all pixel mapping output from the server, whether that output has separate group mastering or not.

Volume

The Volume parameter masters the output volume of all audio playback from the server.

Lighting Fixture

The Lighting Fixtures are used to provide adjustable lighting for 3D objects within the 3D environment of Mbox Designer and Studio. Mbox Mini has lighting for 3D objects, but it is not adjustable.

Intensity

Each Lighting Fixture has adjustable intensity.

Color

Each Lighting Fixture has Red, Green, and Blue subtractive color mixing.

Ambience

The beam spread ("ambience") of each Lighting Fixture is adjustable from fully ambient to tight spot.

Horizontal and Vertical Bearing

The location of each Lighting Fixture is adjustable in a 360° arc around the center of the 3D environment. Lighting Fixtures always point at the center of the 3D environment.

Output Master Fixture

The Output Master Fixture provides controls for mastering intensity, color, brightness, and contrast for the output(s) assigned to it.

Intensity

The Output Master Intensity parameter allows for mastering of the intensity of the output(s) the master is assigned to. It does not affect the intensity of other outputs or the Global Master Intensity.

Color, Brightness, and Contrast

Red, Green and Blue color parameters present in the output may be adjusted in both a subtractive and additive fashion. The Brightness and Contrast of the imagery on the output may also be adjusted.

Output Effects

The Output Effects are pulled from the shader-based texture effects (1-200) that may be used on each layer. The effect will be applied only across the imagery in the output, not affecting imagery on layers or other outputs. Each output effect has five modifiers.

Output Camera Fixture

In Mbox Designer, the Output Camera modifies the 3D perspective viewpoint for only the output(s) it is applied to, allowing a virtual camera position and look-at point for that camera. 3D objects that are visible within the boundaries of the output will be rendered using the perspective of the camera. With default values, the camera is located at a point 10 units in front (0,0,10) of the center of Mbox's 3D space, and is focused on the center of that 3D space (0,0,0).

Enable Projection Camera

The Enable parameter acts as an on/off control to switch between the DMX controlled camera parameters and camera properties defined using the Mbox Remote application.

Position

The Camera Position parameters move the camera's position in 3D space.

Look-at

The Camera Look-at parameters move the point at which the camera is aimed in 3D space. By default this is the center of 3D space (0,0,0).

Field of View

The Field of View parameter is analogous to setting the narrow vs. wide adjustment of a lens. Rather than simply scaling the image – making it large or smaller – FOV will also affect the perspective of objects in view.

Roll

The Roll parameter adjusts the rotation of the camera viewpoint around an axis drawn through the lens of the camera.

Note: Multiple outputs can each have a camera applied to them, allowing for projection mapping onto multiple objects, or onto the same object but from different perspectives.

Output Geometry Fixture

The Output Geometry Fixture parameters may be used to modify supplemental 2D rendering parameters for the assigned output(s) only, not affecting any other outputs from the server. None of the output geometry controls affect the 3D perspective of objects rendered on the output.

Output Position

The Output Position parameters move the imagery within the output left/right and up/down using 16-bit control. These controls may be used to quickly adjust the 2D position of composited imagery within the output. However, since outputs only render imagery that "belongs" to them, any area outside the original rendering boundaries of the output will not be rendered when the output position is adjusted. Meaning that those areas will be black. The output position controls are most useful when the output scale parameter has been set above the default. Use the Mix Offset controls instead to allow imagery from outside the original rendering boundaries to be seen.

Output Scale

The Output Scale parameter may be use to scale down/up the imagery within the output. As with the output position controls, only the imagery within the output's original boundaries will be scaled.

Output Rotation

The Output Rotation parameter rotates the imagery within the output. As with the output position and scale controls, only the imagery within the output's original boundaries will be rotated.

Mix Offset

The Mix Offset parameters work in the same manner as adjusting the output's position on the Global Surface on the Outputs tab of the Mbox application. These controls are scaled so that one "tick" of DMX is equal to one onscreen pixel, meaning that the controls can be used for extremely precise, pixel-accurate offsets. Unlike the output position controls, the mix offset controls do allow imagery from outside the output's original boundaries to be moved into view. This is because these controls effectively move the output's boundaries.

Output Keystone Fixture

The Output Keystone Fixture parameters are used to enable and modify keystone and edge-blending parameters for the assigned output(s) only, not affecting any other outputs from the server. Mbox Mini has reduced keystone functionality when compared to Designer and Studio.

Curve

The Curve parameter enables the DMX keystone controls (as opposed to using the keystone/warp tools in Mbox Remote's projection editor), selects which edge blend curve (Linear/Raised Cosine/Sine) is used, and also enables an overlay grid to assist with keystone setup. The Linear blend curve is recommended for most normal usage.

Gamma

The Keystone Gamma parameter affects the overall brightness of the edge blend area, allowing for better blending with overlaid projector outputs.

Edge Controls

Each of the four output Edge Control parameters affects the position of the edge blend area on the corresponding side of the output. The output edge blend begins at the outside edge of the image and may be moved inwards towards the center of the image. Edge blends follow the angle of the corresponding side of the image, as adjusted by the corner controls (see below).
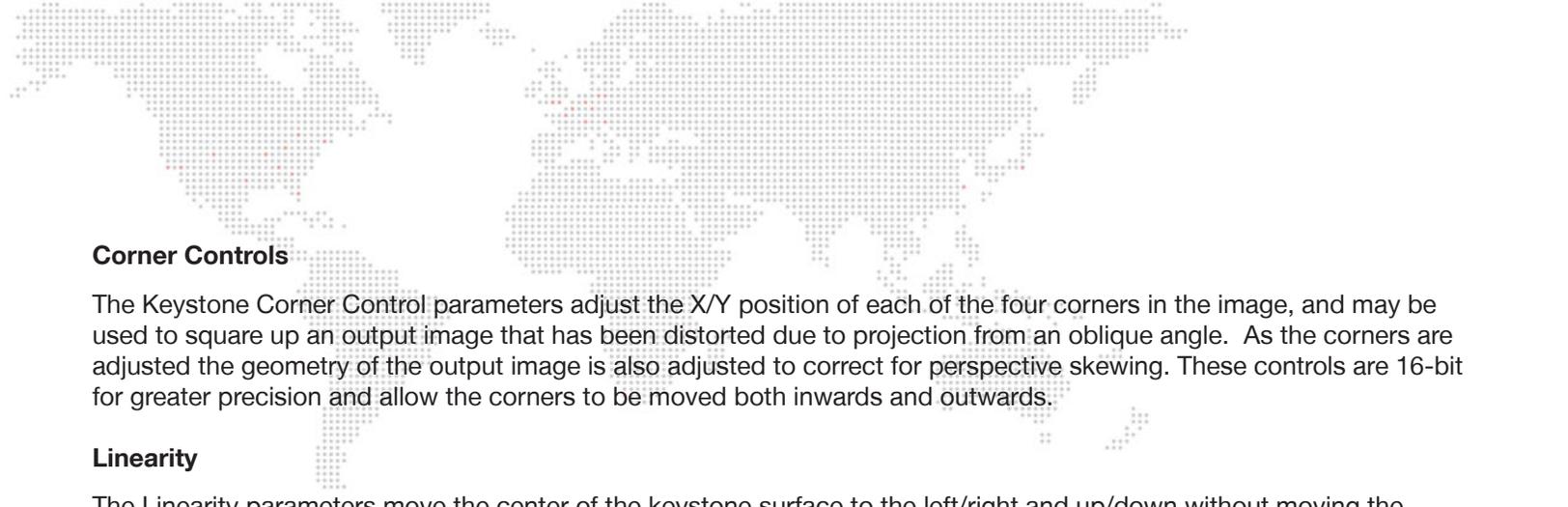
Corner Controls

The Keystone Corner Control parameters adjust the X/Y position of each of the four corners in the image, and may be used to square up an output image that has been distorted due to projection from an oblique angle. As the corners are adjusted the geometry of the output image is also adjusted to correct for perspective skewing. These controls are 16-bit for greater precision and allow the corners to be moved both inwards and outwards.

Linearity

The Linearity parameters move the center of the keystone surface to the left/right and up/down without moving the corners, allowing the output image to have compensation for oblique projection angles where some pixels become larger than others due to a greater distance from projector to projection surface.

Note: Keystone and Warp for outputs can also be pre-set using the Mbox Remote application. Refer to the Mbox Remote manual for more details.

Output Shutter Fixture

The Output Shutter Fixture may be used to apply 2D shuttering that can obscure portions of the output, but which does not affect any other outputs from the server. The shutters can be thought of as sitting between the composited imagery of the output and the virtual camera that provide the view of the imagery. Both Mbox Studio and Mini have reduced shutter functionality when compared to Designer.

Shape

The Shutter Shape parameter enables the shutter controls and selects which shape (Moving Light/Leko/Iris) is used. The Moving Light mode is recommended for most normal usage, where individual sides of the output image need to be cropped.

Note: The default value for the Shutter Shape parameter is 0, which turns the shutters off. This parameter must be set to one of the three shapes for the shutters to work.

Color

The Shutter Color parameters allow an additive RGB color to be applied to the shutter blades. All four shutter blades share the same color.

Shutter Edge

The Shutter Edge parameter adds a blur to help soften the leading edge of the shutters so as to aid in creating a more subtle shuttering result or to create a vignette effect. The softened edge of the shutter is centered on the line of the original shutter edge.

Shutter Controls

When using the Moving Light shape, the Shutter Controls adjust the position of each end of each shutter blade. When using the Leko shape, these controls are used to set shutter Insertion (the A control) and angle (the B control). The shutter controls have no effect when using the Iris shutter shape.

Shutter Position

The Shutter Position parameter allows the shutter blades may be moved as a unit left/right and up/down without affecting their position relative to each other.
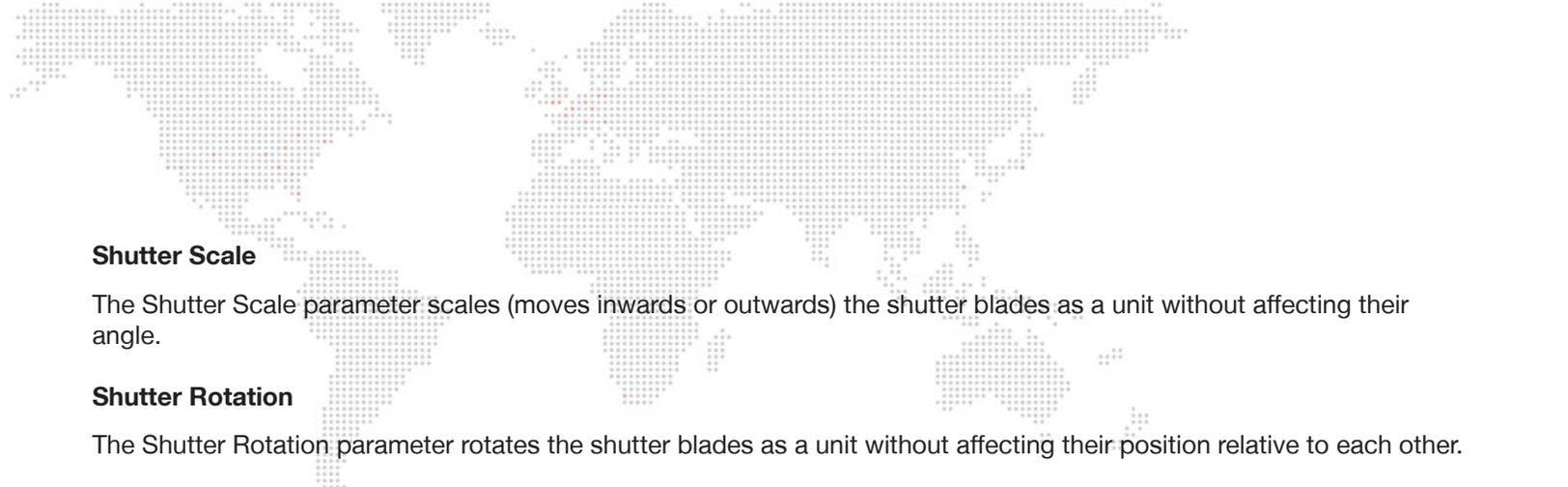
Shutter Scale

The Shutter Scale parameter scales (moves inwards or outwards) the shutter blades as a unit without affecting their angle.

Shutter Rotation

The Shutter Rotation parameter rotates the shutter blades as a unit without affecting their position relative to each other.

Shutter Damping

Similar to the motor speed control on a moving light, the Shutter Damping parameter allows a smoothing action to be applied to shutter movement. The damping may be used to counteract the "steppy" motion if the shutter blades are moved using live control from a DMX source. The shutter damping parameter acts in 30th's of a second increments, adding time to an existing crossfade when applied.

Layer Fixture

The Layer Fixture parameters are used to modify the properties of Texture (2D) and Object (3D) functionality on one of Mbox Designer's 24 layers. The Texture element displays 2D content such as stills and movies, while the Object element displays 3D content such as digital gobos and objects. Each layer may combine 2D and 3D functionality to create the final composite image on the layer. Both Mbox Studio and Mini have slightly reduced layer functionality when compared to Designer.

CAUTION! Even if not actively using 3D objects or digital gobos, there are object-related controls on each layer that can affect a texture on that layer (e.g., X & Y Scale, Z Rotation).

Opacity

The Layer Opacity parameter affects the transparency of content (2D and 3D) displayed on the layer.

Color, Brightness, and Contrast

Red, Green and Blue color parameters on the layer may be adjusted in both a subtractive and additive fashion. The Brightness and Contrast of the imagery on the layer may also be adjusted.

Texture Folder and File

The Texture Folder and File parameters select the location (using 8-bit numbering) of the 2D content displayed on the layer.

Play Mode and Speed

The Play Mode and Play Speed parameters adjust how movie content is played back (forwards, backwards, looping, synced to timecode, etc.) and how fast it plays (pause to 4x normal speed).

In and Out Frame

The In and Out Frame parameters are used to set the beginning and end playback points for movie content, allowing only the desired portion of a movie to be displayed, rather than its entirety.

Sync Stream and Offset

The Sync Stream and Sync Offset parameters are used with the sync playmodes (Layer Sync and/or Timecode Sync) to select the sync stream being output or received by the layer and to adjust the layer's playback offset from its sync source should it be listening to sync.

Aspect

The Aspect parameter allows the aspect ratio of textures <u>only</u> to be adjusted independently of the layer's X and Y Scale parameters, both of which will affect the sizing of objects.

Frame Blending

The Frame Blending parameter adjusts the level of crossfading between consecutive frames of a movie when its play speed has been reduced. Frame blending is used to make slowed-down playback appear to be smoother. Mbox v4.3 and beyond add optional Enhanced Frame Blending for better playback when the content framerate does not match the output frequency. Refer to "Frame Blending Control" on page 229 for more information.

Texture Xfade Type and Time

The Texture Xfade parameters select the crossfade type (wipe, dissolve, etc.) and crossfade time for 2D content on the layer.

IMPORTANT! Mbox can transition from one texture to another on the same layer. This feature makes Mbox both powerful and easy to use. The ability to transition on the same layer speeds up programming and can help in live situations. Different transition styles (e.g., dissolves, wipes, etc.) and timing for the Texture transition can be set on each layer. If a layer's transition time control is set above 0, Mbox will use the layer's current transition mode to change from one texture to the next in the time designated.

Object Folder and File

The Object Folder and File parameters select the location (using 8-bit numbering) of the 3D content displayed on the layer.

Position X, Y, Z

The Position X, Y, and Z parameters allow the position of content on a layer to be adjusted. Within Mbox's 3D environment, the X axis is left/right, the Y axis is down/up, and the Z axis is into/out of the screen. While the Position X and Y parameters can affect both textures and objects, the Position Z parameter can only affect objects.

CAUTION! The Position X and Y parameters have a default scaling factor applied to them. Depending on the width and height of the Global Surface, the scaling factor may not be sufficient to allow layers to be moved entirely off the Global Surface in one direction or another. The scaling factor can be adjusted - refer to "X/Y Position Scale" on page 54.

Scale

The Scale parameter affects the overall size of both textures and objects on a layer.

Scale X, Y, Z

The Scale X, Y, and Z parameters allow the size of content on a layer to be adjusted on a per-axis basis. While the Scale X and Y parameters can affect both textures and objects, the Scale Z parameter can only affect objects.

Rotation X, Y, Z

The Rotation X, Y, and Z parameters allow the rotation of content on a layer to be adjusted on a per-axis basis.

Spin X, Y, Z

The Spin X, Y, and Z parameters allow the size of content on a layer to be adjusted on a per-axis basis. While the Spin Z parameter can affect both textures and objects, the Spin X and Y parameters can only affect objects.

Mix Select and Mode

The Mix Select and Mix Mode parameters are used to assign the layer's rendering to a mix and to select which of the mix properties is assigned (centering, cropping, scaling, etc.)

Blend Mode

The Blend Mode parameter is used to select which blending mode (source over, additive, subtractive, etc.) is used when compositing the layer on top of lower numbered layers.

Draw Mode

The Draw Mode parameter is used to select the draw mode (stenciling) for the layer.

Image Remapping Configuration

The Image Remapping Configuration parameter is used to select from the available configurations for image remapping on the layer. Image remapping configurations are created on the Image Remap tab of Mbox or Mbox Remote.

Layer Effects

The Layer Effects are pulled from both the shader-based texture effects and the object effects. The effect will be applied only across the imagery in the layer, not affecting imagery on other layers. Each layer effect has five modifiers.

Layer Volume

The Layer Volume parameter affects the output volume of audio content on the layer, not affecting audio volume on other layers.

Layer DMX Timecode

The Layer DMX Timecode parameters may be used to apply a live timecode sync value to movie content on the layer when a timecode sync play mode is used. With all four parameters set to their default value of 0, the layer will use an alternate method for linking the file to timecode - e.g. the MediaInfo.plist file. Each parameter has a different allowable range: Hours = 23, Minutes = 59, Seconds = 59, Frames = 29.

2.

INSTALLATION

This chapter provides instructions for installing the Mbox software and launching the application for the first time.

+   **GETTING STARTED**
+   **PATCHING FIXTURES**
+   **DISPLAYING CONTENT (QUICKSTART)**
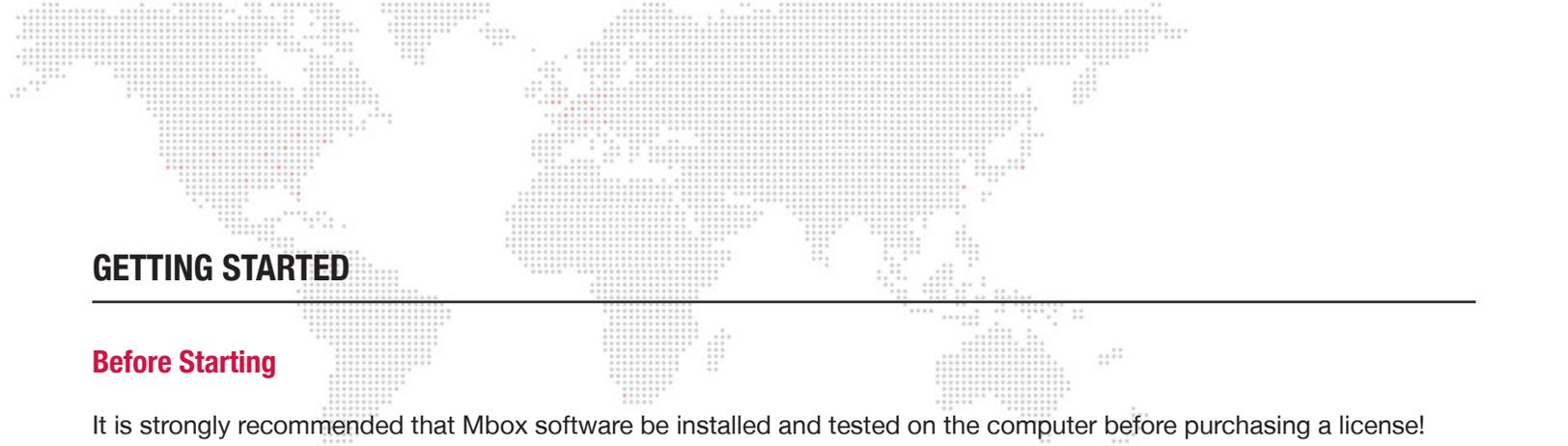
GETTING STARTED

Before Starting

It is strongly recommended that Mbox software be installed and tested on the computer before purchasing a license!

WARNING! The Mbox software is not yet fully compatible with Apple's new Apple Silicon processors and therefore may not run correctly on the newest Macintosh computers that use Apple Silicon.

Mbox requires at least macOS 10.9 and a minimum of 100MB on the Boot Drive plus additional space for content. **The user who** installs and runs **Mbox must have Admin rights on the computer and should be the** same **user!**

Note on Gatekeeper (for OS X 10.9+)

The Mbox applications and installers have been code-signed and notarized by PRG to ensure they are valid and have not been tampered with since their creation. Since the Mbox applications cannot be delivered by way of the Mac App Store, make sure that the computer's Gatekeeper settings will allow applications from approved developers to be installed and launched.

To ensure a successful installation, open the System Preferences > Security & Privacy pref pane and click on the General tab. Then make sure that the setting for "Allow apps downloaded from:" has either the "App Store and identified developers" button or the "Anywhere" button pressed.

Download locations:

+ The latest versions of Mbox software, USB License key drivers, manuals, training movies, and demo content can be found at: http://mbox.prg.com

+ From that main page, scroll to the bottom of the page to find the additional links for each product version, manuals, etc.

Installing Mbox Software

Overview

The Mbox installer will place files in several places on the computer. The user must have the necessary Admin rights to install software on that computer (with password authentication).

+ The Mbox software will be stored in the /Applications/Mbox Designer, /Applications/Mbox Studio, or /Applications/Mbox Mini folder as applicable

+ Utility applications will be stored in the /Applications/Mbox v4 Utilities folder

+ Thumbnail and web images will be stored in the /Library/Application Support/Mbox folder and its sub-folders

+ Support and preference files will be placed into the ~/Library/Application Support and ~/Library/Preferences folders

IMPORTANT!! Beginning with Mbox v4.4.1, the location of the default Mbox content folder has changed! This is because the old location (/Mbox) is not allowed in macOS 10.15 Catalina and beyond. See the next page for more information on this change.

Note: This manual uses file paths formatted like "Mbox/Media" or "Mbox/plugins". Paths using the 'Mbox' prefix resolve to the Mbox content folder. e.g. /Applications/Mbox/Media and /Applications/Mbox/plugins for the paths above.
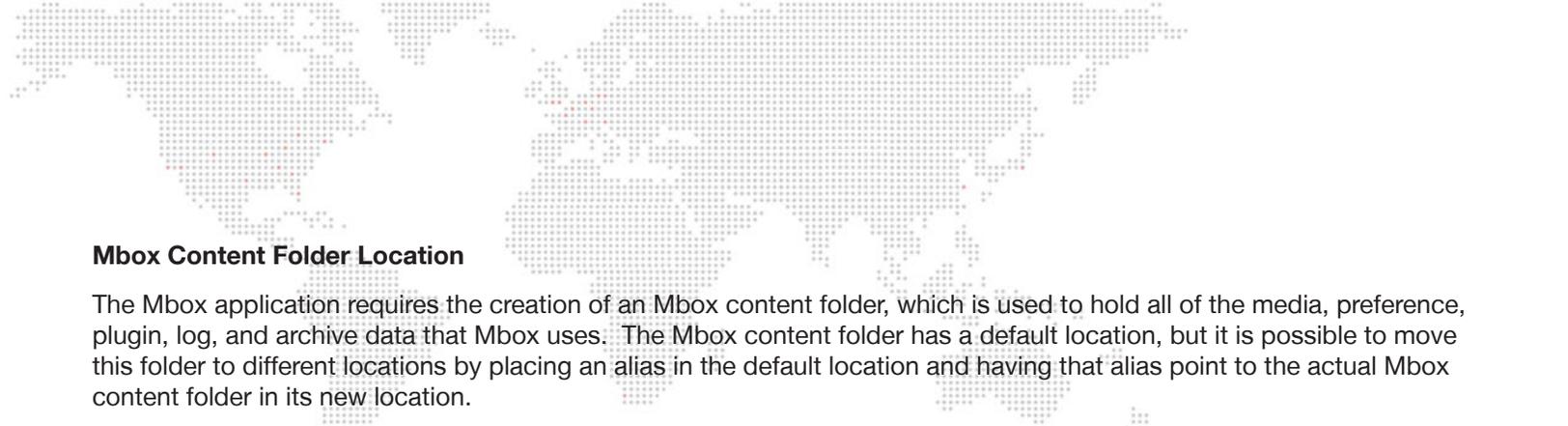
Mbox Content Folder Location

The Mbox application requires the creation of an Mbox content folder, which is used to hold all of the media, preference, plugin, log, and archive data that Mbox uses. The Mbox content folder has a default location, but it is possible to move this folder to different locations by placing an alias in the default location and having that alias point to the actual Mbox content folder in its new location.

Prior to Mbox v4.4.1, the Mbox content folder's default location was at the root of the computer's boot drive. Due to security restrictions starting with macOS 10.15 Catalina, this location can no longer be used. The root of the boot drive is no longer an writable location for users and the Mbox applications and installer cannot add or remove anything there. Therefore, to ensure forwards compatibility, the Mbox content folder must be moved to a new location starting with Mbox v4.4.1.

IMPORTANT! The Mbox content folder should be moved prior to upgrading to Catalina/Big Sur or installing the Mbox v4.4.1 software. If the computer is upgraded beyond Mojave with an existing Mbox content folder or alias at the root location, that folder/alias cannot be deleted! When the Mbox v4.4.1 installer runs, it checks for an existing Mbox content folder or alias at the root and will stop the installation if it finds one.

The new location for the Mbox content folder is the /Applications folder on the computer's boot drive. Pre-existing Mbox installations will have an Mbox content folder or alias at the root of the boot drive. To move the Mbox content folder or alias prior to upgrading to Catalina or installing the Mbox v4.4.1 software:

+ If the Mbox item at the root of the boot drive is a real folder, click and drag the folder from the root location to the /Applications folder to move it and its contents to the new location.

+ If the item is an alias, click and drag that alias to the /Applications folder, or delete the alias and make a new one in the /Applications folder.

+ Delete any remaining Mbox-related items from the root of the computer's boot drive.

It is still recommended practice to place the Mbox content folder onto a separate physical storage device rather than directly on the boot drive of the computer or a partition on the same physical device as the computer's boot drive. Using a separate physical device so can provide better performance as the OS and Mbox won't have to share disk access time on the same drive. If using a separate storage device, the Mbox content folder should be placed on that separate device in its entirety, and an alias to that folder should be created and placed in the /Applications folder of the computer's boot drive.

Note: Versions of Mbox older than v4.4.1 do not use the /Applications location for the Mbox content folder. If using an older version, it is possible to create an alias that points to the actual Mbox content folder and place that alias at the root of the computer's boot drive. But as noted above, this isn't possible in Catalina and beyond, and should be removed before the computer is upgraded.

Installation

As noted above, the Mbox content folder needs to be in the /Applications folder on the computer's boot hard-drive, or in an alternate location with an alias to that location placed into the /Applications folder.

For first-time installations with no pre-existing Mbox content folder, the Mbox installer will create the Mbox content folder and place the necessary files inside it. This folder can then be moved elsewhere, and an alias created. With subsequent installs, the Mbox content folder (no matter if it is an actual folder or alias) can be merged or renamed (and not deleted) by the installer, allowing existing content and preferences from an older version of Mbox software to be used by the new version or set aside.

The Mbox installer does not place any video content in the Mbox/Media folder, but demo content is available as a free download from the Mbox webpages on the PRG website.

Thumbnails and Apache HTTP Server

Mbox creates thumbnail images on the hard-drive of the server. These items can be accessed remotely by Mbox Director, a console (using CITP), or a web browser. Access to the images requires the Apache HTTP Server functionality to be enabled on the Mbox computer. The Mbox installer will enable the Apache server on the computer.

Suggested Hardware Configurations   [Refer to warning on page 20 regarding Apple Silicon!]

Mbox performance options:

+ **Highest performance** - Apple Mac Pro 2019 or iMac Pro with: 8+ CPU cores, separate SSD/flash drives for OS and content, Afterburner card (Mac Pro only), Vega II/Vega64 GPU, 64GB+ RAM.

+ **Medium performance** - Apple iMac, Mac Pro 2013, or MacBook Pro with 6+ CPU cores, flash/fusion drive for OS plus separate Thunderbolt SSD/flash drive for content, AMD Radeon Pro, D700, or Vega 16/20 GPU, 16GB+ RAM.

+ **Portable system** - Apple MacBook Pro or Mac Mini with quad-core processor, flash/SSD/fusion drive for OS and content, optional separate drive for content (Thunderbolt SSD/flash recommended), 8GB+ RAM.

Mbox computer minimum requirements:

+ MacOS 10.9+ with 10.13 and 10.14 preferred. MacOS 10.15 and 11 are supported but currently provide no benefit.

+ Intel Core 2 processor (64-bit)

+ 8GB RAM

GPU hardware guidelines:

+ For best performance if using an AMD GPU, use macOS 10.11 or newer.

+ eGPUs provide little/no advantage when used with Mbox. Contact mboxsupport@prg.com for more information.

To Install Mbox:

Step 1.   Download the latest installer from the Mbox website.

Step 2.   Assure no Mbox-related applications are running (e.g. Mbox Launcher, Daemon, or Remote), then launch the installer. Read and accept the legal and installation notes, then continue.

Step 3.   At the Media Path pane of the installer, choose where the Mbox content folder will be placed, as well as what to do if an Mbox content folder already exists. For a default installation, leaving the options untouched will place the Mbox content folder in the /Applications folder on the boot drive of the computer.

The Mbox Content Folder Destination section can be used to place the Mbox content folder in a custom location. However, since there must be an item called "Mbox" in the /Applications folder on the boot drive, the installer will create an alias at that location, pointing to the selected custom location.

For an upgrade installation, if a folder or alias named "Mbox" is found in the /Applications folder, the pop-up in the /Applications/Mbox Folder section will be relabeled "Found" and the following options are available:

a. If "Rename existing" is selected, the existing Mbox content folder or alias will be renamed as Mbox####. old before a fresh Mbox content folder or alias is created in the same location. After the installation, files can be manually moved into the new Mbox content folder as needed.

b. If "Merge existing" is selected, the installer will merge any installed files with the current installation. This option will not delete any existing content, but may change some settings and will add the default model and plug-in folders.

Step 4.   Acknowledge settings and then agree to the License Agreement to begin the installation.

Licensing Mbox Software

CAUTION! Always perform a full installation of the Mbox software before attempting to apply a license!

Hardware USB License Key (Dongle)

When the Mbox software is installed, the installer will provide the option to install the USB license key drivers as well. If a USB license key isn't being used, the drivers don't need to be installed. If a USB license key is purchased at a later time, then the drivers can be downloaded and installed using the link on the previous page. Once the drivers are installed, Mbox will recognize the license key.

If the Mbox application fails to recognize the USB key at any point after the drivers are installed, please contact mboxsupport@prg.com for assistance.

Soft-license (EWS/eSellerate or QLM) - Mbox Studio/Studio+ and Mini only

If a soft-license for Mbox Studio/Studio+ or Mini was purchased, then a receipt and an email with an activation key will have been sent. Starting with Mbox v4.4, the EWS (eSellerate) licensing scheme has been replaced by the QLM licensing scheme. EWS licenses will continue to work, but new soft-licenses will all use the QLM scheme. An EWS key will start with "PRGMBS4-" or "PRGMBM4-", a QLM key will start with "AMTP". To license an installation of Mbox, connect the computer to the internet and launch the Mbox application. Then click on the License Controls button in the License area of the Preferences tab and select "Activate License" to enter the activation key.
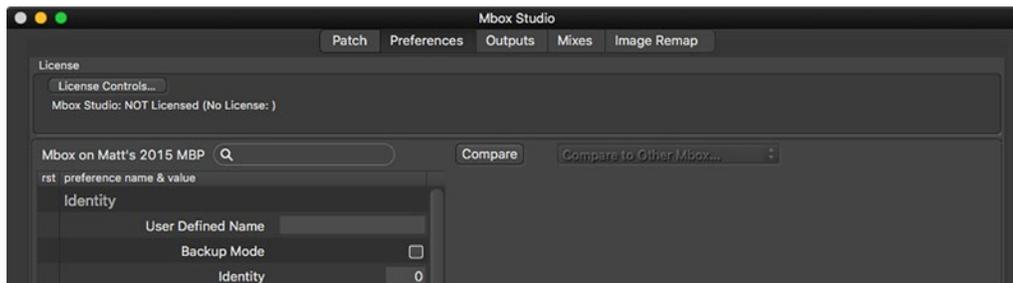
On the window that opens, use the Product pop-up to select the type of soft-license purchased - e.g. Studio -> QLM - and then Activate License from the Operation pop-up. Then enter the activation key in the field below, and press the OK button to activate that license on the machine.
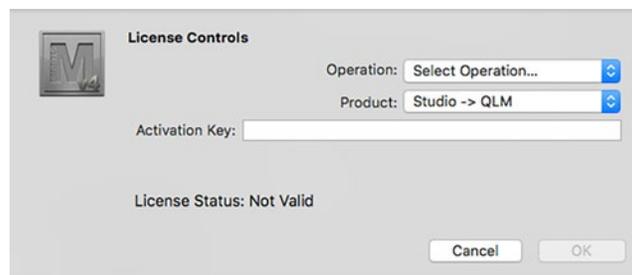
A soft-license can be purchased through the Mbox website - http://mbox.prg.com. Navigate to the correct page for the version of Mbox in question and click the purchase button. This will open a new browser window for the 3rd-party purchasing portal. Once the purchasing process completes successfully, an activation key will be displayed in a confirmation view. An email receipt with the activation key will also be sent and should be saved as a record of the key in case the key needs to be reactivated or moved to another computer at a later date.

Launching Mbox

When launched, the Mbox software will initially show a splash screen. After a brief pause, the application window will appear. During this time the software will scan and index all media. Depending on the preferences, the software may enter either Window or Fullscreen mode. In Fullscreen mode, if no control signal is being received the output screen may be black. This is normal and Fullscreen mode can be exited at any time by using a keyboard shortcut (see below).

While in Window mode, the main application window and all configured output windows will be shown. While in Fullscreen mode, the main application window may continue to be visible if it has been placed onto a display that hasn't been assigned to an output. Individual output windows are not visible in Fullscreen mode as they automatically expand to cover the display they are assigned to when Fullscreen mode is used.

The main window contains four tabs: Patch, Preferences, Outputs, and Mixes as shown in this sample screen below:
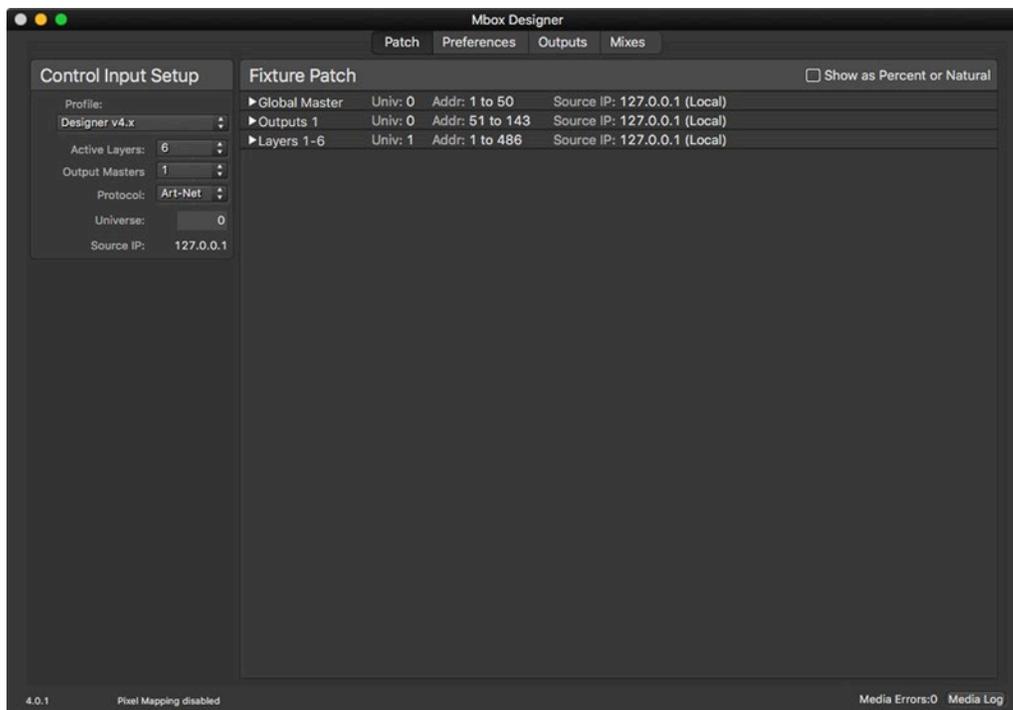
Upon launch, the Patch tab will be selected. This tab shows the server's mode, layer, and output configurations, plus its control protocol and universe. The Patch tab is used to configure control for the software and to view live parameter values. Refer to "Application Windows" on page 45 for more in-depth information about the Patch tab and the other tabs in the application.

While Mbox is running, there are two important key combinations to note:

+ To toggle between Fullscreen or Window mode, press [⌘F].

+ To quit Mbox, press [⌘Q].

Mbox Daemon

Mbox network communication involves an application called Mbox Daemon. This application is required on all Mbox servers to enable remote feedback and configuration. When the Mbox application is launched, it will automatically launch the most recent version of Mbox Daemon that was used on that computer.

To view the Daemon interface if it is not visible, click on its icon in the dock or press [⌘D] while the Mbox application is the active application.

The Mbox Daemon screen will always reflect the Network Interface setting as configured as the Management interface on the Preferences tab of the Mbox application. This Network Interface setting can be changed on the Mbox Daemon window, or in the Mbox application.

Refer to "Network Interfaces for Mbox" on page 74 for additional information on the network configuration for Mbox.
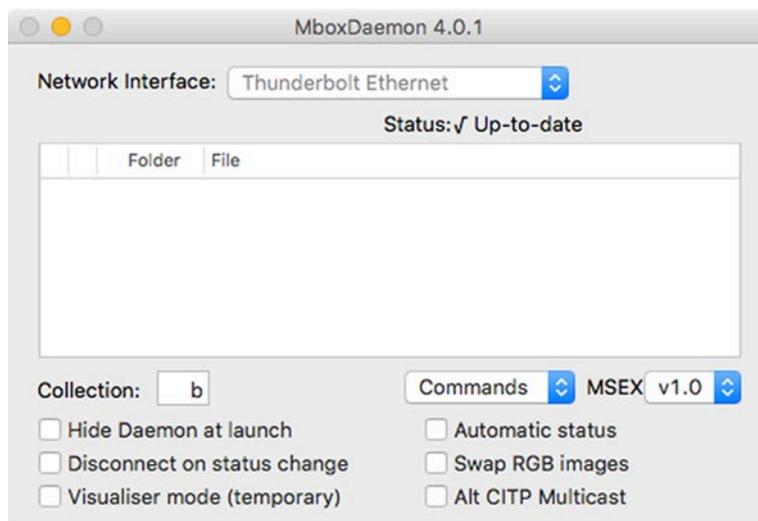
Adding Content

Use the following guidelines when adding content:

+ 2D content (Textures) must be placed inside the Mbox/Media folder.

+ 3D content (Objects) must be placed inside the Mbox/Models folder.

+ The use of both Textures and Objects relies on the correct structure of their parent folders and the correct numbering of folders and files. Mbox Designer allows up to 65535 Textures and up to 65535 Objects. Mbox Studio and Mini allow up to 65535 Textures and up to 255 Objects.

+ Mbox/Media Folder - Texture files may be numbered from 0 to 255 and must be placed into folders numbered 0 to 255 inside the Media folder. Folders 0 and 255 are used for built-in functionality and should be avoided, but can be used if absolutely necessary.

+ Mbox/Models Folder - Object files may be numbered from 0 to 255 and must be placed into a numbered folder inside the Models folder. The Mbox installer will create folder 000 and place some files inside. These files can be replaced as desired and others added. If using Mbox Designer, more folders can be added.

Note: Refer to "Folder and File Numbering" on page 37 for examples of Media and Model folder and file structuring.

PATCHING FIXTURES

Patching Overview

In order to control Mbox, it will need to be patched on a control console or with the Mbox Director application. Patching allows parameters to be mapped to the controllable elements of the Mbox environment. Use the following guidelines when setting up the patch on a control console:

+ The Mbox Designer and Studio software requires at least two universes for control. Mini requires at least one.

+ Adding more output masters and/or playback layers requires additional universes for control. (see below)

+ It is not advisable to patch more than one Mbox server to a single universe, unless the intention is to have two servers that respond identically to the control data.

+ By default, Mbox is configured to respond to Art-Net universe 0; this may be adjusted as desired. Control with Art-Net allows for the selection of universes 0 through 254, which control with sACN allows for the selection of universes 1 through 63998.

CAUTION! For ease of operation, the many parameters that make up one Mbox server are divided into multiple fixtures. It is strongly recommended that all fixtures that are part of the Mbox profile be patched. If all of the associated fixtures, are not patched, undesirable results can occur! The parameter mapping charts on the following pages show all fixtures that make up a single Mbox server. The fixtures must be patched in the order shown.

Output Master and Layer Guidelines

Mbox Designer

Mbox Designer allows up to 32 output masters and up to 24 playback layers. Use the following guidelines when patching more than four output masters or more than six layers:

+ The use of more than four output masters requires an additional universe of control data for each five additional output masters. Additional output masters must be patched to the next sequential universe after existing output masters but before any layers. Therefore, adding output masters will change the universe number of any layers.

+ The use of more than six layers also requires an additional universe of control data for each six additional layers. Additional layers must be patched to the next sequential universe after existing layers.

+ Additional universes can only be sequential universe(s) to those that the server is already using. For example, if the server is patched to universe 0, the first six layers will be on universe 1 and the next six layers will be controlled by universe 2.

+ When adding more output masters or layers, it is important that the server receive correctly patched data on the additional universe(s). If this is not done, the added output masters or layers will not receive appropriate values and may interfere with the normal operation of the software. Additionally, be sure that another server is not set to use any of the same universes.

+ Additional output masters and/or layers must always be patched beginning at address 1 on the universe that they are on.

+ Additional output masters and layers have full functionality. However, the more of each item used, the higher the impact on the performance of the machine.
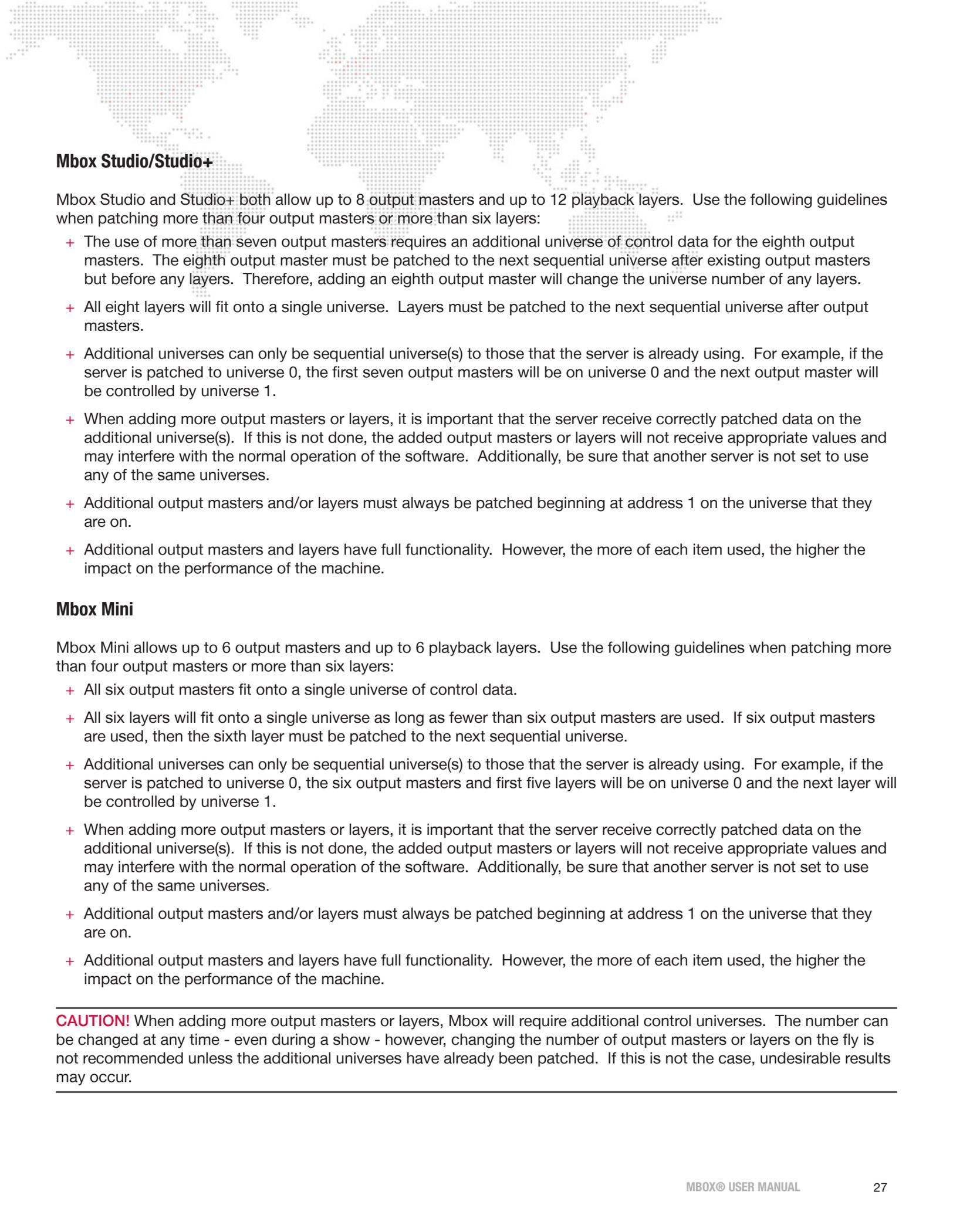
Mbox Studio/Studio+

Mbox Studio and Studio+ both allow up to 8 output masters and up to 12 playback layers. Use the following guidelines when patching more than four output masters or more than six layers:

+ The use of more than seven output masters requires an additional universe of control data for the eighth output masters. The eighth output master must be patched to the next sequential universe after existing output masters but before any layers. Therefore, adding an eighth output master will change the universe number of any layers.

+ All eight layers will fit onto a single universe. Layers must be patched to the next sequential universe after output masters.

+ Additional universes can only be sequential universe(s) to those that the server is already using. For example, if the server is patched to universe 0, the first seven output masters will be on universe 0 and the next output master will be controlled by universe 1.

+ When adding more output masters or layers, it is important that the server receive correctly patched data on the additional universe(s). If this is not done, the added output masters or layers will not receive appropriate values and may interfere with the normal operation of the software. Additionally, be sure that another server is not set to use any of the same universes.

+ Additional output masters and/or layers must always be patched beginning at address 1 on the universe that they are on.

+ Additional output masters and layers have full functionality. However, the more of each item used, the higher the impact on the performance of the machine.

Mbox Mini

Mbox Mini allows up to 6 output masters and up to 6 playback layers. Use the following guidelines when patching more than four output masters or more than six layers:

+ All six output masters fit onto a single universe of control data.

+ All six layers will fit onto a single universe as long as fewer than six output masters are used. If six output masters are used, then the sixth layer must be patched to the next sequential universe.

+ Additional universes can only be sequential universe(s) to those that the server is already using. For example, if the server is patched to universe 0, the six output masters and first five layers will be on universe 0 and the next layer will be controlled by universe 1.

+ When adding more output masters or layers, it is important that the server receive correctly patched data on the additional universe(s). If this is not done, the added output masters or layers will not receive appropriate values and may interfere with the normal operation of the software. Additionally, be sure that another server is not set to use any of the same universes.

+ Additional output masters and/or layers must always be patched beginning at address 1 on the universe that they are on.

+ Additional output masters and layers have full functionality. However, the more of each item used, the higher the impact on the performance of the machine.

CAUTION! When adding more output masters or layers, Mbox will require additional control universes. The number can be changed at any time - even during a show - however, changing the number of output masters or layers on the fly is not recommended unless the additional universes have already been patched. If this is not the case, undesirable results may occur.

Patch Order Summaries

Mbox Designer

Start	Size	Type	Sub-Type	Universe
1	5	Global Master		
6	9	Light 1		
15	9	Light 2		
24	9	Light 3		
33	9	Light 4		1st
42	9	Light 5		
51	6	Output Master 1	Base	143 Total
57	6		FX 1	Channels
63	6		FX 2	(1 Master)
69	16		Camera	
85	12		Geometry	
97	26		Keystone	
123	21		Shutter	
Up to 31 additional Output Masters may be added, 93 channels each, using consecutive universes as necessary.				
1	81	Layer 1	Base	
53	6		FX 1	
59	6		FX 2	
65	6		FX 3	
71	6		FX 4	Next
77	1		Audio Volume	Universe
78	4		DMX Timecode	after Masters
82	81	Layer 2		486 Total
163	81	Layer 3		Channels
244	81	Layer 4		(6 Layers)
325	81	Layer 5		
406	81	Layer 6		
Up to 18 additional Layers may be added, 81 channels each, using consecutive universes as necessary.				

Mbox Studio/Studio+

Start	Size	Type	Sub-Type	Universe
1	5	Global Master		
6	9	Light 1		
15	9	Light 2		
24	9	Light 3		
33	9	Light 4	1st
42	9	Light 5		
51	6	Output Master 1	Base	113 Total
57	6		FX	Channels
63	12		Geometry	(1 Master)
75	26		Keystone	
101	13		Shutter	
Up to 7 additional Output Masters may be added, 63 channels each, using consecutive universes as necessary.				
1	41	Layer 1	Base	
42	6		FX 1	
48	6		FX 2	
54	1		Audio Volume	
55	4		DMX Timecode	Next
59	58	Layer 2		Universe
117	58	Layer 3		after Masters
175	58	Layer 4		
233	58	Layer 5		464 Total
291	58	Layer 6		Channels
349	58	Layer 7		(8 Layers)
407	8	Layer 8		
Up to 4 additional Layers may be added, 58 channels each, using the next consecutive universe.				

Mbox Mini

Start	Size	Type	Sub-Type	Universe
1	5	Global Master		1st
6	6	Output Master 1	Base	
15	6		FX	45 Total
24	16		Keystone	Channels
33	12		Shutter	(1 Master)
Up to 5 additional Output Masters may be added, 40 channels each, using consecutive addresses. Patch before any layers!!				
46	41	Layer 1	Base	
87	6		FX	
93	1		Audio Volume	Same Universe after Masters
94	4		DMX Timecode	
98	52	Layer 2		
150	52	Layer 3		312 Total
202	52	Layer 4		Channels
254	52	Layer 5		(6 Layers)
306	52	Layer 6		
If 6 Output Masters are used, Layer 6 must be moved to the next consecutive universe.				

DISPLAYING CONTENT

Quickstart

Once a console or Mbox Director has been connected, the Mbox fixtures patched, content added to the server's hard-drive, and the display device turned on, it is possible to start displaying content.

To immediately display content:

Step 1.   Select the Global Master fixture and set its intensity to full. Select the first Output Master fixture and set its intensity to full as well. Important! - If one or both of these parameters are set to 0, there may be no visible output - in Window mode or in Fullscreen Mode - depending on the configuration of the software and hardware.

Step 2.   Select the fixture for Layer 1 and set its opacity parameter to full. A white square should appear in the center of the display:

Output 001 - Thunderbolt (1920 x 1080)
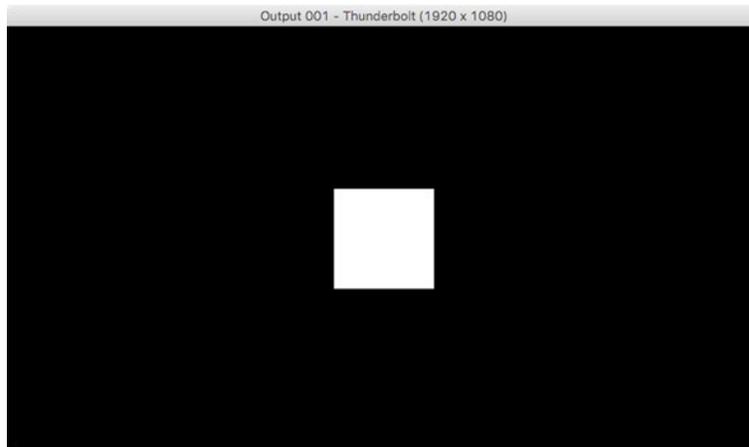
Step 3.   With Layer 1 still selected, set the Folder parameter to a value of 1. Then set the File parameter to a value of 1. If this is a rental Mbox server, an image of bubbly water should appear on the display.

Output 001 - Thunderbolt (1920 x 1080)

Note: Rental Mbox servers come preloaded with more than 1400 content files; if running the Mbox software on a non-rental computer, the content will be different.

Step 4.   At this point, adjust the folder and file parameters to change to over visual content. For example, changing to Texture Folder 11,Texture File 1 will result in the following clip on a rental Mbox:

Step 5.   To apply an effect to the layer, for example, set the Effect 1 parameter to a value of 6 (sepia tone) and set the Effect 1 Modifier A parameter to 255 (full). This should result in a sepia version of the same clip:

3.

CONFIGURATION

This chapter provides information regarding the initial configuration of the Mbox server.

+ **ENHANCING MBOX PERFORMANCE**
+ **MEDIA CONTENT**
+ **APPLICATION WINDOWS**
+ **OUTPUT WINDOWS**
+ **HEADS UP DISPLAYS (HUDS)**
+ **CONNECTED DISPLAYS AND FULLSCREEN MODE INTERACTIONS**

ENHANCING MBOX PERFORMANCE

Recommended Hardware Practices

Use the following recommendations for hardware:

+ Mbox will use as many CPU cores as possible; having more CPU cores provides better performance. The only exception being the Afterburner card in the 2019 Mac Pro, which is strongly recommended for ProRes playback.

+ CPU speed is also a factor, but based on the speed of modern Macintosh hardware, CPU speed has less impact than the number of cores.

+ The OS will let Mbox and its associated tasks use as much RAM as the computer has. More RAM (at least 16GB for best results) can be advantageous.

+ Mbox puts a heavy load on the computer's GPU, the most powerful GPU is always the best choice.

+ Mbox requires fast and constant access to file storage. SSDs and flash-based storage will provide the best results.

+ Modern Mac hardware can connect peripheral devices using Thunderbolt. Computers may have a limited number of Thunderbolt buses available - and therefore a limited amount of bandwidth. Always try to connect Thunderbolt devices to the correct bus to maintain the necessary bandwidth.

+ Depending on the computer, using a large, single video output with a multihead adapter may provide better overall performance than an equivalent number of smaller, discrete video outputs.

Recommended OS Setup

Use the following recommended practices to enhance the performance of the Mbox system:

+ Use macOS 10.13 High Sierra or macOS 10.14 Mojave. Catalina and Big Sur are OK, but provide no benefits at present time.

+ Disable any screen-savers.

+ Disable File Sharing and Remote Management unless you intend to use them:

  - If you want to use Screen Sharing from Director/Remote to Mbox, enable Remote Management (not Screen Sharing). Make sure to enable VNC connection and enter the desired password.

  - If you want to use File Sharing, make sure to enable **SMB** file sharing. You can also enable AFP file sharing, but AFP is not available when using macOS 10.13 or newer with APFS drives.

+ Turn off automatic software updates.

+ Disable Spotlight on all connected hard-drives by placing them in the Privacy table.

+ Set Energy Saver settings to disable computer and display sleep, and to stop hard-drives from being put to sleep.

+ If using a laptop with two graphics modes, disable automatic switching (use max performance).

+ Disable Time Machine.

+ Disconnect the computer from the internet.

+ Disable Mission Control functions and keyboard shortcuts and make sure that the "Displays have separate Spaces" pref is not checked.

+ Turn off FileVault and Firewall.

+ Turn off automatic date and time setting.

+ Quit all other applications and disable unnecessary background processes!

MEDIA CONTENT

File Type Specifications

Previous versions of Mbox used Apple's QuickTime® technology for image and movie rendering and playback. The Mbox v4 software uses Apple's AVFoundation® technology instead. AVFoundation offers modern API's with better performance than QuickTime. However AVFoundation has fewer native file formats and movie codecs. The following file types are supported:

Still Image Files

PNG (.png), JPEG (.jpeg or .jpg), TIFF (.tiff or .tif) for still image files.

+ For still images with or without transparency, PNG is the best choice.

+ For still images not requiring transparency, JPEG is a good choice.

+ For still images with transparency, TIFF files can be used but may take longer to load due to their large file size.

Movie Files

Mbox continues to use the QuickTime container format (.mov) for most movie files and can now also use the MPEG4 container format (.mp4) for H.264 movie files. Spatially-compressed codecs (ProRes, Hap, or Photo-JPEG) will usually provide better playback results than temporally-compressed codecs like H.264.

+ Apple ProRes - The ProRes family of codecs includes five versions.   ProRes Proxy has the lowest bitrate, but consequently the lowest quality. Light and Normal are the recommended codecs for movies. High Quality can be used if the resulting bitrate is not too high (200Mb/sec or lower). ProRes 4444+ may be used if transparency is required in the movie file, but as with ProRes HQ, keep the bitrate below 200Mb/sec if possible. All modern Mac computers can play ProRes movies. But unless the full ProRes codec is installed, the computer is unable to encode ProRes files (e.g. when using Mbox File Convertor).

+ Photo JPEG – Medium-High (60-80%). The quality of Photo-JPEG is not equal to that of the ProRes, but it typically has a lower bitrate and therefore can place a lighter load on the system if a lot of movies are being played.

+ Hap - The Hap family of codecs includes four versions: Hap, Hap Q, Hap Alpha, and Hap Q Alpha. The Hap codec, and especially Hap Q and Hap Q Alpha, trade off higher bitrates for lower CPU load, so keeping the bitrate at a reasonable level is important. The Hap codec does not need to be installed to play Hap movies in Mbox, but must be installed to encode Hap movies or to play them in other QuickTime-based applications.

+ H.264/mp4 - H.264 and mp4 movies work with Mbox v4, and bitrates can be low for quite high-quality. However, because H.264/mp4 is temporally compressed it can't be used with all of the available playmodes in Mbox and playspeed adjustments may lead to jerky playback. This means that H.264/mp4 movies are not normally recommended and any H.264/mp4 content should be tested before being used in a show situation.

Image Sequences

Image sequences are used like movies, but rather than being a single movie file, they are made up of multiple still image files. Mbox supports JPEG, PNG, and TIFF image sequences:

+ JPEG images will produce the smallest file size, but the quality may not be as good as with PNG or TIFF files.

+ PNG images provide the best compromise between file size and quality. Also, PNG supports an alpha channel in the image. PNG images can be 8-bit or 16-bit.

+ TIFF images have the highest quality (they can be virtually lossless) and support an alpha channel. But TIFF files tend to take up a lot of disk space. TIFF images can be 8-bit or 16-bit.

3D Model Files (Objects)

Custom 3D models can be added to the Mbox server. The server supports the Alias Wavefront™ 3D .obj format. There are many third-party applications that can export files to this format, including Cinema4D®, 3ds Max®, and Blender®.

Audio Playback

Mbox can play embedded audio in QuickTime movies or separate sidecar and stand-alone audio files. Separate audio files can use the aiff, .mp3, .wav, and .aac file extensions. Refer to "Audio Output" on page 98 for more information on this topic.

Additional File Types

Scalable Vector Graphics (.svg) for digital gobo files; .rtf for text files.

Note: File extensions are not case-sensitive. For example, files with extension .JPG and .jpg are the same.

Recommended Practices

PNG and JPEG are recommended for creating still image content for optimum output on the Mbox server. ProRes is the recommended codec for optimum movie playback, but care should be taken to choose the right level of ProRes to match quality and performance requirements. Mbox may play movies that use other QuickTime codecs, if the appropriate codec is installed on the server and the codec is compatible with AVFoundation. These movies may not load as quickly or play as smoothly as movies that use the preferred codecs. PNG is the recommended format for the individual image files in an image sequence.

For best results, all custom content should be created in a single, common format. (Refer to "Creating Custom Content" on page 158 for more information)

Note: In this manual, "preferred movie codecs" refers to Photo-JPEG, Hap, and Apple ProRes. The H.264 and mp4 movie formats/codecs are considered "non-preferred."

Typically, movie files should not have embedded audio tracks, although embedded audio tracks in movies can be made to play (see "Audio Output" on page 98). To completely remove audio tracks from movies, use the preferred application to re-render or export the movie without its audio tracks or try dropping the file onto the Mbox File Converter application, making sure the "copy audio" checkbox is not checked (see "Mbox File Convertor" on page 165).

As is the case with all media servers, Mbox playback performance can decrease as the resolution of its media files increases. Content up to and including 4K can be played, keeping in mind that higher-resolution files will usually lead to lower performance than smaller files. The amount of compression used when creating a file will also affect performance. Given equal file resolutions, higher quality (lower compression) files may not play as well as higher compression (lower quality) files. Depending on the display device, high-resolution or low-compression files may not look better than lower-resolution, more highly-compressed files. For best results, try to find a compromise between quality and performance.

Media Content Management

Mbox allows for a flexible media folder structure. Media can reside locally on the Mac hard-drive or on external storage devices connected to the computer. Using separate external devices is recommend in most cases, but may result in poor playback performance if the external device or connection is slow.

IMPORTANT! The hard-drive and folder structure on some computers may be set up differently to that of the rental Mbox server. The Mbox content folder can be placed on any drive of the computer, but there must be an alias to the Mbox content folder placed in the /Applications folder of the boot hard drive of the computer.

At startup, the Mbox software performs a media scan to search all folders inside the Mbox/Media and Mbox/Models folders on the hard-drive of the Mbox server. External media can be attached to these folders using aliases, provided the following guidelines are observed:

+ It is better to place the <u>entire</u> Mbox folder on an external drive, rather than only selected content.

+ Aliases must link to folders on the external drive; they cannot link directly to files.

+ An alias cannot refer to another alias.

+ The Mbox/Media, and Mbox/Models folders cannot be aliases.

Each time the Mbox server completes a media scan, a text file is created with all media files found and their corresponding combined file numbers. This text file can be found at Mbox/Media_Report.txt

Note: The initial media scan allows the locations of files to be resolved at startup, therefore the "distance" of a file from the main folder has no effect on the time required to find a file. In addition, the content in the Media folder is allowed to be nested (folders within folders) to a limit of 64 folders deep.

Folder and File Numbering

Media and object content files are arranged into individual folders within the Mbox/Media or Mbox/Models folders respectively. Each content folder within the Media or Models folders must have a name that begins with a 3-digit index value between 000 and 255. In turn, each file within a content folder must be named using a 3-digit index value between 000 to 255 as a prefix. This structure provides the means to select content by using two 8-bit numbers. Separate control parameters on the console will be used to select the content folder and the numbered content within that folder.
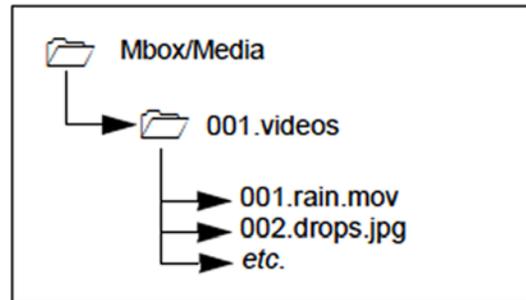
Note: The combination of the folder and file numbers together is referred to in this manual as the file's Folder.File index, or more generically, as its index.

+ Content folders within the Media and Models folders must have an 8-bit numerical prefix and can have a descriptive name separated from the number by a period or a space. For example:

025.Central Park or **025 Central Park**

+ Files within each folder must have a numerical prefix, can have a descriptive name if desired, and must have a three-letter file extension. Each of these parts should be separated by a period:

001.Great Lawn.jpg or **001.Soundtrack.mp3** or **001.obj**

+ Content folders and files don't have to use numbers with padding zeros as shown in the examples above. Using a numerical prefix of "25" is exactly the same as using a prefix of "025". Likewise "1" and "01" are the same as "001". The primary reason for the padding zeros is to keep the folder and file names aligned more evenly when they are viewed in the Finder.

+ Movies, audio files, still images, and image sequences may be numbered between 000 and 255 and placed in folders numbered 001 - 254. Models and digital gobos may be numbered between 000 and 255 and placed in folders numbered 001 - 255. If possible, avoid using folders 000 and 255 in the Media folder and folder 000 in the Models folder, as these folders hold some default content.
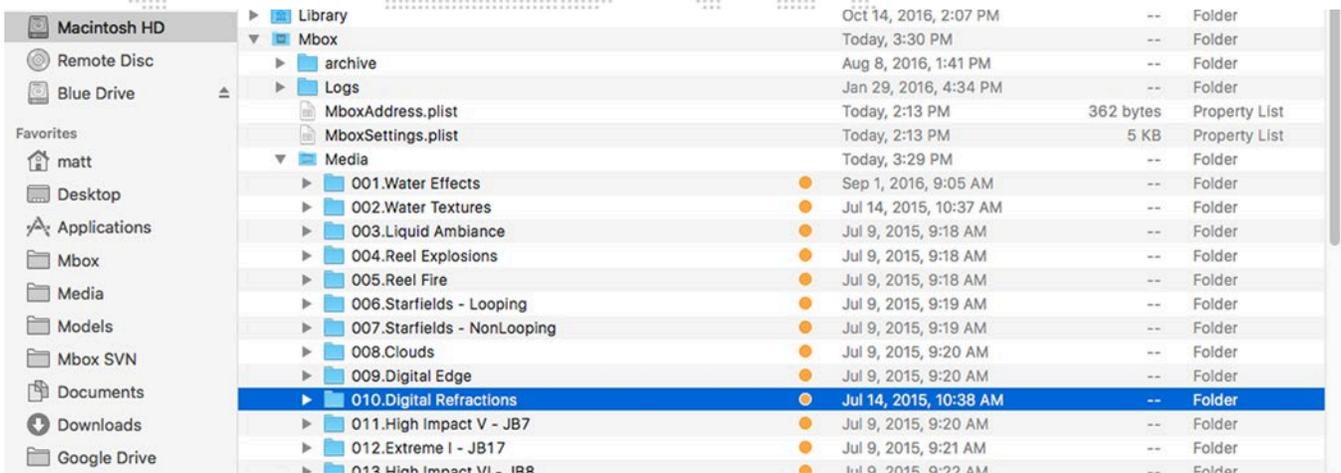
Image sequences require a different folder and file structure:

+ Image sequences should <u>not</u> be placed in the same content folder as normal movies or still images.

+ Within a content folder for image sequences, each image sequence <u>must</u> be placed into a numbered folder (000 - 255). This folder's number is the equivalent to the file number used as a prefix to normal movies or images.

+ Every image sequence folder name <u>must</u> follow this format - ###.name.sequence. Without the ".sequence" suffix, Mbox will not recognize the files in the folder as being part of an image sequence and they will not be indexed or precessed correctly. For example:

001.My Images.sequence

+ Inside the .sequence folder, the individual image files must be named or numbered such that they are organized sequentially in the Finder when using alphabetical sorting. When image sequences are created, the file name and its numbering is typically an option in the export process, therefore sequential numbering should be simple.

+ When Mbox finds an image sequence, a new folder is created parallel to the .sequence folder (i.e. in the same content folder that the .sequence folder is in). This new folder will be given the same numerical prefix, the same name, but a suffix of ".seqdata". For example:

001.My Images.seqdata

+ Processed and converted versions of the original images files are placed in the .seqdata folder, along with a _seq_data.plist file that holds information Mbox uses to index and play the files.
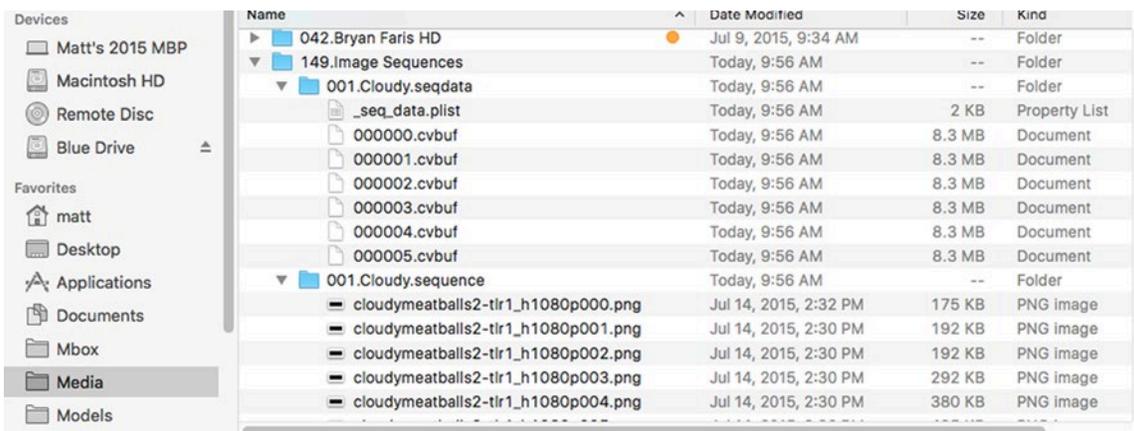
Additional Media Content Organization Guidelines

+ Media folder 000, file 000 is typically reserved as the default "no 2D content" location. Similarly Models folder 000, file 000 is typically reserved as the default "no 3D content" location. Both of these file indices may be used for custom content if desired, as may the remainder of file indices in folder 000.

+ Media folder 255 is reserved for built-in and utility files. The Mbox software includes built-in files and also has Layer Copy, NDI, Syphon, and Video Input functionality.

  - Layer Copy allows the 2D imagery on one layer to be copied to another layer without having to open and play the file a second time on the receiving layer.

  - NDI® technology is an IP video standard created by NewTek Inc. It allows video streams to be transmitted and received over an Ethernet network.

  - Syphon is an open-source third-party technology created by Tom Butterworth and Anton Marini. It allows multiple applications on the same computer to share video textures with each other.

  - Video Input is used to display live video from an external source on a layer. Mbox supports BlackMagic Designs Decklink and UltraStudio devices, Active Silicon Phoenix devices, as well as USB or FireWire® cameras connected directly to the computer. The Preferences tab allows assignment of up to eight video inputs.

Note: If a video input is enabled but no video capture card or camera is detected then Mbox can show a diagnostic/substitute image when this feature is enabled. Refer to "External Video Signal Input" on page 146 for more information.

+ When adding content files, DO NOT duplicate existing folder and file number combinations. It is best to make new folders for custom content.

+ Leading zeros are not required when numbering folders or files, but they can help by making the file listing easier to read.

+ Mbox scans for content upon startup. If new content is added while Mbox is running, the Media and Models folders must be rescanned in order to use that new content. These folders can be rescanned while Mbox is running by pressing [⌘R] on the server's keyboard or from the console by using the control channel on the Global Master fixture. There may be a brief pause in movie playback while the rescan takes place.

+ Media Folder 255 contains the following:

  > 000: Mbox patch info
  > 001-024: Layer Copy FX+ functionality for Layers 1-24 respectively (Refer to "Layer Copy" on page 89)
  > 031-054: Layer Copy Raw functionality for Layers 1-24 respectively
  > 101-112: NDI inputs 1-12 respectively (Refer to "NDI Video Input" on page 153)
  > 201-212: Syphon inputs 1-12 respectively (Refer to "Syphon Video Input" on page 151)
  > 231-238: Built-in 1080p CG images in primary and secondary colors
  > 241-248: Video inputs 1-8 respectively (Refer to "External Video Signal Input" on page 146)
  > 254: Default CG Color Bars image
  > 255: Default zero alpha image

Adding Media Content

When adding content files, it is recommended that new, unique folders be created for each logic group of custom content. It is possible to have more than one folder with the same numerical prefix however, as long as the content files within such folders do not have the same numerical prefix.

CAUTION! Numbered content files will be assigned a folder number that is equal to the numerical prefix of their immediate parent folder. Therefore, using folders without numbers requires caution:

A file at this location: *Media/022.Water/BlueWater/001.SomeWater.mov* - will be assumed to be in folder 000, because the immediate parent of the numbered file has no numerical prefix.

The correct method: *Media/BlueWater/022.Water/001.SomeWater.mov* - would work as desired, assigning the file to folder 022.

To add movie, audio, or image files:

Step 1.   On the computer's content drive, open the Mbox/Media folder.

Step 2.   Using the Finder's File menu, select New Folder and give the created folder a unique 3-digit number (that is not already being used) followed by a descriptive name. For example, "075.My Content Folder".
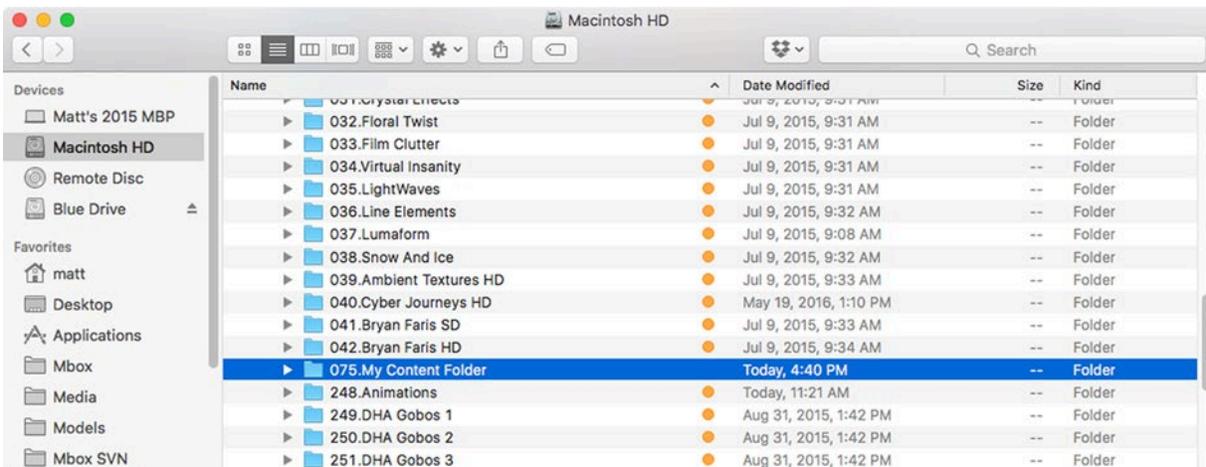
Step 3.   Copy image, audio, and/or movie files into the new folder.

Step 4.   For each file, add a unique 3-digit index value to each file (between 0-255) along with a descriptive name that includes the file extension. For example, "001.earth.jpg", "002.wind.mov", "003.fire.mov", etc. (Note the caution given above.)

To add 3D object files:

Step 1.   On the computer's content drive, open the Mbox/Models folder.

Step 2.   Using the Finder's File menu, select New Folder and give it a unique 3-digit number (that is not already being used) followed by a descriptive name. For example, "012.My Objects".

Step 3.   Place files into the new folder.

Step 4.   For each file, add a unique 3-digit index value to each file (between 0-255) along with a descriptive name that includes the file extension. For example, "001.man.obj", "002.hammer.obj", "003.airplane.obj", etc.
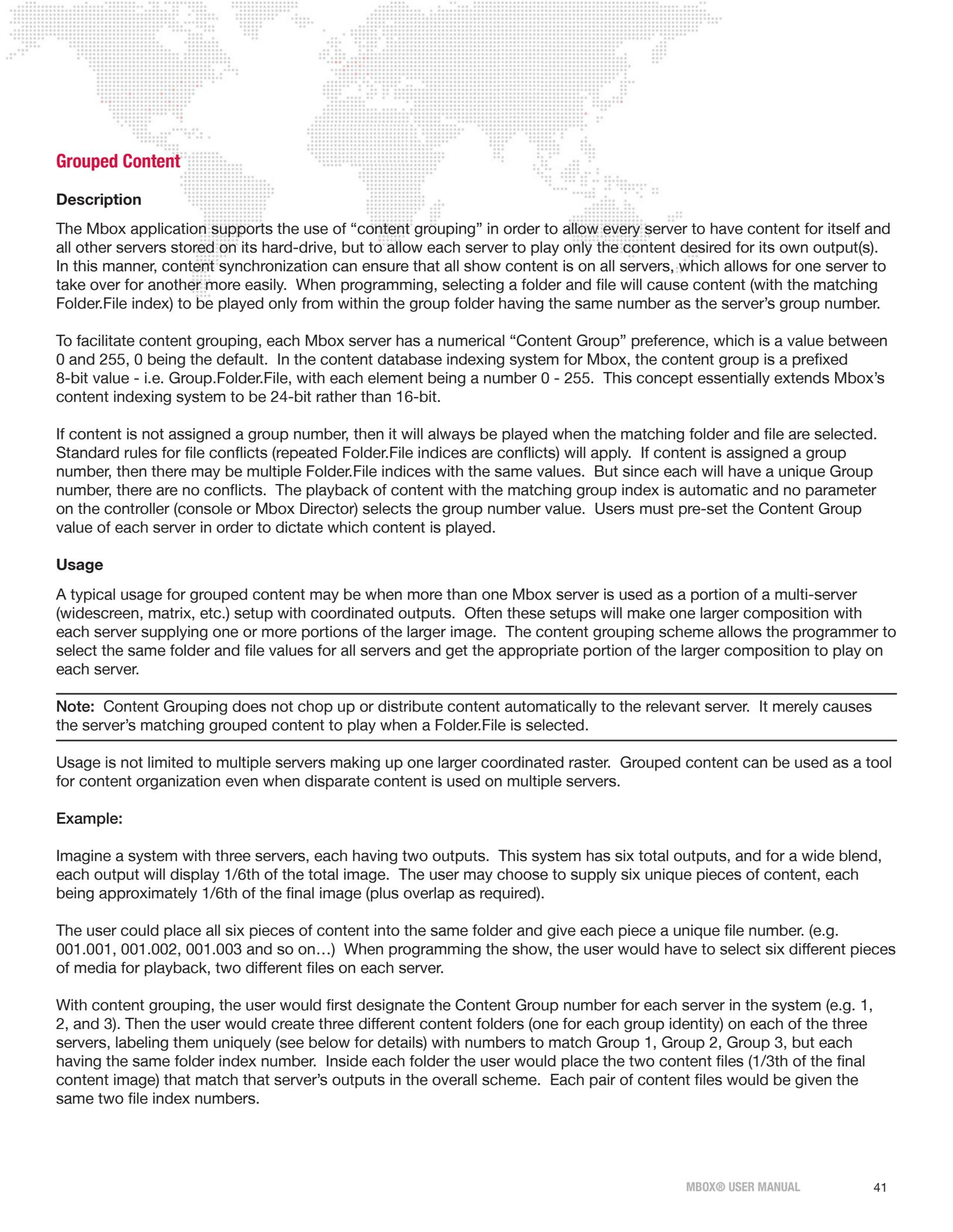
Grouped Content

Description

The Mbox application supports the use of "content grouping" in order to allow every server to have content for itself and all other servers stored on its hard-drive, but to allow each server to play only the content desired for its own output(s). In this manner, content synchronization can ensure that all show content is on all servers, which allows for one server to take over for another more easily. When programming, selecting a folder and file will cause content (with the matching Folder.File index) to be played only from within the group folder having the same number as the server's group number.

To facilitate content grouping, each Mbox server has a numerical "Content Group" preference, which is a value between 0 and 255, 0 being the default. In the content database indexing system for Mbox, the content group is a prefixed 8-bit value - i.e. Group.Folder.File, with each element being a number 0 - 255. This concept essentially extends Mbox's content indexing system to be 24-bit rather than 16-bit.

If content is not assigned a group number, then it will always be played when the matching folder and file are selected. Standard rules for file conflicts (repeated Folder.File indices are conflicts) will apply. If content is assigned a group number, then there may be multiple Folder.File indices with the same values. But since each will have a unique Group number, there are no conflicts. The playback of content with the matching group index is automatic and no parameter on the controller (console or Mbox Director) selects the group number value. Users must pre-set the Content Group value of each server in order to dictate which content is played.

Usage

A typical usage for grouped content may be when more than one Mbox server is used as a portion of a multi-server (widescreen, matrix, etc.) setup with coordinated outputs. Often these setups will make one larger composition with each server supplying one or more portions of the larger image. The content grouping scheme allows the programmer to select the same folder and file values for all servers and get the appropriate portion of the larger composition to play on each server.

Note: Content Grouping does not chop up or distribute content automatically to the relevant server. It merely causes the server's matching grouped content to play when a Folder.File is selected.

Usage is not limited to multiple servers making up one larger coordinated raster. Grouped content can be used as a tool for content organization even when disparate content is used on multiple servers.

Example:

Imagine a system with three servers, each having two outputs. This system has six total outputs, and for a wide blend, each output will display 1/6th of the total image. The user may choose to supply six unique pieces of content, each being approximately 1/6th of the final image (plus overlap as required).

The user could place all six pieces of content into the same folder and give each piece a unique file number. (e.g. 001.001, 001.002, 001.003 and so on…) When programming the show, the user would have to select six different pieces of media for playback, two different files on each server.

With content grouping, the user would first designate the Content Group number for each server in the system (e.g. 1, 2, and 3). Then the user would create three different content folders (one for each group identity) on each of the three servers, labeling them uniquely (see below for details) with numbers to match Group 1, Group 2, Group 3, but each having the same folder index number. Inside each folder the user would place the two content files (1/3th of the final content image) that match that server's outputs in the overall scheme. Each pair of content files would be given the same two file index numbers.
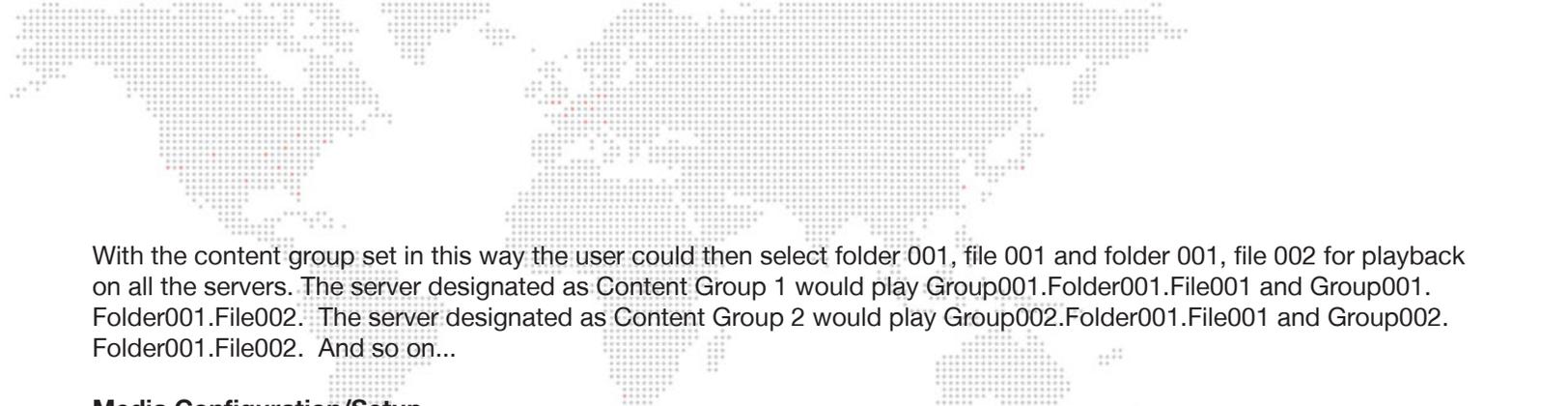
With the content group set in this way the user could then select folder 001, file 001 and folder 001, file 002 for playback on all the servers. The server designated as Content Group 1 would play Group001.Folder001.File001 and Group001. Folder001.File002. The server designated as Content Group 2 would play Group002.Folder001.File001 and Group002. Folder001.File002. And so on...

Media Configuration/Setup

Inside the Mbox/Media and Mbox/Models folders, the actual content folders need to be renamed to enable content grouping. Without content grouping a folder might be called "004.My Movies". With content grouping, a user might have several folders - "[001]004.My Movies", "[002]004.My Movies", [003]004.My Movies" and so on.

The actual text name of the folder does not matter in the indexing system, so for added clarity, the folder could be called something like "[002]004.My Movies Group 2"

Allowed syntax:

+ [Group #]Folder #.Folder Name -> no space or period between [Group] and Folder

+ [Group #] Folder #.Folder Name -> space between [Group] and Folder

+ [Group #].Folder #.Folder Name -> period between [Group] and Folder

Embedded Audio Playback (in QuickTime Movies)

Mbox can play audio that is embedded in a movie. The simplest way to get Mbox to play embedded audio is to rename the file, adding the .audio suffix:

<div align="center">

a file named - **001.MyMovie.mov** would be renamed as - **001.MyMovie.audio.mov**

</div>

Refer to "Audio Output" on page 98 for more details about audio output, plus further details on sidecar, auto-sidecar, and stand-alone audio file playback, audio encoding, and multichannel audio.

Metadata for Content Files

Mbox v4 uses metadata to apply certain properties to content files (2D and 3D) when they are displayed onscreen. The metadata can include properties such as:

+ Enabling embedded audio playback in a movie file. Refer to "Audio Output" on page 98.

+ Linking a movie to timecode start times for timecode sync playmodes. Refer to "Timecode Synchronization" on page 103.

+ Setting the playback rate (in fps) for individual image sequences, overriding the global preference. Refer to "Image Sequences" on page 161.

+ Setting the scaling factor or axis flipping properties for objects. Refer to "Compiling Vertex Array Files" on page 82.

The metadata for Mbox is placed into two separate Property List (plist) files. For movies and image sequences, the metadata file is called "MediaInfo.plist" and is located in the Mbox/Media folder. For objects, the metadata file is called "ModelInfo.plist" and is located in the Mbox/Models folder. Metadata is these files is read when Mbox launched or a rescan is performed.

Note: There are several different applications that can create and edit plist files, in newer versions of macOS, Xcode can be used, whereas in older versions an application called Property List Editor can be used. There are also several commercially available applications for creating and editing plists.

MediaInfo plist

The structure of the MediaInfo.plist file is simple. At the root of the file, each media item may be given an entry, which is a dictionary. The dictionary is named using the Folder.File syntax, with padding zeros as required (e.g. 001.054). Inside the dictionary for each media item are various key:value items that apply properties to the corresponding file.

The supported keys for the MediaInfo.plist file are:

+ **audio** (boolean) - add this key with a value of "YES" to enable embedded audio playback for a movie.

+ **fps** (string) - add this key with a numerical value (e.g. "29.97") to override the global image sequence playback rate for a specific image sequence.

+ **locked** (string) - add this key with a numerical value (0, 1, or 2) to lock or unlock the files in an image sequences's .seqdata folder.

   - **0**: Unlocked - changes in the .sequence folder will be reflected in the .seqdata folder.

   - **1**: Locked - changes, additions, or deletions in the .sequence folder do not affect the .seqdata folder.

   - **2**: Update Only - existing images in the .sequence folder can be updated, or images added, but deletions are ignored.

+ **tc_start** (string) - add this key with an HH:MM:SS:FF value (e.g. "02:23:45:12") to link a movie to a timecode start time for use with the timecode sync playmodes.

+ **activerect** - add this key with a value containing an X/Y origin, width, and height (e.g. "0,0,500,650) to crop a piece of media content, and re-center the visible portion.

ModelInfo plist

The structure of the ModelInfo.plist file is relatively simple, but it can be more complex than the MediaInfo. plist file. In the root of the file, each object may be given an entry, which is a dictionary. The dictionary key named using the Folder.File syntax, with each having padding zeros as required (e.g. 007.012). Inside that dictionary for each media item are various key:value items that apply properties to the corresponding file.
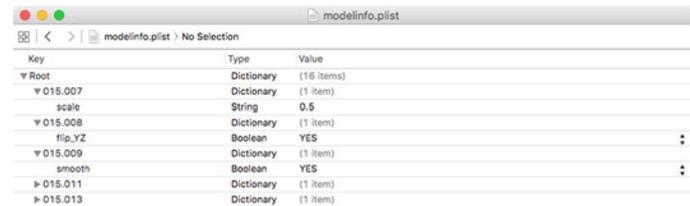
The supported keys for the ModelInfo.plist file are:

+ **flip_YZ** (boolean) - add this key with a value of "YES" to swap the Y and Z axes of the model to correct for the difference between the Y and Z axes in Mbox and some 3D modeling applications.

+ **rebuild** (boolean) - add this key with a value of "YES" to cause the model's corresponding vertex array file to be recompiled every time media is rescanned.

+ **scale** (string #.##) - add this key with a numerical value (e.g. "0.50") to set the scale factor for the object when it is compiled. A scale value of "0.004166666" is equal to using the ".pixels" compile-time switch. (Refer to "Normalization" on page 82)

+ **smooth** (boolean) - add this key with a value of "YES" to enable smooth shading for the object, which may help jagged objects look a little smoother under certain lighting situations.

Note: Based on properties applied to objects using the Mbox Remote application's Projection Editor window, the Mbox application may create entries or add other information to the ModelInfo.plist file.

Creating and Viewing Content Thumbnails

The Mbox Daemon software will create thumbnail images of most content. This process happens automatically when new content is added to the Media or Models folders. No user interaction is required unless some thumbnails seem to be missing.

If some or all thumbs are missing, use the Mbox Daemon application:

+ To trigger an update of missing thumbs click on the Commands pop-up in Daemon and select "Update Thumbnails".

+ To force a rebuild of all the thumbs, click on the Commands pop-up and select "Rebuild Database".

Thumbnail images are stored in a standard location on the computer and are grouped with HTML files that allow any networked computer (Mac or PC) to use an HTML browser to view the thumbnails on the server. Individual thumbnails can also be used by consoles connected to the server via CITP/MSEX. The thumbnail files are located in folders on each server at /Library/Application Support/Mbox.

CAUTION! While thumbnails are being created, playback performance on the server may be slightly affected. Thumbnail creation time will depend on the amount of content in the Media and Models folders. While thumbnails are being created or rebuilt, they will not be viewable them from either a browser or the Mbox Remote application.

Viewing Thumbnails in a Browser

Another way to view media thumbnails on an Mbox server without a CITP-connected console or Mbox Director, is to use the web browser of any computer connected to the Mbox network. Enter the following into the browser:

+ If using a browser on the local Mbox sever, the address http://127.0.0.1/Mbox can be used to view the local thumbnails.

+ To view thumbnails on a remote machine, enter the machine's IP address. For example: http://192.168.0.123/Mbox

When accessing the web pages on a rental Mbox server, the /Mbox portion of the address can be omitted.
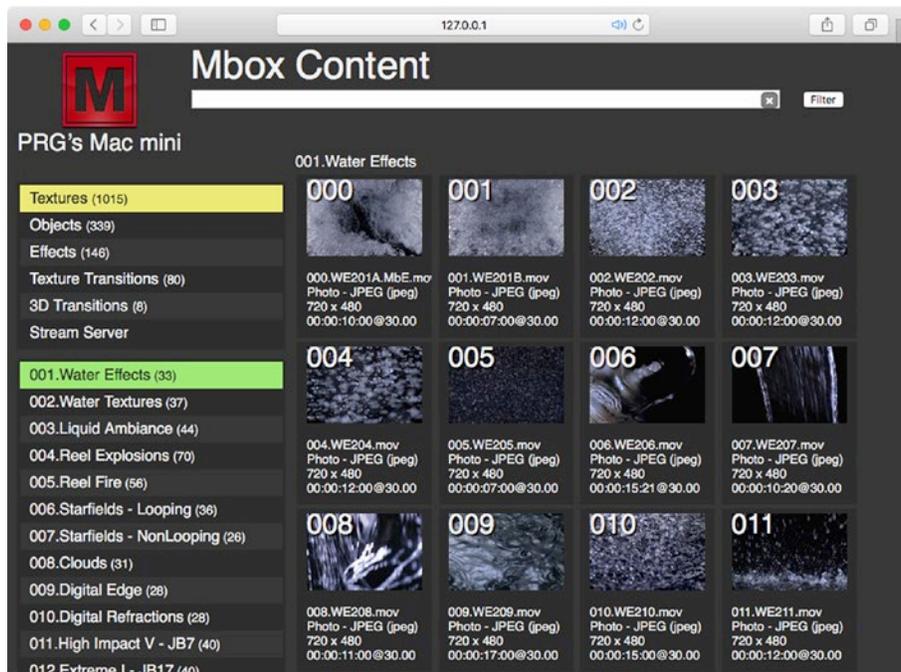
APPLICATION WINDOWS

Overview

The Mbox application window allows the server's outputs to be viewed in either Window or Fullscreen mode on the connected displays.

+ **Window** - While in Window mode, the Mbox application's user interface will be displayed in addition to a separate window for each of the server's outputs. In this mode, each output will be visible in a separate window, with all windows being positionable and scalable (by the same percentage) to allow for arrangement and fit onto the desktop.

+ **Fullscreen** - While in Fullscreen mode, the server's output windows will cover the entire screen of the displays that are assigned to. If all connected displays are used for outputs, then the main Mbox window's user interface will not be visible. However, if there are additional displays, then the main Mbox window can be seen and various settings edited live.

Note: If macOS 10.14 or 10.15 are used, colors in Mbox windows may differ slightly from the images in this manual.

Examples of the Window mode and Fullscreen mode views are shown below, where Mbox is configured with one output that is assigned to the second display:
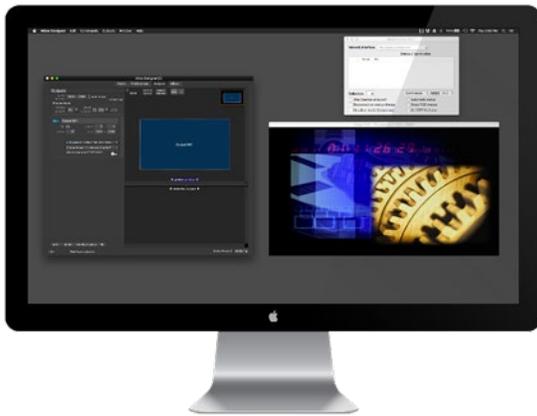
Window Mode
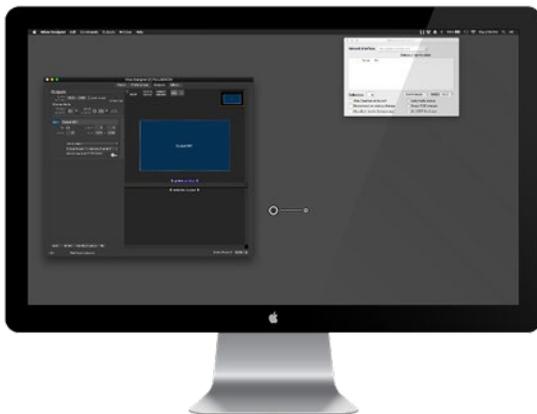
Fullscreen Mode

Main Application Window

The Mbox application has four tabs, each having different functionality within the application: Patch, Preferences, Outputs, and Mixes.

+ **Patch tab** - used for configuring control data input and for viewing live parameter value feedback.

+ **Preferences tab** - used for viewing, comparing, and modifying all server preferences that are not related to patch, outputs, or mixes.

+ **Outputs tab** - used for adding outputs and editing their properties, including their assignment to connected displays.

+ **Mixes tab** - used for adding mixes and editing their properties.

Patch Tab

The Patch tab of the Mbox application is used to:

+ Select the control profile for the Mbox software.

+ Set the number of active playback layers.

+ Set the number of output masters.

+ Select the control protocol: Art-Net or sACN

+ Set the starting universe for control: 0 through 255 for Art-Net and 1 through 63999 for sACN.

+ View the IP address of the device from which Mbox is receiving data on the starting universe.

+ View start universe, address, range, and source IP for the components that make up the Mbox application (Global Master, Outputs, Layers), plus view individual parameter values within each of the components.

Selects control profile, number of layers, number of output masters, control protocol, and starting universe. Shows source IP of start universe being received.

Individual parameter names and live values are shown in table form. Parameter values at their default are shown in green, values not at default are shown in yellow.

Toggles parameter values between natural and percent notation.

Component item rows show universe, address, and IP. Disclosure arrow reveals parameter names and values.

Column headers show name and start universe and address for individual elements.

Shows media scan errors. Press button to open media log file for log of all content indexed plus errors.

Patch Tab: Control Input Setup

The Control Input Setup area on the left of the Patch tab view is used to set the control profile, layer and output count, protocol, and start universe for the server.

+ **Profile** - use this pop-up menu to select the control profile for Mbox - i.e. what the fixture/parameter layout is for incoming control data. Every version of Mbox v4 supports the control profiles for every other version, allowing for control of any version with a patch for one of the other versions. Additionally, legacy emulation modes are provided for v3.x control data.

+ **Active Layers** - use this pop-up menu to select the number of active layers for the server.

+ **Output Masters** - use this pop-up menu to select the number of output masters for the server.

+ **Protocol** - use this pop-up menu to specify whether Mbox will receive Art-Net or sACN (Streaming ACN). This selection applies to all the control data that Mbox receives whether it's for normal control, or for optional functionality like Pixel Map Group controls.

+ **Universe** - this field refers to the <u>first</u> universe that Mbox is "listening to" for control data. Mbox v4 will always use consecutive universes if more than one universe is required. Mbox uses decimal notation for universe numbers: 0 through 255 for Art-Net, and 1 through 63999 for sACN. Some consoles may use different notation for universe numbers so some conversion between numbering systems may be required. Allowable values for Art-Net are universes 0-255 and universes 1-63999 for sACN, but keep in mind that when Mbox needs to listen to more than one universe, setting the start universe to a value that would cause it to require a universe greater than 255 (for Art-Net) or 63999 (for sACN) won't work! If this happens, an error message will be displayed and the universe number automatically reduced to a value that will work.
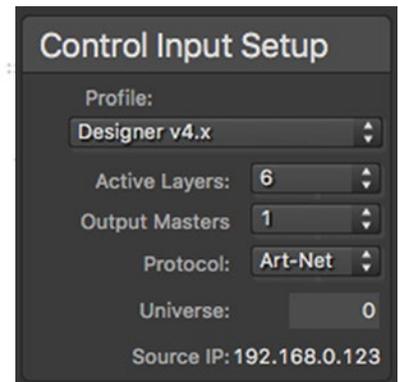
Note: Remember to hit the [tab] or [return] key after entering the start universe value to cause the edited value to be accepted.

+ **Source IP** - this field shows the IP address of the device that Mbox is currently receiving control data from on the universe that is set in the Universe field. This IP address is shown to help indicate that Mbox is receiving data on the selected universe, and as an aid in troubleshooting. In the patch tables to right of the Control Input Setup area, more detailed information can be seen about the required universe(s), the start address and range for each group of fixtures, and the IP address of the source for their data.

CAUTION! While Mbox Mini can be configured to listen to control data intended for Studio/Designer or configure Studio to listen to data for Designer, the software ignores parameter values for features that it doesn't have. e.g. Mini and Studio don't have an Object folder parameter, so will always use Object folder 000. Of course, Designer can always be configured to listen to data for Mini or Studio, and Studio to listen to data for Mini, and have all features work.

CAUTION! Some v3 features (Alignment rectangles, Image Remapping) are handled in a completely different manner in Mbox v4 and cannot be controlled by the new software using legacy emulation. Always test the entire show in advance if attempting to use a pre-programmed legacy mode. In general, it is better to reprogram the show using the new Mbox v4 software.

Patch Tab: Fixture Patch

The right-hand side of the Patch tab has a Fixture Patch table that can be used to see more information about the patched "fixtures" that make up Mbox v4 and the individual parameters that make up each fixture. While Mbox v4 can be considered as one fixture as a whole, it is generally split up into multiple fixtures for control by consoles and Director. The patch table follows PRG's standard conventions for splitting Mbox v4 into multiple fixture groups, though the fixtures contained in each group may have different names and do have different parameters to prior versions. The three groups are: Global Master (overall mastering plus lighting), Outputs (intensity/color, 3D camera, geometry, keystone, shutter, effects), and Layers (texture plus object).

Fixture Patch				☐ Show as Percent or Natural
▶ Global Master	Univ: 0	Addr: 1 to 50	Source IP: 192.168.0.123	
▶ Outputs 1	Univ: 0	Addr: 51 to 143	Source IP: 192.168.0.123	
▶ Layers 1-6	Univ: 1	Addr: 1 to 486	Source IP: 192.168.0.123	

Each of the header rows for the three major fixture groups shows the name of the group, the universe it is patched to, the range of channels on that universe that it is using, and the IP address of the source that is sending that universe to Mbox at present. Each of these header rows has a disclosure arrow to allow it to be expanded to show more detail.

Note: Each row is limited to one fixture group, or to a single universe of control for a fixture group. e.g. Layers 1-6 will have a row, and Layers 7-12 will have a separate row.

At the top-right of the table is a checkbox that allows the parameter values in the table to be shown using percent or "natural" notation rather than the default decimal notation. When this is checked, parameters like intensity, color, or opacity will show percentage values (e.g. 100%), while parameters like scale will show a multiplier (e.g. 2.5x) and rotation will show an amount in degrees (e.g. 45°).

Clicking on the disclosure arrow to expand a group reveals the individual parameters that are used by fixtures in that group. In the case of the Global Master, this is a single column - master then lights.

▼ Global Master	Univ: 23	Addr: 1 to 50	Source IP: 127.0.0.1 (Local)
parameter	address offset	master 23.1	
Global Intensity	0	255	Global Mastering
HUD / Ctrl	1	0	
Ctrl Selector	2	0	
Pix Intensity	3	255	
Global Volume	4	255	
Ints	5	255	Pro Light
Red	6	255	
Green	7	255	
Blue	8	255	
Ambience	9	255	
H Bearing	10	32767	
V Bearing	12	32767	

Note: Beginning with Mbox v4.3, the parameters within each group may be divided by one or more horizontal lines. These lines show a logical split between fixtures or parameter sub-groups for aid in patching or finding parameters on a lighting console. The fixture or sub-group name is shown in the far-right column.

For repeated items like the Outputs and Layers, the table will show multiple columns, with items side by side. The unique name of the each repeated item is shown in the column header, plus its universe and start address (in univ.address notation). The left-most column shows the list of parameter names and the column immediately to the right shows each parameter's address offset from the start address of the item. e.g. If a layer starts at 1.82, and the first parameter (opacity) has an offset of 0, then the address for opacity is 1.82. The aspect parameter has an offset of 16, therefore its address would be 1.98 (i.e. 82+16).

Fixture Patch   ☐ Show as Percent or Natural

▶ Global Master   Univ: 23   Addr: 1 to 50   Source IP: 127.0.0.1 (Local)
▶ Outputs 1   Univ: 23   Addr: 51 to 143   Source IP: 127.0.0.1 (Local)
▼ Layers 1-6   Univ: 24   Addr: 1 to 486   Source IP: 127.0.0.1 (Local)

parameter	address offset	layer 1 24.1	layer 2 24.82	layer 3 24.163	layer 4 24.244	layer 5 24.325	layer 6 24.406	
Opacity	0	0	0	0	0	0	0	Layer Mastering
Red	1	127	127	127	127	127	127	
Green	2	127	127	127	127	127	127	
Blue	3	127	127	127	127	127	127	
Brightness	4	127	127	127	127	127	127	
Contrast	5	127	127	127	127	127	127	
Library	6	0	0	0	0	0	0	Media
File	7	0	0	0	0	0	0	
Play Mode	8	0	0	0	0	0	0	
Play Speed	9	127	127	127	127	127	127	
In Frame	10	0	0	0	0	0	0	
Out Frame	12	65535	65535	65535	65535	65535	65535	
Sync Stream	14	0	0	0	0	0	0	Sync
Sync Offset	15	127	127	127	127	127	127	
Aspect	16	0	0	0	0	0	0	Aspect
Frame Blend	17	255	255	255	255	255	255	
xFade Type	18	0	0	0	0	0	0	
xFade Time	19	0	0	0	0	0	0	
Obj Library	20	0	0	0	0	0	0	Object
Object	21	0	0	0	0	0	0	
Reserved	22	0	0	0	0	0	0	
Reserved	23	0	0	0	0	0	0	
X Position	24	32767	32767	32767	32767	32767	32767	Geometry
Y Position	26	32767	32767	32767	32767	32767	32767	
Z Position	28	32767	32767	32767	32767	32767	32767	
Scale	30	32767	32767	32767	32767	32767	32767	
X Scale	32	32767	32767	32767	32767	32767	32767	
Y Scale	34	32767	32767	32767	32767	32767	32767	
Z Scale	36	32767	32767	32767	32767	32767	32767	

The patch table will also show the current received value for every parameter if the Mbox application is receiving Art-Net/sACN on the correct universe. Similar to how the DMX HUDs worked in prior versions of Mbox, the table shows live changes to incoming control data and colors the values based on whether they are at the default (green text) or at some other value (yellow text). The Patch tab can be used to not only confirm that the correct or expected parameter values are being received but also to confirm that fixtures are patched in the correct order on the console.

▼ Layers 1-6   Univ: 24   Addr: 1 to 486   Source IP: 127.0.0.1 (Local)

parameter	address offset	layer 1 24.1	layer 2 24.82	layer 3 24.163	layer 4 24.244	layer 5 24.325	layer 6 24.406	
Opacity	0	255	255	255	167	121	0	Layer Mastering
Red	1	84	127	127	161	127	127	
Green	2	153	127	127	127	91	127	
Blue	3	127	127	151	127	127	127	

Note: If the console has all fixtures at default values (no active cues and the programmer cleared out) then one or two yellow parameter values may indicate errors in the profile. Yellow parameter values for numerous parameters probably indicates an incorrect patch order or completely wrong profiles.

Preferences Tab

The Preferences tab of the Mbox application is used to:

+ View current license status and apply/remove soft-licensing.

+ View and set preferences for the Mbox application on the local Mbox server.

+ Compare preferences on the local Mbox server with those on a networked Mbox server.

+ Copy preference values from local Mbox to networked Mbox, or vice-versa.

+ View and set preferences for the Mbox application networked Mbox servers.

License area, for viewing current license status and applying/ removing soft-license in the case of Mbox Studio and Mini.

Search box used to find matching prefs using a search string.

Category name

Indicator/Reset button to show a pref not at its default value, click to return pref value to default.

When mouse hovers over a reset button, this area shows the current and default values for the pref.
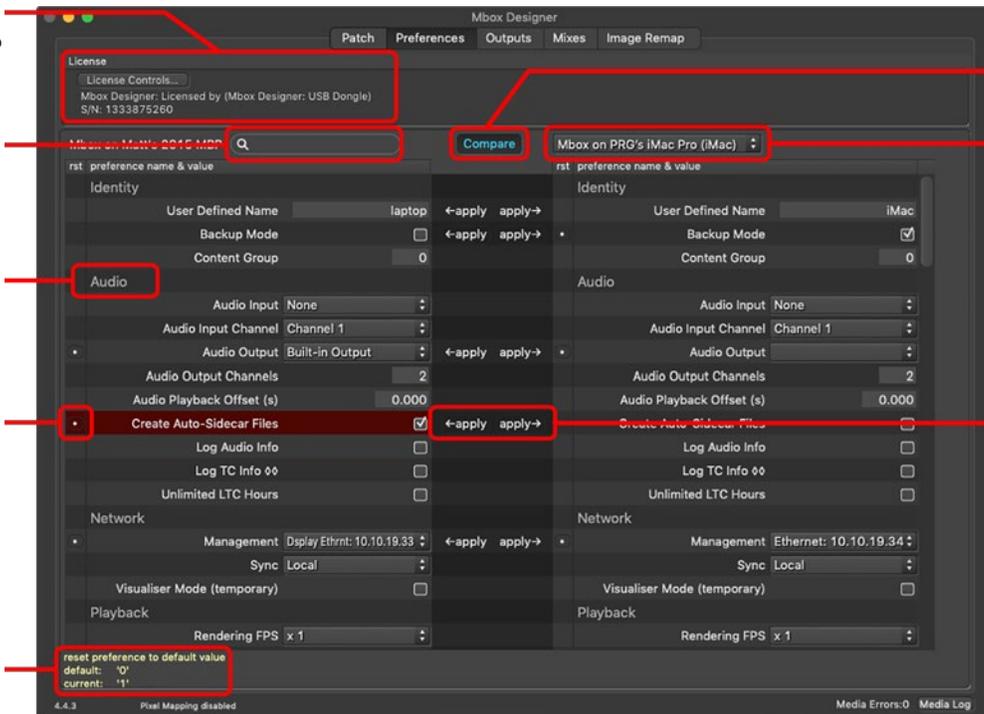
Button to enable pref comparison between local and networked servers.

Pop-up to select networked server for editing and comparison.

Buttons used to copy a pref's value from one server to the other.

The Preferences tab of the Mbox v4 application places all preference settings into a table with individual preferences organized, first by category and then by importance or alphabetically within each category.

Note: The Preferences does not include the full configuration of outputs or mixes as these items are set on the other three tabs of the application. However, basic information about these settings is reported in the table.

Preferences can be on/off checkboxes, pop-up lists, text fields for text or numeric entry, or more advanced edit tools for multi-item preferences (e.g. video inputs). All preferences have a name which may include a hint to show the required formatting or units for their text or numerical values.

A search field at the top of the table allows preferences to be found more rapidly.

Preferences Tab: Licensing

The licensing area of the Preferences tab displays the current product version and state of the license for the application. Mbox may be licensed by connection to a rental IO module, by connection to an Mbox USB license key, by a soft-license (Studio and Mini only), or by a temporary override for evaluation purposes.

If the Mbox application is licensed, this area will show what the licensing method is, and the serial number of the soft-license or dongle as applicable.

License
License Controls...
Mbox Designer: Licensed by (Mbox Designer: USB Dongle)
S/N: 1333875260
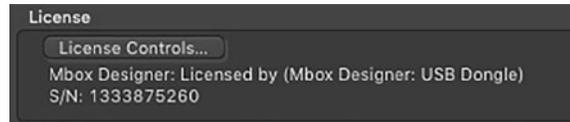
If the Mbox application is not licensed, this will be reported in this area. The License Control pop-up menu would be used to activate or deactivate a soft-license.

License
License Controls...
Mbox Designer: NOT Licensed (No License:)
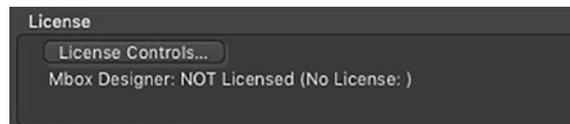
Note: Temporary licenses for product evaluation are available by request from PRG. Please contact a PRG representative if a temporary override license is desired.

Preferences Tab: Search

The search box may be used to quickly find items in the preference table by entering a search term. Search results include both the name of the preference and also their allowable values.

Search terms that have been found will be highlighted in blue, and items with allowable values that match the search term will have the string "(match!)" added to the preference name and highlighted in blue. Repeated pressing the [return] key will toggle the view through the found items.

Preferences Tab: Setup Button

Clicking on this button reveals a menu that allows the size of the font in the Preferences table to be adjusted so as to fit more easily onto different screen sizes.

Preferences Tab: Compare Button and Pop-up

The compare button enables the functionality to compare the preferences of the local instance of the Mbox server with those from a networked Mbox server. This functionality is not enabled by default in order to reduce processing overhead and therefore must be enabled when its use is required.

Clicking on the compare button will darken the button (indicating that the feature is enabled) and will also enable the pop-up to the right of the button. The pop-up provides the means to select the networked server to use for comparison purposes. By default, the pop-up will display "Searching for other Mboxes..." When a networked Mbox is selected, its name will be shown on the pop-up. In order to find networked servers, the local server and the remote server must be on the same network subnet and must have the appropriate network interface selected for management.

With the comparison enabled and a networked server selected, the preferences table will show two columns of preferences side-by-side, with the local server's preferences on the left and the networked server's preferences on the right.

Preferences Tab: Preferences Table

The main portion of the Preferences tab is dedicated to the preferences table itself. In the table, every user-configurable preference for the server is listed. Preferences are organized in the list by category and importance.

Note: Mbox Remote has a Preferences tab that works in the same way as the Preferences tab in Mbox.

The left-hand column of the table displays a reset button for each preference when the preference is set to a value other than its default. If a reset button is present, hovering the cursor over it will reveal information text in yellow at the bottom of the table. This text will show the default value of the preference and its current value - both abbreviated as necessary. Clicking on the button provides a menu with the option to reset the preference to its default value.

Some preferences (e.g. Audio Input and Output) may show their values using yellow text as a warning. This is an indication that the selected device is not connected to the computer.

When comparing the preferences of the local Mbox server to a networked server, the networked server's preferences will be shown in a separate column on the right-hand side of the Preferences tab. Between the columns for the local and networked servers is a darker column. This column will display buttons labeled "←apply" and "apply→" that allow dissimilar preference values to be copied from local to networked server or vice-versa.

CAUTION! There is no undo/redo functionality available on the Preferences tab.

There are several different types of preference values:

+ **Checkbox** - used for standard boolean (on/off or yes/no) preferences.

+ **Text Field** - used to enter string values, e.g. names, floating point numbers.

+ **Pop-Up** - used to enter values from a preset list of possible options.

+ **Complex** - used for setting more complex, multi-value preferences. These preferences will have a disclosure arrow that allows the multiple values to be viewed and edited. Many of these preferences require a button to be pressed to apply the edits.

CAUTION! A few preferences have a double diamond (◇◇) next to their name, indicating that the Mbox application must be quit and relaunched for that preference to take effect.

Preferences Tab: Preferences Table - Categories and Preferences

The following list provides details on each of the available preferences for the Mbox application:

+ **Identity**
    - **User Defined Name:** name for server, overrides OS share name, shown in other Mbox applications
    - **Backup Mode:** puts the server into backup mode, disabling PixMap and Layer Sync output
    - **Content Group:** number used to select content group (Refer to "Grouped Content" on page 41)

+ **Audio**
    - **Audio Input:** selects which CoreAudio input device is used for timecode input, selecting "None" causes Mbox to listen for network timecode
    - **Audio Input Channel:** selects which channel on current audio input device is used for input
    - **Audio Output:** selects which CoreAudio output device is used for output
    - **Audio Output Channels:** sets the number of audio playback/output channels

- **Audio Playback Offset:** sets offset in seconds between video and audio playheads to allow for delay between audio and video
- **Create Auto-Sidecar Files:** enables the creation of automatic sidecar audio files for movies with embedded LPCM audio
- **Log Audio Info:** enables logging of information of audio files
- **Log TC Info:** enables logging of timecode format/rate discrepancies
- **Unlimited LTC Hours:** enables timecode input hour values above 23 hours

+ **Network**

- **Management:** selects network interface for content management, remote configuration, and CITP/MSEX
- **Sync:** selects network interface for input/output of layer sync and MboxTime
- **Visualiser Mode:** enables higher fps MSEX output for use with visualizers, may affect performance

+ **Playback**

- **Rendering FPS:** selects x1 or div2 modes to match rendering rate to full or half output frequency
- **Movie Bitrate:** sets default movie bitrate for read buffer sizing
- **Enhanced Frame Blending:** enables better blending for content framerate vs. output frequency mismatches
- **Image Sequence FPS:** sets default playback rate for image sequences
- **Log Movie Info:** enables logging of information of video files
- **MboxTime Source:** selects between audio or network input for MboxTime
- **Media Key:** credentials (*<username>:<password>)* can be entered here to unlock playback of content locked using the old Mbox Media Lock application.
- **Playout Points:** sets default playout point times (from movie end) for playout play modes
- **Rendering Leader:** sets server as reference source for MboxTime offset calculations
- **TC Default:** sets the default timecode value for movies with no specific timecode assignment
- **TC Reader v3.x 29.97ndf:** enables 29.97ndf compensation (for use with TC Reader application only!)

+ **Output**

- **Disable White Square:** turns off the white square that appears when a 2D content Folder.File location having no indexed content is selected for display
- **Start in Fullscreen:** automatically enters Fullscreen mode when the application launches
- **Outputs & Mixes:** displays number of outputs and mixes (read-only)
- **IO Module #1:** selects dimmer PCB for assignment as output 1 (requires IO Module hardware)
- **IO Module #2:** selects dimmer PCB for assignment as output 2 (requires IO Module hardware)
- **Mix HUD Lineweight:** sets the thickness of mix outlines when they are shown using the Mix HUD [F7]
- **Open Dimmer If No DMX Control:** sets Global Master intensity (and IO Module stage output if applicable) to full when the Mbox application has no control input, so as to allow onscreen HUDs to be visible
- **Software Dimming:** forces software dimming of Global Master even when connected to an IO Module
- **Show Diagnostics:** enables diagnostic images that may be shown onscreen in certain error conditions
- **Window Mode Scale %:** sets Window mode scale as a percentage of Fullscreen mode size
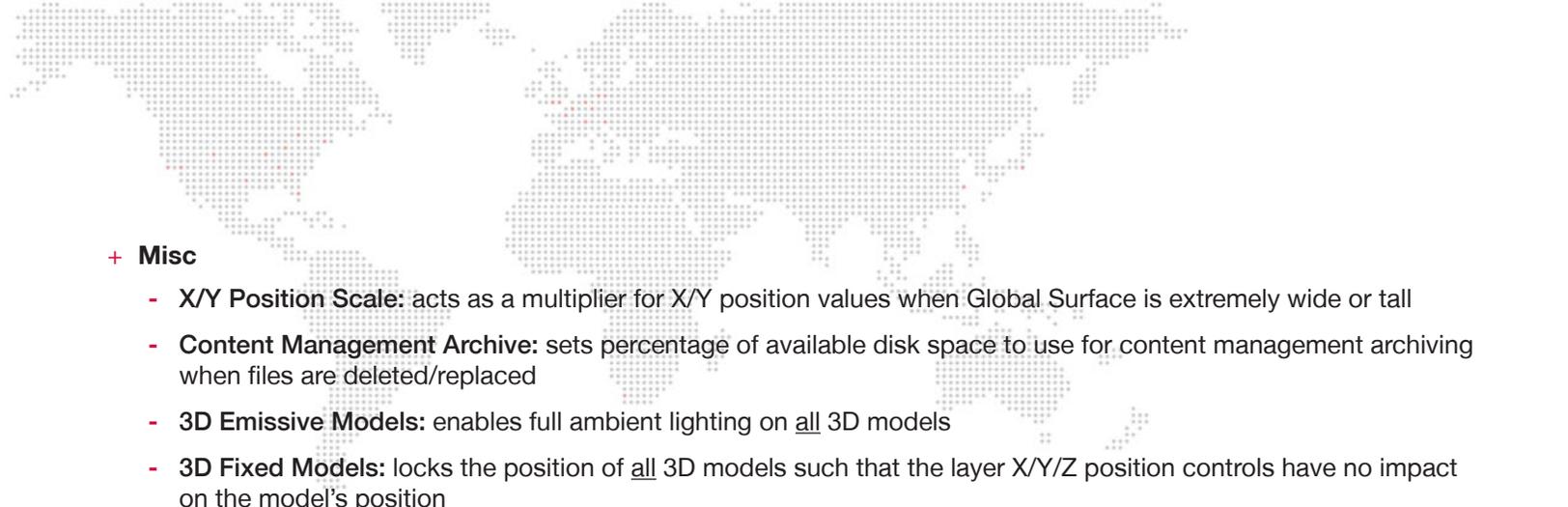
+ Misc

- **X/Y Position Scale:** acts as a multiplier for X/Y position values when Global Surface is extremely wide or tall

- **Content Management Archive:** sets percentage of available disk space to use for content management archiving when files are deleted/replaced

- **3D Emissive Models:** enables full ambient lighting on <u>all</u> 3D models

- **3D Fixed Models:** locks the position of <u>all</u> 3D models such that the layer X/Y/Z position controls have no impact on the model's position

- **Animation Height:** sets default height for animated gobo files

- **Animation Width:** sets default width for animated gobo files

- **SADI Delay Time:** sets delay time for SADI communications

+ Patch

- **DMX Profile:** selects from available control profiles

- **DMX Master Count:** sets number of output masters

- **Layer Count:** sets number of playback layers

- **DMX Protocol:** selects Art-Net or sACN as input control protocol

- **DMX Universe:** sets first control input universe

+ Pixel Mapping

- **PixMap Enable:** enables all pixel mapping processing and output

- **PixMap File Index:** selects active pixel mapping file by index number

- **PixMap Constant Update:** enables constant maximum rate output rather than the default rate which may be reduced if content doesn't change

- **PixMap Delay:** sets inter-packet delay time for pixel mapping output

- **PixMap Disable ArtPoll:** disables ArtPoll to allow broadcast even in the presence of ArtPoll devices

- **RGBAmber White Point:** sets the custom white point used for the RGBAmber pixel type; value is entered as R,G,B with values from 0-255; the value for Amber is automatically set to 255

Note: Refer to the Mbox Remote user manual for more information on pixel mapping preferences and functionality.

+ Video Input

- **Disable Decklink AutoSwitch:** disables automatic format switching by supported Decklink devices

- **Decklink Reset On Lost Signal:** forces reset of video input when Decklink device loses input signal

- **NDI Sources:** provides controls for assigning NDI input sources to specific content indices

- **Syphon Sources:** provides controls for assigning Syphon input sources to specific content indices

- **Video Input (1-8):** provides controls for setup (device, format, etc.) of video input devices

Outputs Tab

The Outputs Tab of the Mbox application is used to:

+ Add, delete, and configure video outputs for the server
  - Edit index, name, origin, size, rotation, and flip value of output
  - Assign display to output
  - Assign output master to output
  - Configure output fit mode and window grouping properties
+ Adjust the size of the Global Surface
+ Adjust the scale of the output windows shown in Window mode
+ Identify connected displays
+ Archive and recall output/mix configurations

Indicator warns of output issues.

Global Surface configuration options.

Window Mode configuration options.

Output tile with configuration options.

Buttons to add/delete Outputs, Identify Displays, and archive/recall configurations.

Mini-map to show zoomed area of overall layout.

Zoom, Snap, and Ortho controls used when manipulating outputs on the layout view.

Top half of layout view shows the selected output on the Global Surface.

Bottom half of layout view shows the selected output on its parent output (as applicable).
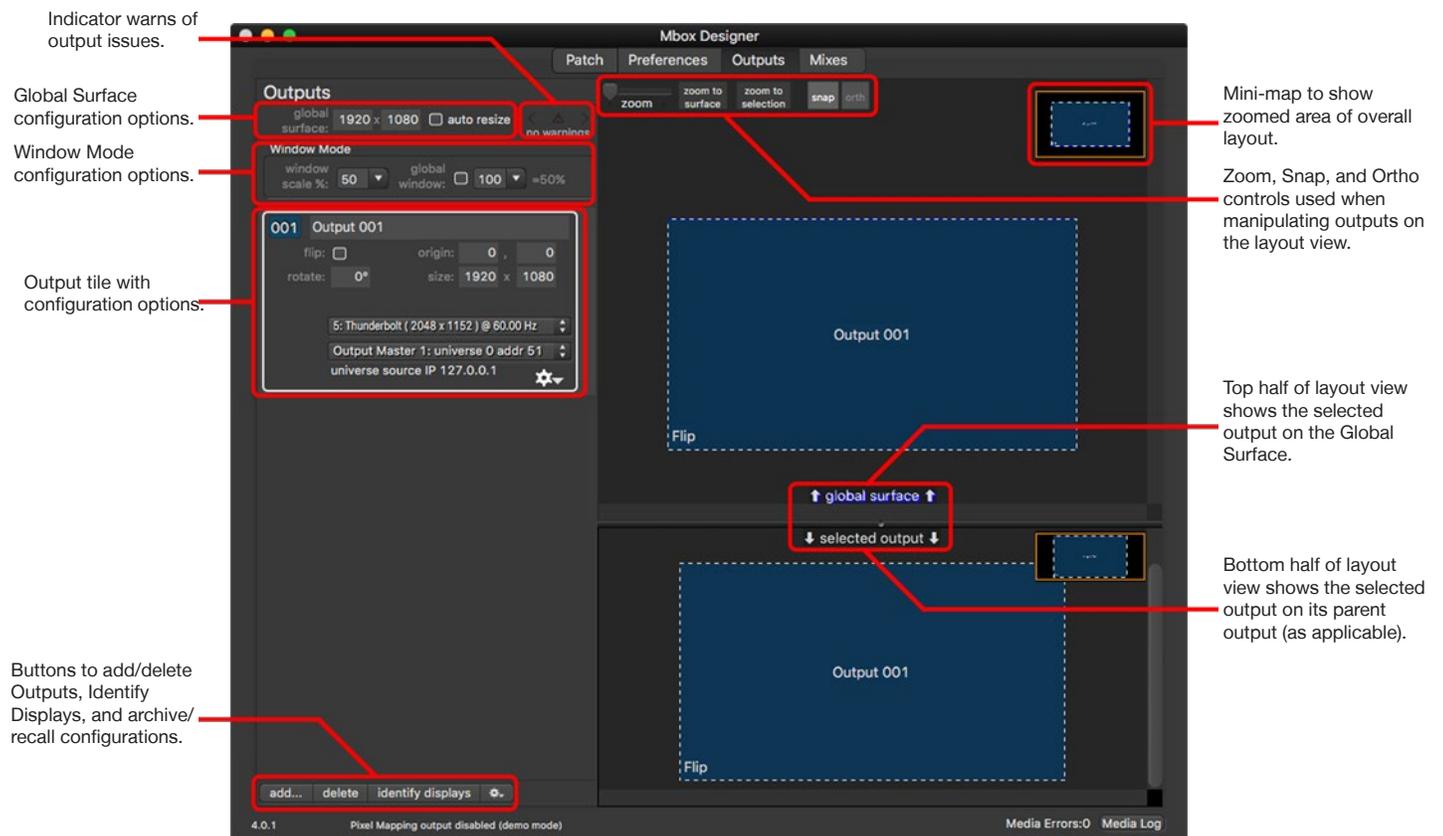
Note: Keystone and Warp for outputs is <u>not</u> configured on the Outputs tab at present time. Keystone can be adjusted using Art-Net/sACN control from Director or a lighting console. Both keystone and warp can be pre-set using the Mbox Remote application. Refer to the Mbox Remote manual for more details.
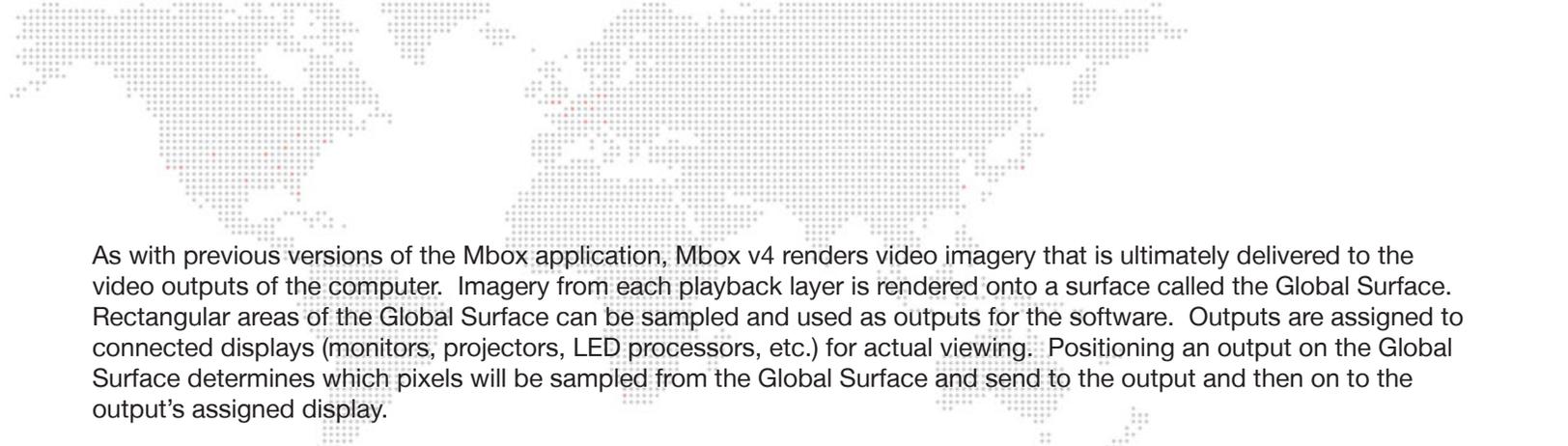
As with previous versions of the Mbox application, Mbox v4 renders video imagery that is ultimately delivered to the video outputs of the computer. Imagery from each playback layer is rendered onto a surface called the Global Surface. Rectangular areas of the Global Surface can be sampled and used as outputs for the software. Outputs are assigned to connected displays (monitors, projectors, LED processors, etc.) for actual viewing. Positioning an output on the Global Surface determines which pixels will be sampled from the Global Surface and send to the output and then on to the output's assigned display.

The Outputs tab provides all the controls for configuring the Global Surface and video outputs of the Mbox application. On this tab outputs can be added and deleted, their properties set, and their arrangement relative to each other adjusted. Each output may be assigned to a connected display. In addition, the Global Surface sizing is set here, as well as scaling properties for output windows that are seen when the Mbox application is in Window mode. Finally, output (and mix) settings can be archived to a file or recalled from a previously archived file.

As noted on page 45, while the Mbox application is in Window mode, all outputs will be shown as separate windows. When Mbox enters Fullscreen mode, these windows will resize and position themselves to fit their assigned display. It is possible to configure and program a show in Window mode without the actual display devices connected, but at some point displays will need to be connected to the computer and outputs assigned to them.

Outputs Tab: Overview

The Outputs tab is arranged in two sections: a scrollable column on the left with controls for configuring outputs and showing the properties of existing outputs, and a layout view to the right for adjusting output position on the Global Surface.

Note: The rendering engine in Mbox v4 allows the use of both outputs and sub-outputs. Sub-outputs are defined as rectangular areas within an output, similar to how outputs are areas within the Global Surface. A parent-child relationship is established between an output and its sub-outputs (its children) allowing sub-outputs to be grouped for organizational purposes or to work in combination with video output to a multi-head display device. Many of the properties and methods of configuration for sub-outputs are identical to those for outputs. The following descriptions may use the word "output" to mean both outputs and sub-outputs in some cases.

Every output has a tile representing it, which is placed in the column on the left side of the Outputs tab. Each output tile displays the output's index number as well as other properties: name, width, height, flip, rotation, assigned display, and assigned output master. Tiles for sub-outputs will be indented slightly from their parent outputs. Clicking on an output's tile in the list or on the output's graphical representation on one of the layout views will select it. Selected outputs will be highlighted in both places. Only one output may be selected at one time. To deselect an output, click on any empty area in the layout view.

The two graphical views on the right side of the Outputs tab show the layout of the outputs and sub-outputs. The top layout view shows all outputs and sub-outputs in their position on the Global Surface. The bottom layout view shows sub-outputs in their position on their parent output. Both outputs and sub-outputs may be moved in the top layout view, but only sub-outputs can be moved on the bottom layout view. Adjusting the position of a sub-output in the correct layout view is important to achieving the desired end result.

+ A sub-output's position on the Global Surface affects which pixels will be copied from the Global Surface and used for the sub-outputs portion of its parent's output.

+ A sub-output's position on its parent affects where on the output the sub-output's pixels will be copied to.

+ A sub-output's position on the Global Surface is linked to their parent's position. If the parent output is moved on the Global Surface the sub-output will move by the same amount.

+ Typically, sub-outputs' positions do not overlap on their parent output. But sub-outputs' positions may overlap on the Global Surface if overlapped and blended projectors are being used.

The top layout view represents the output's position on the Global Surface. The position on the Global Surface dictates where the pixels for that output will be sampled from. Essentially, an output is a viewport of an area of the Global Surface; any imagery in that area will be sampled and copied to the output and therefore will be visible on any display assigned to the output.

The following illustration shows an output positioned on the Global Surface creating a rectangular sample, the sample that is the imagery for the output, and finally that same imagery on the assigned display.

Output sample   Display
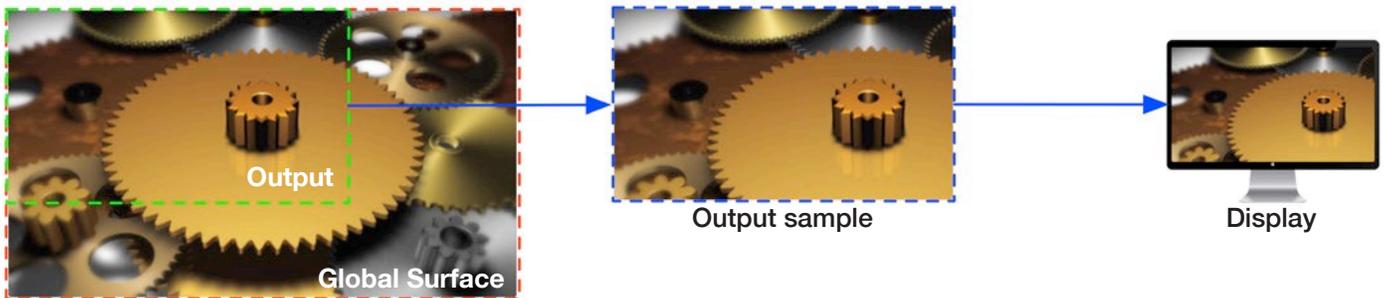
On the bottom layout view, sub-outputs' positions may be moved relative to their parent output. This positioning allows each sub-output's pixels to be copied to a very specific place when they are sent to the output device. Sub-outputs are often used for video outputs that are part of a multi-head output device (e.g. a Datapath FX4), where the sub-outputs are generally arranged in an orderly matrix: 2x1, 3x1, 2x2, etc. Typically, the rearrangement of sub-outputs on their parent output will be unnecessary as the display devices can simply be connected to the correct output of the multi-head device. But there may be cases where the sub-outputs need to be rearranged on the output to achieve the desired result.

The following illustration shows one output with four sub-outputs positioned on the Global Surface, creating four samples, the rearrangement of those four samples to create the imagery for output to a multi-head device (the "virtual" display in this case), and then finally each of those four sub-outputs as seen on the actual displays connected to the multi-head device.
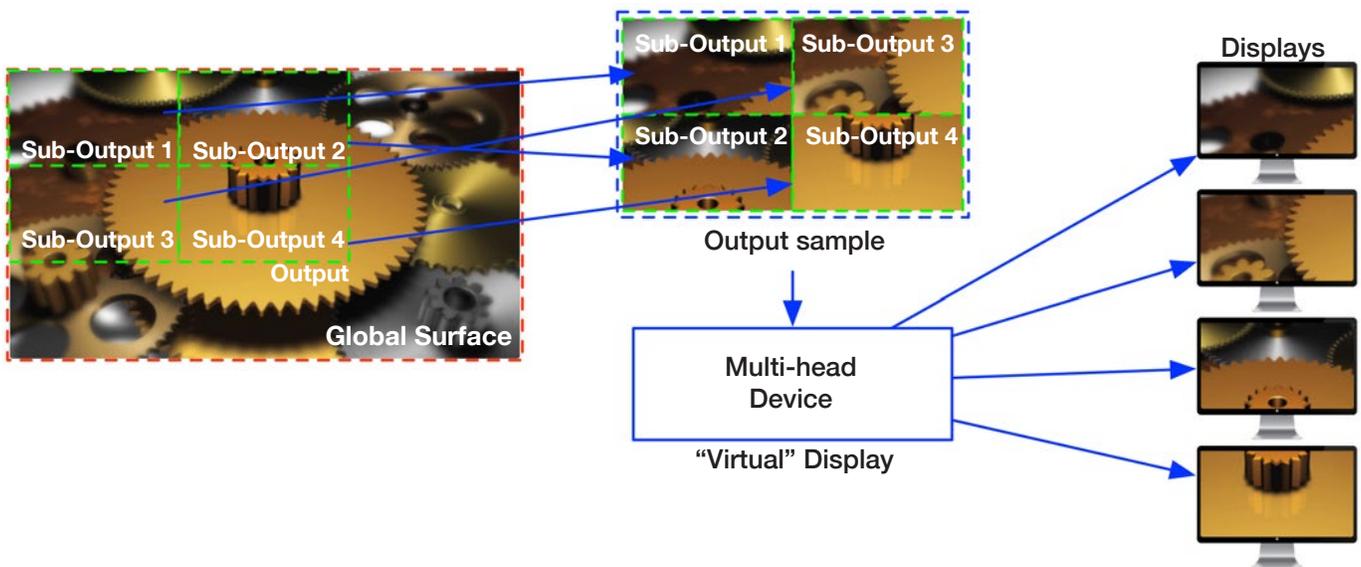
In this manner, imagery from anywhere on the Global Surface can be sampled and sent to the desired display device, whether that display is a single device or a multi-head device. Being able to move outputs on the Global Surface or sub-outputs on both the Global Surface and on their parent output is critical to getting the right pixels onto the display, as displays may want to have imagery that is unique, repeated, or even overlapping.

Outputs and may be placed anywhere on the Global Surface. It is possible to move outputs such that some or all of their area is not on the Global Surface. If a portion of an output extends outside the boundary of the Global Surface, this is indicated on the layout view by showing that portion of the output with red highlighting. The red area of the output will never display any content since content is only ever rendered on the Global Surface.
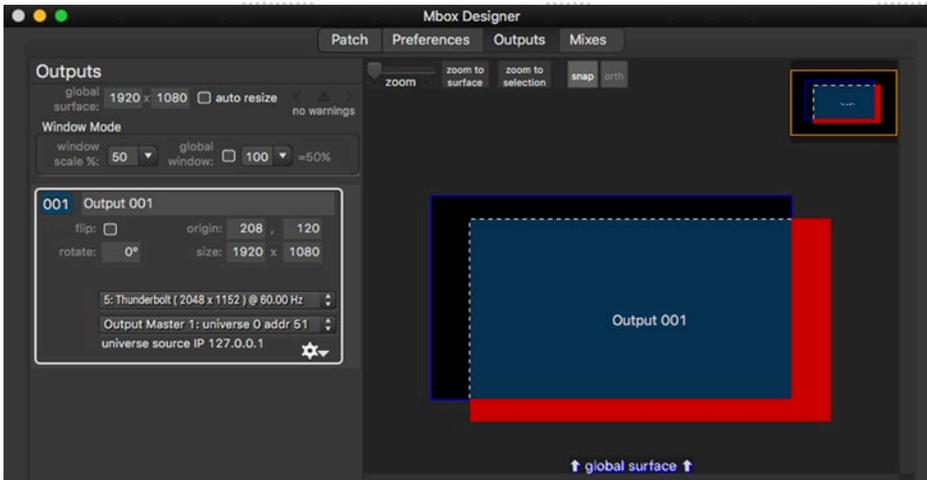
Note: Having a portion of an output outside the boundary of the Global Surface is not normal practice. If an output or mix extends outside the Global Surface's boundaries but needs to render content across its entirety, then either the output needs to be moved back so that all of it is on the Global Surface, or the Global Surface needs to be resized to fully enclose the output.

Outputs Tab: Output Configuration

Index Number

Every output has a unique index number with a value of 001 - 032. This index number is used both for organizational purposes and also for assigning layers to the output when programming. (Refer to) When an output is added, it is given the next available index number. Output index numbers may be changed at any time by double-clicking on the index number. But keep in mind that two outputs can't have the same index number and that any programming that assigns a layer to an output by index number will need to be modified if the index numbers change.

Name

Outputs also have a name. Each output is given a default name when it is added - "Output ###" where the "###" represents the unique index number of the output. Output names can be modified as desired and have no impact on the remainder of their configuration.

Size, Origin, Flip and Rotation

Outputs have configuration parameters that affect how large they are (width and height in pixels) and where they are located (based on their top-left corner) on the Global Surface. Flip and rotation parameters allow an output's imagery to be mirrored and/or inverted for projection, or to have its orientation adjusted for various creative configurations. Sub-outputs have additional X and Y offset parameters that indicate the offset of the sub-output's top-left corner from the top-left corner of its parent output - on the parent output, not on the Global Surface.

An output's size is only adjustable using the width and height text fields, but its origin on the Global Surface may be adjusted either in the corresponding text fields or by dragging the output on the top layout view. A sub-output's position on its parent can either be edited in the offset text fields or by dragging the sub-output on the bottom layout view. When making text edits to size or position, values should be whole numbers, not decimal values. Rotation values can use numbers with up to two decimal places.

CAUTION! Resizing an output to be more than 2x larger than the Global Surface requires the auto-resize preference to be enabled or for the Global Surface to be resized in advance.

Display

Outputs need to have a display assigned to them so that their imagery will be visible on a display device when Mbox is in Fullscreen mode. It is possible to configure and program a show in Window mode without the actual show display devices connected, but at some point the display devices will need to be connected to the computer and outputs assigned to them.

CAUTION! If an output has no assigned display then the output will not be rendered when Mbox enters Fullscreen mode! If an assigned display is disconnected and/or reconnected on a different physical video connector of the computer, it will not be rendered in fullscreen mode. In such cases, a yellow warning icon will appear in yellow next to the display pop-up for the output, indicating that corrective action is needed.

Display devices can include monitors, projectors, LED processors, scan converters, multi-head adapters, and Blackmagic Design Decklink or Ultrastudio devices with output capabilities. Every display device connected to the computer has a name. And because display names may not be unique, connected displays are also given a unique index number based on where or how they are plugged into the computer. Display devices connected directly to the computer using DVI, HDMI, or DisplayPort will have an index in the range of 1 – 8. Blackmagic devices will have an index of 9 or higher. A display's index number will depend on which physical video connector it is attached to on the computer or the order in which it was found if it is a Blackmagic device with output capabilities.
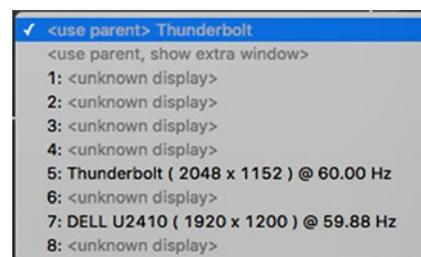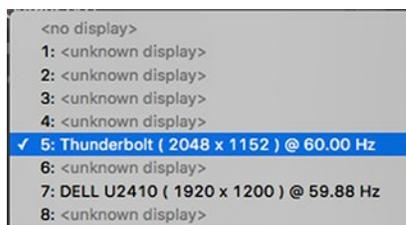
Clicking on the display pop-up for an output will show the list that includes all connected displays, and an option for "no display". In the case of sub-outputs, the "no display" option is replaced by two options: "<use parent>" and "<use parent, show extra window>".

The menu item for each connected display will also show the display's current resolution and frequency. A display's resolution and frequency can <u>only</u> be modified in the computer's System Preferences > Displays pref pane. Mbox v4 will always use this resolution and frequency for a display when going into Fullscreen mode, as Mbox v4 makes no attempt to modify these settings. (Refer to <u>"Connected Displays and Fullscreen Mode Interactions"</u> on page 71)

Assigning a display to an output will cause the output's imagery to be placed on that display when Mbox enters Fullscreen mode. Assigning no display to an output allows the output to have a window when Mbox is in Window mode, but when the application enters Fullscreen mode, the output's imagery will not be rendered, even in a window. For sub-outputs, the "use parent" option causes the imagery to be copied into the parent output (which would then be assigned to a display) and the "use parent, show extra window" option yields the same result but an extra output window is shown when the application is in Window mode.

By default, sub-outputs use their parent output as a display, which allows their imagery to be copied into the output as noted above. However, outputs don't have to have displays assigned to them. Outputs can be used with sub-outputs in a situation where the output is purely a grouping device in the layout to allow the sub-outputs to be moved as a unit. In this case, the output would be configured to have no assigned display, and each sub-output would have a display assigned to it.

Connected displays can be identified by name in the list. However, if multiple displays having the same name are connected this may not work. Therefore each display also has a unique index number. The "identify displays" button at the bottom of the window can be used to determine the index number and name of every connected display, Blackmagic devices included. (Refer to <u>"Outputs Tab: Add, Delete, Identify, and Archive"</u> on page 63)

Output Master

All outputs can have an output master assigned to them. Output masters add parameters for mastering properties of the output such as intensity, color, effects, etc. (Refer to <u>"Output Master Fixture"</u> on page 184) Multiple outputs can use the same output master if desired.

The output master assignment pop-up will show a list of the active output masters. The number of active output masters is set on the Patch tab (refer to <u>"Patch Tab: Control Input Setup"</u> on page 47), and the total number of available output masters is limited depending on the version of Mbox (Designer/Studio/Mini). Each output master has a patch universe and address that is pre-assigned and shown beside the output master's name in the list.

If an output master is assigned and the corresponding universe is active, the words "universe active" should appear below the pop-up. This only denotes that Mbox is receiving the correct universe, not that the data in the universe is correct.

CAUTION! As soon as an output has an output master assigned, it will start responding to data on the corresponding channels of that universe. Therefore, if the control console is not sending any data (or the wrong data) the output's visual properties may immediately change or the output may go completely black.

HUDs

Mbox is able to display HUDs (Heads Up Displays) showing performance and feedback data overlaid on top of the video outputs of the server. In previous versions of the software, HUDs were shown on every output. Mbox v4 includes the option to enable or disable HUDs for that output only. HUDs are enabled by default, to turn them off for an output, click on the gear icon and uncheck the "Show HUD" item in the menu.

Note: At least one output must have HUDs enabled, it is not possible to turn them off for all outputs.

Fit Mode

When the Mbox application goes into fullscreen mode, each output that has a display assigned to it will be shown on the corresponding display. If the output's size is exactly the same as the display's current resolution, then the fullscreen view will be exactly the same as what was seen in the window. If the output's size is different from the display's resolution, then the output will not look exactly the same when Mbox goes into fullscreen mode; it may over/underfill the display, either clipping the imagery or showing a black border. In most cases configuring an output be a different size to its assigned display is not typical operation and would be undesirable. However, it may be unavoidable in some situations, or useful for formatting previously programmed shows to fit onto a differently-sized display.

Each output can have its fit mode adjusted independently from other outputs. The output's fit mode affects how it's imagery will be scaled to fit a display that is a different size. There are four modes that control the fit – center (default), underscan, overscan, and anamorphic fit.

+ Center (default): the output is not scaled at all and maintains its aspect ratio. If the output is bigger than the display then it will be clipped; if the output is smaller then it will have a black border around it.

+ Underscan: the output is scaled so that its largest dimension (width or height) matches the same dimension (width or height) of the output. The output may show letterbox or pillarbox bars, but its aspect ratio is not affected.

+ Overscan: the output is scaled so that its smallest dimension matches the same dimension of the output. The output may be clipped on the sides or top/bottom, but its aspect ratio is not affected.

+ Anamorphic: the output is scaled so that its width and height match the width and height of the output. The entire output will always be visible, but the aspect ratio may be affected.

Window Group

Window groups are used to organize Mbox's output windows when the application is in Window mode only. Output windows that belong to the same window group will automatically be arranged with appropriate spacing - in respect to each other - based on their actual spacing on the Global Surface and will move together if one of the group is moved. All output windows default to window group 1 when they are created, but can be assigned to groups 2 – 8 instead, or have no window group assigned.

CAUTION! Mbox Studio and Mini have limits on the total pixel count for outputs. Mini supports up to 4.6 millions pixels (2x 1920x1200). Studio supports up to 8.85 million pixels (4096 x 2160). If the output pixel limit is reached, any outputs using pixels beyond the limit will be disabled and a warning "Total Output Resolution Exceeded" will be shown on the Outputs and Mixes tabs.

Outputs Tab: Global Surface Properties

The Global Surface in Mbox v4 is the "sandbox" that all rendering for the application happens in. This means that any imagery that is intended for output as video or as pixel mapped data must be rendered onto the Global Surface. All rendering happens on the Global Surface and is then "copied" to an output or to the pixel mapping engine for conversion.

Therefore, the Global Surface needs to be sized to be at least as large as the combined area of all outputs plus any area devoted to pixel mapping. The rendering area for one or more outputs (and the pixel mapping) can be overlapped or combined however.

The Global Surface has a default size of 1920x1080 pixels. If there is only one display device connected to the server, and that display has a resolution of 1920x1080 then there is no additional configuration required. If there are two outputs, each 1920x1080 with no overlap, then the Global Surface needs to be made bigger, 3840x1080 in this case. Adding an overlap to these two outputs would reduce the overall width of the Global Surface.

Mbox v4 eliminates the concept of Texture Size that limited the rendering in previous versions of Mbox. Mbox v4 automatically sizes its playback engine no matter the size of the content, and therefore the size of the content doesn't need to be factored into the configuration of the Global Surface (or anything else). Of course, larger content will have an impact on server performance, so content should be kept as small as possible to meet the needs of the show.

CAUTION! In most cases, the Global Surface should not be larger or smaller than the total area required by the outputs. Making the Global Surface too large affects performance, and making it too small means that some portions of outputs may be unable to show any imagery.

The Global Surface's width and height can be independently adjusted keeping two limits in mind:

+ The Global Surface's width and height both have maximum sizes of 16,384 pixels. The larger the Global Surface is, the more impact it will have on performance, so the Global Surface's size should be kept to the smallest possible size that allows all outputs and mixes to be placed on it as desired.

+ The Global Surfaces width and height must each be divisible by 16. If incompatible values are entered, Mbox will make the Global Surface slightly larger so that the width and/or height are divisible by 16.

When the auto resize checkbox is checked, the Global Surface will auto resize to enclose all outputs and mixes. When adding and moving outputs or mixes this can be useful. If the auto resizing is disabled, outputs and mixes can be placed partially or entirely outside the boundaries of the Global Surface.

Outputs Tab: Window Mode Properties

Three controls on the Outputs tab allow for the adjustment of window sizing in Window mode, and for turning on and off an optional window for the Global Surface.

+ The window scale property assigns an overall scaling percentage to all output windows, including the Global Surface window (if enabled).

+ Checking the global window checkbox causes an additional, separate window to be drawn that shows the full Global Surface.

+ Because it might be a very large window, there is an additional scaling factor pop-up for the Global Surface window. The size of the global window is scaled by both the window scale and global scale values. e.g. 50% and 50% = 25%

Outputs Tab: Add, Delete, Identify Displays, and Archive

At the bottom of the Outputs tab there are four buttons that perform actions to assist in output setup.

Adding Outputs

Clicking the Add... button reveals a menu with four options. If no output is selected in the pane above, then only two of the options - "Add One Output" and "Add Matrix of Outputs..." - will be available. If an output is selected, then two additional options - "Add One Sub-Output to ###" and "Add Matrix of Sub-Outputs to ###..." - will be available, with the "###" being replaced by the index of the selected output.

+ Add One Output - a single output will be added and placed onto the Global Surface. The output will be placed in the top-left corner of the Global Surface, given a size of 1920x1080, and given an index number based on the lowest unused output index number.

+ Add Matrix of Outputs - two or more outputs will be added and placed onto the Global Surface. Selecting this option will open the matrix configuration window. In this window, the properties of the matrix can be set - number of horizontal and vertical outputs, width and height of the outputs, horizontal and vertical overlap, and window group. The matrix of outputs will be placed at the top-left corner of the Global Surface and the outputs will be given index numbers in sequence based on the lowest unused output index number.

+ Add One Sub-Output - a single sub-output will be added and placed onto the selected output. The sub-output will be placed in the top-left corner of the Global Surface, given a size equal to the output's size, and given an index number based on the lowest unused output index number,

+ Add Matrix of Sub-Outputs - two or more sub-outputs will be added and placed onto the selected output. Selecting this option will open the matrix configuration window. In this window, the properties of the matrix can be set - number of horizontal and vertical sub-outputs, width and height of the sub-outputs, horizontal and vertical overlap, and window group. The matrix of sub-outputs will be placed at the top-left corner of the output and the sub-outputs will be given index numbers in sequence based on the lowest unused output index number.
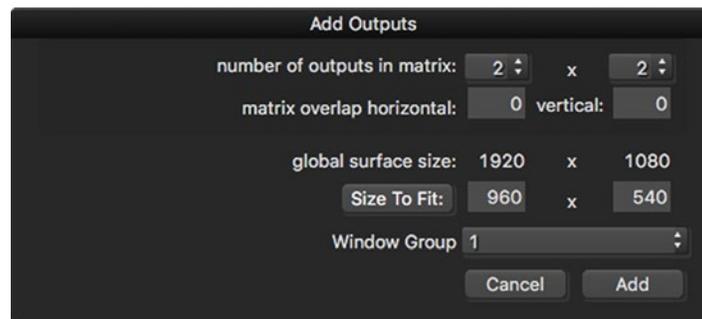
Deleting Outputs

Clicking on the Delete button will immediately delete the selected output or sub-output, leaving the next consecutive output selected if one exists.

Note: The Outputs tab user interface includes undo and redo functionality using standard keyboard shortcuts: [⌘Z] for undo and [⌘⇧Z] for redo.

Identify Displays

The Identify Displays button is useful when assigning outputs to displays. Sometimes it can be confusing to determine which display should be assigned to which output – particularly in the case of multiple displays with the same name.

Clicking the Identify Displays button puts a temporary overlay onto each display connected to the computer. The overlays are colored and show the name and unique number of the display. The name and number can then be referenced when assigning displays to outputs.

+ Click on the Identify Displays button to display semi-transparent overlays that disappear automatically after five seconds.

+ Control-click on the Identify Displays button to display opaque overlays that do not automatically disappear. Click anywhere with the mouse to remove the overlays on all outputs.

+ Shift-click on the Identify Displays button to bring all output windows to the current display, arranging them at the top-left corner of the display. Note that this action on works in window mode.

Archive

The Gear button is used primarily to save and recall output settings, but can also be used as an alternate way to modify an output or sub-output's index number.

Archiving output settings is generally used for the purpose of backing up data or creating a waypoint during edits. It may be useful at times to make a separate copy of the current output settings or to restore previous output settings. Clicking on "Save to Archive" stores a new copy of the entire MboxSettings.plist (all preferences for the server) to the Mbox/Archive/MboxSettings folder. "Restore Outputs & Mixes From Archive" displays a menu of all of the files in the archive folder, and selecting a file causes only the outputs and mixes data from that file to be restored, and not the remainder of the preferences. Clicking on "Reveal Archive in Finder..." will open a Finder window showing the Mbox/Archive/MboxSettings folder.

Note: Archived settings files are given a name that uses the Mbox software version and a time/date stamp. If desired, these files can be renamed in the Finder to give them more meaningful names.

Changing an output's index number requires an output tile to be selected and the replacement index number to be unused. Note that it's also possible to change an output's index number by double-clicking on the index number on the output's tile.

Mixes Tab

The Mixes Tab of the Mbox application is used primarily to:

+ Add and configure mixes, sub-mixes, and multi-mixes: editing their index, name, origin, size, and rotation

The user interface of the Mixes tab also allows the following tasks, the same as on the Outputs tab:

+ View configuration of existing outputs
+ Adjust the size of the Global Surface
+ Adjust the scale of the output windows shown in Window mode
+ Identify connected displays
+ Archive and recall output/mix configurations

Output tile showing read-only configuration options.

Mix tile with configuration options.

Layout view shows the selected mix or output on the Global Surface.
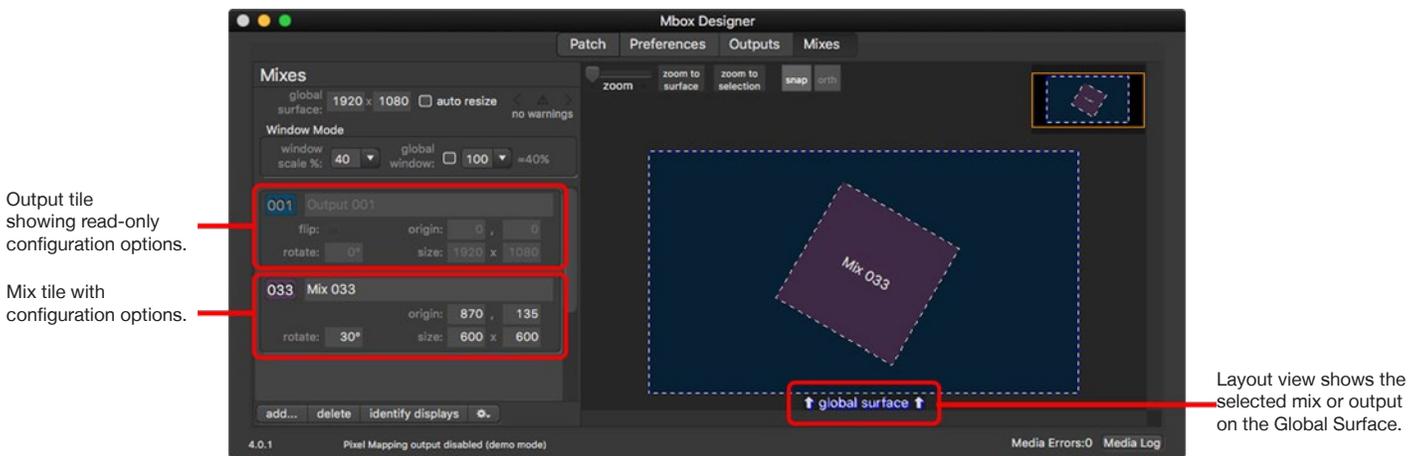
Mixes Tab: Overview

The Mixes tab of the Mbox v4 application is very similar to the Outputs tab both visually and conceptually. Some controls are repeated between the two tabs, and the configuration of mixes is almost identical to that for outputs.

The reason for this is because mixes and outputs are almost the same thing. In fact, outputs are mixes, and the Global Surface is a mix as well. These three items use essentially the same structure within Mbox, but the exposed functionality of each is slightly different. By strict definition, a mix is a rectangular area of the Global Surface, as are outputs.

Note: There are 256 mixes and/or multi-mixes available for use within the Mbox application. The Global Surface is always Mix 0, outputs are always Mixes 1 - 32, and "normal" mixes and multi-mixes are Mixes 33 - 255.

But mixes can't be used as outputs, even though an output is a mix. Mixes are meant to be used by a layer to help with composition. A layer can use a mix for positioning, cropping, scaling, and rotation. Mixes make it fast and easy to take the imagery from a layer and arrange it exactly how it needs to be for a desired look.

Mixes typically represent important areas of the Global Surface where content needs to be repeatedly placed. These important areas could be:

+ The entire Global Surface: for creating a background spread across all outputs
+ An output: for limiting content to a specific display
+ Any other area: for formatting and limiting content to areas that correspond to a particular display surface

Multi-mixes are a new concept introduced in Mbox v4.3. Multi-mixes have their own unique mix number and are created from a combination of mixes. The mixes used to make up a multi-mix can be some combination of the Global Surface, outputs, or normal mixes, but the Global Surface typically is not used.

Mixes Tab: Creating Mixes

Similarly to how outputs are created (see "Adding Outputs" on page 63) mixes are created using the Add... button at the bottom-left of the Mixes tab. The resulting menu provides option for adding one mix, a matrix of mixes, one sub-mix (to the currently-selected mix), a matrix of sub-mixes, or a multi-mix.

When added, a mix, sub-mix, or multi-mix, is always given the next available index number. Refer to "Adding Outputs" on page 63 for information on configuring sub-mixes when they are added, as the process is identical to that for adding sub-outputs. Refer to the "Multi-Mix Configuration" section below for more information about multi-mixes.

Mixes Tab: Mix Configuration

Index Number

Mixes use unique index numbers with a value of 033 - 255. As with outputs, this index number is used both for organizational purposes and also for assigning layers to the mix when programming. (Refer to "Using Outputs and Mixes with Layers" on page 75) As with outputs, mix index numbers may be changed at any time, by double-clicking on their index number. And just as with outputs, remember that two mixes can't have the same index number and that any programming that assigns a layer to an mix by index number will need to be modified if index numbers are changed.
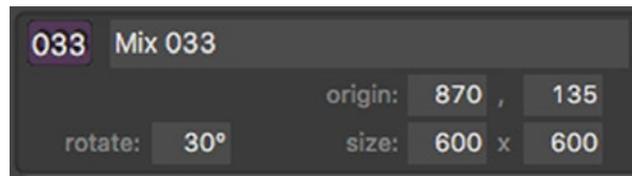
Name

Each Mix is given a default name when it is added - "Mix ###" where the "###" represents the unique index number of the mix. Mix names can be modified as desired.

Size, Origin, and Rotation

Mixes have a size (width and height in pixels), an origin (based on their top-left corner), and can be rotated. Mix sizing is only adjustable using the width and height text fields, but mix position may be adjusted either in the corresponding text fields or by dragging the mix on the layout view. When making text edits to size or position, values should be whole numbers, not decimal values. Rotation values can use numbers with up to two decimal places.

Note: Outputs are shown on the Mixes tab for reference. But their properties are only editable on the Outputs tab.

Mixes Tab: Multi-Mix Configuration

Each multi-mix tile has an index number and name that can be edited in the same way those values are edited for any other mix.

When a multi-mix is first created, it is empty and needs to have one or more mixes added to it. The mixes that make up a multi-mix can be added or deleted at any point in time, and can be added to or removed from the multi-mix at any point in time too. Multi-mixes are not shown on the layout view as a separate object, but when their tile is selected in the left-hand column, the mixes that belong to the multi-mix will be highlighted.

Each multi-mix tile has an Edit button that is enables the ability to add or remove mixes from the multi-mix. When the Edit button is clicked the button text will be colored green and a text prompt appears:
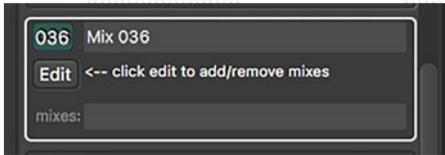
When in edit mode, mixes can be added to or deleted from the multi-mix by clicking on other mix tiles in the left-hand column or on mixes in the layout view. Mixes that are part of the multi-mix are outlined with a green dashed outline and will also be listed in selection order in the textfield on the multi-mix's tile.

Note: Selection order is important if any mixes in the multi-mix are overlapping. Mixes receive a "stacking order" based on their selection order, with the first mix in the list being at the back and subsequent mixes being placed in front. Make sure to get the stacking order correct for the desired effect when using the multi-mix.
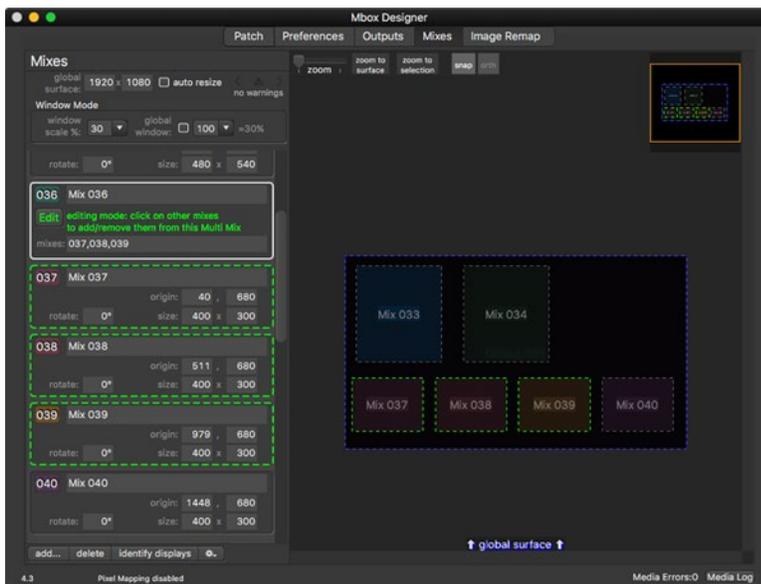
The mixes in the multi-mix can also be added or deleted by index number in this textfield. Their stacking order can be edited by rearranging the order of the index numbers in the field.

To apply an edit in the textfield either press the [tab] or [return] key or press the Edit button to leave edit mode. Changes are saved at this point and not before.

Outputs and Mixes Tab Layout View Navigation Controls

The layout views on the Outputs and Mixes tabs have identical controls for navigation and layout. These controls allow the layout view to be scaled and scrolled, and also provide aids for arranging outputs and mixes.
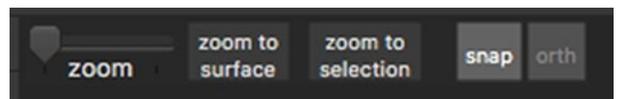
There are four ways to adjust the sizing of the layout view: the zoom slider, the mouse or trackpad scroll controls, and the two "zoom to..." buttons. The zoom slider adjusts the view sizing in a simple manner. The "zoom to surface" button resizes the view to show the entire Global Surface. The "zoom to selection" button resizes the view so that the currently selected output or mix fills the view. When using scroll controls on a mouse or trackpad to zoom the view, the cursor needs to be over the mini-map view. The orange box on the mini-map is a representation of the portion of the Global Surface in view. Scrolling will change the size the size of the orange box and therefore the zoom level of the layout view. The layout view will also recenter based on where the cursor is when zooming.
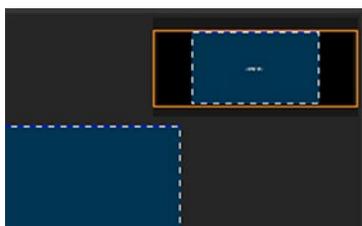
The snap and ortho buttons are used when arranging outputs and mixes on the Global Surface. Enabling snap causes guidelines to be created when dragging an output or mix around the layout view. These guidelines will indicate the snaps status: snapping to the object's parent will be shown with a blue guide and snapping to other objects will be shown with a green guide. A red guide is an indication that while the object is close to a snap point, it isn't quite snapped. Enabling ortho causes the object being dragged to be locked to movement on one axis (horizontal or vertical) only. This makes it easier to move an object in one direction without losing its current position on the other axis. When enabled, the ortho button's label will change to show the locked axis, X or Y.

The snap and ortho functions can be enabled/disabled by clicking on their respective buttons. Their functionality can also be temporarily toggled using a keyboard combination while dragging. Hold down the [control] key to toggle the snap function, or hold down the [shift] key to toggle the ortho function.

Note: When an output or mix is selected by clicking on it on the top layout view, the arrow keys on the keyboard may be used to nudge the output's position one pixel at a time. Holding down the [shift] key while using the arrow keys will nudge the output/mix's position ten pixels at a time.

Image Remap Tab

The Image Remap Tab of the Mbox application is used to:

+ View and edit image remapping data.

    - Open MultiScreenData.plist from disk or in live session with Mbox application.

    - Add, delete, or edit image remapping configurations, screen objects, and controls for screen objects.

Refer to "Chapter 5. Image Remapping" on page 123 for detailed information on the use and configuration of image remapping in Mbox.

Used to toggle between edit modes: edit file from disk, or edit live data in Mbox.

The configuration list shows all configurations, their screen objects, and the controls for each screen object.

Press to reload image remap data from file.

Universes entered here may be used for screen object controls.

Displays data for selected item in configuration list. Edits are made here.

Previsualization of the selected configuration/screen objects. A custom background image may be loaded.

HEADS UP DISPLAYS (HUDS)

Overview

Mbox provides Heads Up Displays (HUDs) that are onscreen overlays containing useful information - control input data, statistics, onscreen overlays. HUDs will be shown an all outputs that have their "Show HUD" property enabled. The HUDs are intended to be used for supplemental information that might be helpful during programming for troubleshooting informational purposes.

There are two methods for calling up the HUDs: the Global Master fixture control channel or the keyboard. Refer to the chart on page 214 for a listing of discrete values for the Global Master's Control Channel.   For keyboard activation of the HUDs, press one of the function keys listed below:

+ **F1** - Global Master, Output 1 (Master, Effect, Keystone, Shutter) HUD

+ **F2** - Layer Texture HUD

+ **F3** - Layer Effect HUD

+ **F4** - Control Input Universe HUD

+ **F5** - Pixel Mapping Previsualization

+ **F6** - Version HUD

+ **F7** - Outputs and Mixes Overlay

+ **F8** - Output Statistics HUD

+ **F9** - Performance HUD

+ **F10** - Timecode/Activity HUD
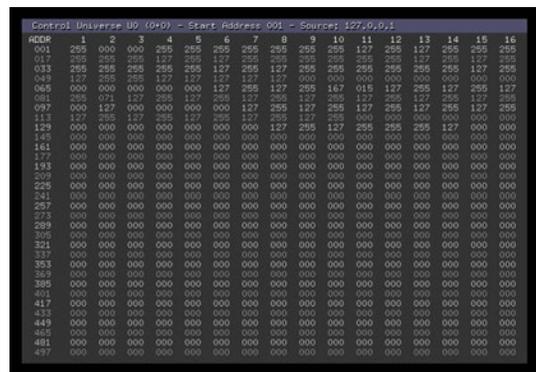
Example of the F4 HUD

Note: On some keyboards it may be necessary to press a combination of the [fn] key and the function [F1 - F10] key since the function keys are mapped to OS-specific tasks.

Use the following guidelines when working with the HUDs:

+ Any HUD called from the keyboard will override a request for a HUD by the Global Master Control Channel.

+ Press [esc] to clear any keyboard HUD or press the activating key a second time.

+ HUDs activated from the keyboard can also be cleared from the control console through the use of the Global Master Control Channel.

+ [F2] and [F3] have a double toggle action. The first press is for the first universe of control data (Art-Net or sACN) that the server receives (Layers 1-6), while the second press is for the second universe (Layers 7-12).

+ [F4] has a four-way toggle action. The first press is for the first universe of control data (Art-Net or sACN) that the server receives, the second is for the second universe, the third press is for the third universe, and the fourth press to see SADI status.

+ [F5] cycles through the previsualization for Pixel Mapping contexts that use outputs as sources.

+ [F7] may be added on top of any of the other HUDs except for the Pixel Mapping previsualization.

Note: The [F1} - [F3] HUDs omit some parameter data. For full control input monitoring, use the Patch tab in the main application window instead.

Pixel Mapping Previsualization

When using the pixel mapping features of the Mbox application it can be useful to view the subsampling and fixture layout for contexts that are using outputs (but not mixes) as their source. Pressing [F5] will toggle through previsualization of all outputs, followed by each output (1-9) in order.

The Mbox Remote application is able to show more pixel mapping previsualization that the Mbox application. Refer to the Mbox Remote user manual for more information on configuration and monitoring of pixel mapping.

Output and Mix Overlay

When setting up a configuration of outputs and mixes in advance, or performing the same tasks onsite, it can be helpful to view the outlines of outputs and mixes on Mbox's outputs. These outlines can be used a helpful guide when adjusting the configuration of LED processor sampling, or when trying to identify important onscreen regions for mix setup. Pressing [F7] will turn on and off an overlay that shows the outlines and index numbers of outputs and mixes. Outputs will have a yellow outline and mixes will have a white outline.
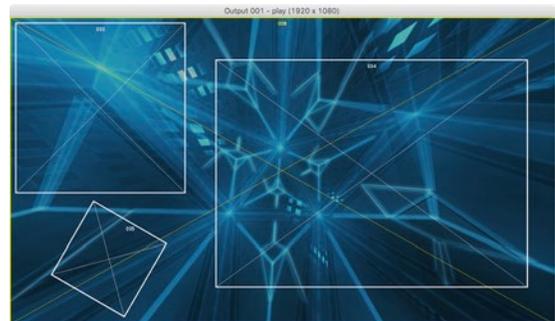
Activity/Timecode Monitoring

Program activity and timecode input can be monitored using the [F10] HUD. This HUD provides an on-screen indication of current timecode input, and because show programming may cause to go completely black at certain points in time, this HUD also provides an indication that the Mbox application is running.

Pressing [F10] will cycle through the five display positions for the Timecode/Activity HUD: center, top-right, top-left, bottom-left, and bottom-right. The HUD position can also be set using the "Global Master Control Channel" (page 214).

The green activity indicator moves across the gray notification field from left to right, indicating program activity. When timecode is being received, the current timecode value (HH:MM:SS:FF) is displayed in the notification area - colored yellow for good code and red for bad code. If timecode stops, the timecode notification will go away, but the green activity indicator will continue to move.

CONNECTED DISPLAYS AND FULLSCREEN MODE INTERACTIONS

Overview

Without special hardware or software, a typical computer can only output video resolutions and frequencies that are supported by the connected display equipment. Display devices communicate their possible input formats via EDID (Extended Display Identification Data). The EDID data provides information on preferred formats and available alternate formats.

When connecting the video outputs of the Mbox server to a display device, confirm that the display device appears in the computer's System Preferences > Displays pref pane. On most Macs, the computer will automatically read the EDID of displays when they are first connected. It is possible to force the computer to reread EDID from connected displays by pressing the "Detect Devices" button on the Displays pref pane.

Note: In newer versions of the Mac OS, the Detect Displays button is not visible unless the [option] key is pressed.

Once EDID has been read from the display, the Displays pref pane will display the available formats. By default, the pref pane will select the preferred format for the display. Clicking on the "Scaled" radio button will allow the selection of additional formats. Some formats will allow a selection of alternate refresh frequencies, but this will depend on the display device.

Note: Even after clicking on the "Scaled" radio button, all of the possible formats for the display may not be shown. Holding down the [option] key and clicking on the radio button may reveal more possible formats.
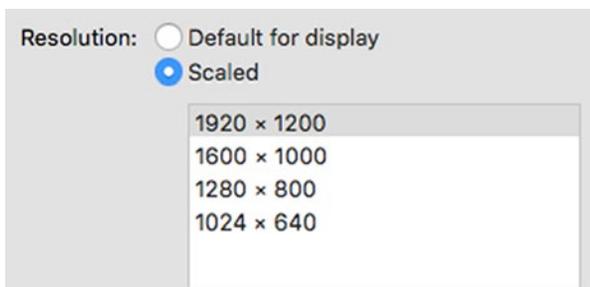
Clicking on "Scaled"
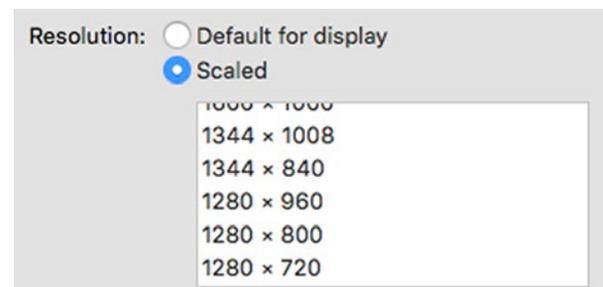
Option-clicking on "Scaled"

Note: The arrangement of connected display devices is not important for the Mbox application when it enters Fullscreen mode. However, it may be helpful to arrange display devices to provide a useful working environment when the Mbox application is in Window mode.

Assuming the desired format (resolution and frequency) are available for selection on the Displays pref pane, the next step is to actually select that format. If the desired resolution and/or frequency are not available, then it may be that the connected display does not support the desired format. In which case, the display should be replaced with one that does support the desired format. In some cases it may be necessary to use a device between the Mbox server and a display to "spoof" EDID. Spoofing EDID allows the computer to output formats that may not be supported by the display. In some cases this can be critical to getting the desired output format, but in other cases it may result in a lack of picture on the display device.

Note: Devices like the Mbox Dual IO Module and the Gefen DVI Detective may be used to spoof EDID.

The Mbox application is able to read the current resolution and frequency of all connected displays, as this information is provided by the OS. When Mbox goes into Fullscreen mode it will **only** use the resolution and frequency that the display is currently set to.

Older versions of the Mbox application attempted to change the resolution and frequency of outputs when entering Fullscreen mode. At times this could lead to confusing situations where the desired resolution or frequency were not applied, or where the display device could not display a picture based on the received format.

To eliminate these issues, Mbox v4 will not attempt to change the display into another format when going into Fullscreen mode. **The resolution and frequency of a display, must be pre-set in the System Preferences > Displays preference pane before entering Fullscreen mode.** When a display's format has been changed on the Displays pref pane, that new format will update automatically in the display assignment menu for outputs in the Mbox application.

In this manner it is possible to ensure that the selected output format is supported before ever launching the Mbox application and also guarantees that nothing that the Mbox application does ever changes the format that has been selected.

CAUTION! For best results, all video outputs of the Mbox computer should run at the same frequency! Running multiple outputs at differing frequencies (even if Mbox is not using those outputs) may result in rendering issues. If using a MacBook or MacBook Pro, it is always better to close the computer's "lid" and only run with external displays connected.

4.

OPERATION

This chapter provides operating instructions for the Mbox software

NETWORK INTERFACES FOR MBOX

Overview

The Mbox application relies on a multitude of network communications to control and configure the software, as well as to provide feedback and monitoring capabilities. The network communications involve both industry-standard protocols like Art-Net, sACN, and CITP, and also proprietary Mbox-only protocols.

All of this network communication needs to happen via the network interfaces of the computer that is running the Mbox software. This computer may have more than one network interface and therefore it is important to connect to the correct interface and also to configure any interfaces appropriately for use with Mbox.

Mbox can use any interface on the computer, but the most common interfaces are the localhost - for communication between Mbox and other applications running on the same computer (e.g. Daemon) - and the standard RJ45 interfaces. The Wi-Fi interface of the computer can be used for some communications, but this is not recommended due to the complexity and limitations Wi-Fi may put on the communications.

For some communications that require the localhost, no configuration is required. This includes any communication between Mbox and the Mbox Daemon application. But for other most other communications, a choice must be made for which network interface Mbox will use:

+ The **Sync Interface** will be used for all transmission and reception of playback synchronization communications. This includes MboxTime, Layer-to-Layer Sync, and network timecode from TC Reader or Mbox Director.

+ The **Management Interface** will be used for all other configuration and feedback communications as well as for content management. This includes monitoring and configuration from Mbox Remote (including pixel mapping, image remapping, and projection mapping configuration), CITP/MSEX communications to lighting consoles and visualizers, and content management synchronization between servers.

Guidelines for interfaces:

+ Mbox also needs to receive control data (Art-Net or sACN) from a control console or Mbox Director. These two protocols can be received on any active interface, and therefore no configuration is required to select which interface is used.

+ It is generally preferable that the Sync and Management interfaces be separate, to ensure that communications on one do not affect communications on the other. However, it is not required that they be different, and in some cases they must be the same.

+ The Sync and Management interfaces are selected on the Preferences tab of the Mbox application, in the Network section. Each has a pop-up that will show the currently-selected interface, and will allow the selection of another active interface when clicked on.

+ One of the choices on the pop-ups is an interface called "Local." Choosing this item will ensure that the associated communications will only be routed internally on the computer, using the localhost.

+ If an active interface is selected but then becomes inactive then any communications using that interface will not occur. The inactive interface will need to be restored or an alternate interface selected.

+ Disable power-saving for USB - Ethernet adapters if possible, or use a device that does not have this feature.

All network communications to and from the Mbox server require correctly configured network interfaces. If the selected interfaces do not have the correct IP address or subnet mask, then they may be unable to communicate with any other networked devices. Make sure that all devices are configured correctly to be on the appropriate subnet. Refer to "Mbox Networking Guidelines" on page 170 for more information.
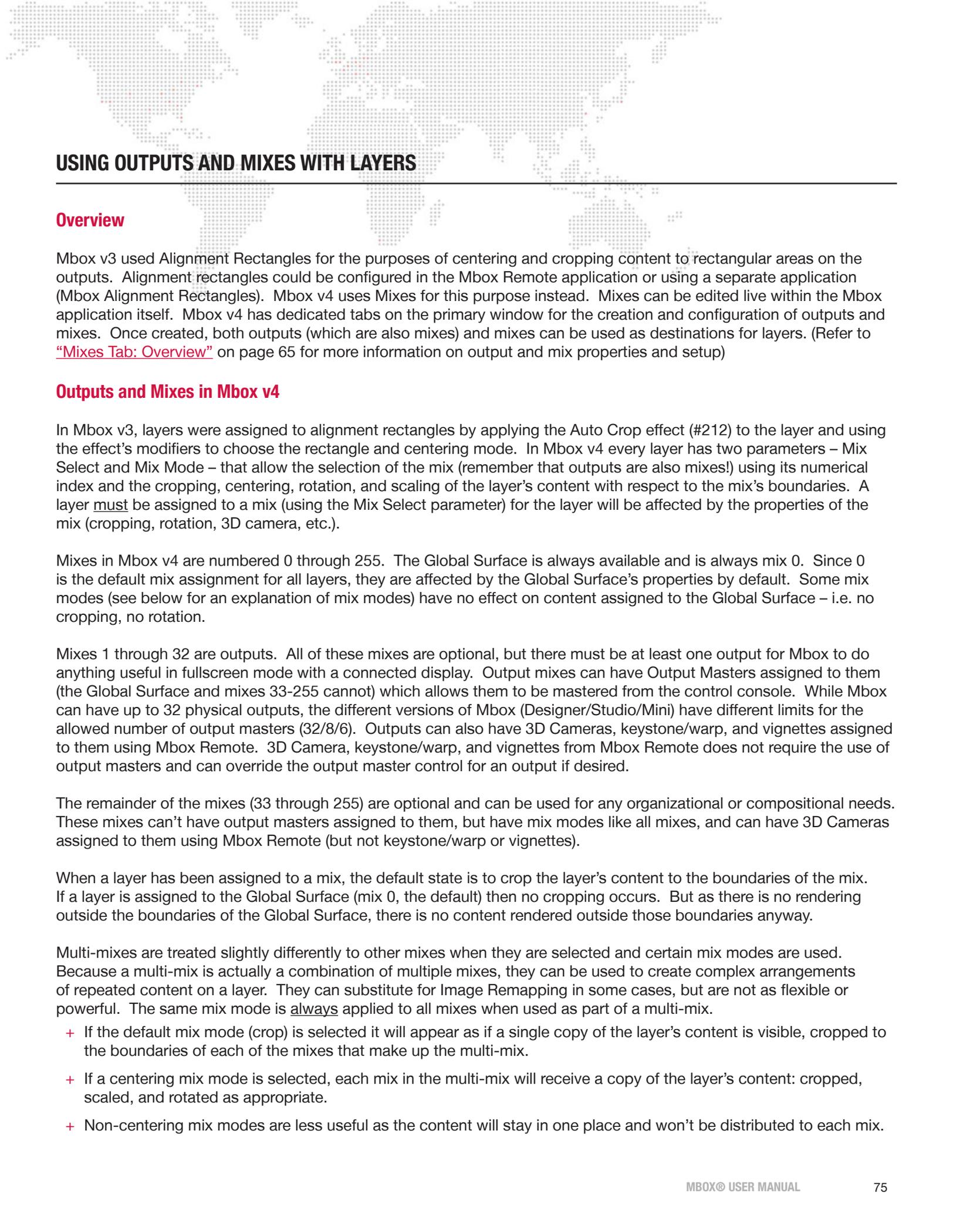
USING OUTPUTS AND MIXES WITH LAYERS

Overview

Mbox v3 used Alignment Rectangles for the purposes of centering and cropping content to rectangular areas on the outputs. Alignment rectangles could be configured in the Mbox Remote application or using a separate application (Mbox Alignment Rectangles). Mbox v4 uses Mixes for this purpose instead. Mixes can be edited live within the Mbox application itself. Mbox v4 has dedicated tabs on the primary window for the creation and configuration of outputs and mixes. Once created, both outputs (which are also mixes) and mixes can be used as destinations for layers. (Refer to for more information on output and mix properties and setup)

Outputs and Mixes in Mbox v4

In Mbox v3, layers were assigned to alignment rectangles by applying the Auto Crop effect (#212) to the layer and using the effect's modifiers to choose the rectangle and centering mode. In Mbox v4 every layer has two parameters – Mix Select and Mix Mode – that allow the selection of the mix (remember that outputs are also mixes!) using its numerical index and the cropping, centering, rotation, and scaling of the layer's content with respect to the mix's boundaries. A layer must be assigned to a mix (using the Mix Select parameter) for the layer will be affected by the properties of the mix (cropping, rotation, 3D camera, etc.).

Mixes in Mbox v4 are numbered 0 through 255. The Global Surface is always available and is always mix 0. Since 0 is the default mix assignment for all layers, they are affected by the Global Surface's properties by default. Some mix modes (see below for an explanation of mix modes) have no effect on content assigned to the Global Surface – i.e. no cropping, no rotation.

Mixes 1 through 32 are outputs. All of these mixes are optional, but there must be at least one output for Mbox to do anything useful in fullscreen mode with a connected display. Output mixes can have Output Masters assigned to them (the Global Surface and mixes 33-255 cannot) which allows them to be mastered from the control console. While Mbox can have up to 32 physical outputs, the different versions of Mbox (Designer/Studio/Mini) have different limits for the allowed number of output masters (32/8/6). Outputs can also have 3D Cameras, keystone/warp, and vignettes assigned to them using Mbox Remote. 3D Camera, keystone/warp, and vignettes from Mbox Remote does not require the use of output masters and can override the output master control for an output if desired.

The remainder of the mixes (33 through 255) are optional and can be used for any organizational or compositional needs. These mixes can't have output masters assigned to them, but have mix modes like all mixes, and can have 3D Cameras assigned to them using Mbox Remote (but not keystone/warp or vignettes).

When a layer has been assigned to a mix, the default state is to crop the layer's content to the boundaries of the mix. If a layer is assigned to the Global Surface (mix 0, the default) then no cropping occurs. But as there is no rendering outside the boundaries of the Global Surface, there is no content rendered outside those boundaries anyway.

Multi-mixes are treated slightly differently to other mixes when they are selected and certain mix modes are used. Because a multi-mix is actually a combination of multiple mixes, they can be used to create complex arrangements of repeated content on a layer. They can substitute for Image Remapping in some cases, but are not as flexible or powerful. The same mix mode is always applied to all mixes when used as part of a multi-mix.

+ If the default mix mode (crop) is selected it will appear as if a single copy of the layer's content is visible, cropped to the boundaries of each of the mixes that make up the multi-mix.

+ If a centering mix mode is selected, each mix in the multi-mix will receive a copy of the layer's content: cropped, scaled, and rotated as appropriate.

+ Non-centering mix modes are less useful as the content will stay in one place and won't be distributed to each mix.
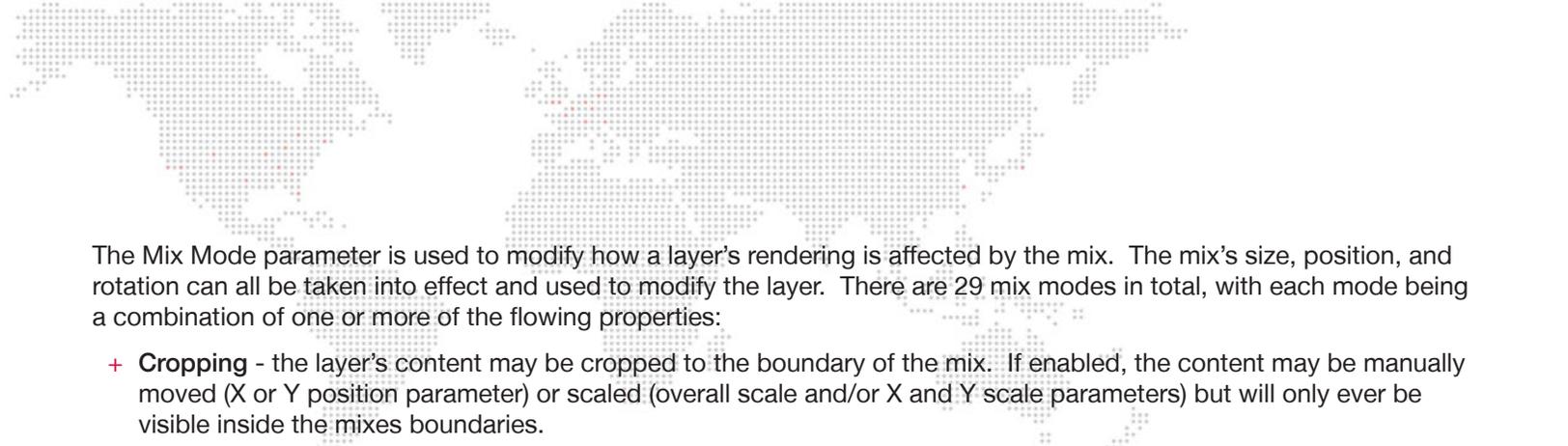
The Mix Mode parameter is used to modify how a layer's rendering is affected by the mix. The mix's size, position, and rotation can all be taken into effect and used to modify the layer. There are 29 mix modes in total, with each mode being a combination of one or more of the flowing properties:

+ **Cropping** - the layer's content may be cropped to the boundary of the mix. If enabled, the content may be manually moved (X or Y position parameter) or scaled (overall scale and/or X and Y scale parameters) but will only ever be visible inside the mixes boundaries.

+ **Centering** - the layer's content may be centered in the center of the mix. If enabled, the content may be manually moved and that will act as an offset from the center of the mix.

+ **Fit H** - the layer's content will be scaled up or down to fit the width of the mix. The width of a rotated mix is different to the width of the same mix if it were not rotated; it's the distance between the two opposite corners. If enabled, the content can be scaled, and that will act as an offset from the automatic horizontal fit scaling. The aspect ratio of the content will not be affected.

+ **Fit V** - the layer's content will be scaled up or down to fit the height of the mix. The height of a rotated mix is different to the height of the same mix if it were not rotated; it's the distance between the two opposite corners. If enabled, the content can be scaled, and that will act as an offset from the automatic vertical fit scaling. The aspect ratio of the content will not be affected.

+ **Fit H and V** - a combination of the above two properties. However, in this case, the aspect ratio of the content may be affected.

+ **Fit Best** - content is scaled proportionally such that the largest dimension fits the mix exactly and the smaller dimension fits within the mix. No cropping occurs and the aspect ratio of the content is not affected.

+ **Rotate** - the layer's content will be rotated to match the rotation of the mix. If enabled, the content can be manually rotated using the Z rotation parameter, and that will act as an offset from the automatic rotation.

3D Perspective Camera

All versions of Mbox have a default 3D camera that allows a basic, straight-ahead, perspective view of 3D objects within Mbox's 3D environment. This default 3D camera is permanently assigned to the Global Surface (Mix 0) and is not configurable.

However, in Mbox Designer, one or more 3D cameras can be added and configured:

+ Outputs can have a live-controlled (from Director or lighting console) "DMX Camera" if an output master is assigned to the output.

+ Any mix (including outputs) can have a 3D camera applied to it using the Mbox Remote Projection Editor toolset. These 3D cameras can only be adjusted from within Mbox Remote

+ It is possible to switch an output's 3D camera back and forth between a live DMX camera and a static camera configuration created in Mbox Remote.

Typically, 3D cameras will be used on outputs when projection mapping, but it is possible to create and configure a 3D camera for various compositional purposes.

Note: In Mbox Studio/Studio+ and Mini, only the Global Surface has a 3D camera.

In the default state, none of Mbox's mixes have a 3D camera assigned to them, except for the Global Surface. In this state it is possible to use 3D objects and to see them in perspective, with the center of 3D space being the center of the Global Surface and the camera's view being centered on the center of the Global Surface. Objects on layers can be moved and the camera's view of them will change perspective as the objects move. However, in this default state, the position, look-at point, and properties of the camera are preset and cannot be changed.
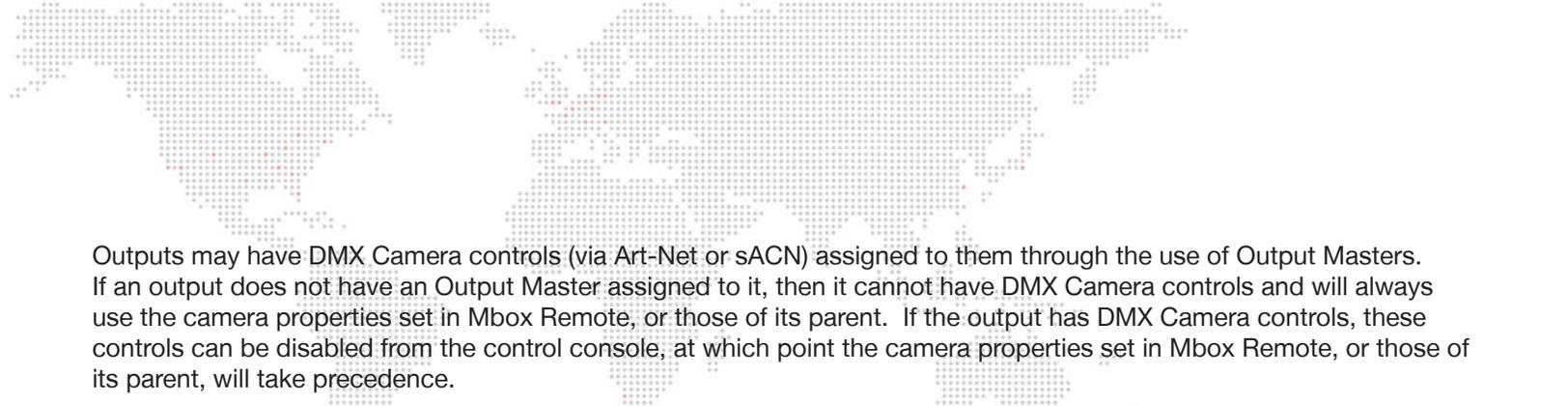
Outputs may have DMX Camera controls (via Art-Net or sACN) assigned to them through the use of Output Masters. If an output does not have an Output Master assigned to it, then it cannot have DMX Camera controls and will always use the camera properties set in Mbox Remote, or those of its parent. If the output has DMX Camera controls, these controls can be disabled from the control console, at which point the camera properties set in Mbox Remote, or those of its parent, will take precedence.

As noted in the previous paragraph, Camera assignment to outputs follows a hierarchy. The hierarchical nature of mixes in Mbox v4 means that the Global Surface is the "parent" of all mixes (including outputs) and that every output or mix can be the parent of sub-outputs or sub-mixes. The assignment and control of the 3D perspective view for a mix depends on whether it has its own projection settings (3D camera) and controls. If a mix is lacking projection settings, then it will use its parent's settings instead. And if the mix's parent is lacking projection settings, then that parent's parent's (i.e. the Global Surface) settings will be used.

Hierarchy = Global Surface -> Output -> Sub-Output …or… Global Surface -> Mix -> Sub-Mix

Layer Assignment with 3D Cameras

In order to use a 3D camera's viewpoint for a layer, the layer must be assigned to a mix that has a 3D camera configured. Therefore, it's important to assign layers to the correct mix to ensure they use the correct 3D camera. This can mean that a layer is assigned to the Global Surface, to an output, or to a mix.

If a layer is assigned to Mix 0 (the default) then the layer is assigned to the Global Surface and will use the standard 3D camera viewpoint for the Global Surface. If a layer is assigned to Mix 1 - 32, then the layer can use with the 3D camera for one of the possible output masters, or a 3D camera configured in Mbox Remote. Finally, if a layer is assigned to Mix 33 - 255, then the layer can use a 3D camera configured in Mbox Remote.

If a layer is assigned to an output and the output has an output master with DMX Camera controls, it's important to remember that the layer's 3D Camera can be adjusted in two different ways: either from Mbox Remote or from the DMX Camera controls. Make sure to enable and use the correct controls for configuring the 3D camera.

DMX Camera Control in Mbox v4

Mbox Designer v4's 3D camera and its live control parameters work differently to the camera and controls in Mbox v3.x. In Mbox v3.x the camera was always pointing towards the center of 3D space (X,Y,Z = 0,0,0) unless the pitch or yaw controls were changed. The v3.x camera could be orbited around the center of 3D space. While these controls were simple, they meant that the camera could not be horizontally or vertically panned, and that the camera position, which used 16-bit controls, couldn't be related to actual 3D coordinates.

In Mbox v4, the camera itself has an adjustable X,Y,Z position (which defaults to 0,0,10) and also has an adjustable lookat position (which defaults to 0,0,0). This allows both the camera and its position to be adjusted, either independently or at the same time – thereby allowing for panning. The orbit, pitch, and yaw controls have been eliminated.

Note: The DMX camera controls in Mbox Designer v4 shares the same core parameter set as the camera controls in Mbox Remote.

Due to these changes in the 3D camera's controls, two of the controls have non-typical defaults. The camera Z position default is 42767, which equates to a value of 10 units in 3D space. And the camera FOV has a default value of 71, which equates to 25°, the default FOV in the projection editor in Mbox Remote. These defaults allow the camera to be seamlessly switched between DMX control and Mbox Remote control without any perspective shift if the values (in both DMX and Remote) are at the same.

PLAYMODES

Basic Modes

Loop (Forward & Reverse) - Looping playmodes will play the movie from In-Frame to Out-Frame (Forward) or Out-Frame to In-Frame (Reverse) in a looping fashion. When the layer's opacity is reduced to 0, the playhead continues to mark time, meaning that when opacity is restored, the playhead will be at a later point in time.

Once (Forward & Reverse) - Once playmodes will play the movie from In-Frame to Out-Frame (Forward) or Out-Frame to In-Frame (Reverse) but will pause on the final frame rather than looping. When the layer's opacity is reduced to 0, the playhead continues to mark time, meaning that when opacity is restored, the playhead will be at a later point in time.

Modifiers:

+ **Pause when Opacity = 0** - When the layer's opacity is reduced to a level of 0, the playhead stops. When opacity is restored, playback resumes with the playhead at the same point it was when opacity was set to 0.

+ **Pause and Reset when Opacity = 0** - When the layer's opacity is reduced to a level of 0, the playhead stops. When opacity is restored, playback resumes at the In-Frame/Out-Frame - depending on the direction of playback.

Bounce/Random

Bounce (Forward & Reverse) - Bounce playmodes will play the movie in the selected direction initially, but playback will switch to the opposite direction when the last frame is reached. (This is also know as "ping-pong.")

Random - A pseudo-random frame of the movie from between the In and Out-Frames will be displayed. This mode is pseudo-random because using the same movie and playback settings on more than one layer/server will cause the same frame to be played at the same time on both layers/servers. This is done so as to allow for playback sync between multiple servers in a blended arrangement.

Scrub

Scrub In - Playback is paused and the playhead is moved to the In-Frame. The In-Frame parameter can be adjusted and the movie will scrub to the new In-Frame.

Scrub Out - Playback is paused and the playhead is moved to the Out-Frame. The Out-Frame parameter can be adjusted and the movie will scrub to the new Out-Frame.

Note: Setting a layer's playspeed parameter to zero allows both the In and Out-Frames to be scrubbed without modifying the playmode for the layer.

Restart on In-Frame Change

Forward Loop - Movie will play forwards from In-Frame to Out-Frame, looping at the Out-Frame. If the In-Frame value is modified during playback, then the playhead will jump to the frame associated with the new In-Frame value.

Forward Once - Movie will play forwards from In-Frame to Out-Frame, pausing on the Out-Frame. If the In-Frame value is modified during playback (but not after the pause), then the playhead will jump to the new frame associated with the In-Frame value.

Forward Loop with Crossfade - As with Forward Loop Restart on In-Frame Change, but the layer's current crossfade type and time are used to transition to the new In-Frame value.

Forward Once with Crossfade - As with Forward Once Restart on In-Frame Change, but the layer's current crossfade type and time are used to transition to the new In-Frame value.

Crossfade on Out-Frame

Forward Loop - Movie will play forwards from In-Frame to Out-Frame, looping on the Out-Frame. If the layer has a crossfade time greater than 0 assigned to it, the movie will crossfade (using the layer's crossfade type) to the In-Frame. Because the Out-Frame triggers the crossfade, to ensure a pause-free crossfade the Out-Frame should be moved (towards the beginning of the movie) by at least the same amount of time as the crossfade time.

Reverse Loop - Movie will play backwards from Out-Frame to In-Frame, looping on the In-Frame. If the layer has a crossfade time greater than 0 assigned to it, the movie will crossfade (using the layer's crossfade type) to the Out-Frame. Because the In-Frame triggers the crossfade, to ensure a pause-free crossfade the In-Frame should be moved (towards the end of the movie) by at least the same amount of time as the crossfade time.

Timecode Sync

Strict Lock - Used with a timecode (LTC or MTC) input. Movie playback waits on In-Frame for matching timecode value, at which point playback is locked to timecode. If timecode stops, the playback stops. If timecode jumps (forward or backwards) playback will jump accordingly.

Sync then Freewheel - Used with a timecode (LTC or MTC) input. Movie playback waits on In-Frame for matching timecode value, at which point playback is started but ignores timecode (freewheels) until the movie or playmode is changed on the layer.

Jam Sync - Used with a timecode (LTC or MTC) input. Movie playback waits on In-Frame for matching timecode value. If timecode continues playback is locked to timecode. If timecode goes away, playback continues (freewheels). If timecode returns, the playhead will jump to the point of the movie matching that timecode.

Layer Sync

Receiver - Used with one of the Layer Sync Sender modes on another layer/server. A Receiver layer pauses on its In-Frame and listens for sync signals on its selected Sync Stream. If sync is received, the layer plays the same relative frame as the Sender, and at the same speed.

Sender Forward Loop - Used with the Layer Sync Receiver mode on another layer/server. A Sender Forward Loop layer plays between In and Out-Frames, loops at the Out-Frame, and transmits a sync signal on the selected Sync Stream.

Sender Forward Once - Used with the Layer Sync Receiver mode on another layer/server. A Sender Forward Loop layer plays between In and Out-Frames, pauses at the Out-Frame, and transmits a sync signal on the selected Sync Stream.

Kiosk

Non-Looping, Pause on Last Frame of Last File - Playback between In and Out-Frame begins with the initially-selected file in a folder, automatic sequential transitions (using layer's transition type and time) happen until the Out-Frame of the last movie in the folder is reached. At which point the movie will pause on the Out-Frame until the movie or playmode is changed.

Non-Looping, Loop Last File - Playback between In and Out-Frame begins with the initially-selected file in a folder, automatic sequential transitions (using layer's transition type and time) happen until the Out-Frame of the last movie in the folder is reached. At which point the movie will loop back to its In-Frame continuously until the movie or playmode is changed.
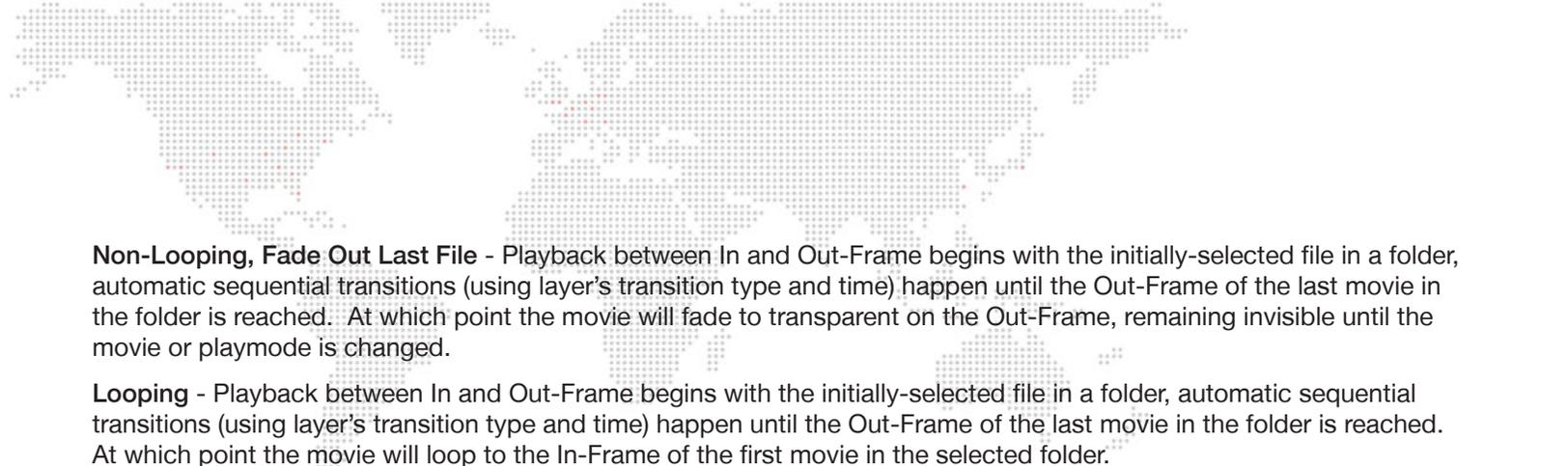
Non-Looping, Fade Out Last File - Playback between In and Out-Frame begins with the initially-selected file in a folder, automatic sequential transitions (using layer's transition type and time) happen until the Out-Frame of the last movie in the folder is reached. At which point the movie will fade to transparent on the Out-Frame, remaining invisible until the movie or playmode is changed.

Looping - Playback between In and Out-Frame begins with the initially-selected file in a folder, automatic sequential transitions (using layer's transition type and time) happen until the Out-Frame of the last movie in the folder is reached. At which point the movie will loop to the In-Frame of the first movie in the selected folder.

SMPTE - A valid movie folder/file must be selected to initiate playback. This movie will stay paused on its In-Frame until timecode reaches the start of any movie in the folder. At which point the incoming timecode value will trigger the playback of the movie with the matching time.

Guidelines for Kiosk modes:

+ The two non-SMPTE Kiosk modes use the layer's current crossfade type and time when switching from one piece of content to the next. These two modes require the first desired piece of content in the folder to be selected.

+ The SMPTE Kiosk mode requires any valid SMPTE-linked piece of content in a folder to be selected on the layer; this content should be the first piece of content desired.

+ Folders for use with SMPTE Kiosk mode should not include any non-SMPTE linked content. Content should be given sequenced file numbers with the same order as their intended timecode playback order.

+ It is also a good idea to make the first and last frames of any SMPTE-linked content black to avoid an undesirable paused frame while the layer waits for the appropriate SMPTE to initiate playback.

+ The SMPTE Kiosk mode requires the use of the MediaInfo.plist or MediaTimeCodes.plist for assignment of start times for the individual files. (Refer to "Timecode Synchronization" on page 103) It is not compatible with the layer TC DMX Controls.

Playout

Playout modes allow the playhead to skip ahead to a predetermined point before the end of the movie. The Playmode value should be returned to its prior value afterwards, therefore this playmode works best as a temporary setting, as with a bump button on a console.

5 Seconds - playback position will skip ahead to five seconds from the end of the movie.
10 Seconds - playback position will skip ahead to ten seconds from the end of the movie.
15 Seconds - playback position will skip ahead to fifteen seconds from the end of the movie.
20 Seconds - playback position will skip ahead to twenty seconds from the end of the movie.
30 Seconds - playback position will skip ahead to thirty seconds from the end of the movie.

The time values above represent the default values. Playout points can be modified on the Preferences tab of either Mbox and Mbox Remote. The preference is called "Playout Points" and the format is in whole numbered seconds (five separate values).

Restart

Restart Movie from In-Frame - This playmode always returns the playhead to the current In-Frame point. The Playmode value should be returned to its prior value after a restart is triggered, therefore this playmode works best as a temporary setting, as with a bump button on a console.

IMPORTANT! Some movie types will not work with certain playmodes. For example: Movies that use either H.264 or mp4 encoding cannot use the Random playmode (and others). This is due to their temporal compression scheme. Content that uses Spatial compression (e.g. ProRes, Hap, Photo-JPEG) can be used with all playmodes.

3D OBJECTS AND DIGITAL GOBOS

Overview

The Mbox application can display 3D objects and "Digital Gobos." Objects and digital gobos can be displayed both with and with a texture, with objects using the UV mapping coordinates stored in the .obj file and digital gobos using automatic UV mapping. Objects are treated as being fully three-dimensional, allowing positioning, scaling, rotation, and spins in 3D space. Digital gobos have no depth and therefore cannot have their Z-Scale adjusted.

3D Object and digital gobo files are arranged into individual folders within the Mbox/Models folder. Refer to "Media Content Management" on page 36 for information on adding 3D content and supported file formats.
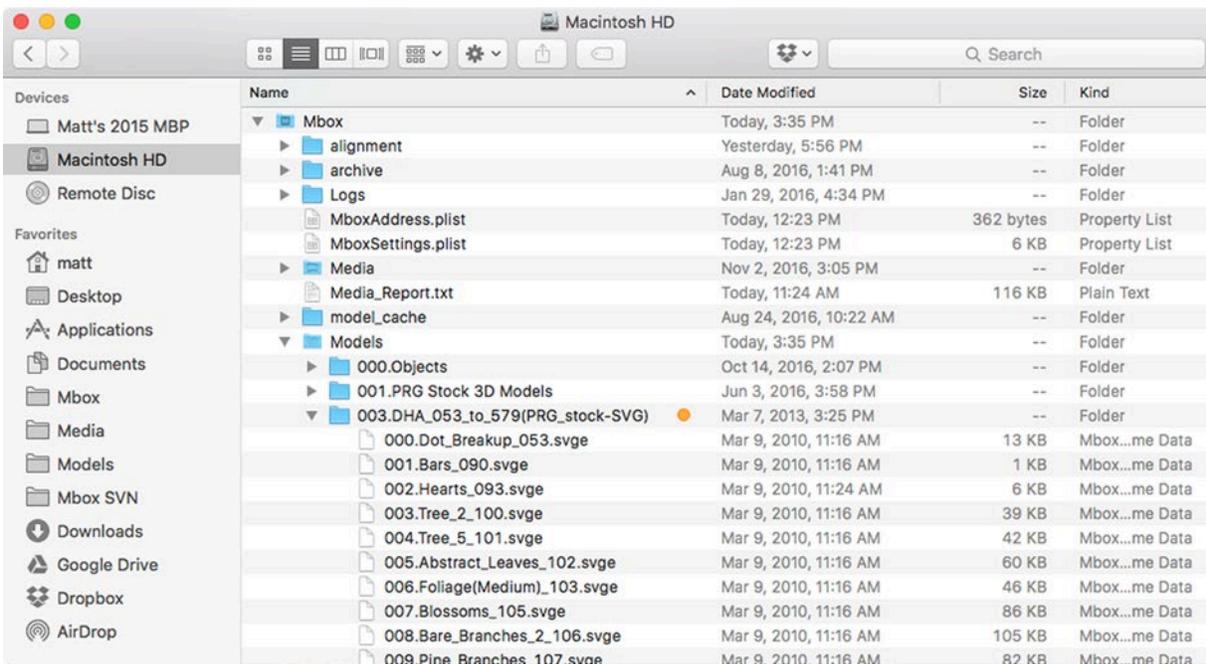
Lighting

All 3D models and digital gobos require lighting to be properly visible. If the object file is used without turning on one lighting fixture or without using Drawmode 1 (Light), then the object will appear on the screen as a black silhouette.

Guidelines:

+ 3D models without a texture look best to the lighting fixtures with their ambience reduced. The resulting shadows help enhance the 3D nature of the model.

+ When an object has a texture applied, some ambience may be required in order to properly see the texture.

+ Digital gobos respond best to the lighting fixtures with higher ambience or to Drawmode 1.

Refer to "Fixture Parameter Data" on page 192 for information on control parameters for lighting fixtures.

Refer to "Draw Modes" on page 235 for information on Drawmode 1.
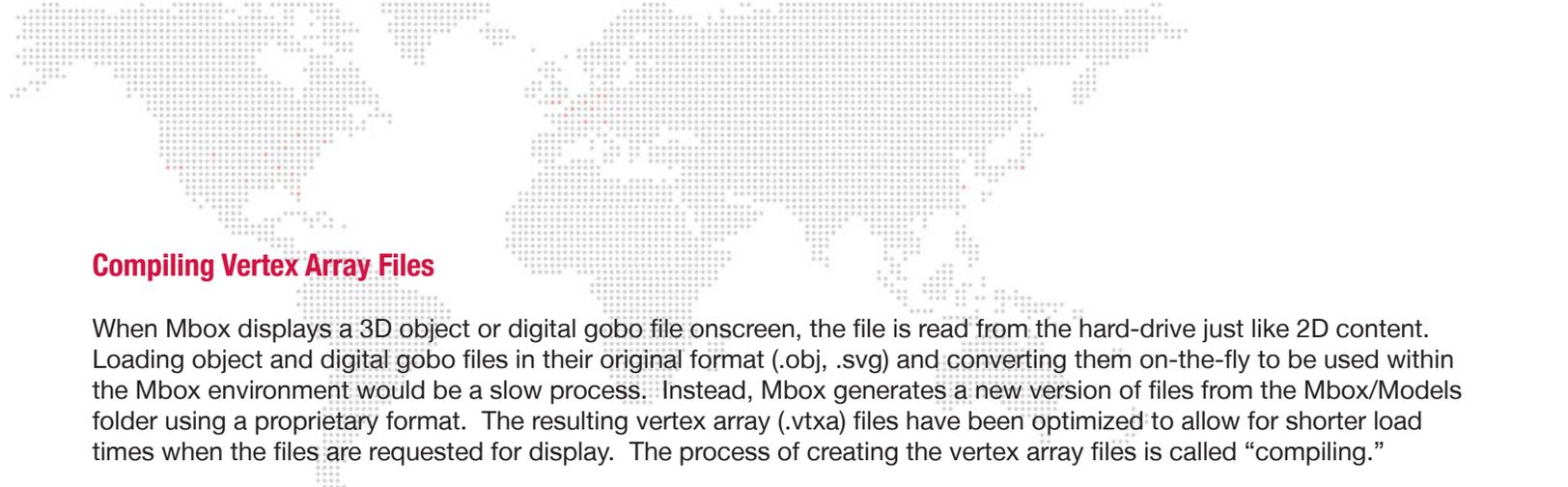
Compiling Vertex Array Files

When Mbox displays a 3D object or digital gobo file onscreen, the file is read from the hard-drive just like 2D content. Loading object and digital gobo files in their original format (.obj, .svg) and converting them on-the-fly to be used within the Mbox environment would be a slow process. Instead, Mbox generates a new version of files from the Mbox/Models folder using a proprietary format. The resulting vertex array (.vtxa) files have been optimized to allow for shorter load times when the files are requested for display. The process of creating the vertex array files is called "compiling."

All appropriate files in the Models folder will be compiled automatically the first time the Mbox application is launched and new or modified file are successfully located. Thereafter, existing files in the Models folder need not be recompiled unless they have been modified since the last time media was rescanned or the Mbox application was launched. Compiling a large number of files in the Models folder takes some time, but this task only needs to happen once and can happen in the background, allowing all other functions to run with minimal impact during this process.

If objects or digital gobos are still waiting to be compiled and a layer attempts to display them, Mbox will display a fully-transparent null image until the requested file has been compiled.

Note: If a large number of new files are placed into the Models folder, they may not be available as soon as the application launches or immediately after a rescan. But once compiled, the files will be available immediately.

Compiled object files are automatically placed in the Mbox/model_cache folder. These files are given a numerical prefix and the .vtxa (vertex array) suffix. These vertex array files cannot be edited or renumbered. Any additions, deletions, or renumbering of object or digital gobo content should be done using the original versions of the objects in the Models folder rather than in the model_cache folder.

Preloading

If large, complex 3D objects are used, even being compiled as vertex array files they may not appear on screen as quickly as desired. To assist, Mbox can be told to preload specific 3D objects into system RAM at startup. In order to force a file to preload, either append ".preload" to its filename or to the name of its immediate parent folder - which would cause all of the files in that folder to be preloaded. Examples:

<div align="center">

single file - **001.Object.preload.obj**   entire folder - **002.LargeObjects.preload**

</div>

Preloading a large number of objects will cause Mbox to take longer to start up and should only be done if the objects in question do not appear on screen as quickly as desired. When objects are preloaded, it is the vertex array file that is preloaded rather than the original .obj or .vle file. Because of this, preload time is reduced, but it could take longer than normal for the application to launch.

Normalization

By default, all object and digital gobo (.svg) files are "normalized" when they are compiled. Mbox's vertex array compiler performs this task to ensure that files appear at a usable scale rather than being too large or too small. Given the variety of applications that can be used to create objects and digital gobos, an object that appears to be just right when created might appear to be gigantic or tiny when displayed by Mbox.

3D modeling applications can be configured to use different units of scale – pixels, inches, meters, etc. – but two objects that are the same size may be created using different units. An object that is 1m tall and uses millimeters for scale will be 1000 generic units tall when saved as an .obj file. An identically sized unit that uses feet for scale will be 3.29 generic units tall. Even though the objects are the same height, when their resulting .obj versions are drastically different heights.

Therefore, when compiling vertex array files, Mbox's default action is to normalize all models and digital gobos. Normalization is accomplished by scaling objects to fit into a bounding cube that is 2 generic units on each side. Objects are scaled up or down so that their largest dimension (X, Y, or Z) is two generic units and then their other

dimensions are scaled proportionally.

Normalization converts all objects a similar size, but in many cases, it is very important to have objects be different sizes. For example, when projection mapping and using .obj files for the objects to map onto, it is critical that the objects used are the correct scale and also in correct proportion to each other.

CAUTION! When making 3D objects it is very important to use the same unit scale for all objects. AS noted previously, 2D modeling applications allow the use of different unit scales, but each of these units of measure will be saved as a generic unit in an .obj or .svg file. This can mean that an object sized to 1000mm tall will be 1000 units tall when saved as an .obj and an object sized to 1000ft tall will also be 1000 units tall - and therefore both will be the same size if the "noscale" file suffix is used.

To stop the compiler from normalizing an object, the suffix ".noscale" can be added to the object's file name before the file is compiled. If this option is used, the object will not be normalized. Example:

> a file named - **001.MyObject.obj** would be renamed as - **001.MyObject.noscale.obj**

To create an object with a specific scale factor (relative to its size if using the noscale suffix), use the ".scale" switch. In the following example, the second file would appear at half the size of the noscale original:

> a file named - **023.DigiGobo.svg** would be renamed as - **023.DigiGobo.scale_0.50.svg**

For .svg objects that need to have a scale matched to a particular piece of 2D content (which is measured in pixels), the compiler can scale the object so that generic units are treated as pixels, add the suffix ".pixels" to the file's name before it is compiled. Example:

> a file named - **001.NewObject.obj** should be renamed as - **001.NewObject.pixels.obj**

In this case, an .svg object that is 200 generic units tall will appear as 200 pixels tall within Mbox. With default scale settings the object would appear onscreen as 200 pixels tall.

Due to 3D camera changes in Mbox v4, using the .pixels suffix with .obj objects does not result in 1:1 scaling: generic units to pixels. However, these objects can still be displayed at near-perfect 1:1 scale if the layer's scale is adjusted to a value of 30624, or if the layer is assigned to an Output Master mix and that Output Master's 3D Camera Z-Position parameter is set to a value of 42940. Note that although this scaling is very close to 1:1 scale, it is not absolutely perfect.

Note: The scaling switches do not affect the texture (UV) mapping for object files, only the size of the object onscreen.

Other Compile-time Switches

There are a few additional compile-time switches that can be enabled by editing the filename of an object or by using metadata in the ModelInfo.plist file. Refer to "ModelInfo plist" on page 43 for information about metadata that can be added for models.

To cause the object's vertex array file to be rebuilt every time Mbox performs a rescan, the suffix ".rebuild" can be added to the file name or to the object's metadata. This can be useful if the object file is being edited and saved with the same index number and name.

To enable openGL smoothing for the lighting on a object, the suffix ".smooth" can be added to the file name or to the object's metadata.. The smooth function affects lighting on the object by averaging adjacent face normals for lighting, and can result in a smoother looking object under certain lighting conditions.

Note: The capitalization of all file name suffixes (e.g. 'preload' or 'noscale') are case insensitive.

Creating Custom Digital Gobos

Overview

Custom digital gobos can be created for use with Mbox. Custom digital gobos should use the SVG file format. Adobe Illustrator® is the best application for creating custom digital gobos because it provides the best toolset for features that Mbox supports. Mbox's vertex array compiler pays attention to "object fill" information in these file types. Path and Stroke information is ignored, unless special steps are taken with the file. (Refer to the Adobe Illustrator documentation for more information on path, fill, and stroke)

Scale-To-Fit vs. Arbitrary Fit

Before beginning, determine the intent of the digital gobo. When creating an SVG gobo file, there are two options for how a layer's texture will be mapped to the digital gobo:

+ Scale To Fit - The texture will be scaled (up or down) to fit onto the digital gobo.

+ Arbitrary Fit - The texture will be applied to the digital gobo with a specific fill factor given to the texture. This option is useful if the digital gobo is being used as a texturable masking aid or if the texture should not be scaled.

Creating a Digital Gobo with Adobe Illustrator CC 2015.3

The following steps provide a general guideline for creating custom digital gobos using Adobe Illustrator CC 2015.3. Note that older versions of Illustrator may require slightly different steps to achieve the same results. For more information regarding the use of Illustrator, consult the Illustrator Help documentation included with the application.

Step 1.   Start a new document and name it appropriately. The orientation of the document are not critical at this point, nor is the color space (RGB or CMYK). While the size of the artboard is also not critical at this point (see Step 7), to keep things simple there should only be one artboard. For now, just make sure the artboard is large enough to hold all of the objects.
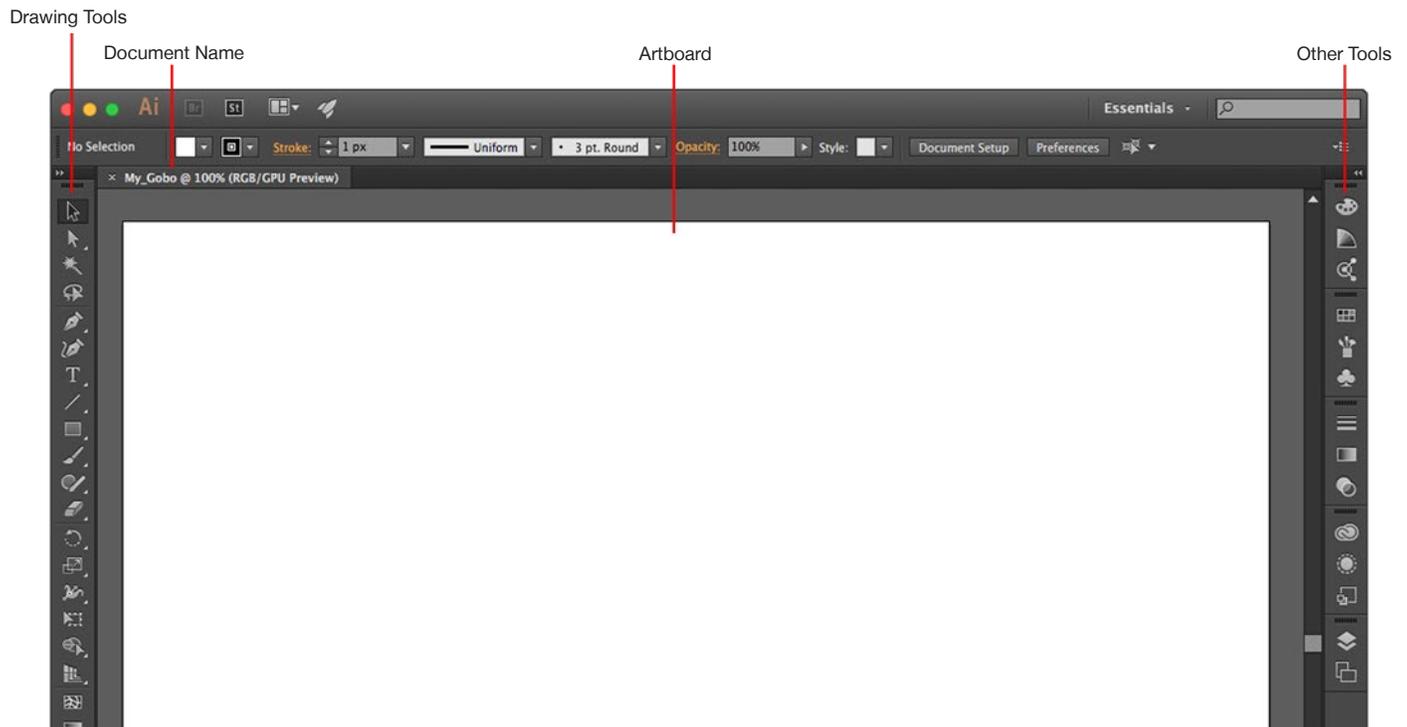
Step 2.   Use the various drawing tools to compose the gobo. The most useful tools are the objects (ellipse, rectangle, polygon, or star), the paintbrush, the linear tools (line, arc, spiral), text tool, and the pencil. All of these tools, except the line tool, will create a filled object. Filled objects will be compiled as solid areas in Mbox and will be the areas that accept a texture, if one is applied.
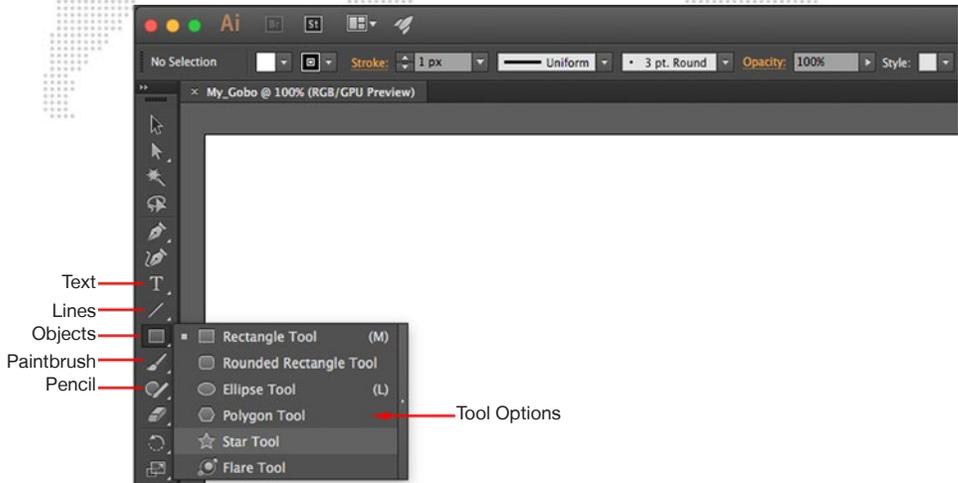
Step 3.   To make an outline of an object, turn off the object's fill, adjust the thickness of its stroke, and then expand the object. To turn off the fill, select the object in question and then make sure the Fill/Stroke portion of the toolbar looks like the example below.
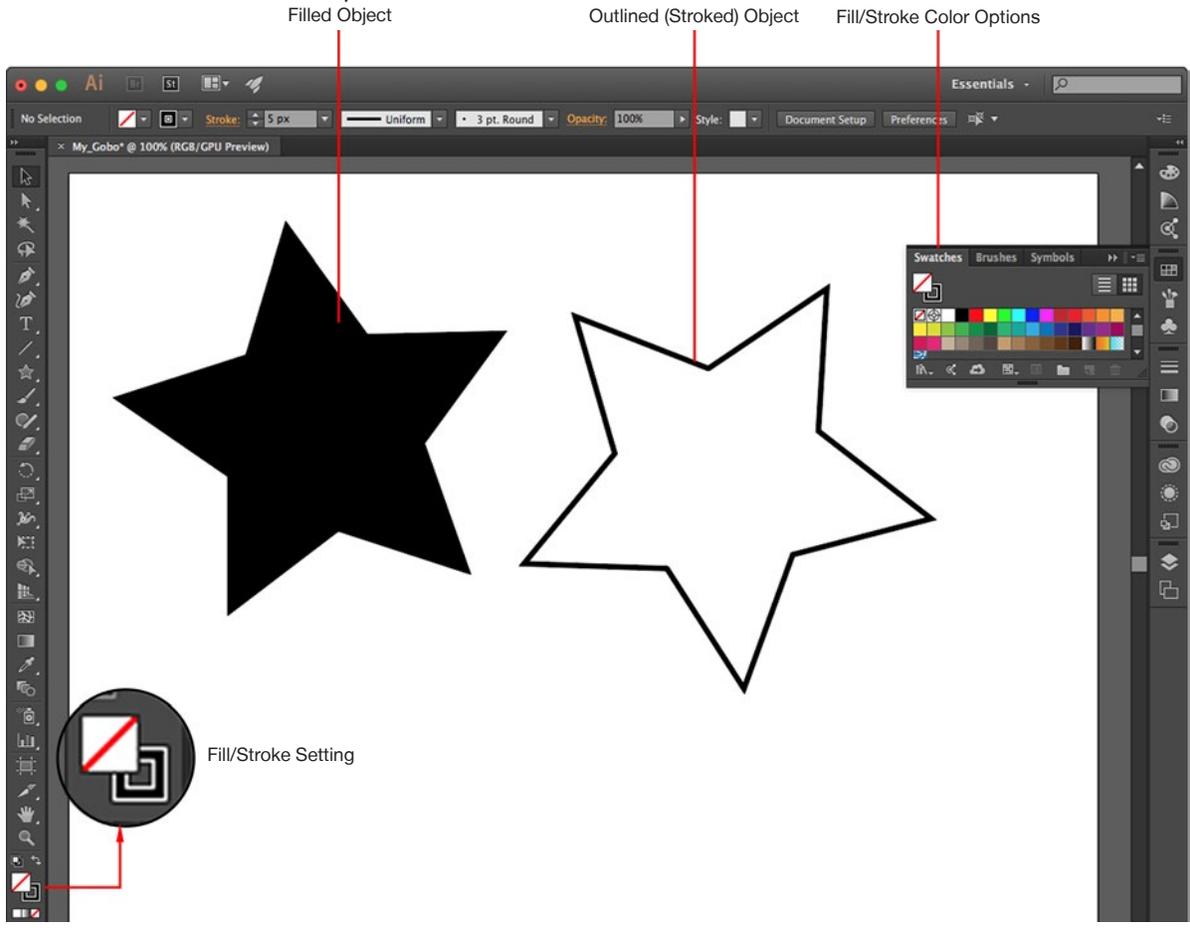
Step 4.   To expand an object, first select the object, then choose Expand from the Object menu. This will open a
           pop-up window. The default options in the window are fine, just press OK. Add more objects as desired.
           (Use multiple layers, if required.)
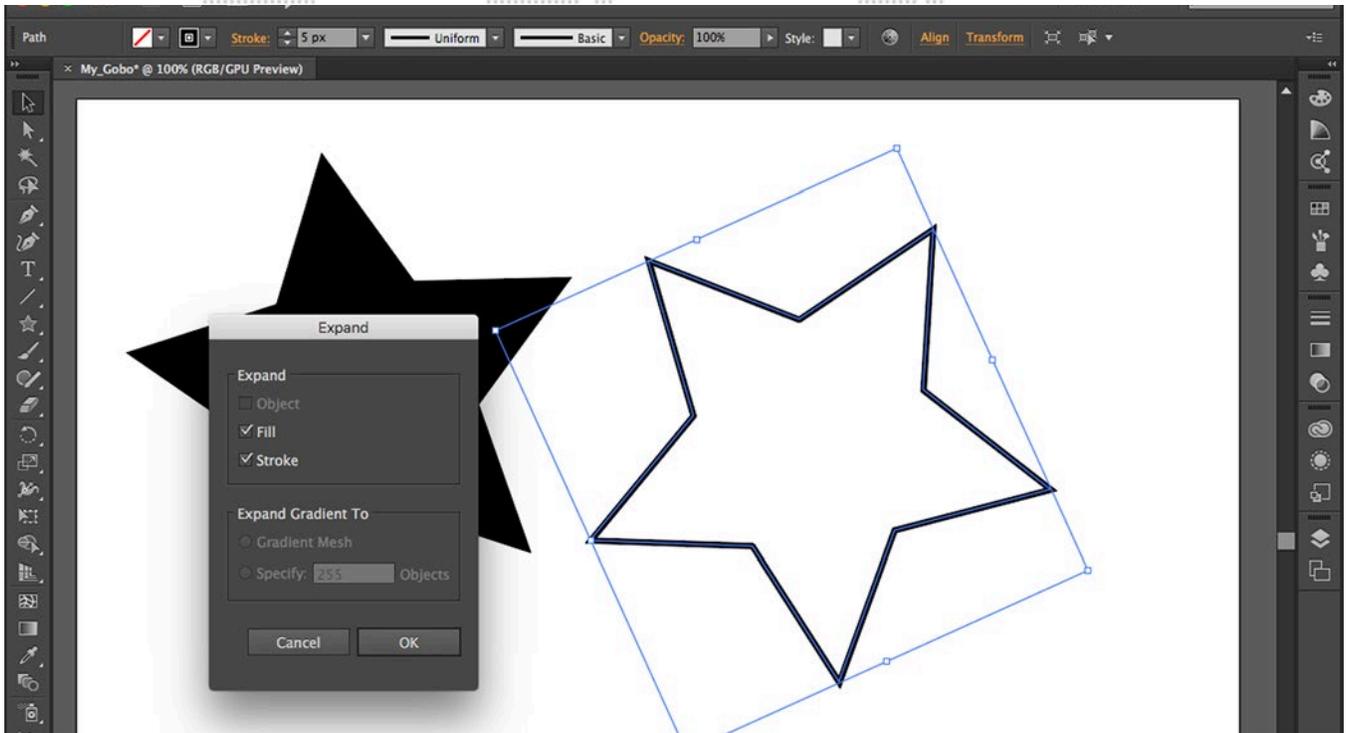
Step 5.   Use the text tool to create text as desired. Use the Character options to set font and size.
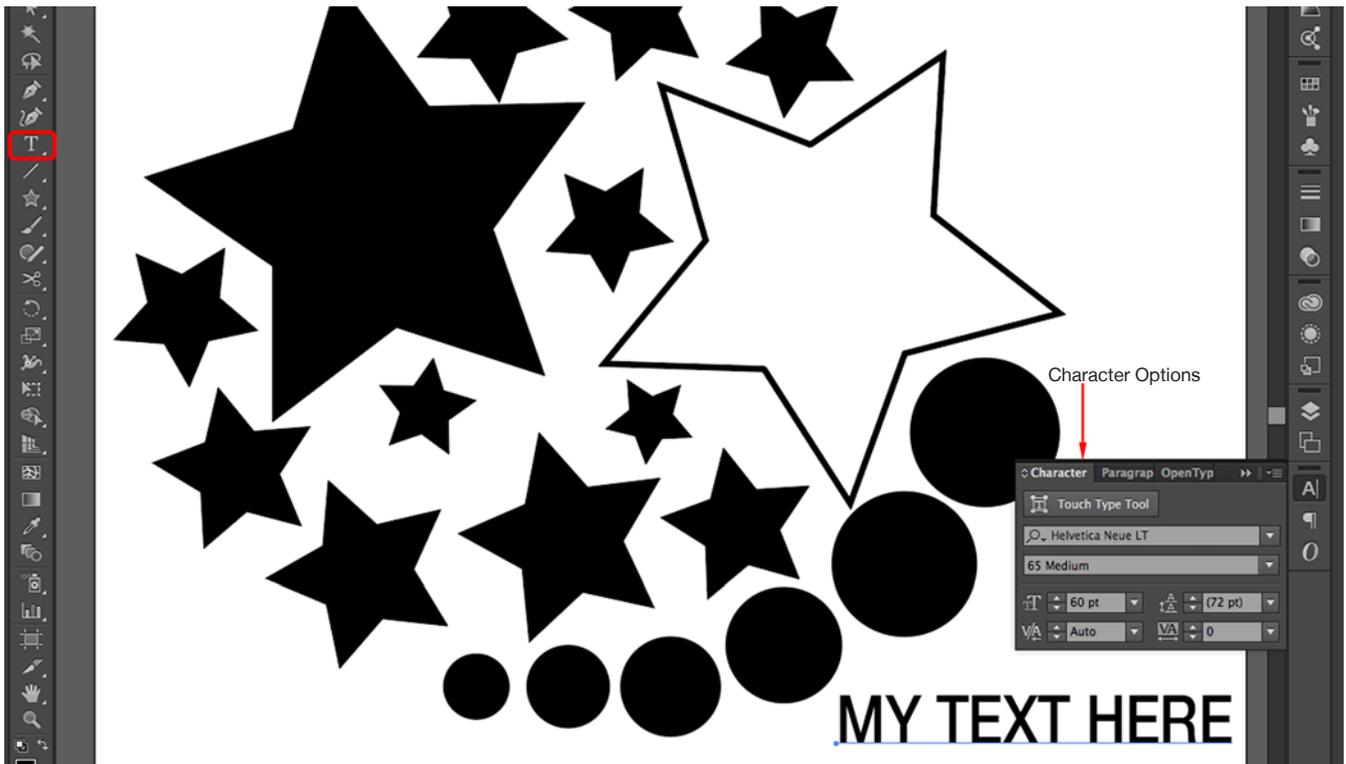
Step 6.   Text is a special case, and must be converted out "outlines." This can be accomplished in two ways.

    a. For each text object in the document, switch to the Selection Tool and select the text. Then select "Type" in the menu bar, and select "Create Outlines." Test cannot be made of only outlines (stroke only), it has to be filled.

    b. When saving the file as an SVG, make sure the "Type: Convert to outline" option is enabled. (See step 10)
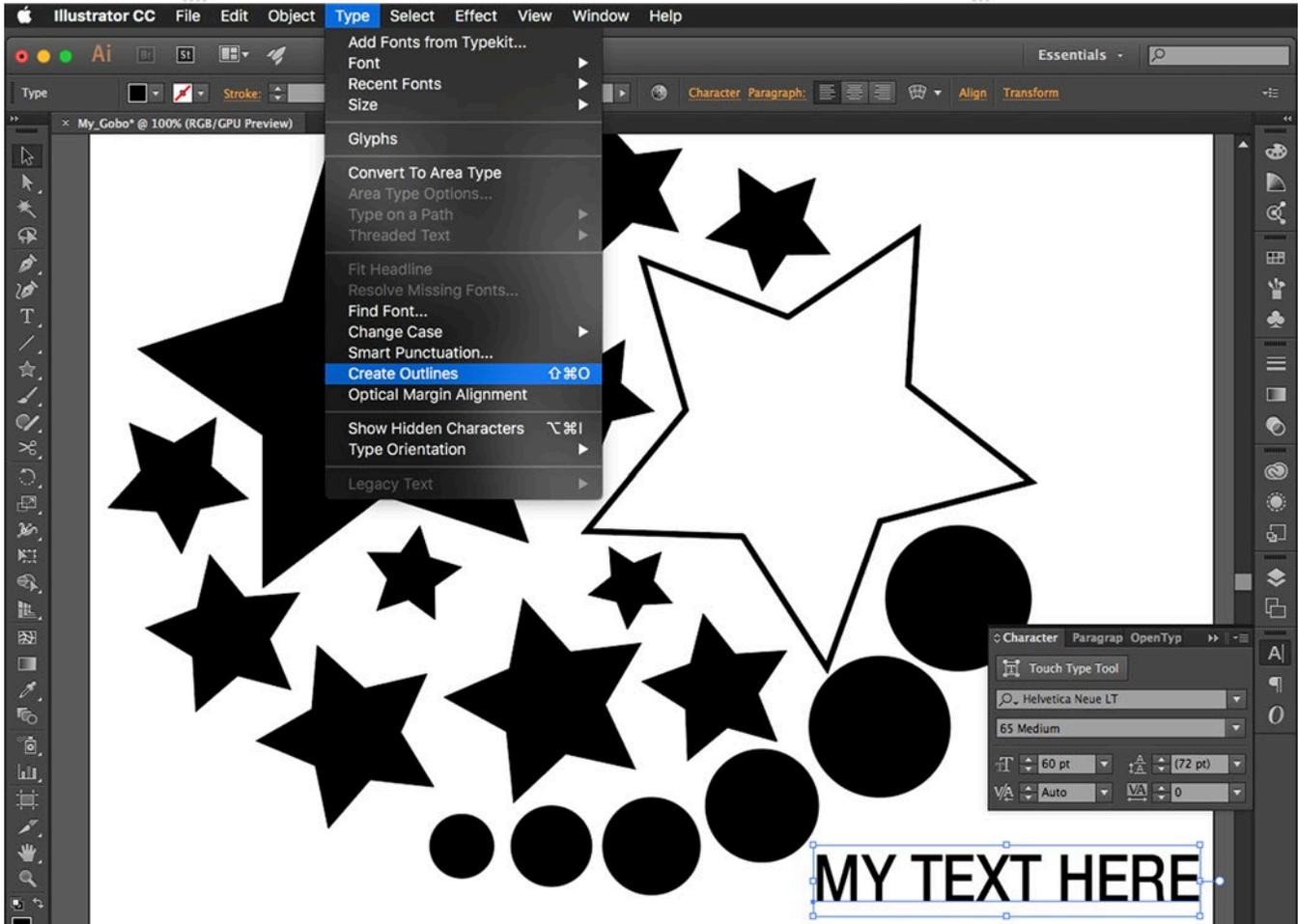
Step 7.   Before saving the SVG gobo, the document's artboard may need to be adjusted. The size of the artboard will determine whether the digital gobo will fall under Option 1 or Option 2. The texture applied to the gobo will fill the artboard when the gobo is used in Mbox. Note: It is not recommended that the artboard be sized or positioned so that any portion of an object falls outside the artboard.

    a. Option 1: If the texture of any size should be scaled to fit to the gobo such that the texture completely fills the gobo, create the artboard so its borders are at the edges of all of the objects in the composition. Illustrator provides a preset artboard sizing option for this: Fit to Artwork Bounds.

    b. Option 2: If the texture should not be scaled (or scaled to a specific size), make the artboard the same size as the texture (in pixels) and arrange the objects in the file on the artboard in the desired layout.

Step 8.   Before saving the gobo file, consider where the center of the file should be. The center of a digital gobo will be placed in the center of the Mbox window and the gobo will rotate around that center point. The rotational center of the gobo will default to the center of the artboard. In some cases it may be possible to adjust the size of the artboard to change the center of the gobo.

Step 9.   Save file, choosing the SVG format, and making sure that the "Use Artboards" option is checked. If the Illustrator only has one artboard (recommended) then the radio button labeled "All" can be selected. Otherwise, the "Range" button should be selected, and a single artboard's number entered in the field to the right of the button.
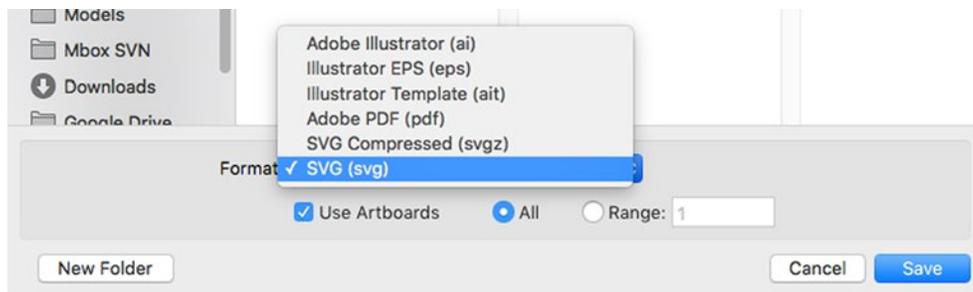
Step 10.   Selecting the SVG file type will prompt a secondary pop-up window to set options when saving the file. When saving as an SVG file, the default values should be OK.
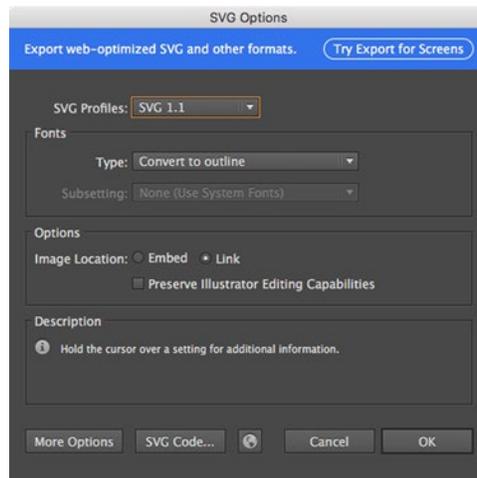
Step 11.   After creating an digital gobo, changing the gobo's file extension from .svg to .svge will allow Mbox Daemon to generate thumbnails of the SVG file.

LAYER COPY

Using Layer Copy

At times, there may be a need to play the same movie content on more than one layer at the same time. The same content can be requested on multiple layers, but doing so causes the content to be read from the hard-drive more than once, as well as being decompressed more than once. This is a waste of resources if the intention is to display the same frame of the same movie on multiple layers at the same time. The Layer Copy function provides a way to copy the content from one layer to another and to receive the source layer's effects and transitions, or to ignore the source layer's effects and transitions.

There are three modes of Layer Copy: FX+ and Raw:

 + FX+ is a layer copy where the source layer sends its effects and transitions to the destination layer. The destination layer can add more effects via its own controls (allowing up to eight effects to be visible on a destination layer).

 + Raw is a layer copy where the source layer does not send its effects or transitions to the destination layer. The destination layer can add more effects via its own controls.

Layer Copy functionality is selected as if it were a piece of content in the media folder. Folder 255 is selected, and the file number attribute controls which layer is being copied and which mode of copying takes place.

Folder 255/File #	Mode	Layers	Notes
001 - 024	FX+	1 - 24	File numbers 001-024 correspond to the FX- mode for Layers 1-24. i.e. 001 = Layer 1 FX- copy mode, 002 = Layer 2 FX- copy mode, and so on.
031 - 054	Raw	1 - 24	File numbers 031-054 correspond to the Raw mode for Layers 1-24. i.e. 031 = Layer 1 Raw copy mode, 032 = Layer 2 Raw copy mode, and so on.

Guidelines:

 + Layer Copy does not work with transition 255 (Object Dissolve).

 + When using the Raw copy mode, if a source layer makes a timed transition, then any destination layers using a copy of that source will not receive the transition. Their content will change immediately.

 + A layer cannot copy another layer that is already copying a third layer.

Syphon

Mbox includes the Syphon framework, which allows Mbox to either send or receive real-time, full-framerate videos or stills between applications on the same machine. For example, it is possible to place the video output from Quartz Composer, Unity 3, or other applications on a layer within Mbox. Refer to "Syphon Video Input" on page 151 for more information about this feature.

DRAWMODES

Using Drawmodes

Drawmodes provide three separate special functions on a layer. These functions are:

+ Automatic full ambient lighting for 3D objects on the layer, without affecting the lighting on objects on other layers.

+ Selection of modes for the "Cut and Stencil" feature.

+ Enabling the "opacity fades to black" functionality on a layer, whereby reducing the opacity parameter on the layer dims the layer to black rather than making it transparent.

Each layer has its own drawmode parameter with the following modes:

+ 0 = Idle

+ 1 = Light

+ 2 = Cut Stencil

+ 3 = Cut Stencil plus Light

+ 4 = Cut Stencil and Draw

+ 5 = Cut Stencil, Draw, plus Light

+ 6 = Draw Through Stencil

+ 7 = Draw Through Stencil plus Light

+ 8 = Draw Onto Stencil

+ 9 = Draw Onto Stencil plus Light

+ 14 = Opacity Fades to Black

For a complete parameter map, refer to <u>"Draw Modes"</u> on page 235.

Drawmode 1 Example:

Using Drawmode 1, Light, on a layer automatically raises the ambient lighting level to 100% for the that layer only. This control enables objects (both digital gobos and 3D objects) and any applied texture to be seen without affecting the lighting on other layers. To achieve the results shown in the images to the right, do the following:

Step 1.   Set the Global Master intensity (and Output Master intensity if applicable) to 100%. Confirm that all lighting fixtures have an intensity value of 0 (i.e. they are off). On Layer 1 only, with all other attributes set to default values, set the opacity to 100%. The white square should appear (if it is not disabled) because Folder 0, File 0 has no associated texture file.

Step 2.   With Layer 1 still selected, choose object folder 000, file 001. The screen should turn entirely black - although an object has been selected and applied, and the white square is still active. The selected object is not visible yet because there is no lighting.

Step 3.   Set layer 1's Drawmode parameter to a value of 1, now the Mbox Designer digital gobo is visible, colored white. Various parameters on the layer can affect the gobo at this point. The layer's color parameters will affect the color of the gobo, and because it is a 3D object (but with no thickness), it has almost all the properties of a 3D object: scale, rotation, spin, and X/Y/Z position. Most importantly, a texture (movie or still image) can be applied to the gobo, replacing the white.

Step 4.   The fourth image shows the same gobo with a texture applied. In this case, the result looks like the result of a mask. Although the texture is applied onto the gobo, it looks like a background layer is visible through the gobo. But rather than using two layers, one as a background and a second as a mask, this uses only one layer. Set the Drawmode back to 0 and test the lighting fixtures to see how they affect the gobo.
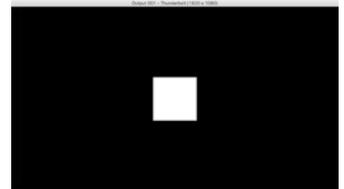
The Stencil

To explain the Drawmodes other than "Light" requires an explanation of the "Stencil" and what it means to cut it, draw onto it and draw through it. The Stencil is an imaginary layer that can be cut, as if cutting holes in a piece of cardboard. The stencil can then be used as a tool to tell other layers how their textures are applied: either onto the areas where the stencil is whole or the areas where the stencil has holes in it - a bit like adding a label to a roadcase by spray-painting through a cardboard stencil.

There are two important things to note:

1) When using a layer to cut the stencil, the holes that it makes in the stencil can only affect higher numbered layers. For example, if Layer 3 is used to make cuts to the stencil, those cuts will never affect Layer 1 or 2 no matter what Drawmode those layers are set to.

2) For useful results, the layer used to cut the stencil must be a 3D object and/or have some transparency. A 3D object or gobo can be used for cuts similar to static masking. Alternately, a movie with some transparency - use a texture effect like Key - Black or Edge Work on the layer to give it transparency in some areas - can be used to cut animated holes in the stencil. If rectangular image or movie clip with no transparency is used to cut the stencil, it will only create a rectangular hole in the stencil.

The following example images illustrate the process of cutting the stencil. The blue rectangle represents the imaginary stencil and the red digital gobo is the object that will cut the stencil:
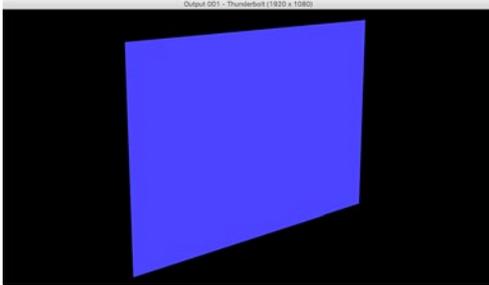
The following images first shows the two together and then shows the holes being cut into the stencil by the gobo:
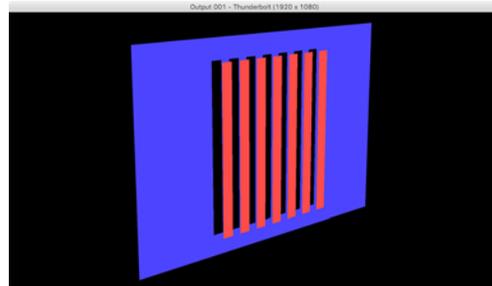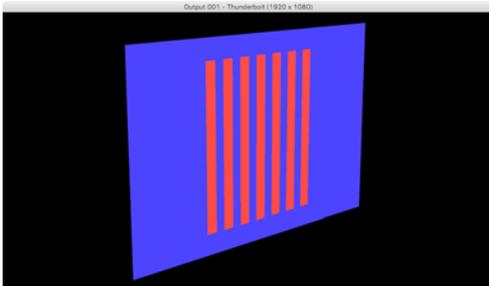
Finally, the following image shows the stencil on its own showing the holes cut into it:
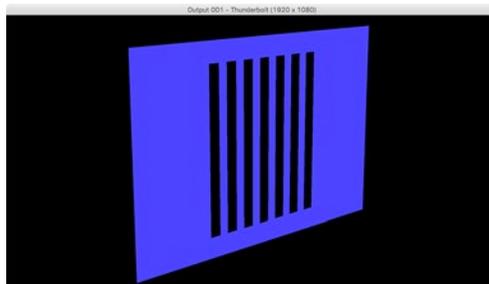
The following illustrations show an example of using a gobo to cut the stencil then using the stencil to affect a movie on a higher-numbered layer. The left image shows a digital gobo on Layer 1 using Drawmode 1 (Light) - so that it can be seen. The right image shows a movie clip on Layer 2 using Drawmode 0 (idle). The movie on Layer 2 obscures the gobo on Layer 1 because Layer 2 is in front of Layer 1.
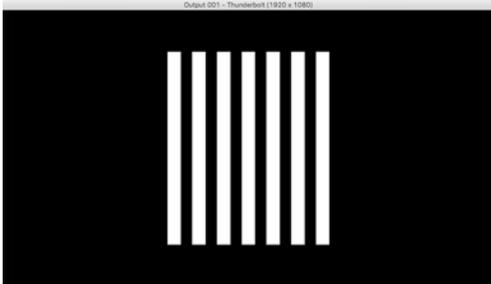
Below, on the left, Layer 2 has been set to Drawmode 6 (Draw thru Stencil), and on the right Layer 2 has been set to Drawmode 8 (Draw onto Stencil). In both cases, the gobo on Layer 1 has been set to Drawmode 2 (Cut) to make it cut the stencil. The the lighting on the gobo is now off, because the Drawmode has been changed.

It is important to realize that when a layer's Drawmode is set to 6, the term "Draw **Through** Stencil" really means: draw this layer's texture only where the holes are in the stencil. This is like spray-painting **through** the holes in a cardboard stencil. In the opposite case, if a layer's Drawmode is set to 8, the term "Draw **Onto** Stencil" really means: draw this layer's texture only where the stencil does not have holes. This is like spray-painting **onto** the cardboard stencil itself.

By setting Layer 1 to Drawmode 5 (Cut and Draw plus Light) and applying a texture to Layer 1, Layer 1's texture can be shown instead of the black areas seen in the right-hand image above.

In the example below, Drawmode 5 causes the shape of Layer 1's gobo to be cut into the stencil. Also, Layer 1's texture is applied to the gobo and the end result is that Layer 1's texture is see in the holes in the stencil.

Note: In this particular example, the same result could also be achieved without using Drawmodes by placing the green clip on Layer 1 and placing the textured gobo on Layer 2 making sure that Layer 2's Drawmode set to 1 so the texture is visible on the gobo.

The benefits of the various Drawmodes become more apparent when the holes cut into the stencil are used to affect more than one layer. Creative compositional effects can be generated by using a movie with a transparency effect to cut the stencil. In the first two illustrations below, the left-hand image shows a movie playing on Layer 1, and on the right, that same movie with the Key - Luma effect (056) turned on.

In the next two illustrations, Layer 1 is using Drawmode 5 and a movie is placed on Layer 2. The result is shown with Layer 2 using Drawmode 6 on the left and then with Drawmode 8 on the right.
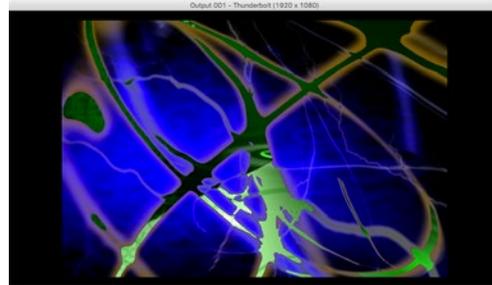
LAYER BLENDING

Layer Blending Modes

In addition to stacking and positioning, opacity and effects can help with the basic compositing of imagery. However, aside from stenciling and one of two of the texture effects, the actual content on one layer doesn't affect other layers. But Mbox includes Layer Blending modes that allow the color on a layer to blend with the color on underlying layers.

The default "overlay" layer blend mode disables any blending, and there are ten other blending modes. Each layer's blending mode is selected using the Blendmode parameter. Many of the layer blending modes have been chosen to best replicate common modes found in commercial image editing software (e.g. PhotoShop®, After Effects®).

The modes, their values, and descriptions are as follows:

+ 0 = Overlay - layer's colors completely obscure underlying color; no blending.
+ 1 = Additive - layer's colors are added to underlying colors (blacks appear transparent).
+ 2 = Screen - similar to above, with less of underlying color (blacks appear transparent).
+ 3 = Multiply - multiplies a layer's color with underlying color (blacks appear opaque).
+ 4 = Subtractive - layer's colors are subtracted from underlying colors (blacks appear transparent).
+ 5 = Exclusion - underlying colors are inverted where layer color is lighter; layer's colors are then added to underlying colors (blacks appear transparent).
+ 6 = Invert Subtractive - underlying colors are subtracted from layer's colors (blacks appear opaque).
+ 7 = Invert Additive - layer's colors are inverted and are added to inverse of underlying colors (blacks appear transparent).
+ 8 = Darken - underlying dark areas darken layer (light areas appear transparent).
+ 9 = Lighten - underlying light areas lighten layer (blacks appear transparent).
+ 10 = Psychedelic - colors are blended in a psychedelic fashion

Overlay (No Blend)	Additive	Screen	Multiply
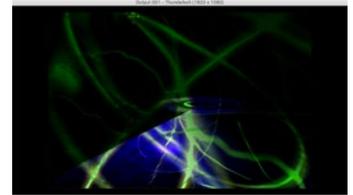
Subtractive	Exclusion	Invert Subtractive	Invert Additive

Darken	Lighten	Psychedelic
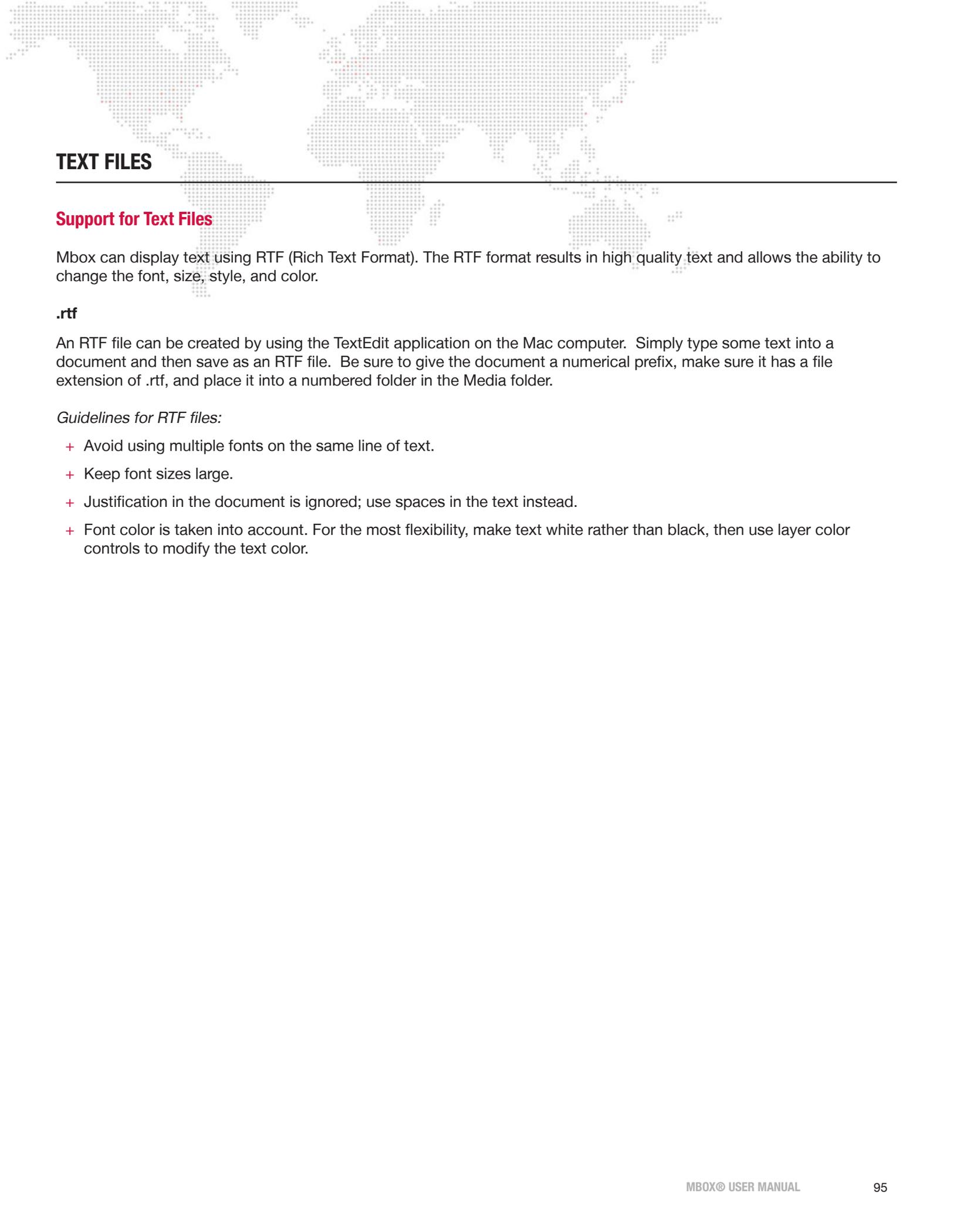
TEXT FILES

Support for Text Files

Mbox can display text using RTF (Rich Text Format). The RTF format results in high quality text and allows the ability to change the font, size, style, and color.

.rtf

An RTF file can be created by using the TextEdit application on the Mac computer. Simply type some text into a document and then save as an RTF file. Be sure to give the document a numerical prefix, make sure it has a file extension of .rtf, and place it into a numbered folder in the Media folder.

Guidelines for RTF files:

+ Avoid using multiple fonts on the same line of text.

+ Keep font sizes large.

+ Justification in the document is ignored; use spaces in the text instead.

+ Font color is taken into account. For the most flexibility, make text white rather than black, then use layer color controls to modify the text color.
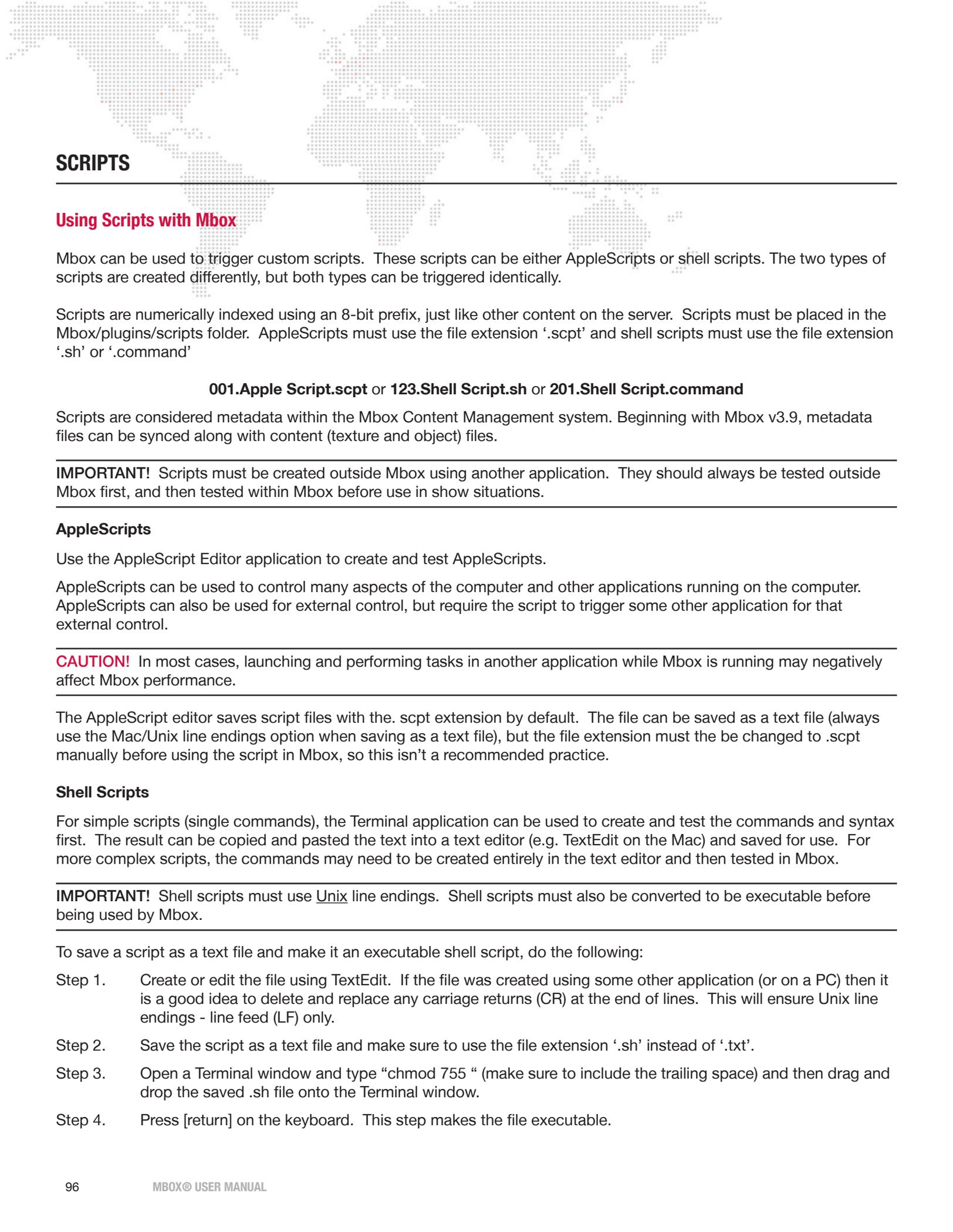
SCRIPTS

Using Scripts with Mbox

Mbox can be used to trigger custom scripts. These scripts can be either AppleScripts or shell scripts. The two types of scripts are created differently, but both types can be triggered identically.

Scripts are numerically indexed using an 8-bit prefix, just like other content on the server. Scripts must be placed in the Mbox/plugins/scripts folder. AppleScripts must use the file extension '.scpt' and shell scripts must use the file extension '.sh' or '.command'

<p align="center">001.Apple Script.scpt or 123.Shell Script.sh or 201.Shell Script.command</p>

Scripts are considered metadata within the Mbox Content Management system. Beginning with Mbox v3.9, metadata files can be synced along with content (texture and object) files.

IMPORTANT! Scripts must be created outside Mbox using another application. They should always be tested outside Mbox first, and then tested within Mbox before use in show situations.

AppleScripts

Use the AppleScript Editor application to create and test AppleScripts.

AppleScripts can be used to control many aspects of the computer and other applications running on the computer. AppleScripts can also be used for external control, but require the script to trigger some other application for that external control.

CAUTION! In most cases, launching and performing tasks in another application while Mbox is running may negatively affect Mbox performance.

The AppleScript editor saves script files with the. scpt extension by default. The file can be saved as a text file (always use the Mac/Unix line endings option when saving as a text file), but the file extension must the be changed to .scpt manually before using the script in Mbox, so this isn't a recommended practice.

Shell Scripts

For simple scripts (single commands), the Terminal application can be used to create and test the commands and syntax first. The result can be copied and pasted the text into a text editor (e.g. TextEdit on the Mac) and saved for use. For more complex scripts, the commands may need to be created entirely in the text editor and then tested in Mbox.

IMPORTANT! Shell scripts must use Unix line endings. Shell scripts must also be converted to be executable before being used by Mbox.

To save a script as a text file and make it an executable shell script, do the following:

Step 1.   Create or edit the file using TextEdit. If the file was created using some other application (or on a PC) then it is a good idea to delete and replace any carriage returns (CR) at the end of lines. This will ensure Unix line endings - line feed (LF) only.

Step 2.   Save the script as a text file and make sure to use the file extension '.sh' instead of '.txt'.

Step 3.   Open a Terminal window and type "chmod 755 " (make sure to include the trailing space) and then drag and drop the saved .sh file onto the Terminal window.

Step 4.   Press [return] on the keyboard. This step makes the file executable.

To test a script using Mbox:

Step 1.   Create an AppleScript or Shell script as explained on the previous page.

Step 2.   Give the script a numerical index number (0-255) prefix (e.g. 001.MyScript.sh), make sure it has the correct file extension, and place the file into the Mbox/plugins/script folder on the Mbox computer.

Step 3.   If Mbox was already running, make sure to perform a rescan after adding a script file.

Step 4.   From Mbox Director or the control console, select the Global Master fixture and:

      a. Set the Control Selector parameter to a value matching the script's index number.

      b. Set the Control Channel parameter to a value of 201.

      c. Wait 1/4 of a second.

      d. Set the Control Channel parameter to a value of 0.

Step 5.   Open the Mbox log to check to see if the script was triggered, it should show two lines for each script that is triggered: *Running script at path Mbox/Plugins/Scripts/208.MyScript_8.sh* and *issuing command: "Mbox/Plugins/Scripts/208.MyScript_8.sh"*

Shell scripts can be used to control many things, including external network communications (e.g. projectors or other devices that can receive serial-over-ethernet commands and/or OSC). Shell scripts do not require other applications to be launched on the computer and therefore may have less impact on the performance of Mbox. However, shell scripts can be dangerous if they modify the core functionality of the computer or its communications.

For More Information

There are many sources for information about AppleScripting and shell scripting on the internet and in book form.

Suggestions:

https://developer.apple.com/library/prerelease/content/documentation/AppleScript/Conceptual/AppleScriptX/AppleScriptX.html

http://macosxautomation.com/applescript/index.html

http://en.wikipedia.org/wiki/AppleScript

http://macscripter.net/

AUDIO

Audio Output

In addition to movies, still images, and 3D objects, Mbox can also play audio files. Audio can be output from the computer using any of the following interfaces or devices:

+ The current OS default output device.

+ The computer's internal speaker.

+ The computer's line out or headphone audio jacks.

+ USB, FireWire, or Bluetooth audio interfaces/devices connected to the computer.

+ Blackmagic Designs devices [Only in very specific circumstances].

Selecting an Output Device

Getting Mbox to play audio does not require any preferences to be set, but in order for the resulting audio to be audible, the appropriate audio output device must be selected in the Audio section of Mbox's Preferences tab.

Note: The selection of audio output (and input) devices in Mbox is separate from any OS default selection made in the System Preferences > Sound pref pane. It is possible to have different devices selected as the input/output devices for Mbox and the OS.
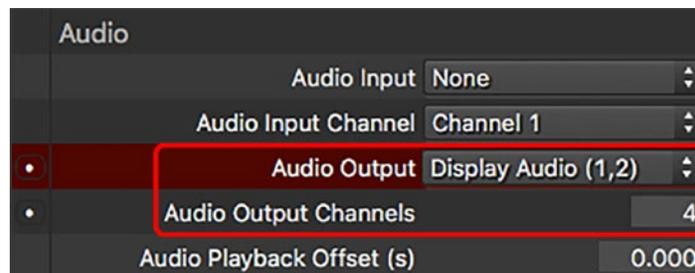
Clicking on the pop-up will reveal a list of available devices for output. The "OS Default" option will cause Mbox to use the audio output device that is selected in the System Preferences > Sound > Output pane. The "Built-in Output" option will cause Mbox to use the computer's built-in speakers. Selecting "None" will disable any audio output from the Mbox application. Other CoreAudio devices connected to the computer will be shown and can be selected.

Mbox will remember the selected device and its connection (i.e. which interface it is connected to) to the computer if the application is quit and relaunched. If the Mbox application relaunches and the previously selected device is not available or that device is connected to a different interface on the computer at any point in time, the connection between device and Mbox is no longer valid no audio will be output from the Mbox application. If the connection is broken, the device's name will be colored yellow on the preference table, as an indication of an error condition. This can be resolved by connecting the device to the original interface or by reselecting the device in the pop-up.

Note: Blackmagic devices *can* be used for audio output but <u>only</u> when they are also being used as a video output device. The Blackmagic device must be assigned as the display device for an output in Mbox before the audio output is assigned to the same Blackmagic device.

Audio Output Volume Control

There are two available parameters for controlling audio output volume from Mbox:

+ The master volume control provided by the Global Master fixture. (Refer to "Fixture Parameter Data" on page 192)

+ Individual layer volume controls.

Multi-channel Audio Output

Multi-channel audio playback with more than two channels of audio is supported with embedded, sidecar, and auto-sidecar audio. Mbox supports up to 24 channels of audio playback in all cases.

+ For embedded audio, the AAC audio format must be used. As noted on the following pages, playback of AAC audio can be problematic, therefore sidecar or auto-sidecar files are recommended for multi-channel audio output.

+ For sidecar, auto-sidecar, and stand-alone audio, the AIFF, WAV, M4A, or AAC container types can be used for multi-channel output. The MP3 container cannot be used for multi-channel output.

When the Mbox application launches, it is configured for a specific number of channels of audio playback using the Audio > Audio Channels preference. This preference defaults to 2 channels, but any value from 2 to 24 can be entered.

Guidelines:

+ If audio with more channels than the current audio channels preference is played, then in some cases no audio output will occur. The audio channels preference should always be set to the correct number to match the content that will be played. (See below for exceptions)

+ However, if a multichannel audio device is connected to the computer and selected as the audio output device, the number of audio channels will automatically be increased to match the number of channels supported by the device provided that number is higher than the current value. Note that this will not change the audio channels preference on the Preferences tab.

+ If the currently selected audio output device supports fewer channels than the current audio channel preference and a movie with more channels is played, only the channels supported by the selected audio device will be audible.

+ The Mbox log file [⌘ L] shows Information related to multichannel audio playback and output devices, and can be used to diagnose issues where the expected audio is not output from the computer or audio interface device.

External Audio Files

AIFF, WAV, MP3, and AAC audio files can be placed into the Media folder alongside texture files. These audio files can be played when a movie file having the same folder.file index is played (i.e. "sidecar" and "auto-sidecar"), without any visual content (i.e. "stand-alone"), or with an associated still image (still considered to be "stand-alone").

Sidecar Audio Files

Sidecar audio files are always played with movie files, and are a preferred alternative to creating movies with embedded audio because they have a wider range of compatible codecs. Sidecar audio files are associated with a specific movie file and require the audio and video tracks of the movie to be separated before the content files are copied onto the Mbox computer. The association between movie file and audio file is typically done by placing the audio file into the same numbered folder as the movie file, and giving both files the same file number. Once this is done, the audio file will play whenever the associated movie file plays. Sidecar audio will play at the same rate as the movie and will loop whenever the movie loops.

Auto-sidecar Audio Files

Starting with version 4.4.3, the Mbox application can automatically make "auto-sidecar" audio files from movie files having embedded audio using LPCM encoding. This auto-sidecar functionality eliminates the need to manually make separate movie and audio files in this specific case, thereby saving an extra step at the content creation stage and helping to avoid poor audio playback results if that extra step was not taken.

Auto-sidecar was created to address a deficiency in the immediate, unbuffered playback of embedded LPCM audio whereby audio playback was delayed and then briefly distorted once playback began. The deficiency is doubly frustrating because LPCM is the most common type of audio encoding for the type of movies that Mbox plays and because LPCM is one of the only compatible encodings that allows for more than two audio channels. Due to the overwhelming preference for LPCM encoding, and the fact that AAC encoding doesn't lead to this issue - but also doesn't allow more than two audio channels - the auto-sidecar functionality only works with movie having embedded LPCM audio.

The auto-sidecar functionality must first be enabled using the "Create Auto-sidecar Files" preference. Once enabled, whenever the Mbox application launches or a media rescan is performed, auto-sidecar files will be generated for any movie that has embedded audio which uses LPCM encoding. Auto-sidecar files are placed into the /Mbox/auto-sidecar folder and do not require any further action to play. Each file is named using a folder.file prefix and a file reference number, and has a file extension of .caf. e.g. 051.008.4309039617.caf

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Note: Only the first audio track of a movie having multiple audio tracks will be converted into an auto-sidecar audio file, avoid creating movies with more than one audio track. However, that track can have multiple channels.

Stand-Alone Audio Files

Stand-alone audio files do not require a movie file for triggering, but can have an associated still image. Stand-alone files are different from sidecar and auto-sidecar files in that the length of the audio file dictates the loop point of the audio, as opposed to the length of the visual content on the layer.

When a stand-alone audio file is selected on a layer, its audio will play, and unless there is a still image file having the same index number, no image will be visible on the layer. The stand-alone file's out-frame is automatically set to the audio's last frame, which means the audio will loop when it reaches the end -provided a looping playmode is used.

A still image can be associated with the stand-alone audio file by giving it the same folder.file index number as the audio file. At which point the still image will be displayed as long as the audio file is selected on the layer. Stand-alone files allow for the same wide range of audio encoding and number of audio channels as sidecar files.

Guidelines for sidecar, auto-sidecar, and stand-alone audio:

+ No preferences need to be enabled to play sidecar, auto-sidecar, or stand-alone audio files. But the "Create Auto-sidecar Files" preference must be enabled to create auto-sidecar files in the first place! However that preference does not need to be enabled to actually play the created auto-sidecar files.

+ Sidecar audio files given the same folder.file index as a movie file will play whenever the movie plays. Stand-alone audio files do not need a file to cause them to play, but can be associated with a still image file that will be visible while the audio file is selected on a layer.

+ Once created, auto-sidecar files will always play when the movie with the same folder.file index plays. To stop them from playing, the file must be manually deleted, and the "Create Auto-sidecar Files" preference disabled to stop new auto-sidecar files from being made on future rescans or launches.

+ Sidecar, auto-sidecar, and stand-alone audio files will only play in the forward direction. The audio will play when the layer uses any forward playmode, including Layer Sync Sender/Receiver and Timecode sync, but will not play when the layer uses reverse playmodes, or playmodes like random or bounce.
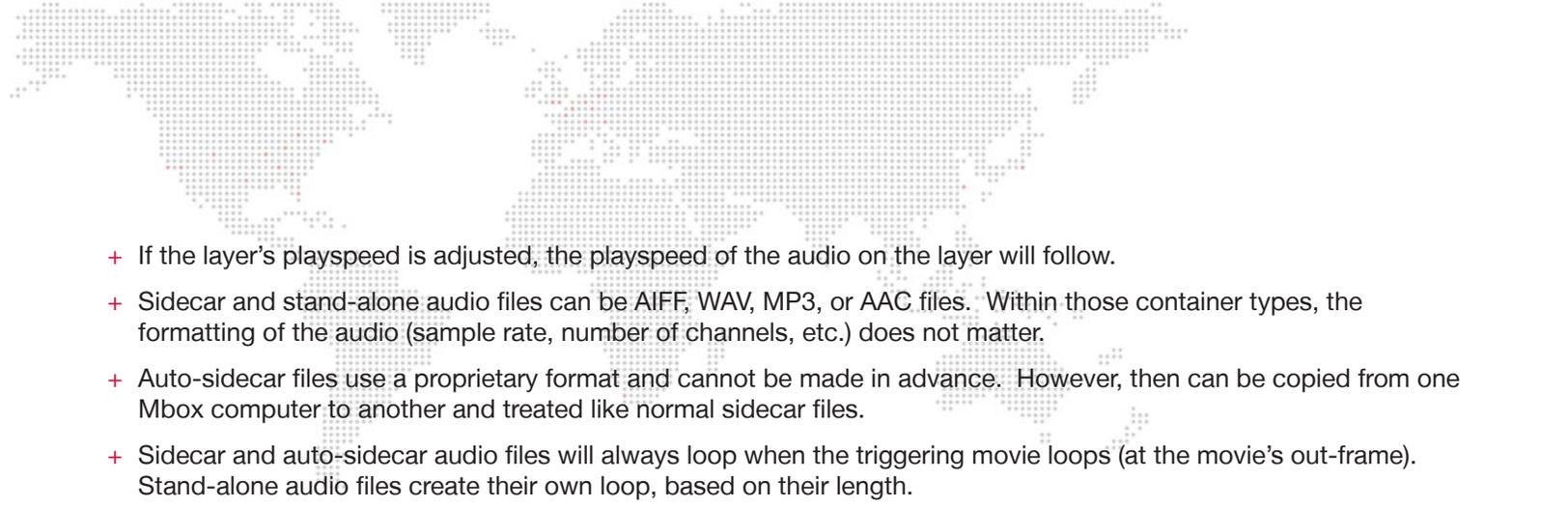
+ If the layer's playspeed is adjusted, the playspeed of the audio on the layer will follow.

+ Sidecar and stand-alone audio files can be AIFF, WAV, MP3, or AAC files. Within those container types, the formatting of the audio (sample rate, number of channels, etc.) does not matter.

+ Auto-sidecar files use a proprietary format and cannot be made in advance. However, then can be copied from one Mbox computer to another and treated like normal sidecar files.

+ Sidecar and auto-sidecar audio files will always loop when the triggering movie loops (at the movie's out-frame). Stand-alone audio files create their own loop, based on their length.

+ Because sidecar and auto-sidecar audio files loop at the exact same time as their corresponding movie, audio files that are longer or shorter than the triggering movie will not loop at the end point of the audio file.

  - For a sidecar file to loop at its end point, the movie must be exactly the same length, down to the frame.

  - Auto-sidecar files are automatically exactly the same length as the movie they are derived from.

+ Stand-alone audio files loop at their end point automatically if the default out-frame value of 65535 is set on the layer. As with a movie, the layer's in and out-frame values can be used to alter which portion of the audio is played.

Note: There is no harm in attempting to use embedded audio, but be prepared to switch to sidecar or auto-sidecar audio if the results with embedded audio are not satisfactory.

Embedded Audio Tracks

Mbox *can* play audio from a movie having embedded audio. This may seem like a convenient feature, but has many limitations and should be avoided in most cases. Embedded audio playback only works correctly when the movie uses AAC encoding, and it has become very hard to create AAC audio using modern content creation tools. With the end result being that most movies use LPCM audio encoding.

There are two ways to get Mbox to play embedded audio:

+ Rename the file, adding the .audio suffix (",audio" is not case-sensitive):

  a file named - **001.MyMovie.mov** would be renamed as - **001.MyMovie.audio.mov**

+ Create an entry for the file to the MediaInfo.plist file in the Mbox/Media folder. Then add the "audio" key to that entry, with a boolean value of "YES". Refer to <u>"MediaInfo plist"</u> on page 43 for more information.

Note: It is not necessary to use the .audio suffix to get any of the sidecar, auto-sidecar, or standalone audio to play!

In order to play movies with embedded audio tracks, Mbox must play the movie in the fallback AVFoundation playback engine, rather than the optimized Mbox playback engine. The AVFoundation engine does limit the available playmodes. However, as with sidecar audio playback, all the forward-playing playmodes will work.

Guidelines for embedded audio:

+ Embedded audio tracks <u>must</u> use AAC encoding. For best results use 48KHz sampling.

+ Embedded audio that does not use AAC encoding either will not play or may not play correctly.

+ Embedded audio tracks can have as many audio channels as can be handled by the connected hardware - up to 24.

CAUTION! Beginning in 2019, Adobe apps no longer create/export QuickTime movies with embedded audio that uses AAC encoding. Because of this, the use of embedded audio with Mbox may not be possible unless an alternate movie encoding method (e.g. FFMPEG) is used, and therefore sidecar audio should be used instead.

Audio Input

In addition to be able to output audio, the Mbox application can receive audio for synchronization purposes. Mbox v4 has the ability to receive SMPTE timecode audio directly into the Mbox application for the purposes of timecode sync or for the MboxTime playback synchronization functionality.

Receiving timecode as an audio signal directly into the Mbox application has several advantages over the previous method (from Mbox v3) of receiving timecode in a separate application (TC Reader) which would then transmits the timecode to the Mbox application over the network.

The required setup for getting Mbox to receive audio is similar to that for selecting the audio output interface/device. In the Audio section of the Preferences tab there is a preference for audio input. As with the output preference, this is pop-up that allows the selection of desired input interface or device. The input channel on the input device must also be selected using the Audio Input Channel pop-up.
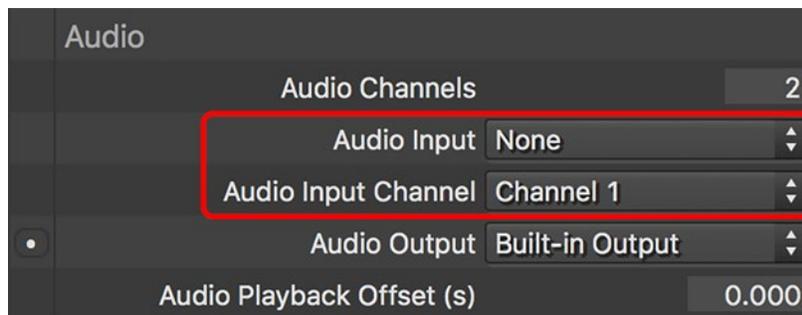
The same guidelines exist for selecting audio input devices as for audio output devices; Mbox remembers the selected device and its connection to the computer, and what happens when the interface/device is not available when the application launches.

Additional Audio Input Guidelines:

+ When an audio interface/device is selected, all timecode input for playback synchronization will be received as SMPTE LTC timecode on that interface/device. This is the recommended setup for Mbox v4. Mbox will ignore any network timecode (as from the TC Reader application) in this case.

+ When the item labeled "None" is selected, Mbox will ignore any timecode input on audio interfaces/devices and will listen to timecode over the network from the TC Reader or Mbox Director applications instead.

+ With audio input direct to the Mbox application, it may be necessary to provide some "upstream" gain control for the audio signal to make sure that the signal is loud enough, but not so loud as to be clipping. Mbox does not require a particularly loud signal for timecode.

+ If the "OS Default" item is selected, Mbox will use the audio input device selected in System Preferences > Sound > Input. This can be useful in some cases to avoid issues where the same device is used, but may get plugged into a different interface on the computer, which would normally cause the link between device and Mbox application to be broken and the input device would need to be reselected.

Refer to <u>"Timecode Synchronization"</u> on page 103 for information on using the timecode input to synchronize playback.

Refer to <u>"MboxTime"</u> on page 109 for information on the MboxTime functionality.

Note: Blackmagic devices *cannot* be used for audio input due to the asynchronous manner in which they receive audio. Rather than being a continuous stream, any received audio will have dropouts.

PLAYBACK SYNCHRONIZATION

Timecode Synchronization (Timecode Sync Playmodes)

Mbox allows movie playback to be synchronized to external SMPTE or MIDI timecode, input directly into the Mbox application or over the network when using the TC Reader application. The timecode sync works with all common timecode rates - 30, 29.97, 25, and 24 - and supports both non-drop and drop-frame formats.

SMPTE audio timecode (LTC) can be input directly into the Mbox application (refer to "Audio Input" on page 102) or into the TC Reader application (explained later in this section). MIDI timecode (MTC) can only be input into the TC Reader application.

Timecode Start Time

By default, with no action taken by the user, every movie file in the Media folder gets automatically linked to a timecode start time of 01:00:00:00 (HH:MM:SS:FF). Therefore, to simply trigger any file and have it sync to incoming timecode, set the layer to the timecode sync playmode (see below) and then run the timecode clock signal up to 1 hour.

Note: The default timecode setting can be changed on the Preferences tab of the Mbox application and through the Mbox Remote application. The preference is in the Playback section and is called "TC Default". The preference's value is formatted as HH:MM:SS:FF. (Refer to "TC Default" on page 53)

There are three methods for linking movies to a timecode start time on a per-movie basis:

1) Using the MediaInfo.plist file to link files to timecode start times.

2) Using the MediaTimeCodes.plist file (as used with Mbox v3.x) to create a new MediaInfo.plist file with timecode start times copied from the MediaTimeCodes.plist file. Thereafter, all edits must be made in the MediaInfo.plist file.

3) Using Layer DMX Timecode Controls. (Refer to "Fixture Parameter Data" on page 192 for info on these controls)

(X) **Deprecated Feature:** The MediaTimeCodes.plist is deprecated and will be eliminated in a future version of Mbox.

Guidelines:

+ The MediaInfo.plist and Layer DMX controls timecode linking methods can be used at the same time.

+ If a MediaTimeCodes.plist file is placed into the Mbox/Media folder, Mbox will automatically create the required entries in a MediaInfo.plist file <u>only if</u> no MediaInfo.plist file already exists. Otherwise no entries are created.

+ Sync times generated by the Layer TC DMX Controls method will override times generated by entries in the MediaInfo.plist file.

Linking Files to Timecode - MediaInfo.plist file

Refer to "MediaInfo plist" on page 43 for information on the MediaInfo.plist file and the metadata that it holds. In the illustration below, Folder 001.File 001 has a start time of 01:00:00:15 and Folder 001.File 002 has a start time of 02:00:00:00:
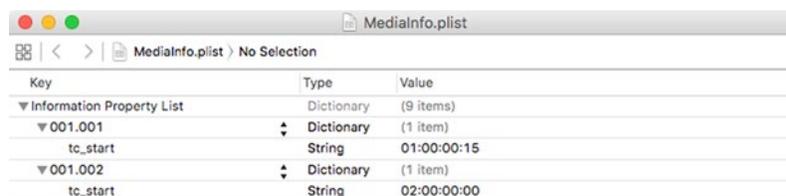
Linking Files to Timecode - MediaTimeCodes.plist file

For the time being, the MediaTimeCodes.plist file can be used to create a MediaInfo.plist. This can be useful to translate an existing MediaTimeCodes.plist file from Mbox v3 for use with Mbox v4. As noted above, this method is deprecated and results in the information being copied into a new MediaInfo.plist file only if one does not already exist.

The data formatting in the MediaTimeCodes.plist file is different to that found in the MediaInfo.plist. The root of the plist has keys that are strings (not dictionaries), with each key's name being the Folder.File index for a file (e.g. 001.002) and the value for each key being a string representing the start time for the file in HH:MM:SS:FF format.

In the illustration below, Folder 101.File 004 has a start time of 04:00:00:00 and Folder 101.File 005 has a start time of 05:00:55:00:
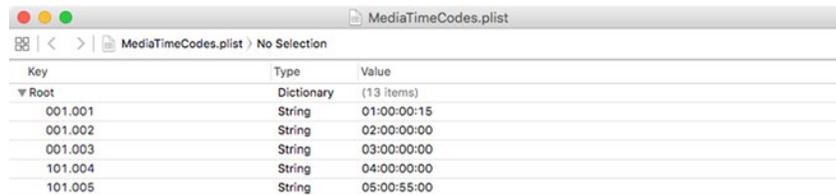
IMPORTANT! All values entered in the MediaInfo.plist and MediaTimeCodes.plist files must have the padding zeros. Folder and file numbers must have three digits, and each field in the timecode values must have two digits. Incorrectly formatted values will result in those entries being ignored.

Linking Files to Timecode - Layer DMX Timecode

In addition to assigning timecode values to individual media elements using the one of the .plist methods (refer to previous page), the timecode start value for a movie on a specific layer can be modified by using the Layer DMX Timecode parameters on each layer.

Mbox v4 has permanently added four control parameters to every layer - Hours, Minutes, Seconds, and Frames. These parameters can be used to set the timecode start time to any value, regardless of other methods. Using these controls, the control console may be used to instantly set the timecode start time on the corresponding layer.

Note: Layer DMX Timecode values override all other timecode linking methods. If all four Layer DMX Timecode parameters are set to 0 or if one or more of the parameters are set to invalid values, timecode sync for the media on the layer will revert back to one of the other methods mentioned above.

Using Timecode Sync Playmodes

Timecode Sync does not control any properties of a layer except the playback position and rate. All other functions (e.g. opacity, folder, file) must still be programmed separately. If layer is set to one of the three Timecode Sync playmodes, the movie on the layer will sit, paused on its in-frame until the linked time is reached. At that point, the movie will play based on the selected Timecode Sync playmode's characteristics until reaching its out-frame, at which point it will stop on that frame. The movie will not loop or fade out.

There are three Timecode Sync playmodes, each of which has its own benefits:

+ 130 > 134 = TC Sync - strict lock to timecode; movie waits for appropriate timecode to initiate playback, and if timecode stops or goes away, the movie playback stops.

+ 135 = TC Sync then Freewheel - movie waits for appropriate timecode to initiate playback, but then ignores timecode for the remainder of that movie's playback

+ 136 = TC Jam Sync - movie waits for appropriate timecode to initiate playback, if timecode stops or goes away, the movie freewheels. However, if timecode returns, then the movie will resync to the incoming timecode.

Note: When using a timecode sync playmode on a layer, If the in-frame parameter is modified, the movie will start from the new in-frame when the linked time is reached, rather than from the movie's first frame.

The Timecode Offset channel on each layer allows modification of a file's start time by approximately 4 seconds without having to rename the file and rescan the content. The offset value options are:

+ 0 > 126 - Positive offset (movie plays later) -> 1 point = 1 frame

+ 127 - Default, no offset

+ 128 > 255 - Negative offset (movie plays sooner) -> 1 point = 1 frame

Receiving SMPTE Timecode

SMPTE (LTC) timecode input to the Mbox application may be achieved in one of two ways. The preferred method is through an audio input to the Mbox computer, with input directly to the Mbox application. (Refer to "Audio Input" on page 102 for more information) An alternate method is through an audio input to a computer that is running the TC Reader application, or in special circumstances from the Mbox Director application.

Receiving timecode directly into the Mbox application is preferred because it eliminates any potential delays or data issues that might affect the network traffic between the Mbox computer and the computer running TC Reader or Director, even if they are the same computer. Additionally, the Mbox v4 software is able to automatically detect the incoming timecode framerate and format, speeding up the locking to timecode and eliminating the need to provide compensation for 29.97ndf timecode - TC Reader and Director do not.

(X) Eliminated Feature: With the release of Mbox v4.1, the ability for the Mbox Remote application to receive and distribute timecode over the network has been removed.

Receiving MIDI Timecode

MIDI timecode (MTC) input is achieved through a MIDI/USB interface connected to the computer. When using a MIDI/USB interface, the TC Reader application must be used.

CAUTION! MIDI/USB devices may require the installation of drivers in order to work.

Setup for Timecode Input

To receive timecode directly into the Mbox application, follow the guidelines for audio input on page 102. If Mbox is receiving an audio signal, then no other steps need be taken aside from selecting the audio interface for input. However, if Mbox is receiving timecode over the network from the TC Reader or Mbox Director applications, then follow the guidelines below. For the input of network timecode from Director to the Mbox application make sure to refer to "Configuring Mbox to Receive Network Timecode from TC Reader or Director" on page 107.

Note: Timecode input can be monitored using the [F10] Timecode HUD. Refer to "Activity/Timecode Monitoring" on page 70.

Mbox Director

The Mbox Director application can send network timecode to the Mbox application. Refer to the Mbox Director manual for information on the output of network timecode from Director.

TC Reader

The TC Reader application may be used to receive timecode on either a separate computer or the Mbox computer. The TC Reader application reads the actual timecode signal (SMPTE or MTC) and then retransmits it over the network to the Mbox application.

When using TC Reader to receive a SMPTE audio signal, the computer's audio input must be configured correctly. TC Reader can only use the default audio input interface on the computer as its input and only allows the selection of left vs. right channel. The default audio input to the computer could be the line-in connection or a USB/FireWire interface.

The default audio input to the computer is set in the System Preferences > Sound pref pane of the computer.
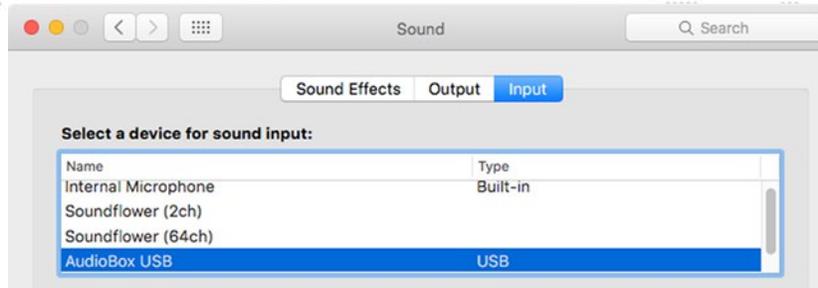
CAUTION! For TC Reader, the default audio input needs to be selected <u>before</u> the application is launched. If changes are made to the default input, then the TC Reader application will need to be quit and relaunched.

The TC Reader application has a single window. The timecode window displays the incoming timecode and has several settings and buttons:

+ Source – choose the appropriate source for timecode: Generator, Audio, or MTC. TC Reader has separate selections for Audio Left and Audio Right.

+ Output – Local (internal routing only), or an active Ethernet interface (for sending timecode over the network).

+ Auto-Start – checking this box will cause timecode be active as soon as the TC Reader application launches. Depending on the source setting, the application will immediately begin generating or listening for external timecode.

+ Start – starts generating code from Start Time value if generator is selected, otherwise will start listening for external code.

+ Pause – pauses/resumes generating internal code or listening for external code (toggle action).

+ Start – specifies a time where the internal generator will start.

+ End – specifies a time where the internal generator will loop back to the start time.

Note: The TC Reader window does not have to be visible onscreen to function. When the Mbox application is receiving timecode, this can be monitored using the [F10] HUD or through the main window of the Mbox Remote application.

Guidelines:

+ Since TC Reader retransmits the timecode data via Ethernet, a timecode source can be connected to any computer and then retransmitted to any networked Mbox servers.

+ Timecode reception and transmission may be affected by other applications running on the computer. Quit all unnecessary applications.

+ TC Reader attempts to automatically interpret the incoming timecode framerate and format. This will be displayed at the top of the window - e.g. "30 NDF" for 30fps non-drop timecode.

+ While TC Reader is receiving timecode, a number in parentheses will be shown to the left of the Auto-Start checkbox.

  - This is the actual framerate of the incoming code. If the number in parentheses is colored red and does not match the number shown at the top of the window, then TC Reader was not able to interpret the incoming timecode correctly.

  - The most common cause of incorrect timecode interpretation is 29.97fps non-drop timecode. If 29.97ndf timecode is being received by TC Reader, the Mbox application must be set to compensate by enabling the correct preference on the Preferences tab. (Refer to <u>"TC Reader v3.x 29.97ndf"</u> on page 53)

+ For receiving timecode for show purposes, the use of SMPTE directly into the Mbox application (as an audio input) is strongly recommended over the use of TC Reader. The TC Reader application is provided primarily as a convenience in situations where it is impossible or impractical to connect SMPTE directly to each Mbox server.

CAUTION! The TC Reader application is designed to perform best when receiving audio streams at a sampling rate of 44.1KHz. If a USB or FireWire audio interface is being used to receive timecode on the computer, open the Audio MIDI Setup application on the computer and set the interface's sampling rate to 44.1KHz. If 44.1KHz is not available, choose the next lowest option.

Configuring Mbox to Receive Network Timecode from TC Reader or Director

When receiving network timecode from either TC Reader, each Mbox server must be told which Ethernet interface is being used for the timecode stream. The Network section of the Mbox application's Preferences tab can be used to select the interface for receiving timecode. Use the Sync pop-up to select the interface. Only currently connected interfaces will be shown in the pop-up menu.
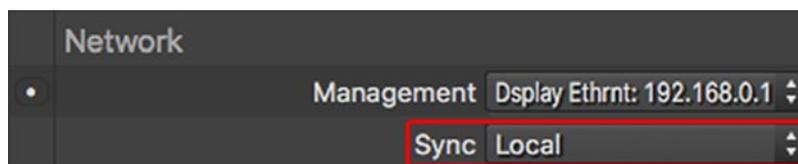
In addition to setting the network interface, the Mbox application <u>must</u> be told to ignore any audio input for timecode. To do this, go to the Audio Input pop-up in the Audio section of the Mbox application's Preferences tab, and select the option for "None."
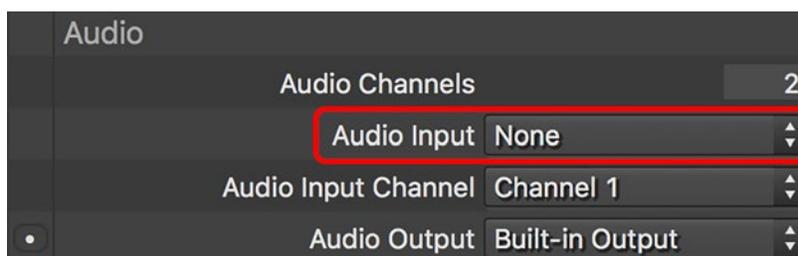
Layer-To-Layer Playback Synchronization

Mbox can synchronize the playback of a layer on one server to another layer on the same server or to a layer on another server. A layer on one server can sync to the <u>same</u> numbered layer on <u>another</u> server, or one of 32 sync streams can be selected for sync sending and receiving, allowing sync from any layer to any other layer on the same or different servers.

Note: Mbox Studio can only output 16 sync streams, and Mini 8; both can receive 32 streams (e.g. from Designer)

Using Layer Sync typically means that most of the layers' media settings (e.g. Folder, File, In-Frame, Out-Frame, etc.) between synced layers are identical with exception of the playmode, which designates the sync **Sender** or **Receiver**:

+ 140 > 149 - Layer Sync Receiver

+ 150 > 159 - Layer Sync Sender - FWD Loop

+ 160 > 169 - Layer Sync Sender - FWD Once

In practice, it is possible make many parameters of sender and receiver layers different to each other, and even to play different movies. Differing parameter values can lead to odd results however, if the two layers are part of a blended/overlapped system or if the lengths of the sender and receiver movies are not the same. Layer sync is quite accurate when used between Mbox servers, but it is not perfect. For perfect synchronization between Mbox servers, it is necessary to use the MboxTime functionality of the Mbox application. (Refer to <u>"MboxTime"</u> on page 109 for details)

To select which sync stream is used by a layer while using layer sync, adjust the layer's Sync Stream parameter appropriately on both sender and receiver layers:

+ 0 - Layer to Layer by layer number - This mode only works from one server to another, not on the same server. If Layer 1 on a server is set to a sender playmode and Stream 0, then Layer 1 on any other server (but not the same server) can be set to the receiver playmode and Stream 0, causing the receiving layer to sync to the sending layer.

+ 1 - 32 - Stream 1 thru 32 - Any layer can be set to be a sender and a stream number, and any layer on any server set to be a receiver with the same stream number will then sync to the sending layer.

CAUTION! Having two or more layers set to either of the sync sender playmodes while also using the <u>same</u> stream number will cause serious playback issues with any receiving layers listening to that same sync stream number.

With a sync relationship set up between sending and receiving layers, the Timecode Offset parameter on the receiving layer can be used to fine tune the sync by up to 127 frames in a forward or backward direction.

Note: When attempting to use layer sync between Mbox v3 software and Mbox v4 software, the Mbox v3 software must be the sender of the sync. Mbox v3 will not respond to layer sync sent from Mbox v4.

Specifying the Network Interface for Layer Sync

As when using network timecode, when using layer sync, each Mbox server must be told which Ethernet interface is being used for synchronization messages. This is achieved using the Sync popup in the Network section of the Mbox Preferences tab. See <u>"Configuring Mbox to Receive Network Timecode from TC Reader or Director"</u> on page 107.

To prevent a server from transmitting layer sync streams, the Sync preference can be set to "Local" rather than an actual interface name. When syncing from server to server, select the name of an active Ethernet interface to use for the sync streams to be received/transmitted from. In typical setups, the selected interfaces should use the same subnet on all machines, whether the server is sending or receiving sync.

MboxTime

As noted in the previous section, layer sync between two Mbox servers is very good, but it is not perfect. It is possible for the two servers to deliver a frame of video slightly out of sync due to delays in sync stream transmission over the network or because the playback engines of the Mbox applications on the two computers are not perfectly in sync. The results of imperfect sync are most noticeable when outputs from multiple servers are used in an overlapped and blended projection system or with adjacent LED displays. The playback from one server may be slightly ahead or behind that of another, causing imagery to look as if there is an imperfect blend or a "tear" between outputs.

The Mbox application's playback and rendering engines run in lock-step with the internal processing "clock" of the computer. But two different computers will always have very slightly different clocks. Without a common timing reference, it is impossible to guarantee that two computers will deliver the same video frame at exactly the same time. In order to get perfect playback sync between two Mbox servers, the two servers must have a common timing reference, which is what MboxTime provides. When the Mbox application is receiving an MboxTime reference signal, it can determine the host computer's clock offset from that reference time, and apply an offset to playback as required.

MboxTime encompasses the common timing reference and the compensation that each instance of Mbox applies to its playback to be in sync with the common reference. The MboxTime common timing reference can be received as either a timecode signal or as a network signal. The type of signal to be used is selected in the Misc section of the Mbox application's Preferences tab.
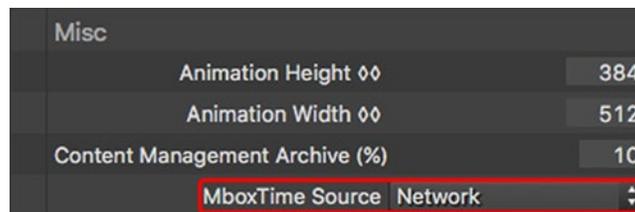
Because every computer's clock is slightly different, each computer will require a slightly different offset. These offsets need to be made in relation to one reference computer, which is designated as the "Rendering Leader." By default, the computer that acts as rendering leader is selected from among all Mbox servers on the same sync network. It is possible to manually select the computer that will be the rendering leader, by checking the Rendering Leader checkbox on Mbox's Preferences tab on that computer.

IMPORTANT! MboxTime is not the same as network timecode from TC Reader or Mbox Remote or layer sync streams from Mbox, but is intended to be used with some form of playback sync.

Guidelines:

+ All Mbox servers must receive only one MboxTime reference, from a single source, whether it is timecode or network-based.

+ When MboxTime is used, Mbox servers MUST use a synchronization playmode - layer sync or timecode sync, otherwise the MboxTime reference will be ignored because no attempt is being made to sync playback.

+ Use of the Rendering Leader preference is not required, as a rendering leader will automatically be selected if one is not designated. But it can be beneficial to manually select the rendering leader especially if using layer sync. In such cases, the Mbox that is the sync sender should also be the rendering leader.

+ When received as timecode, the MboxTime reference <u>must</u> be received as SMPTE timecode (LTC) directly into the Mbox application; the TC Reader application cannot be used.

  - The Mbox application must have its audio input preference configured to receive audio on an active interface, this preference cannot be set to "None".

  - There can be only one source of the SMPTE signal for use as the timing reference.

  - For best results SMPTE used as the MboxTime reference should not start and stop or jump around. The Mbox application is able to adjust for this, but when the reference is not running or when it jumps, the sync may not be perfect. Therefore, it is not a good idea to use the same SMPTE as the MboxTime reference and for playback sync, as timecode for playback sync often starts and stops or jumps around.

+ When received as a network signal, the MboxTime timing reference must come from the Mbox Network Clock application.

  - The Mbox application does not need to have its audio input preference configured, but it is OK if an interface is configured for use with timecode sync for playback.

  - Mbox Network Clock can run locally on an Mbox or on a separate computer, transmitting over the network.

Mbox Network Clock

  - There should be only one computer running Mbox Network Clock for each system! Multiple instances will cause serious issues.

  - The Mbox Network Clock application starts running automatically when launched. The only configuration required is to set the desired network interface for the timing reference to be transmitted from. This must be set to something other that "Local" for the MboxTime reference to be used by more than the one computer that is running the Mbox Network Clock application.
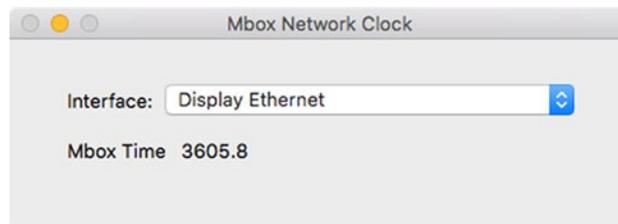
+ When using MboxTime from either a SMPTE source or the Mbox Network Clock application, it is possible to check that the Mbox application is receiving MboxTime by bringing up the [F9] HUD. The MboxTime value and type (Network or LTC) will be reported in the HUD:
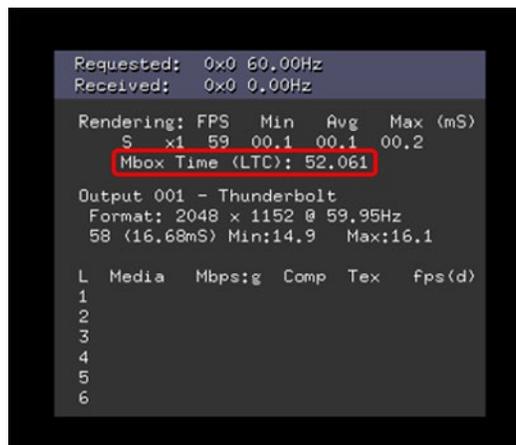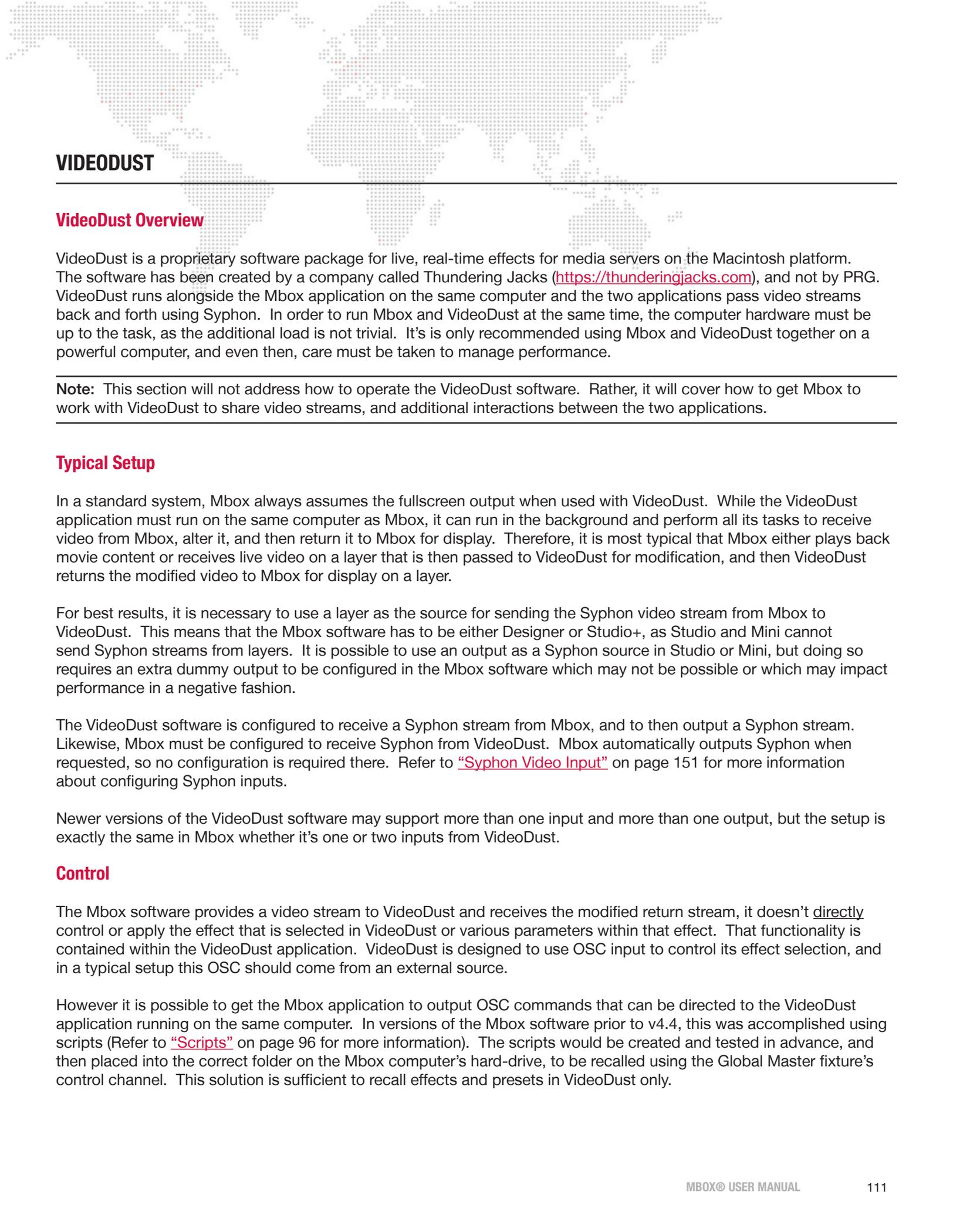
VIDEODUST

VideoDust Overview

VideoDust is a proprietary software package for live, real-time effects for media servers on the Macintosh platform. The software has been created by a company called Thundering Jacks (https://thunderingjacks.com), and not by PRG. VideoDust runs alongside the Mbox application on the same computer and the two applications pass video streams back and forth using Syphon. In order to run Mbox and VideoDust at the same time, the computer hardware must be up to the task, as the additional load is not trivial. It's is only recommended using Mbox and VideoDust together on a powerful computer, and even then, care must be taken to manage performance.

Note: This section will not address how to operate the VideoDust software. Rather, it will cover how to get Mbox to work with VideoDust to share video streams, and additional interactions between the two applications.

Typical Setup

In a standard system, Mbox always assumes the fullscreen output when used with VideoDust. While the VideoDust application must run on the same computer as Mbox, it can run in the background and perform all its tasks to receive video from Mbox, alter it, and then return it to Mbox for display. Therefore, it is most typical that Mbox either plays back movie content or receives live video on a layer that is then passed to VideoDust for modification, and then VideoDust returns the modified video to Mbox for display on a layer.

For best results, it is necessary to use a layer as the source for sending the Syphon video stream from Mbox to VideoDust. This means that the Mbox software has to be either Designer or Studio+, as Studio and Mini cannot send Syphon streams from layers. It is possible to use an output as a Syphon source in Studio or Mini, but doing so requires an extra dummy output to be configured in the Mbox software which may not be possible or which may impact performance in a negative fashion.

The VideoDust software is configured to receive a Syphon stream from Mbox, and to then output a Syphon stream. Likewise, Mbox must be configured to receive Syphon from VideoDust. Mbox automatically outputs Syphon when requested, so no configuration is required there. Refer to "Syphon Video Input" on page 151 for more information about configuring Syphon inputs.

Newer versions of the VideoDust software may support more than one input and more than one output, but the setup is exactly the same in Mbox whether it's one or two inputs from VideoDust.

Control

The Mbox software provides a video stream to VideoDust and receives the modified return stream, it doesn't directly control or apply the effect that is selected in VideoDust or various parameters within that effect. That functionality is contained within the VideoDust application. VideoDust is designed to use OSC input to control its effect selection, and in a typical setup this OSC should come from an external source.

However it is possible to get the Mbox application to output OSC commands that can be directed to the VideoDust application running on the same computer. In versions of the Mbox software prior to v4.4, this was accomplished using scripts (Refer to "Scripts" on page 96 for more information). The scripts would be created and tested in advance, and then placed into the correct folder on the Mbox computer's hard-drive, to be recalled using the Global Master fixture's control channel. This solution is sufficient to recall effects and presets in VideoDust only.

In Mbox v4.4, additional capability has been added to allow more direct control of the effect parameters in VideoDust, in addition to the effect/preset selection. Because this added functionality requires more control, and live parameter adjustment, the solution using scripts cannot work, so this has been superseded by a new method that allows the Mbox application to receive more control Art-Net or sACN and to process and convert that data into OSC that is sent to the VideoDust application.

Note: Only the newest versions of VideoDust can interface with Mbox in this manner. Check with Thundering Jacks for more information on compatibility.

DMX to OSC

Starting with Mbox v4.4, this feature allows the Mbox software to receive additional control data to be converted into OSC. While this feature was initially added to allow better integration between Mbox and VideoDust, the feature may be beneficial for any direct OSC output from the Mbox application. This feature is called "DMX to OSC" (or dmx2osc) within Mbox. In this case the "DMX" equates to Art-Net or sACN control data rather than actual DMX.

The functionality allows one or more control channels to be received and based on a preset configuration file (Mbox/dmx2osc.json) the incoming control data is converted into outgoing OSC messages. The Mbox application handles the reception of the Art-Net or OSC, along with the normal control data. Unlike other added control for things like pixel mapping group control or image remapping, the DMX to OSC control data does not have to be the same protocol as what Mbox is using for primary control.

Note: The DMX to OSC configuration file uses JSON (Java Script Object Notation) rather than Apple Property List formatting. The dmx2osc file can be opened and edited easily using the TextEdit application found on the Mbox computer.

The formatting and contents of the dmx2osc.json file controls everything about the conversion of control data to OSC. The JSON formatting is to make the file easier to read and edit. But this format is no less demanding when it comes to proper syntax and content. If the Mbox application finds a dmx2osc.json file in the Mbox content folder upon launch, the contents of the configuration file will be read and automatically used.

WARNING! If there is a dmx2osc.json file found when the Mbox application launches, it will always be read and used. If matching universe and address control data is received, then the conversion to OSC will always happen and OSC data will be output. There are two ways to stop this: a. quit Mbox, remove the dmx2osc.json file from the Mbox content folder, or b. use the Global Master control channel to temporarily stop all OSC output.

A report of the dmx2osc file is written to the Mbox log whenever the application launches. This makes it easier to find and troubleshoot errors in the configuration. It's usually better to start with a template file, either from a previous show or one supplied by the Mbox Product Management team. The required configuration for VideoDust is such that it is recommended to start with a dmx2json file provided by PRG unless the user has prior experience with the functionality.

The dmx2osc.json file requires the following items:

+ Correct file location - the file must be placed directly in the Mbox content folder

+ Correct syntax - all brackets, braces, quoted, colons, and commas must be in the right place

+ Correct object naming - the key:value relationships must use the correct object names for each type of supported key

+ Plain text formatting - the file must be saved as plain text rather than formatted text

+ Correct file extension - the file extension must be .json and nothing else

Note: The picture to the right represents an example of the structure of a dmx2osc file for Mbox. While it is formatted correctly and represents some of the data required to control VideoDust it is by no means complete and is only shown as an example of the formatting.

```
                                    dmx2osc.json ⌄
{
    "dmx2osc_if": "Display Ethernet",
    "dmx2osc": [
        {
            "sacn": "5.1",
            "dest": "127.0.0.1:8022",
            "path": "/vd_mbox/fx_select",
            "type": "i"
        },
        {
            "sacn": "5.2",
            "dest": "127.0.0.1:8022",
            "path": "/vd_mbox/fx_preset",
            "type": "i"
        },
        {
            "sacn": "5.3",
            "dest": "127.0.0.1:8022",
            "path": "/vd_mbox/source_mix",
            "type": "i"
        },
        {
            "sacn": "5.4",
            "dest": "127.0.0.1:8022",
            "path": "/vd_mbox/main_mix_r",
            "type": "i"
        },
        {
            "sacn": "5.5",
            "dest": "127.0.0.1:8022",
            "path": "/vd_mbox/main_mix_g",
            "type": "i"
        },
        {
            "sacn": "5.6",
            "dest": "127.0.0.1:8022",
            "path": "/vd_mbox/main_mix_b",
            "type": "i"
        }
    ]
}
```

Primary Object Keys and Values

+ "dmx2osc_if" - this is the network interface used to receive the control data for the entire DMX to OSC process.

    - Acceptable values are either the strict name of a network interface on the computer (capitalization matters!), or the IP address of a network interface.

+ "dmx2osc" - this is an array (noted by the square brackets at beginning and end [ ]) of the control channels used, their protocol, universe, and address, the destination (IP address and port) for the OSC message, the OSC message itself, and a standardized description of the formatting of the OSC message's type and argument.

Control Object Keys and Values

+ "sacn" or "artnet" - this key sets whether the control listens for sACN or Art-Net.

    - The associated value is the "universe.address" that the control responds to.

    - The address value can have a "d" added (e.g. "5.8d") to indicate that two consecutive addresses (a double) should be read to allow a 16-bit value to be read and converted to OSC. Note that the actual number of consecutive addresses read and processed also depends on the type selected, as doubling the type value (e.g. "ff") means that the OSC message outputs two values. Therefore an address with the "d" suffix plus a doubled type value means that four consecutive channels are read.

+ "dest" - the destination for the OSC message.

    - The value is the "Destination IP address:Destination Port" for the OSC message. For VideoDust this will usually be the localhost (127.0.0.1) and port 8022. For other purposes this value will need to be edited.

+ "path" - the path information for the OSC command.

    - The value equates to the receiving object followed by the command string, with objects separated by slashes (/) in standard OSC fashion. This information would be provided by the documentation from the receiving application/device. No trailing slash is required. Capitalization absolutely matters!!

+ "offset" - an offset that can be subtracted from the incoming control channel value before any processing occurs. Typically used with a float output type.

    - This can be set to the default (typically the midpoint) for a incoming value. For example, if a centered 16-bit value is used, the default may be 32768, with decreasing range to 0, and increasing range to 65535. With no offset value and a float output type, an incoming value of 0 is output as 0.0, 32768 as 0.5, and 65535 as 1.0. But with the offset value set to 32768, an incoming value of 0 is output as -0.5, 32768 as 0.0, and 65535 as 0.5.
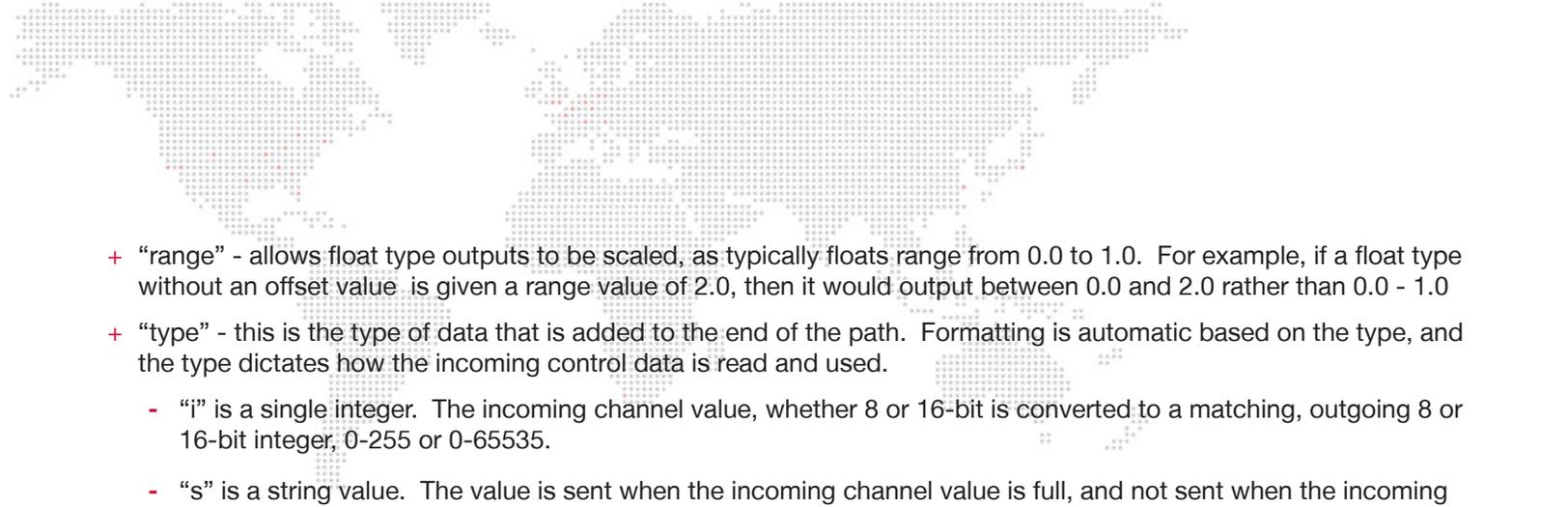
+ "range" - allows float type outputs to be scaled, as typically floats range from 0.0 to 1.0. For example, if a float type without an offset value is given a range value of 2.0, then it would output between 0.0 and 2.0 rather than 0.0 - 1.0

+ "type" - this is the type of data that is added to the end of the path. Formatting is automatic based on the type, and the type dictates how the incoming control data is read and used.

  - "i" is a single integer. The incoming channel value, whether 8 or 16-bit is converted to a matching, outgoing 8 or 16-bit integer, 0-255 or 0-65535.

  - "s" is a string value. The value is sent when the incoming channel value is full, and not sent when the incoming value is 0.

  - "f" is a single float value - typically a value between 0.0 and 1.0. The actual output value can be scaled by the range type described above. The zero point of the value (with regard to the incoming value) can be offset using the offset type described above.

  - "ff" is a double (i.e. two values grouped together) float value. This type may be used for things like combined X/Y position commands.

Note: The offset and range keys affect all values within the same control channel object to receive the same offset or scaling. In such cases, if the output type is "ff" then both float outputs would get offset and scaled accordingly.

As a real-world example for the keys and values explained above, here is an object from the standard VideoDust 2.0 control dmx2osc.json file:

```
{
    "sacn": "5.18d",
    "dest": "127.0.0.1:8022",
    "path": "/vd_mbox/z",
    "range": "2.0",
    "offset": "32768",
    "type": "f"
},
```

Explanation:

+ This control listens to sACN at universe 5, address 18. It receives values from two consecutive addresses, i.e. a 16-bit value, 0 - 65535.

+ The destination is the same computer (127.0.0.1 = localhost), port 8022.

+ The OSC path is "/vd_mbox/z" which is actually the VideoDust Z position parameter.

+ The range is 2.0, therefore 2x normal range of 0.0 to 1.0 (0 - 1.0 because this is a float, see below).

+ The incoming value is first offset by 32768 before being converted to a float and scaled.

+ The outgoing value is a single float.

All of which means that while the incoming control value varies from 0 to 65535, the output OSC value will be -1.0 to 1.0.

+ Incoming value has 32768 subtracted from it, result is divided by 65535, result is multiplied by 2.0

+ e.g. 65535 - 32768 = 32767, 32767/65535 = 0.5, 0.5 * 2.0 = 1.0 or...

+ e.g. 2000 - 32768 = -30768, -30768/65535 = -0.47, -0.47 * 2.0 = -0.94

EFFECTS AND TRANSITIONS

Effects and Transitions with Additional Input Files

Effects and transitions that require additional image input files will use numbered files placed in a specific location inside the Mbox content folder. The actual parent folder of the image files will depend on the effect or transition in question:

+ Alpha Mask From File Effect - Mbox/plugins/images/masks/

+ MetaImage Effect - Mbox/plugins/images/masks/

+ Custom Wipe Transition - Mbox/plugins/images/grayscale/
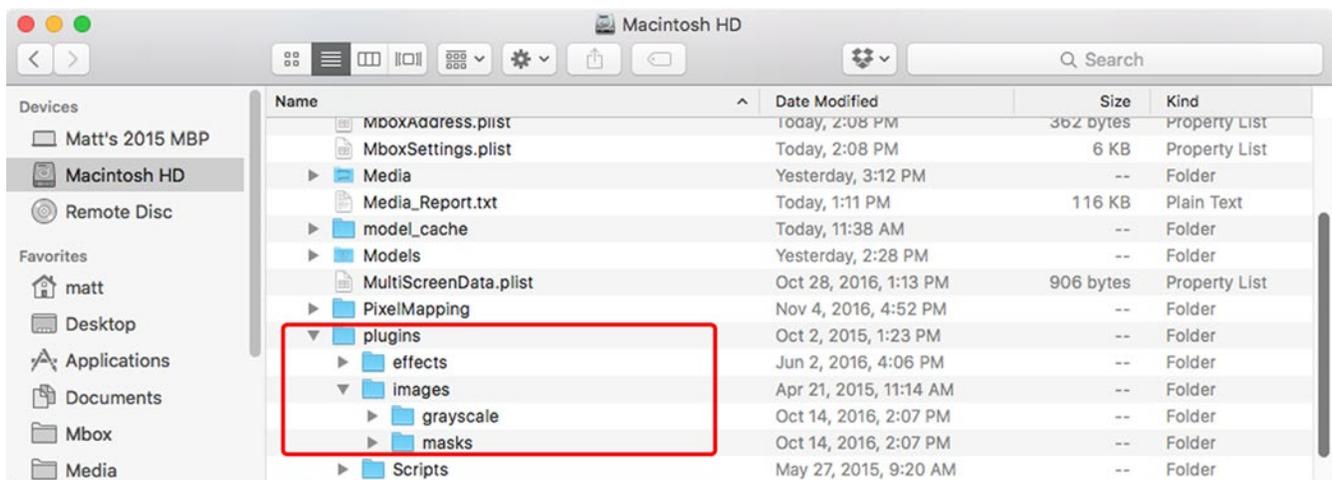
Within each of these folders, files will have 8-bit numbering. The Alpha Mask and MetaImage effects share the same folder, there may be up to 255 files, numbered 001 – 255 to share between those effects. The Custom Wipe Transition can only have up to 20 different input files – ten are used for hardedge wipes 001 – 010, and ten are used for soft-edge wipes 011 – 020. Numbering, naming, and file extensions conventions follow the same rules as standard Mbox content. [e.g. 001.MyFile.png]

Guidelines:

+ The input image files do not have to be the same size as the texture they are applied to (layer or master) because they are automatically scaled to fit. However...

  - Alpha Mask effect: For best results with files used for accurate masking, the input image file should be exactly the same size as the texture it will be applied to. Make sure the input image file is the same size as the content it will be used on. i.e. Masking content that is 1024 x 768 would require a mask file that is also 1024 x 768.

  - Custom Wipe transition: Input image files that are not the same aspect ratio as the texture on the layer may lead to undesirable results. For best results the outgoing and incoming textures should also be the same size.

+ The Alpha Mask input image file should be a PNG file saved with an alpha channel. The effect uses the alpha channel information in the input file to generate the mask.

+ The Custom Wipe input image file can be a JPG or PNG and can be grayscale or color. No alpha channel is required. A grayscale file will provide the best indication of how the transition will work, as this effect uses luminance values to create the wipe. The darker areas will start to show the incoming content first, followed by lighter areas.

Adding Custom Effects or Transitions

Mbox provides the ability for users to add their own effects and transitions or to make modified versions of existing built-in effects and transitions. This process is quite complex and the following information only outlines the process. Modifying existing effects/transitions or create new custom effects should not be attempted without first talking to a PRG representative for further instruction.

The Mbox software can access new Image Units placed in the /Library/Graphics/Image Units folder. In addition to placing Image Units into the folder, a file must be created to define the parameters of the effect. The file enables Mbox to use these Image Units properly. These definition files are saved in the standard Apple Property List format, but with special file extensions instead of the typical .plist file extension. For effects, the file extension is ".txfx" (texture effect), and for transitions, the file extension is ".txtx" (texture transition).

Creating a working Image Unit (the basis of effects and transitions) is far harder than generating the definition file and this manual will not go into the process of creating an Image Unit. Contact MboxSupport@prg.com for more information on this process.

It is much easier to create modified versions of existing effects and transitions. In order to do this, knowledge of the input structure of the Image Unit is required. The easiest way to do this is to look at the existing txfx or txtx file that dictates how the built-in Image Unit's input structure is set up. Parameters in the existing file can be modified and the results saved as a new version (with a unique effect or transition number) for use with Mbox.

Example 1: Modifying the character string in the ASCII Art effect

For the ASCII Art effect, a rectangular group of pixels in the original image are sampled, and based on the averaged luminance of the sample, the pixels are replaced by one of twelve characters from a string. The darkest sampled areas are replaced by the first character in the string, and as the sampled areas get brighter, they are replaced by characters further to the right in the string.

The string is made up of the default characters - space, period, and the numbers 0 through 9 - " .123456789". In the illustrations below, the original movie is on the left, and the movie with the unmodified ASCII Art effect is on the right:
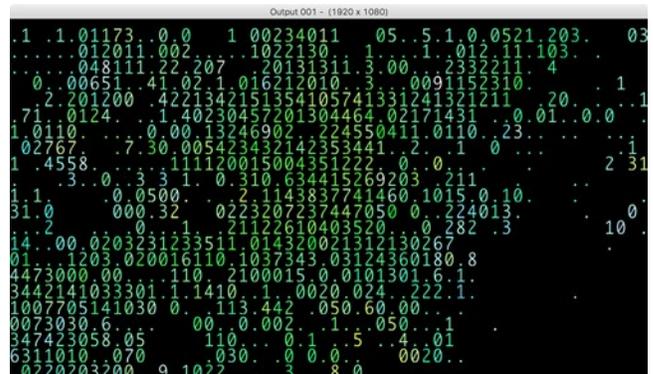
The twelve different characters in the string are supposed to represent progressively brighter areas, are doing so by increasing the numerical value of the character. But what is that isn't the right look, and instead the characters should cover more screen area rather than increase in value. To accomplish that, the string should be modified to be something like " .!-+*oO0@$#" instead.

Every effect has a txfx file that defines the parameters of the effect. For the effects that are built into the Mbox application, these txfx files can be found in the application's bundle. To open the application bundle first find the Mbox application's executable file; it should be in the /Applications/Mbox Designer folder. Right-click on the application and select "Show Package Contents" from the menu that appears. The Finder window will show a single folder called "Contents". Look inside that folder to find the folder with the path of: Contents/Resources/Plugins/texture effects. All the txfx files for the application are in this folder. Find the existing ASCII Art txfx file and make a copy of it outside of the application bundle.

Note: In order to edit the txfx file either the Apple Property List Editor, Xcode, or one of several commercially available property list editing applications can be used. Change the file extension to ".plist" temporarily may be required in order to be able to open the file.

This is what the data in the txfx file looks like:
The root of the plist has been expanded to show the key:value pairs in the plist. Each key:value pair holds information critical to the operation of the effect, and both the key name and its value must be formatted correctly for the effect to work. To modify how an existing effect works, all that is required is to edit the appropriate values. Most values are simple numbers that describe a range for parameters of the effect, but they can get more complicated in some cases.

CAUTION! The txfx files for Mbox v4 hold parameter data for Mbox when in v4 mode, but also when it's in v3 emulation mode. The txfx file's root has two primary keys: Parameters (for v4 operation) and V3Parameters (for v3 emulation). Make sure to edit the data in the correct location - in Parameters, not V3Parameters

For the ASCII Art effect, the value that needs to be edited is the "inputString" dictionary's "String" value. The default value, as seen in the illustration above, is " .123456789". In order to change the string, it's just a case of double-clicking on the current value and typing in the new string - " .!-+*oO0@$#" and then saving the file with a new and unique index number, a descriptive name, and the correct file extension: e.g. "200.ASCII Art Modified.txfx".

It's important to use a unique index number to make sure that this new version of an existing effect doesn't interfere with the operation of the built-in effects. Once the edits are complete, the new txfx file can be placed in the Mbox/plugins/effects folder and the Mbox application launched. The results should look like this:

Example 2: Reworking the White Diagonal Transition

This is how the White Diagonal transition normally looks about halfway through the transition. It wipes from the top-left corner to the bottom-right corner. The stripe at the transition point is white and has a particular thickness.

The White Diagonal transition has a fair number of parameters that can be edited to change how it looks:

+ inputAngle, Value: number = -0.7854: This is the angle of the swipe of the transition.

+ inputColor, Color: array = four values (Red, Green, Blue, Alpha) = 1, 1, 1, 1: These four values relate to the color of the swipe of the transition. Although this includes a value for alpha, there is a separate control, inputOpacity, that controls the opacity of the edge.

+ inputOpacity, Value: number = 1: This is the opacity of the colored swipe of the transition.

+ inputWidth, Value: number = 150: This is the width of the colored swipe of the transition.

There are some values in the plist that should not be edited

+ inputImage, inputTargetImage, inputTime, outputImage: These items are critical to getting the transition to work, and must stay the same.

+ Filter Name: string = CISwipeTransition: This is the name of the Image Unit for this particular transition.

+ inputExtent, Extent: array = two values (X, Y) = 1, 1: These two values relate to how far across the image the transition will move from beginning to start. To ensure a complete transition, these two values must be left at 1.0.

Remember that if incorrect keys or inappropriate values are entered, then it is likely that the entire effect or transition will fail when used with Mbox. It is best to start by modifying values to a small extent and examine the result of those changes. So, to change the transition around a bit, change the following properties:

+ inputAngle = 0.7854

+ inputColor = 0, 1, 0, 1

+ inputOpacity = 0.5

+ inputWidth = 500

+ UserVisibleName = Green Diagonal

Note: The UserVisibleName doesn't have to be changed, but it is used when indexing content and making thumbnails, so having a unique name can be helpful.

PIXEL MAPPING

Overview

Pixel Mapping is an advanced Mbox feature that allows mapping of specific functions of sACN, Color Kinetics KiNET, or Art-Net-controlled fixtures (RGB, Intensity, CMY, etc.) to each of the pixels in a composite video image. Pixel mapping data is generated from the onscreen imagery of the Mbox server and is output from an available Ethernet interface of the computer. While pixel mapping, Mbox retains the normal video output so a video signal can still be sent to a display device.

Pixel Mapping for Mbox is configured using the Mbox Remote application. For full instructions on using pixel mapping, refer to the Pixel Mapping section within the Mbox Remote User manual.

New Concepts

In the Mbox v4 application the pixel mapping engine has been enhanced in that individual contexts can use different sources for their sampling. In previous versions of Mbox, only the final output of the server (Output 1 in Single and Dual Independent modes or the combination of Output 1 and Output 2 in the Panoramic modes) was available to be the source for sampling. As a result of the changes in Mbox v4 - the addition of the Global Surface and Mixes - the pixel mapping engine can now use a variety of sources: the Global Surface, Mixes (which include outputs), and Layers.

The pixel mapping configuration is still handled by the Mbox Remote application, and aside from the additional sources the remainder of the interface and setup process is the same. What is different is the area below the context grid, where the context tabs are shown and the contexts' properties are set.

Each context now has a pop-up that allows the source for that context's sampling to be selected. The pop-up provides selections for the Global Surface, mixes, and layers. The Global Surface is always available for selection, but unless the pixel mapping editor is in a live editing session - using a network connection to the Mbox v4 application - mixes and layers will not be available. This is because Mbox Remote does not know the configuration of the Mbox application (how many mixes and how many layers) unless a live session has been started. If mixes or layers were previously set (in a live session) as the source for pixel mapping, they will remain the source even during an offline editing session.
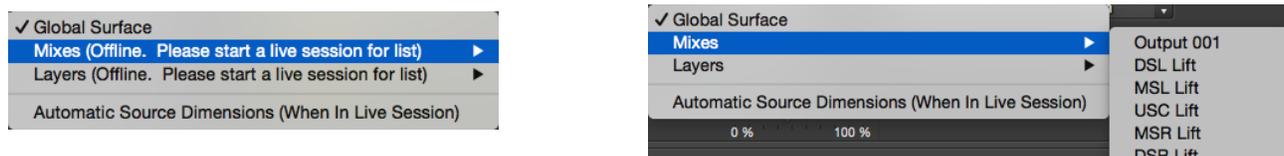
Note: If a pixel mapping configuration is created from scratch without a live session, the Global Surface should be used as the initial source for every context. When offline, the selected source does not affect the remainder of the configuration – sampling rate, fixture placement/patch, protocol selection, etc. Later, a live connection to the Mbox application can be established and the desired sources can be set.

At the bottom of the source pop-up is an item that allows the context to automatically resize based on the size of the source. This is a very important option. In all cases, the sources for pixel mapping in Mbox v4 can change size, and that change in size may affect the sampling for pixel mapping. While enabling the auto resize option still means that the result of pixel mapping can change if the source size changes, it does mean that there will always be a result, rather than no output.
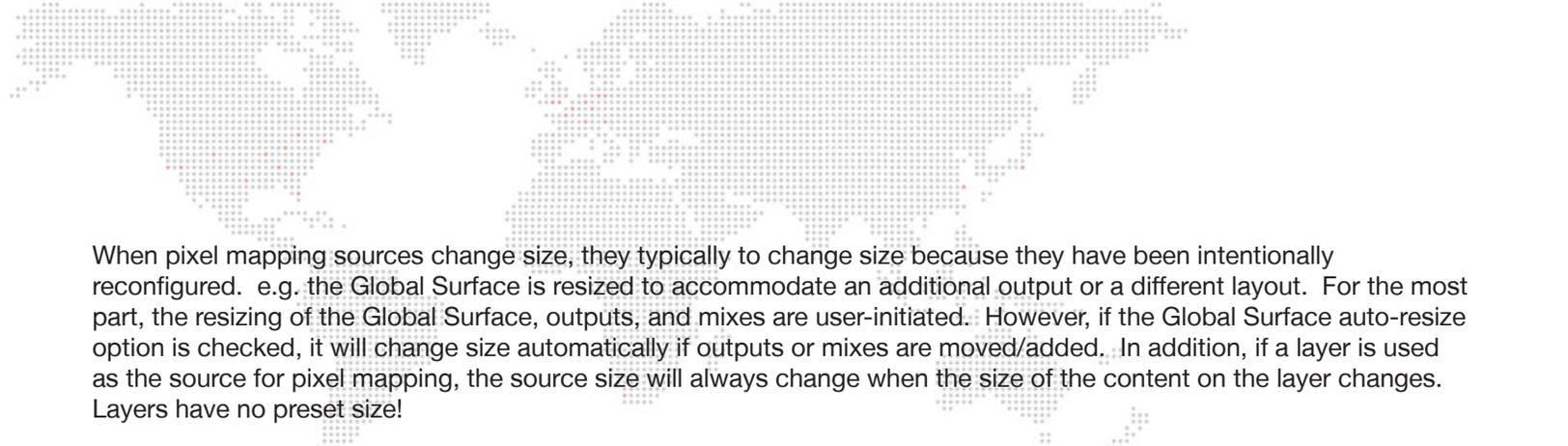
When pixel mapping sources change size, they typically to change size because they have been intentionally reconfigured. e.g. the Global Surface is resized to accommodate an additional output or a different layout. For the most part, the resizing of the Global Surface, outputs, and mixes are user-initiated. However, if the Global Surface auto-resize option is checked, it will change size automatically if outputs or mixes are moved/added. In addition, if a layer is used as the source for pixel mapping, the source size will always change when the size of the content on the layer changes. Layers have no preset size!

This means that attention should be given to what the pixel mapping sources are and whether they might need to change size during setup and programming, or whether (in the case of layers) they might even change size at different moments during the show. If the sources are the Global Surface and/or outputs and mixes, then once setup is complete these will likely never change size again, and for the most part these sources won't need the auto-resizing enabled. But if the source is a layer and content sizes change during the show, it's a very good idea to enable the auto-resizing. Of course, if a particular layer only ever plays a single size of content, then that size could be set and the auto-resizing not enabled.

When a new source (i.e. a source that isn't already being used by another context) is selected for a context, a tab will appear for that source. The source tabs are labeled with the name of the source. Clicking on the tab shows the currently set size of the source, and if this size does not match what the Mbox application is using for that source, the button below will have the current source size shown in red. Pressing the button will change the source's size to whatever size Mbox is using. There is a new checkbox to the right of the size fields that when checked causes the source size in the pixel mapping editor to automatically update when the actual source changes size. This setting can be used together with the auto-resize option for the contexts to ensure that the correct/current sizes for sources and contexts are shown in the editor.

If Mbox Remote is in a live editing session when a pixel mapping source changes size and both of the resizing preferences are enabled then the only indication will be that content may no longer fill, or may overfill the current layout of fixtures. With the source size automatic updating disabled, the tab for that source will be colored red if the source changes size.

CAUTION! If the pixel mapping is set up to for pixel-for-pixel sampling between content and fixtures, enabling the auto-resizing can affect that relationship severely. Care should be taken if the source size changes, and changes on the fly (i.e. using a layer as a source and playing content of a different size) should be avoided.

PROJECTION MAPPING

Overview

Projection Mapping is an advanced feature accessed through the Mbox Remote application. Projection mapping, in its basic form, can used to configure output settings for keystone and warp. Projection surfaces (Topography files) and more complex projection mapping settings can also be created, applied, and adjusted for use with Mbox. For instructions on using projection mapping, refer to the corresponding section within the Mbox Remote User manual.

5.

IMAGE REMAPPING

This chapter provides instructions for the Mbox image remapping feature.

ABOUT IMAGE REMAPPING

Overview

The Image Remapping functionality of the Mbox software allows the creation of one or more configurations of two-dimensional rectangular "screen objects" that may be used to reposition, copy, or alter pixels on a layer, while keeping everything absolutely pixel-accurate. The screen objects within the configuration receive the texture that is provided by 2D content used on the layer. Each screen object can have extra control parameters added, allowing for changes to the imagery shown on the screen object. Standard control parameters for image remapping allow for intensity or opacity changes, position changes, rotations, and color changes. Additional parameters allow for further mastering and the creation of repetitive identical elements with a regular offset.

The image remapping file (Mbox/MultiScreenData.plist) can hold multiple configurations, and each configuration may be made up of multiple screen objects that can each have unique controls and mapping properties. This structure creates a hierarchical relationship: File > Configuration > Screen Object > Control. External control over screen object parameters is handled through Art-Net or sACN input to the Mbox server.

Note: Mbox Designer can have 255 Image Remapping configurations, Studio+ can have 16, Studio can have 8, Mini can have 2.

Editing Image Remapping Data

There are two different applications that can be used to edit image remapping data for the Mbox server: the Mbox application itself and Mbox Remote. The methods for editing image remapping data are the same in both applications.

(X) **Eliminated Feature:** The Multiscreen Editor application has been superseded with functionality in Mbox and Mbox Remote and should not be used.

File Mode

Mbox and Mbox Remote are both capable of opening any image remapping file from disk, editing that file, and then saving that file or saving it with a new name. When opening a file from disk the edits are not live and must be saved to disk as the default Mbox/MultiScreenData.plist file for the Mbox application to be able to use them:

Step 1.   In Mbox and Mbox Remote, click on the Image Remap tab, and then click on the file mode button. Then click on Open in the Image Remap menu (or press [⌘O] if using Mbox) to open a file selection dialog.
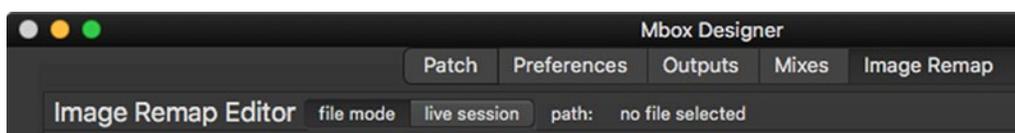
Step 2.   In the file selection dialog, select the image remapping file to open. The file that the Mbox application uses must be called MultiScreenData.plist and be located in the Mbox content folder, but any image remapping file can be opened for editing.

Step 3.   Click on the Open button at the bottom of the dialog window. The image remapping data will be loaded and displayed.

Step 4.   Edit the data as desired, then save the file using the Save item in the Image Remap menu (or by pressing [⌘S]) A "save-as" option is also available to allow the file to be saved with a different name or in a different place.

Live Session

The default editing mode for all three applications is to edit image remapping data in a live session, where changes are instantly visible onscreen in the Mbox application. Live editing can take place on the Mbox computer itself (when using any of the three applications) or from a remote computer (when using Mbox Remote).

Note: To edit image remapping data in a live session using Mbox Remote, the Mbox application must be running on the Mbox server, and must have the appropriate management network interface selected to connect to the computer that is running Mbox Remote. Refer to "Networking for Mbox" on page 74 for more information.

The steps required to begin a live edit session are slightly different between Mbox and Mbox Remote because Mbox can always get data from itself and doesn't require a network connection between computers.

Step 1.   If using Mbox, only the image remapping data on the same server can be edited, therefore no network configuration is necessary. If using Mbox Remote, confirm that the computer is on the same subnet as the Mbox server, add the server if necessary, and then select the server on the left side of the main window.

Step 2.   Click on the Image Remap tab, and click on the live session button if not already selected. If switching from a file mode session, an alert panel will appear. Select the appropriate option to copy the current data to Mbox or to discard the current data and load data from Mbox.

Step 3.   The live data will load. Large files may take a few seconds to load.

Step 4.   Edit the data as desired, all edits will automatically be saved to the default Mbox/MultiScreenData.plist file. The data can also be manually saved to a file on disk other than the default by using the file save-as option.

Switching Between File Mode and Live Session

Both Mbox and Mbox Remote allow a switch from file mode to a live session and provide the ability to copy the data from the file on disk to Mbox or to re-read the current data from Mbox (discarding the existing data) and load that into the editor.

Step 1.   With Mbox or Mbox Remote in file mode, click on the live session button. An alert dialog will open asking if the current file should be copied into the Mbox application's live memory:

Step 2.   If the intention is to copy the current file to Mbox, then press [return] or click on the button labeled "Yes (Copy to Mbox)". To discard the current file (any unsaved changes will be lost), click on the button labeled "No (Reread from Mbox)". To cancel the switch, press the cancel button.
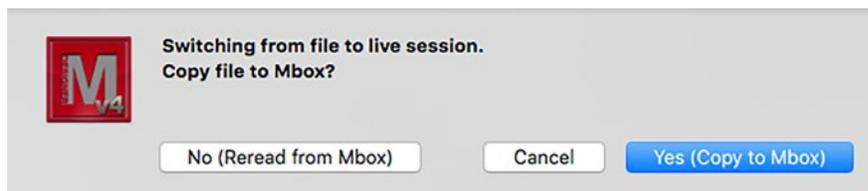
CAUTION! It is possible to have both Mbox and Mbox Remote open, with both applications editing the image remapping configuration. **However, this is not recommended!** If both applications are in a live session, any changes made to the configuration in one will immediately be reflected in the other. However, if one application is editing the default MultiScreenData.plist file in file mode, those changes will not be reflected in the other application. If the application in file mode is switched to a live session and told to copy its data to Mbox, any changes made in the other application will be lost!

User Interface

The illustration below shows the user interface of the Image Remap tab of the Mbox application. An identical interface can be found on the Image Remap tab of the Mbox Remote application:

+ The data editing and preview areas are combined onto the Image Remap tab.

+ The entire Mbox application window can be resized to make the edit and preview areas larger.

+ The edit mode is selected at the top of the main window by clicking on the file mode or live session buttons.

+ File open, save, and save-as options are found in the Image Remap menu and have corresponding keyboard shortcuts: [⌘O], [⌘S] , and [⌘⇧S].

+ A hierarchical table of the configurations and their screen objects is found on the left of the window.

+ The view in the preview area can be scaled. In Mbox use [⌘+] to zoom in, [⌘-] to zoom out, and [⌘⇧0] to zoom to fit. In Mbox Remote use [⌘+] to zoom in, [⌘-] to zoom out, and [⌘0] to zoom to fit. Click and drag on the view to pan.

+ A background image for the preview area can be loaded using the File > Open menu item, and then selecting a JPEG or PNG image file. Beginning with Mbox/Remote v4.3.3 the background image supports transparency (PNG only).

Edit mode selection.

Reload image remap data from file

Configuration & Screen Object List.

Control Universe Setup

Screen Object/Control Parameter Setup
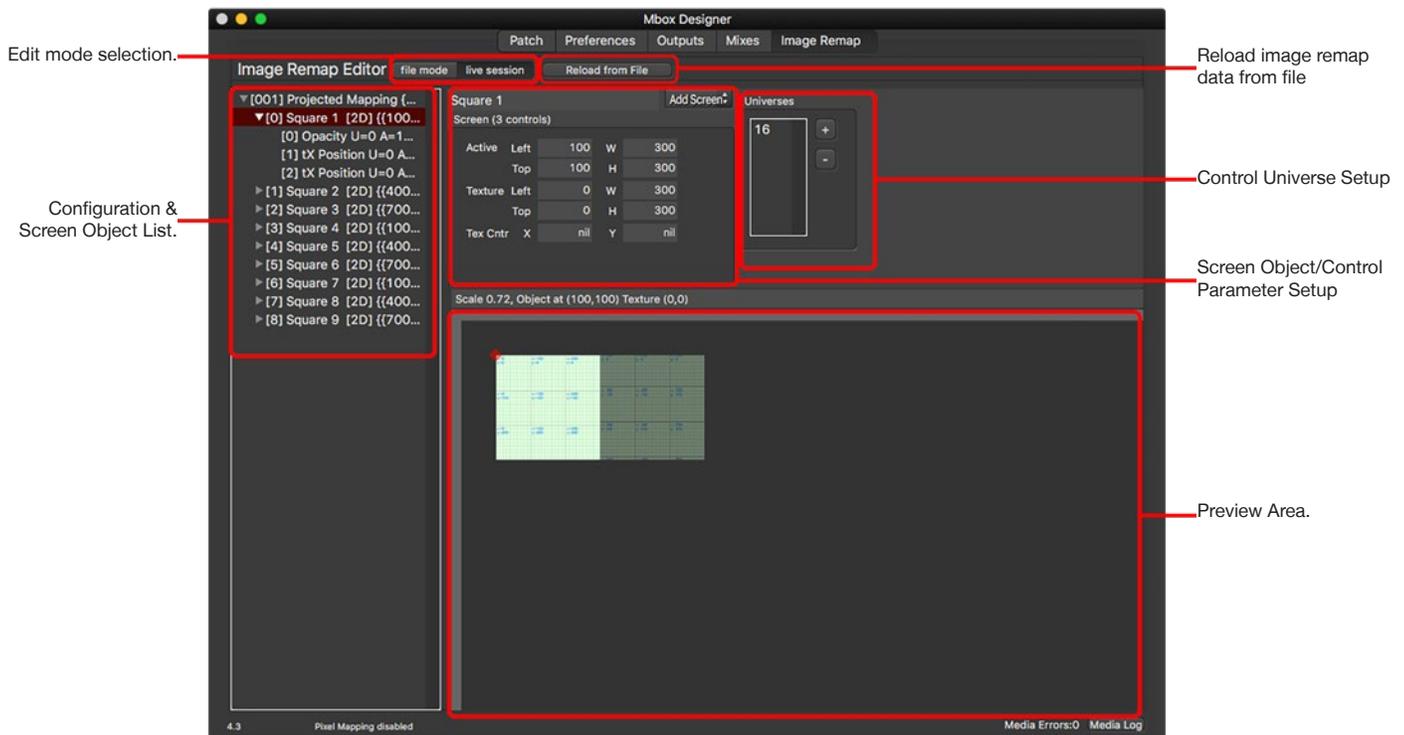
Preview Area.

The information shown above the preview will change depending on what type of item is selected in the table at the left:

+ With no configuration selected (click on a blank area of the table to deselect) this area will show the global Texture Position Scale parameter, which will default to a value of 1.

+ If a configuration is selected, then its name, texture size, and display size will be shown.

+ If a screen object is selected, its name, active and texture coordinates, and texture center will be shown.

+ If a control is selected, its name and control properties will be shown.

Screen Object Parameters

Each image remapping configuration is made up of screen objects. Each screen object has several parameter that define where onscreen the screen object appears, and also what portion of the layer's imagery it gets textured with. These parameters are split into three categories: Active, Texture, and Rotational Center.

The Active parameters define the location and size of the screen object on the Global Surface. These values are measured in pixels. The Left and Top values define the top-left corner of the screen object (its origin), and the W and H values define the width and height of the screen object.

WARNING! The Global Surface doesn't have to be the same size or the same origin as an output. In fact, there may be more than one output on the Global Surface. Therefore giving a screen object a specific active origin doesn't mean that it will appear in the same place on an output; the offset between output and Global Surface must be factored in.

The Texture parameters define how the layer's texture gets applied to the screen object. As with the Active parameters, these values are measured in pixels. The Left and Top values define the specific point in the layer's texture that will be pinned to the top-left corner of the screen object. The W and H values define how much of the layer's texture will be placed onto the screen object.

Note: Each Texture parameter can use the same value as the corresponding Active parameter. In which case there will be a one-to-one relationship between the screen object's coordinates/scale and those of the layer's texture.

Advanced Screen Object Parameters

Standard screen objects have one pair of Rotational Center parameters - Tex Cntr or Texture Center- that define the X/Y point in the layer's texture that it will rotate around if the Tex Rotate control (refer to "Screen Object Control Types" on page 143) is used. Triangle-based screen objects (refer to "Triangle-Based Screen Objects" on page 140 for more information) have an additional pair of Rotational Center parameters - Pos Cntr or Position Center - that define the X/Y point on the Global Surface that the entire screen object rotates around if the X, Y, or Z Rotate controls are used.

The Rotational Center parameter values are measured in pixels. By default, these parameters have no value, which is not the same as a value of "0." Therefore their value will be reported as "nil" in the user interface until either value is edited, and if either value in the pair is edited and set to nil, both values are reverted nil. Nil values are treated in the following manner:

+ **Position Center** - If the screen object is a triangle strip it will rotate around the first vertex which is usually the top-left corner of the screen object. If the screen object is triangle fan, it will also rotate around the first vertex, but this point is typically the center of the screen object since it is common to all of the triangles.

+ **Texture Center** - The texture will rotate around the center of the screen object. This is not necessarily the center of the texture if the texture and the screen object are not the same size.

This means that when editing these values, both values should be edited at the same time. And if the value is intended to be "0" then that needs to be explicitly entered.

CAUTION! Once each pair of rotational center parameters has been modified from the default "nil" values, those values can only be returned to nil by entering "nil" into one of the values in the pair. It is also possible to enter a value that is equivalent to the nil value, such that the screen object or texture rotates around the default point as mentioned above.

Note: Instead of nil, the default rotational center values can be entered manually: Tex Cntr X = Tex Left + Tex Width/2 and Text Cntr Y = Tex Top + Tex Height/2. Pos Cntr X/Y = use X/Y coordinates of the first vertex.

IMAGE REMAPPING TUTORIAL

Overview

The examples provided in the following pages are intended to mimic two different type of mapping onto LED panels. The sample content is a square that can be broken into nine smaller squares. To make the math simpler, the dimensions of the large square are 900 pixels on each side, and the smaller squares 300 pixels on each side. The sample image is shown to the right.

The tutorial will create two separate configurations. The first configuration will be set up using "Projected Mapping" and the second configuration will use "Discrete Mapping." Projected mapping is meant to look as if a projector were pointing at one or more screens that can move through the projector's beam; as the screens move, the content on them moves too. Discrete mapping is when the image on each square will stay pinned to the screen now matter how it moves.
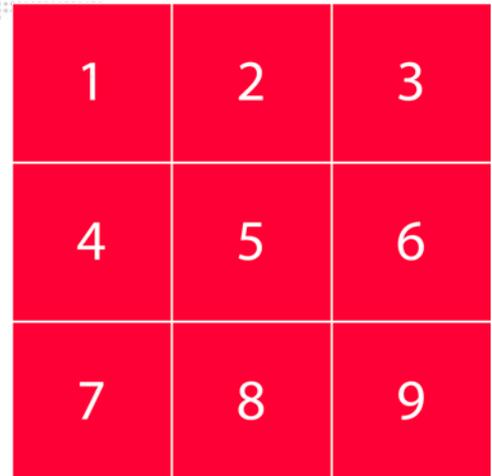
For both of these modes, each of the smaller squares (the screen objects within each configuration) will need some combination of added control parameters - opacity, texture position, and position - depending on the intent of the configuration.

External control over the screen object properties of the image remapping is handled through Art-Net or sACN input to the Mbox server. The control protocol for image remapping must be the same as the control protocol for the entire Mbox application and is selected on the Patch tab.

While the control for image remapping could be patched to one of the same universes as Mbox, this may be impractical unless very few channels are required. Ideally, a unique universe should be used. In the case of moving scenery, the external control data may be derived from positional data that a scenic feedback system creates and which is then converted into Art-Net or sACN. In other cases (and for this tutorial), extra fixtures/channels can be patched on a console to generate the necessary data.

For the purposes of this tutorial, each of the nine squares will get three extra channels patched for each of Mbox's playback layers. These extra channels are to control the square's properties: X Position, Y Position, and Opacity. This setup uses per-layer controls because the same image remapping configuration can be used on each layer of Mbox and depending on the design intention, each layer might require separate, unique control of some aspects.

Note: When using image remapping for scenic tracking, per-layer position control may be unnecessary, but per-layer opacity or intensity may be necessary.

All controls will use 8-bit values for this tutorial to keep things simple and to use fewer channels. With nine squares each having three channels, and six layers set up on the server, Mbox will need to receive $9 \times 3 \times 6 = 162$ additional channels from the control source. These could be set up as a custom fixture profile on a lighting console, with one channel for Opacity, and then a pair of channels for X and Y Position. 54 of these three-channel fixtures could be patched (9 squares x 6 layers).

The following example illustrations show the editing interface in Mbox. The interface in Mbox Remote is virtually identical, to that found in the Mbox application. The tutorial assumes that no MultiScreenData.plist file already exists or that only the default data exists in the file.

Note: To eliminate all Image Remapping data, quit Mbox, then delete the MultiScreenData.plist file and relaunch Mbox.

Projected Mapping

The first two steps are to set up the additional universe of control (via Art-Net or to sACN), and to edit the base information in the configuration.

Step 1.   Click on the Image Remapping tab, then double-click on the "0" in the Universes area - the default universe 0 - and type in a new number (this tutorial uses universe 16) that is not one of the current control universes for the Mbox server. Press [return] to accept the change.

Step 2.   Next, if there is no configuration already in the configuration list, click on the Add button at the top right of the window and select Add Configuration from the menu. Don't change the Global Texture Position Scale setting.
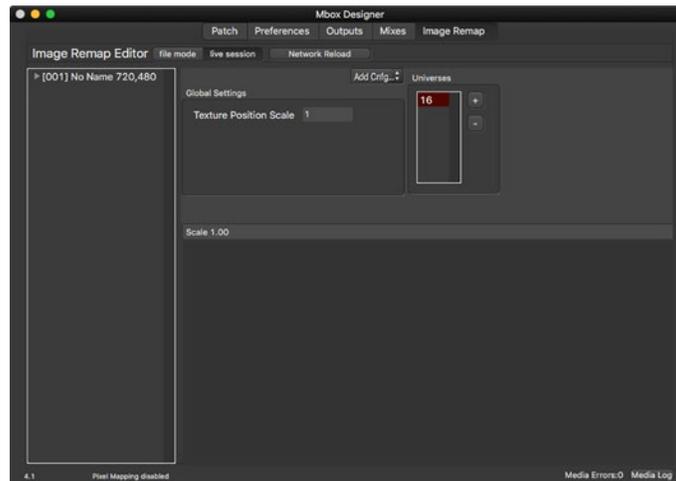
There should be one entry in the configuration list "[001] No Name {720, 480}"): this is the first configuration and has an index of 001. Mbox Designer allows up to 255 configurations (though this tutorial will only have two), with each having its own set of screen objects. Every configuration can be unique or can have the same screen objects but with different image remapping positioning, image scaling, or controls. All configurations get saved into the same MultiScreenData.plist file and a layer can use the Image Remap parameter to enable remapping for that layer and to select a configuration by index value (between 1 and 255).

Step 3.   Click on the configuration ([001]) in the list at the left of the window and notice that the window changes from showing the Global Scale setting to showing the configuration's settings: specifically Texture Width & Height and Display Width & Height. Edit those values to be 900 x 900 and 1920 x 1080 respectively, make sure to press [tab] or [return] after each entry. Give the configuration a new name, "Projected Mapping", as well.
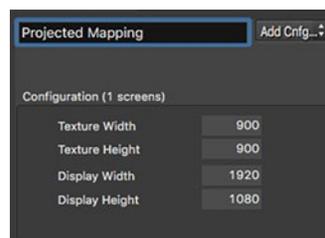
The texture width and height define the size of the content to be used with the configuration. This needs to be pre-set to provide the correct pixel-accurate positioning relationships between the content and the remapping.

Note: Pre-setting a configuration's texture size doesn't mean that content of a different size cannot be used, however its origin will be offset from the origin of the configuration. The layer's X and Y position parameters can be used to affect this, but that placement may not be pixel-accurate. Therefore in some cases it may be necessary to create more than one nearly identical configuration, with only a different texture width and/or height.

Because there is specific content for this tutorial, the texture width and height here are set to match: 900 x 900. The display width and height are analogous to the pixel size of the Global Surface in Mbox. Again, this needs to be pre-set to maintain a pixel-accurate relationship between the image remapping configuration data and the rendered output pixels.

CAUTION! When editing the image remapping configuration session, make sure that the Global Surface size in the Mbox application is the same as your display width and height or vice versa! In Mbox v4, these two items represent the same rendering area and if they are not the same size, the preview area in the Image Remapping user interface will not show the correct result.

Note: Pre-setting a configuration's display size doesn't mean that the configuration cannot be used on an output with a different size, however its origin will be offset from the origin of the output. However, unlike with the texture, it's not as easy to move the entire configuration on the output.

Step 4.   When editing the image remapping configuration in a live session, any edits made to the configuration will be saved automatically. Therefore, there's no need to save anything unless the application being used is in file mode.

Step 5.   With configuration [001] still selected, click on the Add button again and choose Add Screen from the list. There will be a small disclosure arrow visible to the left of the configuration's entry in the listbox. Click on this arrow to expand it. The configuration now has one screen (Screen index [0]). When the screen is selected, its properties will be visible on the right side of the window.
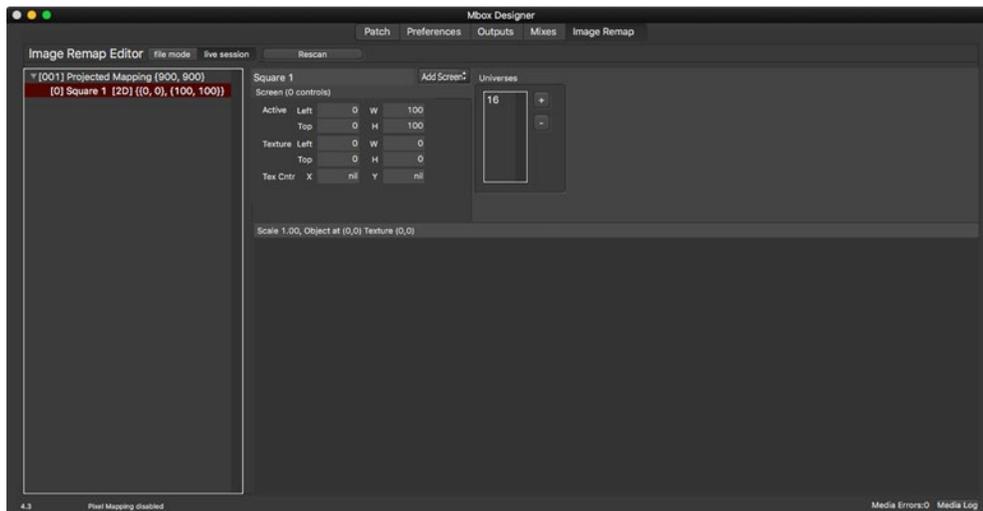
Step 6.   With the first screen selected, take a look at the application's preview area. Before any screen objects were added, it was blank, with only a dark gray background. Press [⌘⇧0] to automatically scale the preview to fit the preview area. The view should now show a light green square at the top-left of a dark gray rectangle in the preview area. Pressing [⌘-] on the keyboard will reduce the scale of the view in the preview area, whereas pressing [⌘+] scales it up. Clicking and dragging will pan the view.

Note: The text field at the top of the Preview area shows the current scale of the view and information about the selected screen object.

Step 7.   Adjust the scale and center the background within the view, resizing the entire Mbox or Mbox Remote window as required. The selected screen object appears as a light green square at the top-left of the background, with its top-left corner (its origin) indicated by a red diamond. If the view is scaled up and then panned, it's easier to see that the screen object is represented as a piece of graph paper, with overlaid grid lines and X/Y coordinates. These coordinates refer to the coordinates of the texture that will be applied to the screen object and not to the screen object itself or the entire configuration.
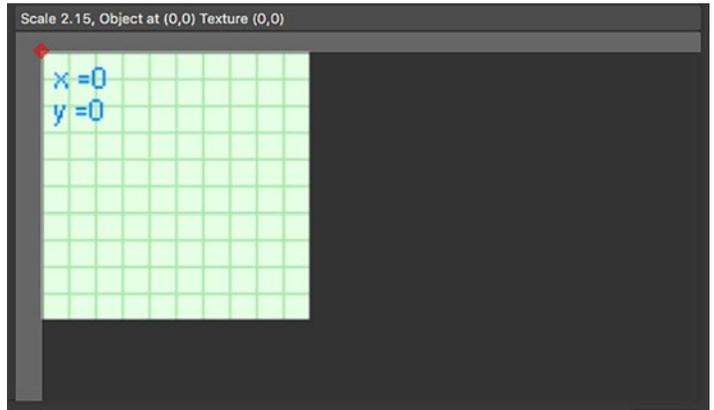
Note: The graph paper background can be useful in some cases, particularly when there is no reference image to work from. Often when talking about projection or LED configurations, this reference image may be called a "Pixel Map," which should not be confused with the concept of Pixel Mapping from Mbox. It's totally different as in this case the document describes how/where pixels in the content will be mapped on outputs, whereas Pixel Mapping is the process of turning screen pixel color into control data to be output to external lighting fixtures.

Step 8.   To make it easier to match the configuration and its screen objects to the desired end result, a background image (a "pixel map") can be loaded as a replacement for the graph paper. To load a background image, click on the Image Remap menu, select "Open" and choose a JPEG or PNG image. To be a useful reference, the image must be pixel-accurate. To begin with, it may not show much, but as the screen objects are configured it will show the correct imagery.

Note: All origins are based on the top-left corner of the Mbox output, the MultiScreen object, or the screen object; with that origin having coordinates of 0,0).
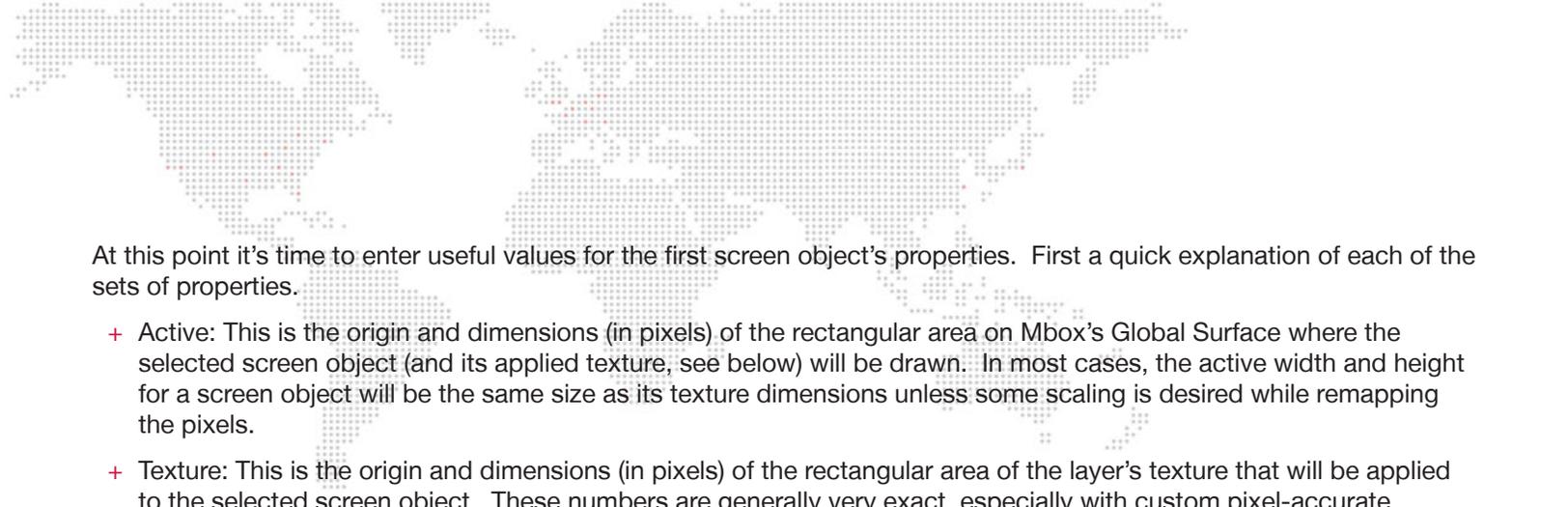
At this point it's time to enter useful values for the first screen object's properties. First a quick explanation of each of the sets of properties.

+ Active: This is the origin and dimensions (in pixels) of the rectangular area on Mbox's Global Surface where the selected screen object (and its applied texture, see below) will be drawn. In most cases, the active width and height for a screen object will be the same size as its texture dimensions unless some scaling is desired while remapping the pixels.

+ Texture: This is the origin and dimensions (in pixels) of the rectangular area of the layer's texture that will be applied to the selected screen object. These numbers are generally very exact, especially with custom pixel-accurate content made specifically for LED screens.

CAUTION! To ensure that content is centered on image remapping configurations, all texture origin values are evaluated taking the current configuration's texture width and height into account. This means that if the configuration's texture width and height are set to a size that isn't the same as the content's size, the top-left corner of the content won't appear at the top-left of the configuration, it will be offset.

Using this tutorial as an example: with a texture that is exactly 900 x 900, this texture's top-left corner (its 0,0 origin) would be placed onto the top-left corner of the screen object by using a Texture origin of 0,0 as well. But if a texture having a size of 720 x 480 is used instead, the screen object's texture left and top values must be set to 90 and 210 respectively to get the origin of the smaller content into the top-left of the screen object. This is because all textures are placed so that their center is placed at the center of the configuration's area. Therefore, smaller content has to be offset to the left and upwards to get its top-left corner into the top-left corner of the screen object.

The math:

+ Left = (configuration width - content width)/2 -> (900 - 720)/2 = 90

+ Top = (configuration height - content height)/2 -> (900 - 480)/2 = 210

Note: If the content is larger than the configuration's texture size, then the offset values will be negative.

Step 9.   This configuration will require nine square screen objects. The following are the guidelines for their creation:

a. For the active origin of the first screen object, think about where it should to appear onscreen. Where it should appear onscreen may be totally arbitrary, or may be driven by the device that the video output is being sent to - an LED processor perhaps. The processor's mapping may dictate where the image should appear onscreen in order to be mapped correctly on the LED wall. For this example make the active origin (Left, Top) of the first screen object 100,100. This individual screen object is 300 pixels on each side and there is no scaling required, so the active width and height of the square will also be 300 and 300.

b. The texture origin of this screen object should be 0,0. This is because the top-left square of the source texture should be applied to the top-left of the screen object. The texture width and height will be 300 x 300, to match the portion (1/9th) of the larger red square that makes up the entire image.

Note: The ability to copy and paste items when editing image remapping configurations makes it quick to create new configurations, screen objects, or controls once the measurements and the properties of the first object have been entered. To copy an item, first click on it to select it, then press [⌘ C] to copy the item. Then, click on an item of the same type that you want to paste the copied item after. Press [⌘ V] to paste the item.

The chart below shows the active and texture origins and dimensions for all nine screen objects in this first configuration. Don't add the other eight screen objects yet, as it is faster to add the necessary controls to the first screen object and then use the copy/paste functionality to quickly make the other eight screen objects. And then the values in the chart can be applied to the respective screen objects.

	Square 1	Square 2	Square 3	Square 4	Square 5	Square 6	Square 7	Square8	Square9
Active Left	100	400	700	100	400	700	100	400	700
Active Top	100	100	100	400	400	400	700	700	700
Active Width	300	300	300	300	300	300	300	300	300
Active Height	300	300	300	300	300	300	300	300	300
Texture Left	0	300	600	0	300	600	0	300	600
Texture Top	0	0	0	300	300	300	600	600	600
Texture Width	300	300	300	300	300	300	300	300	300
Texture Height	300	300	300	300	300	300	300	300	300

Step 10.   Before adding the other eight screen objects, controls need to be added to the first screen object. Remember that Opacity, X Position, and Y Position controls will be needed for each screen object. With the Square 1 screen object selected, click once again on the Add button. This time select "Add Control" from the menu. As when the screen object was added, a disclosure arrow will appear in the configuration list, to the left of the screen object. Click on it to expand it.

Step 11.   There is now one control attached to the screen object, give it the name "Opacity." Each control has properties that can be edited:

a. **Universe**: If the control will use external control data (Art-Net or sACN), this is the universe that it will listen to. The options in the list are populated from the pool of universes provided by entries in the universe area listbox at the bottom main window. The Universe pop-up shows a number in parentheses to the left of the absolute universe number. The number in parentheses is the zero-based index number of that universe within the entire group of universes entered in the universe area.

CAUTION! If any universe number is edited in the universes area those edits will not be automatically updated to the universe value for controls that have already been configured to use that universe. The new universe value must be reselected for each of those controls.

b. **Address**: The address of the first channel within the selected universe that the control will listen to for its data. Values between 1 and 512 are valid.

c. **Stride**: This number will typically be equal to the total number of control channels that this screen object uses for all of its controls, not just this one. The stride setting simplifies the use of an image remapping configuration on more than one layers at the same time. The intention is to eliminate extra time spent patching or creating multiple configurations, one for each layer, with different addressing. The stride setting tells the screen object how many channels to automatically skip when it is used on multiple layers, so it can use the correct address offset for each layer.

Note: In the case of controls where each layer may not need a different/unique value (e.g., positional data) the Stride value should remain at 0. For controls like opacity that might need a unique value for each screen object for each layer, the stride setting becomes very useful.

Step 12. Because some controls need to have a per-layer value and some do not, this leaves several options on how to patch everything. Every control could have a unique address for control on every layer. But this would require the use of more control channels and might require the source of control to have to send the same values on more than one channel at the same time. One alternative is to use the stride setting (where applicable), and to use the same address for controls that need to receive the same data. This cuts down on repeated data, but leaves empty channels in the patch. The other alternative is to patch all unique control channels sequentially (at the beginning of the universe) before any controls that require a stride setting, and then patch the per-layer controls using a stride setting.

   a. **Data Format Pop-up:** Sets the range and default value of incoming control data. As with typical fixtures, 8-bit data uses one channel (0 - 255), 16-bit uses two (0 - 65535). 32-bit signed data uses four (-2,147,483,648 - 2,147,483,648) for extra accuracy with moving scenery.

      1) In the case of the 8-bit controls, "unsigned" relates to a control with a range of 0-255 and a default that is one end of that range (usually 0). "128" relates to a control with a range of 0-255 and a default of 128, and which varies above and below the default. "127" is like "128" but with a default of 127.

      2) In the case of the 16-bit controls, "unsigned" is as with the 8-bit version noted above, but with a range of 0-65535. "Offset" relates to a control like the 128/127 varieties of the 8-bit controls, with a default at halfway: 32767.

      3) And finally, the 32-bit signed control has a very large range that is both negative and positive. 32-bit signed controls are generally reserved for positional feedback from very accurate scenic encoders. The large range allows the control to be extremely accurate, receiving actual encoder counts in many cases.

   b. **Control Type Pop-up:** The parameter of the screen that is to be controlled is selected here - position, texture position, rotation, etc. Refer to "Screen Object Control Types" on page 143 for more details on the control types.

   c. **Scale/Counts Pop-up:** Switches between the two methods of scaling incoming control data when it is applied it to a control.

      1) For example, if Mbox is receiving a 16-bit offset value for the X Position parameter, but only ever needs to move a screen object 100 pixels left or right, then it may make sense relate the full range of 0-65535 (65536 steps) to a range of 100px to the left to 100px to the right (-100 to +100). Since the total range of movement is 200 pixels, the Scale value would end up being 200/65536 = 0.00305176.

      2) As an alternative to scale, counts (typically used for linear position controls) equate to the number of control data steps (i.e. counts) that should be received by Mbox in order to cause one pixel of total travel. With the above example, since 65536 steps of data will move the screen object 200 pixels, the Counts value ends up being 65536/200 = 327.68

      3) The two methods are just the same information presented in a different ways, one is the reciprocal of the other: 200px/65535counts = 0.00305176 (scale = pixels per count) and 65535counts/200pixel = 327.68 (counts = counts per pixel). 1/0.00305176 = 327.68.

Note: The sign (+ or -) of the scale/counts value is used to invert the parameter's direction of adjustment relative to the incoming data. Be aware that if the sign on the scale/counts value is switched, the min and max values may need to be checked to ensure that the desired movement is possible.

d. **Min and Max:** These values can be used to limit the travel of a linear control used for scenic tracking to a specific number of pixels; so as to keep the screen object or its applied texture from moving too far when incoming tracking data values exceed the expected limits. Min and max value may not be necessary with controls that don't deal with movement or rotation (e.g. opacity or color), as the scale/counts value for these controls tend to be automatically limited. If <u>both</u> min and max are set to 0, then no limit is applied.

CAUTION! When either of the Min or Max values are edited, <u>both</u> are active! This means that if a max value of 720 is set, but the min value is left at 0, the control can only move in one direction (positive). This could cause issues if the sign on the scale/counts control is made negative, as the movement can't be negative with a min value of 0.

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e. **Offset:** The Offset value is used to set a value for a control that does not respond to external data. Offset is typically used with the Repeat controls, but can be used to move or rotate a screen object by a fixed amount. When using an offset value the Scale value should be set to zero (0).

f. **Tex Cntr:** The Tex Cntr value adjust the point around which the texture will rotate if the Texture Rotate control is added to the screen object. By default this is the coordinate on the texture that matches the center of the screen object. These values are typically left at their default = "nil."

Step 13.   The opacity control that was added in Step 11 now needs to be configured to respond to some control data and also to have the appropriate scale. First of all, click on the universe pop-up and make sure that "(0) Universe 16" is selected. Leave the address value set to 1.

Step 14.   Choose "8-bit unsigned" for the data format, and "Opacity" for the control type. To figure out the stride value some math is required. Assuming per screen object uses three channels (opacity, X position, and Y position), and nine screen objects, 3 x 9 = 27. Therefore the stride value should be 27. Finally for the scale of the opacity parameter, there's a bit more math. An 8-bit control has a range of 0-255 (256 steps), and the opacity parameter has a range of 0.0-1.0 so divide 1 by 256 = 0.00390625. No offset, min, or max values
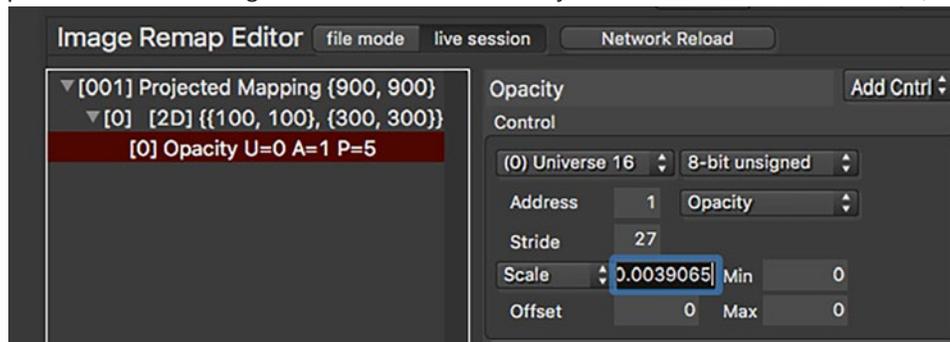
are needed.

Step 15.   After adding the opacity control the X and Y position controls can be added. Here's where using copy and paste can speed things up. Make sure that the opacity control is highlighted in the configuration list, then press [⌘C] and then [⌘V], and a copy of the opacity control will be created. Rename it "tX position."

a. For the Texture X position control, the universe is the same, the address should be changed to 2, the data type is "8-bit 127", and stride is still 27. Two complex decisions remain though. Should the control type be Texture X Pos or just X Position? And what should the control's scale value be?

b. For this particular screen object in this configuration (using projected mapping), select "Texture X Pos" as the control type because the intention is to move the texture around on the screen object, not to move the screen object on Mbox's screen. Imagine an LED screen moving left and right on-stage. Projected mapping doesn't need to move the corresponding screen object onscreen. If the screen object were to

move onscreen (on Mbox's output), it would move away from the area that the LED processor is mapping to that particular LED screen. To keep projected mapping correct only the texture needs to move, but in the opposite direction to the screen's apparent movement.

Note: Why would the screen object actually move? If this configuration were for a system with an actual projector instead of LED's, then the screen object might need to move as an actual piece of scenery is moved, so the image stays on the object.

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      c. For the control's scale value, the goal is to be able to move the texture on the screen object so any part of the 900px x 900px texture can be seen. Since the screen object is 300 x 300, this means that the texture only needs to move a maximum of 600 pixels in either direction (min and max values could be used eventually, but not now). With an "8-bit 127" data format, its range being 127 counts in either direction, the calculation is: divide 600 pixels by 127 counts to get a scale of 4.72440945.

Regarding the accuracy of scale values. The more accurate the resulting values scale/counts calculations are, and the more decimal places used when entering those values, the more accurate the screen object's responses to input will be. For linear movements, use at least 4 digits after the decimal point.

(Tip) Step 16.   Copy and paste the X Position control that was just created, and rename it "tY Position." Change the new control's address to 3, and set the control type to "Texture Y Pos".

Once there is one screen object created in the editor, it's a good idea to test the configuration in Mbox to make sure the correct sign (i.e. direction) has been applied to the scale value for the texture X and Y position properties. In most cases, particularly with console control (i.e., no scenic encoders), once the direction (and therefore the sign for the scale property) of one screen object has been determined, the same signing convention can be applied to all following screen objects.

(Tip) Step 17.   Leave the texture X position's scale as positive, but make the texture Y position's scale negative. To do this, put the cursor before the value, and type a [-] on the keyboard, then hit [tab] to accept the change.

There is a Control Test Value slider on the main window that changes scale based on the selected control's data format, and allows for testing of linear controls (e.g., position, opacity) within the editor. When looking at the
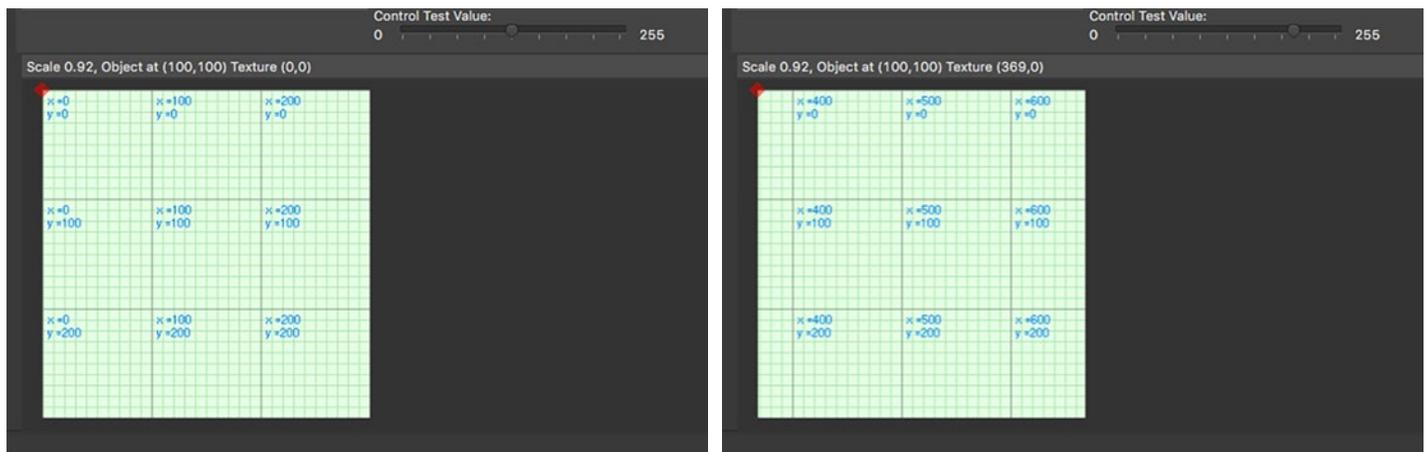
preview area, the text field at the top will show both the screen object's location and its texture location. As the slider is moved, check to see that these values change and also check to see if the direction of movement is correct.

Step 18.   With the first screen object setup correctly, go ahead and add eight more screen objects by copying and pasting the first screen object. Make sure to use the correct active and texture origins and width and height values from the chart on page 133, and also to substitute the correct address for each control. The result should be what is shown below:
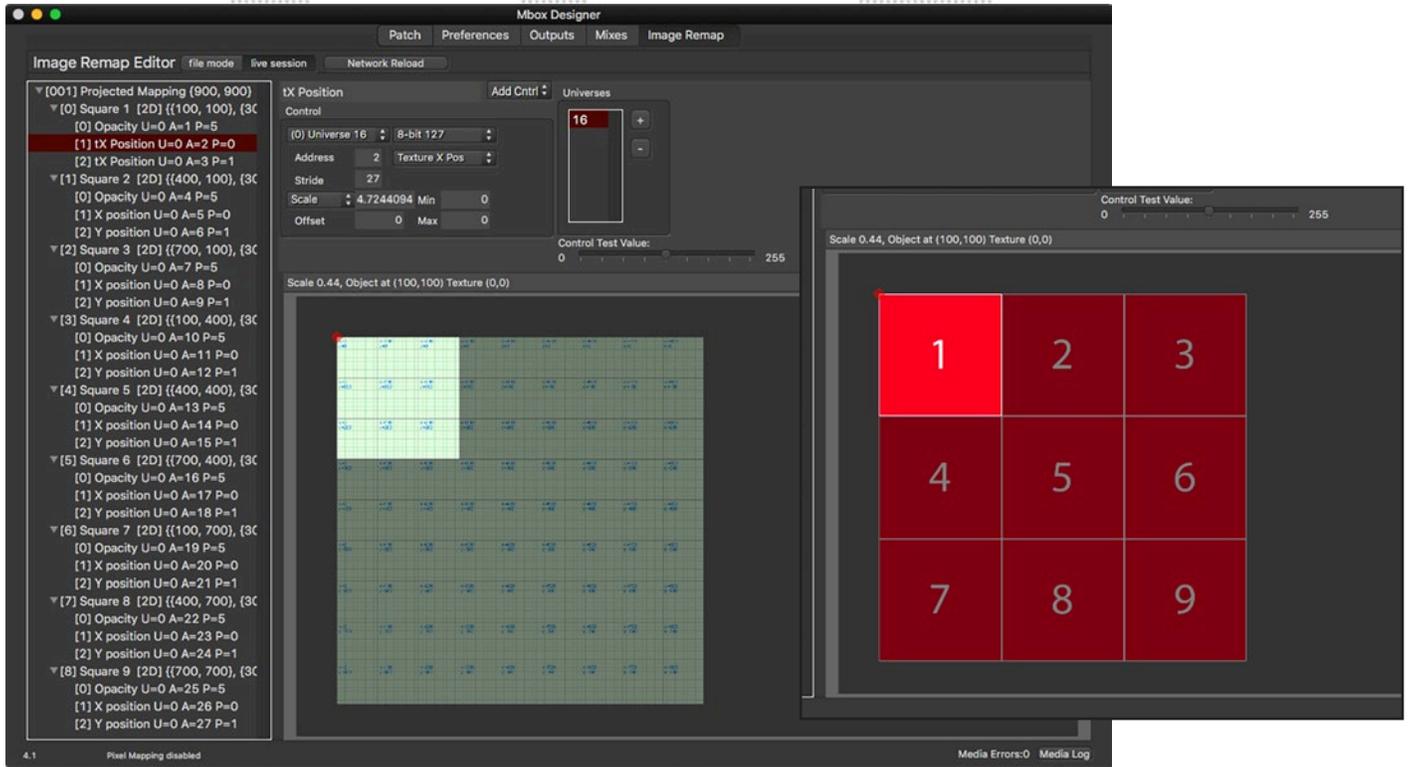
Step 19.   With the configuration done, it's time to test it in Mbox. On Layer 1 - bring up the opacity, select the sample PNG as the texture on the layer, set the Image Remap parameter to a value of 001, and also supply the correct default external control data (for the opacity and texture X & Y position parameters) on Universe 16. The result should be something like this:
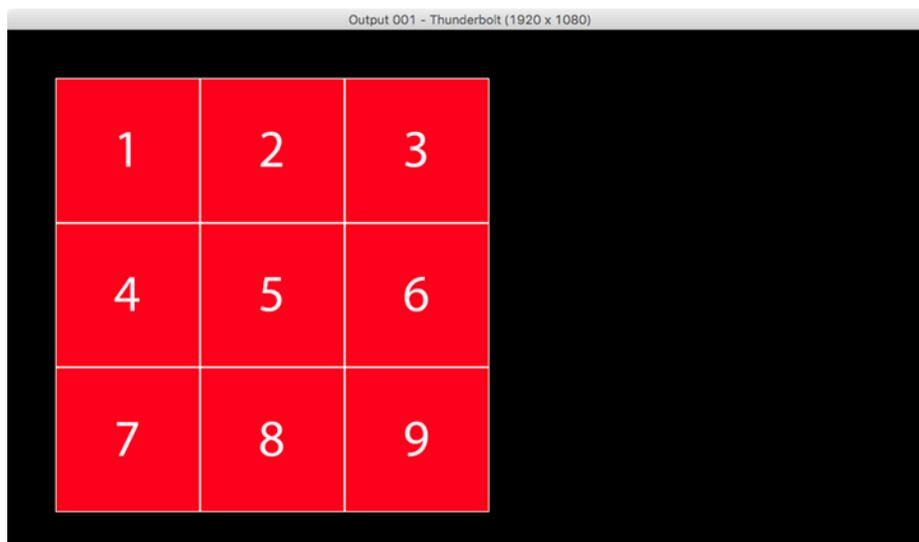
Note: Since the texture X & Y position controls default to 127, they will need to be set to that value to see the portion of the texture in the illustration to the left. With different values, the texture will move, and as it moves off the surface of a screen object, it becomes fully transparent.

Note: The Mbox output's size is set to 1920 x 1080 to match the image remapping configuration's Display Width and Height values.

Using the first 27 channels on control universe 16, the opacity and the visible portion of the texture on each of the nine squares can be adjusted. The same image remapping configuration can also be used on other layers. Keep in mind though, that due to the stride value on each control, subsequent layers will have an offset start address for their controls: 28 for Layer 2, 55 for Layer 3, 82 for Layer 4, and so on...
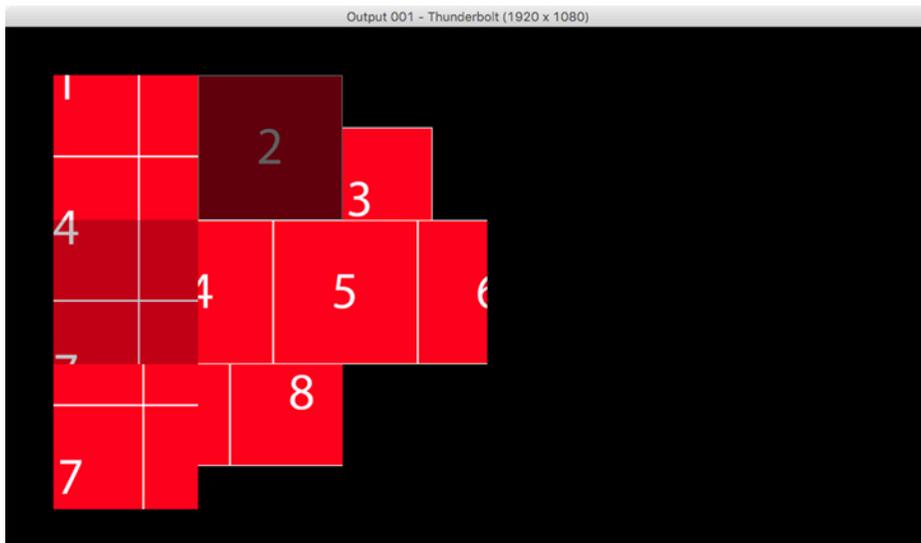
Through various changes to the opacity and texture X and Y values for each screen object it is possible to fade the screen objects in and out and to adjust which portion of the layer's texture appears on each of them:
Notice though that the texture on each screen object can't extend beyond the boundary of the screen object, no matter how much the texture X and Y parameters are changed. This is because the screen object is designed in such a way as to only show texture within those boundaries - to avoid the texture from "spilling" onto another screen object.

It is possible to overlap screen objects by giving them active top and left values (or active width and height values) that cause them to overlap on screen. But no matter what, the texture on a screen object can't extend outside the boundary of the screen object.
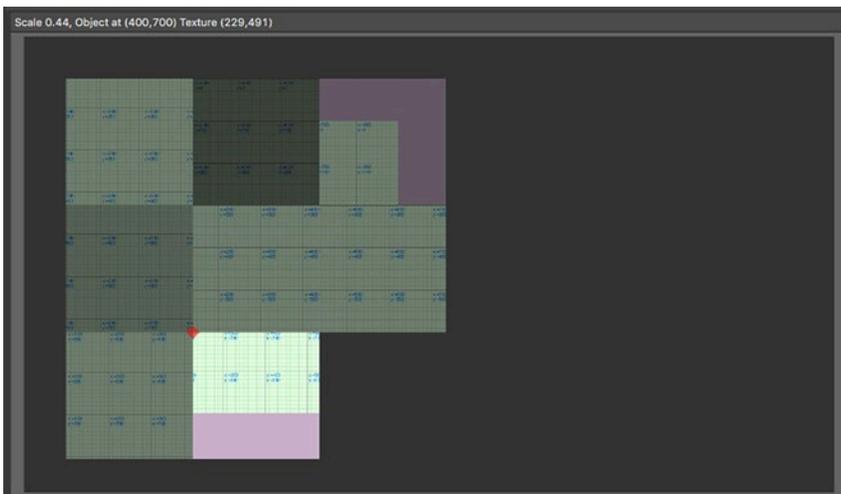
Note: In the image remapping preview area, the pink coloring is used to show a portion of the screen object that has no texture (i.e., where the screen object is fully transparent) due to the either the received control values or perhaps incorrect texture origin/width/height values for the screen object.
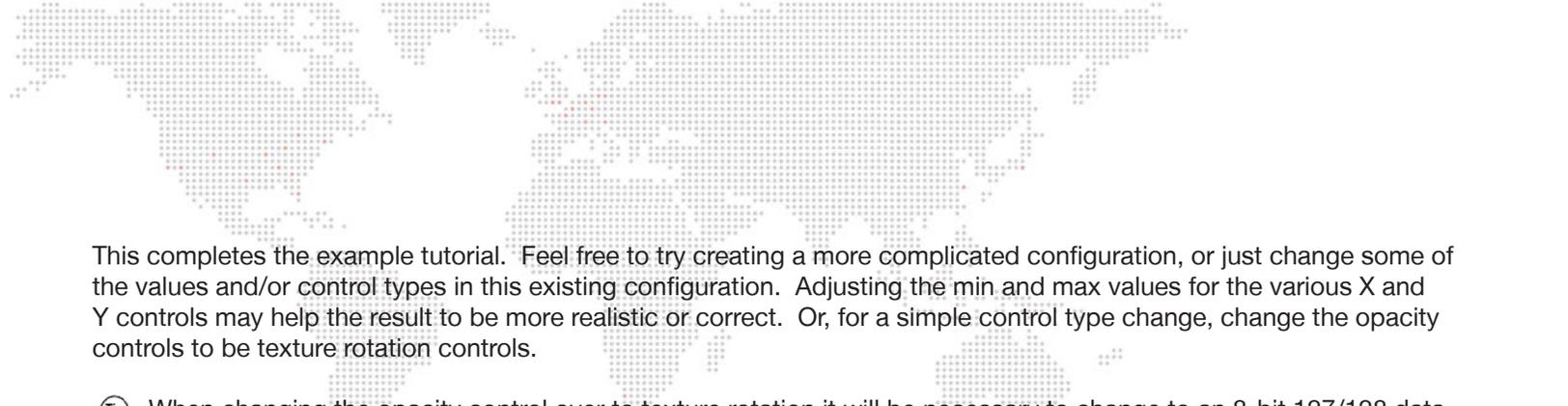
This completes the example tutorial. Feel free to try creating a more complicated configuration, or just change some of the values and/or control types in this existing configuration. Adjusting the min and max values for the various X and Y controls may help the result to be more realistic or correct. Or, for a simple control type change, change the opacity controls to be texture rotation controls.

> When changing the opacity control over to texture rotation it will be necessary to change to an 8-bit 127/128 data type (instead of the unsigned 8-bit data type) and also to adjust the scale value. Refer to "Screen Object Control Types" on page 143 for information on typical scale values for the various parameter types. Also, try modifying the Texture Cntr values for the screen object to modify what point the texture rotates around.

Discrete Mapping

It is very easy to take the existing Projected Mapping configuration (created in the "Projected Mapping Tutorial" on page 129) and make a second configuration that uses the same screen objects but with Discrete Mapping instead. Use the copy and paste functionality to make a copy of the configuration created in the tutorial. Then all that is required is to is remove some controls from each of the screen objects.

Copy and paste the first configuration, then rename it to be "Discrete Mapping" so it's easy to tell it apart from the first. Then, click on the disclosure arrows to the left of each screen object to expand and show the controls. With discrete mapping, the texture is going to stay pinned to the screen object no matter where it moves. So just delete all controls that deal with texture positioning - the tX Position and tY Position controls. If the controls were labeled as in the previous tutorial it will be easy to make the deletions. Select any control that starts with "tX" or "tY" and press the [delete] key. Be careful though, as there is no undo!

It might seem that the addressing for the control parameters should be changed for this second configuration, but most likely this is not the case. If the addressing is left alone, the nice thing is that the same external control channels still affect the same features in both configurations. Since it is possible to instantly switch from one configuration to another on-the-fly (using the Image Remap parameter on the layer) it's easy to use additional configurations at any time. Keeping the same patch for the controls means that control values don't have to be changed or repatched when switching configurations.

TRIANGLE-BASED SCREEN OBJECTS (3D VERTEX ARRAYS)

Overview

The following section covers Triangle Strips and Fans. Triangle Strips and Fans allow the creation of image remapping screen objects with more complex shapes, and also unlock some 3D functionality (e.g. X, Y, and Z rotation of the screen object). Use of triangle-based screen objects goes beyond typical rectangular screen objects for image remapping and can be confusing. If unsure about how to use these features, contact Mbox support for assistance.

CAUTION! Once a screen object has been converted to a triangle strip or fan, the change cannot be undone. To revert to a non triangle-based screen object, create a new screen object with the original properties of the object, then delete the triangle strip or fan version of the object.

Triangle Strips

In order to support non-rectangular shapes, standard screen objects may be converted to Triangle Strip screen objects. Standard rectangular screen objects are referenced by their origin and their width and height. Triangle strips are referenced by their vertices.

To convert a screen object to a triangle strip or fan, select the screen object in the listbox on the main window. Then click on the Add button at the top-left of the window and select "Convert to Strip" or "Convert to Fan" from the list.

Triangle strips are the simpler of the triangle-based screen objects. The standard rectangular screen object is converted to a screen object made from two triangles, placed side by side as in the right-hand illustration below. The conversion results in four vertices being created, one for each corner of the screen object. Active coordinates (X and Y) are created for each vertex, as are Texture coordinates (X and Y).

The two illustrations below show the coordinate data for the standard rectangular screen object and the triangle strip screen object:
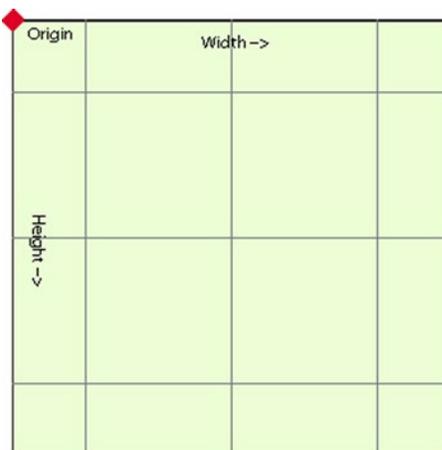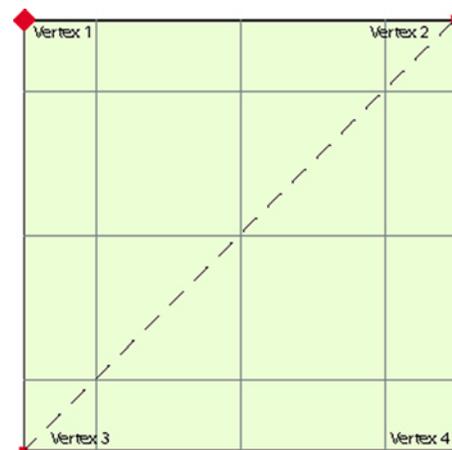
| Rectangular Screen Object | Equivalent Triangle Strip Screen Object |

The rectangular screen object on the left only requires one coordinate, the "top, left" coordinate that specifies its origin. The coordinates for the other three corners are implied by the width and height. The triangle strip object on the right has four vertices, one for each corner of the object. Each vertex has X and Y coordinates to locate it onscreen, and also a texture coordinate that locks that point in the texture to that vertex.

When a rectangular screen object is converted to a triangle strip, the screen object will have exactly four vertices. The data for each of the four vertices is shown in a table, replacing the Active and Texture data that was shown for the rectangular object. Additionally, the converted screen object adds a new property, the Position Center ("Pos Cntr") which has X and Y coordinates.

Standard Screen Object — Add Screen
Screen (0 controls)

Active	Left	100	W	300
	Top	100	H	300
Texture	Left	0	W	0
	Top	0	H	0
Tex Cntr	X	nil	Y	nil

Triangle Strip — Add Screen
Screen (0 controls)

X	Y	tX	tY
100	100	100	100
400	100	400	100
100	400	100	400
400	400	400	400

Pos Cntr X nil Y nil   [+] [-]
Tex Cntr X nil Y nil

The four vertices are not ordered in a circular fashion around the perimeter the rectangle, but are ordered such that each set of three consecutive vertices describes a closed triangle. In the right-hand illustration above, the first, second, and third vertices create the one triangle, and the second, third, and fourth vertices create the other triangle. By their nature, the triangles share vertices - two in this case.

Editing the X and Y coordinates of each vertex in the triangle strip, modifies the shape and size of the triangles. Editing the tX and tY coordinates adjusts the texture mapping to the vertices of the screen object. The texture coordinate specified will be "pinned" to that vertex and the texture is then stretched or squished as required to match the coordinates of the other vertices in the same triangle. Be careful when adjusting the tX and tY coordinates, as improper values will cause the texture to be distorted! Furthermore, the nature of the triangles means that the edges between triangles may become apparent if texture coordinate values are incorrect.

As with standard, rectangular screen objects, the Texture Center ("Tex Cntr") coordinates can be modified to adjust the rotational center of the texture on the screen object (when using the Tex Rotate control). Because triangle strips can have complex texture mapping, adjusting the texture center can be helpful, but if the texture mapping is irregular, rotating the texture can lead to undesirable visual results.

The Position Center coordinates are used to adjust the rotational center of the screen object itself, which is taken into account when the X/Y/Z Rotation controls are used. Position Center is not available with the standard, rectangular screen objects, and the object must be converted to a triangle strip or fan to take advantage of it. By default, all screen objects rotate around their first vertex. This is the top-left corner of a Triangle Strip object, and typically the center of a Triangle Fan object. Modifying the Position Center values allows that rotational center to be moved.

When the triangle strip (or fan) is created, the Position Center X and Y values will be noted as being "nil." This means that they are defaulted to the first vertex's coordinates (i.e. then object's top-left corner). Once either of these coordinates has been modified from the default "nil" values, those values can only be returned to nil by entering "nil" into one of the values in the pair. It is also possible to manually enter a value that is equivalent to the nil value (i.e. the coordinates of the correct vertex), such that the screen object rotates around the default point as mentioned above.

The + and - buttons at the bottom-right of the table can be used to add or delete vertices to the screen object. Additional vertices can be used to create shapes that are not four-sided. Each vertex that is added will cause a new triangle to be created using the new vertex and the two previous vertices.

Triangle Fans

Triangle Fan screen objects are similar to triangle strip objects in that they can create a more complex shape by creating vertices from the original screen object, and then combining triangles to make the final result. But with triangle fans the ordering of the vertices is different and every triangle shares the first vertex in the list. In other words, the origin is used as one point in <u>every</u> triangle. The same screen object from the previous illustrations above becomes more complex when converted into a triangle fan, requiring six vertices. Instead of being only two triangles, the object is now four triangles. Each triangle is made up of the first vertex and two other adjacent vertices.
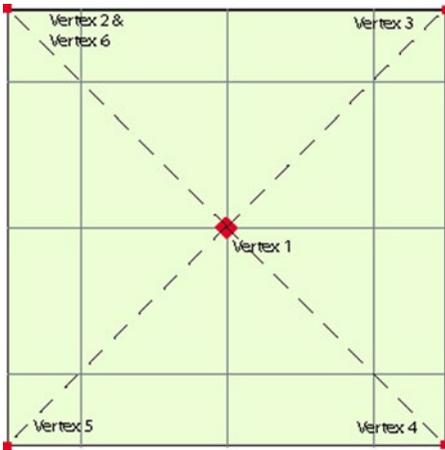
Triangle Fan

Screen (0 controls)

X	Y	tX	tY
250	250	250	250
100	100	100	100
400	100	400	100
400	400	400	400
100	400	100	400
100	100	100	100

Pos Cntr X nil Y nil

Tex Cntr X nil Y nil

+ Triangle 1 is built from the 1st, 2nd, and 3rd vertices.

+ Triangle 2 is built from the 1st, 3rd, and 4th vertices.

+ Triangle 3 is built from the 1st, 4th, and 5th vertices.

+ Triangle 4 is built from the 1st, 5th, and 6th vertices.

In this manner it is possible to make an object with radial symmetry, and if enough vertices/triangles are added, a smooth curve, arc, or circle.

Triangle Fan

Screen (0 controls)

X	Y	tX	tY
300	250	150	150
100	100	0	0
300	50	300	0
500	100	300	300
500	400	0	300
300	450	0	0
100	400	0	300
100	100	0	0

Pos Cntr X nil Y nil

Tex Cntr X nil Y nil

Scale 0.80, Object at (300,250) Texture (150,150)
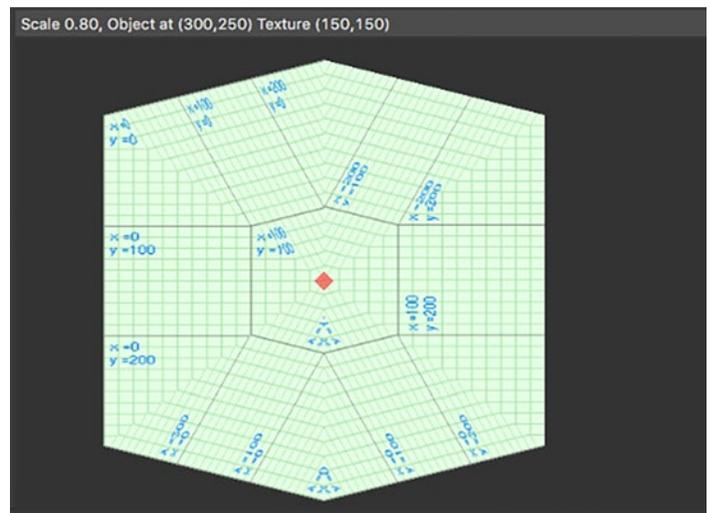
IMAGE REMAPPING GLOSSARY

Screen Object Control Types (Units, Typical Scale Value)

Control Parameter	Description	Units	Typical Scale Value
Texture X Position	Left/Right position of the texture on screen object	Pixels	Varies
Texture Y Position	Up/Down position of the texture on screen object	Pixels	Varies
X Position	Left/Right position of the screen object	Pixels	Varies
Y Position	Up/Down position of the screen object	Pixels	Varies
Dimmer	Brightness (fade to black, not transparent) of texture on screen object	0 - 1.0	0.00390625
Opacity	Transparency (fade to transparent) of texture on screen object	0 - 1.0	0.00390625
Tex Rot 90	Texture rotation in 90° increments. This is a sticky control[1]	90° Steps	1
Tex Flip	Texture flips in 4 steps - normal, reverse, upside-down, reverse and upside-down	Steps	1
Enable	Enable/Disable rendering of screen object - make it visible/invisible	Enable/Disable	1
Abort	Enable/Disable rendering of all screen objects after current object. This is a sticky control[1]	Enable/Disable	1
Texture Gain	Multiplier for texture position on screen object. Allows texture position controls to be scaled on demand for either greater accuracy or increased range	%	Varies
Position Gain	Multiplier for position of screen object. Allows position controls to be scaled on-demand for either greater accuracy or increased range	%	Varies
Tex Rotate	Texture rotation in an arbitrary fashion	0 - 1.0	0.00390625
X Rotate	Rotates Triangle Strip or Fan screens about their X axis, with the screen's origin being the origin of rotation[2]	0 - 1.0	0.00390625
Y Rotate	Rotates Triangle Strip or Fan screens about their Y axis, with the screen's origin being the origin of rotation[2]	0 - 1.0	0.00390625
Z Rotate	Rotates Triangle Strip or Fan screens about their Z axis, with the screen's origin being the origin of rotation[2]	0 - 1.0	0.00390625
Repeat Count	Sets number of automatic repeats of current screen object, typically used with a fixed offset value only, not live control	# of repeats	0 - use offset value
Repeat X Dist	Sets X position offset distance of each repeat of a repeated screen object, typically used with a fixed offset value only, not live control	Pixels	0 - use offset value
Repeat Y Dist	Sets Y position offset distance of each repeat of a repeated screen object, typically used with a fixed offset value only, not live control	Pixels	0 - use offset value
Repeat tX Dist	Sets texture X offset distance for texture on each repeat of a repeated screen object, typically used with a fixed offset value only, not live control	Pixels	0 - use offset value
Repeat tY Dist	Sets texture Y offset distance for texture on each repeat of a repeated screen object, typically used with a fixed offset value only, not live control	Pixels	0 - use offset value
Repeat X/tX	Sets both X position and texture X position distances for each repeat of a repeated screen object, typically used with a fixed offset value only, not live control	Pixels	0 - use offset value

Screen Object Control Types continued...

Control Parameter	Description	Units	Typical Scale Value
Repeat Y/tY	Sets both Y position and texture Y position distances for each repeat of a repeated screen object, typically used with a fixed offset value only, not live control	Pixels	0 - use offset value
Opacity (Global)	Transparency (fade to transparent) of texture on all screen objects	0 - 1.0	0.00390625
Origin X	Moves the origin X from the default origin (top left corner) of a screen object. This is a sticky control[1]	Pixels	0 - use offset value
Origin Y	Moves the origin Y from the default origin (top left corner) of a screen object. This is a sticky control[1]	Pixels	0 - use offset value
Expand	Used to proportionally scale up a screen object. If the screen object is not square, the aspect ratio of the texture will be affected!	Pixels	0 - use offset value
Red	Controls Red subtractive color mixing on the screen object	0 - 1.0	0.00390625
Green	Controls Green subtractive color mixing on the screen object	0 - 1.0	0.00390625
Blue	Controls Blue subtractive color mixing on the screen object	0 - 1.0	0.00390625
RGB	Controls RGB subtractive color mixing (combination of Red, Green, and Blue as above)	0 - 1.0	0.00390625
RGBW	Controls RGBW color mixing (combined) in a manner similar to RGBW lighting fixtures (e.g. white is required to get any output)	0 - 1.0	0.00390625

Note 1: Sticky controls affect the current screen object and <u>all</u> following screen objects until another sticky control of the <u>same</u> type is used on a following screen object.

Note 2: The X/Y/Z rotations only work if screen objects are converted to 3D vertex screen objects - either Triangle Strips or Triangle Fans.

6.

VIDEO INPUT

This chapter provides instructions for the Mbox video inputs.

+ **EXTERNAL VIDEO SIGNAL INPUT**
+ **SYPHON VIDEO INPUT**
+ **NDI® INPUT**

EXTERNAL VIDEO SIGNAL INPUT

Overview

Mbox supports three types of external video inputs: PCIe cards, Blackmagic UltraStudio Thunderbolt devices, and other video capture devices - typically USB or Firewire devices. For best performance (i.e. lowest latency and best image quality), Mbox has native support for Blackmagic (Decklink and UltraStudio) and Active Silicon Phoenix devices. Other PCIe cards that support AVfoundation capture formats may work, but not as well as Blackmagic or Active Silicon devices. USB/FireWire devices must output a AVFoundation compatible format and will usually have greater latency and lower quality than PCIe or Thunderbolt devices.

Mbox Designer allows up to eight video inputs per server. The actual number of inputs will depend on the video input device(s) used. Each of the eight inputs must be set up in advance to work properly with Mbox; setting the input type, input number, and video format.

Mbox rental servers come equipped with a Decklink Quad capture card installed in the Mac computer. In both cases the inputs to the card are connected to the input connectors on the rack. The Decklink Quad capture card supports four SDI (1.5G SD/HD) inputs.

CAUTION! Before using Mbox with any capture device, make sure an OS-compatible version of that device's drivers have been installed.

Blackmagic UltraStudio devices and Decklink/Active Silicon Phoenix PCIe Capture Cards

The Mbox software has been optimized to provide the best possible video input (high quality, smooth framerate, low latency) with Blackmagic UltraStudio devices and Blackmagic Decklink or Active Silicon Phoenix PCIe cards.

WARNING! Mbox only supports Active Silicon Phoenix cards but not LFG cards. Active Silicon cards do not work in newer versions of the macOS - Catalina 10.15 and beyond!

To set up Blackmagic devices in Mac Preferences:

Before use with Mbox, some Blackmagic devices may need to be configured to receive the correct video signal type (SDI, component, or composite and so on) using the Blackmagic preference pane in the Mac System Preferences. Whether this is the case or not depends on the device, as some can receive multiple video signal types.

Note: Active Silicon cards do not require any configuration in System Preferences.

Step 1. Quit the Mbox application, if running.

Step 2. On the Apple menu, select System Preferences.

Step 3. On the System Preferences window, click on the Blackmagic Desktop Video button. This will launch the Blackmagic Desktop Video Utility in a separate window.
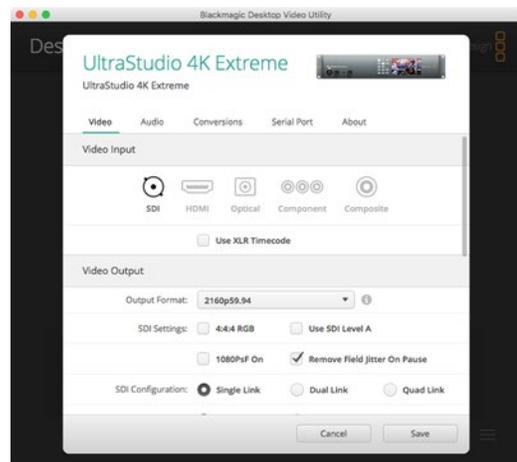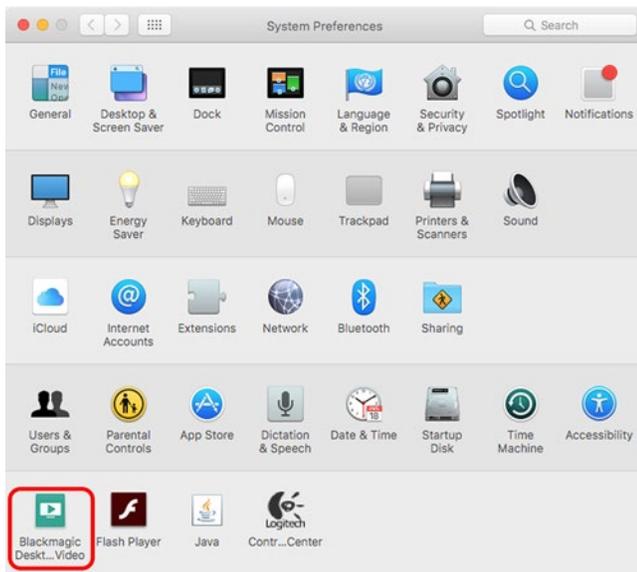
Step 4. On the Blackmagic Desktop Video Utility window, click on configuration button to open the pane where the input type can be selected.

Step 5. After making changes, press the save button on the configuration pane and then close the Blackmagic Desktop Video window and relaunch the Mbox application.

Note: The audio inputs on Blackmagic devices only receive/capture audio when the unit is actively capturing video (i.e. only when Mbox is displaying that video input on a layer) and therefore the audio inputs cannot be used as a timecode audio input to the Mbox application.

To configure Mbox video inputs for Blackmagic or Phoenix devices:

Step 1.   Go to the Preferences tab in Mbox or Mbox Remote. In the Video Inputs section, find the input (1 - 8) to be configured. Click on the disclosure arrow to the right of the input's name to reveal the configuration pane.

Step 2.   Set the input type pop-up to "Blackmagic" or "Phoenix". Click on the input number pop-up to assign the physical input on the device to the input that is being configured. It is always best to assign inputs in sequential order, but it is possible to assign them non-sequentially. Click on the input format pop-up and select the format for the input, and finally click on the color space pop-up and select YUV or RGB as required.
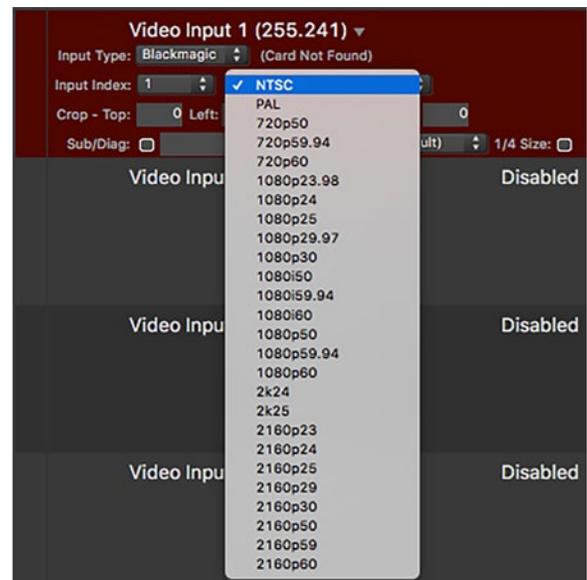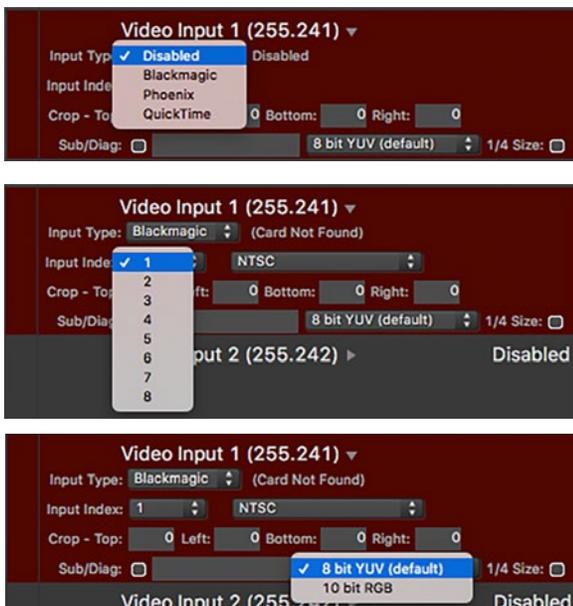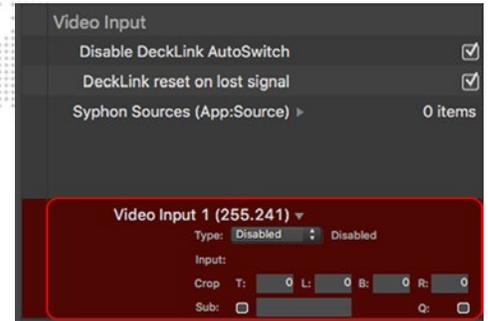
CAUTION! The choices on the input format and color space pop-ups may include formats that do not work with the connected capture hardware. Check the documentation for the capture device to determine what formats it can receive. Do not select a format or colorspace that the hardware does not support!
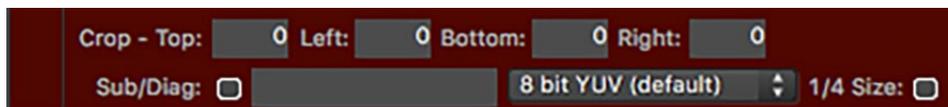
Step 3.   The textfields labeled Crop - Top, Bottom, Right, and Left can be used to apply a crop (in pixels) to the incoming video signal. The resulting image will be re-centered.

Step 4.   Checking the "Sub/Diag" checkbox will cause a substitute/diagnostic image to be displayed if the video input is requested on a layer but there is no signal or the input device is not found. The default image is a blue rectangle displaying the input type, number, and format. The default image can be replaced with a custom still image by typing the Folder.File index (e.g. 004.001) or the full path for the file (e.g. /Users/username/Documents/Raster.jpg) into the textfield next to the checkbox.

Step 5.   Checking the "1/4 Size" checkbox will reduce the incoming video to one quarter its native size. This can be useful to reduce processing overhead, but will result in a smaller image.

Step 6.   Once everything is set up correctly, the input should show a √ prefix and start working immediately.

Notes regarding Blackmagic devices:

+ Each input shows status text with a √ or ? prefix, plus the current format's resolution and abbreviation (e.g. 'Hp60')

  - The √ or ? prefixes indicate either good or bad input respectively. "Bad" in this case meaning no input, incorrect format, incorrect colorspace, or unsupported format.

  - If the Mbox application is launched and no layer has used the video input, the status text will be followed by the note "asleep: no layers using." This note will go away when any layer uses the input for the first time.

  - The status text may be colored yellow to indicate a warning or error condition, and will have a description of the warning or error (e.g. "Mode not supported!")

+ Manual selection of the correct input format (and colorspace) is the recommended method of operation.

+ The format list shown on the input format pop-up is a static list of all possible input formats for Blackmagic devices. Therefore this list may include formats that are not supported by the current hardware.

+ If an unsupported input format is manually selected, the input's status text will be colored yellow and include the warning "Mbox not supported!" In such cases, a supported format should be selected.

+ Once an input format has been manually selected it will be remembered whenever the Mbox application is quit and relaunched.

+ Many Blackmagic capture devices (both UltraStudio and Decklink) support autoswitching for the input format. While this autoswitching functionality works some of the time, it can be unreliable at times.

  - Mbox has a "Disable Decklink AutoSwitch" preference that is enabled by default. This serves to disable the autoswitching.

  - It is recommended to leave the autoswitching disabled and to manually select the input format whenever possible.

+ When autoswitching is enabled, the input format pop-up will continue to show the manually selected format (with a warning icon if that format is not supported), but the input status will show the current input format (if supported) and a message that the selection is "Temporary, not saved".

  - If the Mbox application is quit and relaunched, the format selected on the pop-up will be reselected. But if the autoswitching is enabled and a supported format received, the device will switch.

  - The "Temporary, not saved" message is a prompt that the current (autoswitched) format can be manually selected by clicking on the input format pop-up. Clicking on the pop-up will reveal the current selection (with warning icon) and the autoswitched format with a three-asterisk (***) prefix and the notation "AutoSwitched, must select to save permanently."

  - If the autoswitched format is selected, that manual selection will continue to be used and then will be saved when the Mbox application quits.
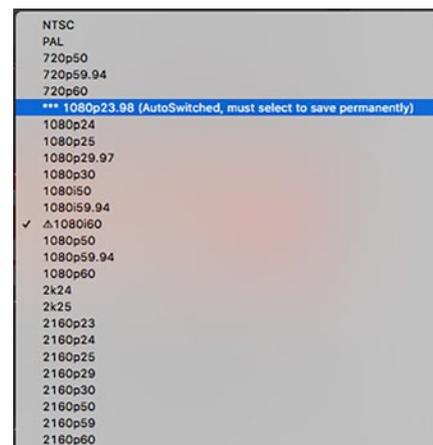
Alternative Cropping for Video Inputs

The cropping for video inputs mentioned on the previous page is intended to be used for small amounts of cropping, to clean up the edges of a video input signal. If there is a need to crop out larger parts of the input, then there is an alternate method of cropping.

The MediaInfo.plist file (Refer to "MediaInfo.plist" on page 43) has a metadata entry that causes a crop to be made on a media file. The media file could be a video input, a movie, or a still image. The key is "activerect" and the value (a string) entered is the X/Y origin for the top-left corner of the resulting image and then the width and the height of the result. A value of "0,0,500,650" would indicate that the resulting image starts at the top-left corner of the original image and extends 500 pixels to the right and 650 pixels down.

The activerect is interpreted as a percentage of the original media if any non-zero number under 1.0 is entered into the value string. For example, a value of "0.5, 0.5, 0.5, 0.5" would cause the bottom-right quadrant (1/4 of the image) to be used, no matter the size of the media.

The activerect method of cropping can be used directly on video input media locations (255.241 and so on) if the desire is to crop out some of the input. If however the desire is to receive an input signal that is several video inputs that have been combined externally and received as a single input (e.g. four 1080p inputs combined into a 4K signal and received by a Blackmagic Ultrastudio 4K device) then applying a single crop to the video input media item would not allow all four quadrants to be used separately.

In such cases, the activerect metadata entry can be used with the .mblk (Mbox Link) media item to get the desired result. The .mblk media item acts as a built-in alias for movie and still image items in the Mbox/Media folder. Adding a .mblk media item allows there to be different properties (e.g. an activerect) for different virtual copies of the same media item.

To create a .mblk alias:

Step 1.   Create a plain text file using the TextEdit application. This file does not need to have any contents.

Step 2.   Save the file with the desired name, but change the file extension from the default (.txt) to .mblk.

Step 3.   Put the file into a numbered folder in the Mbox/Media folder. Give the file an 8-bit numerical prefix, like all media content files have. This will be the file number used to recall the .mblk item.

Step 4.   Add a numerical Folder.File suffix to the file that designates the original media item that the .mblk item is an alias of. i.e. Index#.Name.Folder#.File#.mblk

Step 5.   The final result would look like: "001.MyAlias.255.241.mblk - this is an alias to the first video input.

For example: In the previous situation where a single 4K input represented four individual 1080p video inputs, four .mblk items could be created, all pointing to the same original media item. Each .mblk item would be given an entry in the MediaInfo.plist file, with each entry having an activerect key and a corresponding value describing one quarter of the original input.

Other Video Capture Devices (Built-in, PCIe, or USB/FireWire)

Mbox also supports all other capture devices that provide a video capture format that is compatible with AVFoundation. Such devices may include USB or FireWire cameras or capture devices, and some PCIe capture cards. The configuration for these devices is the same as for Blackmagic and Active Silicon PCIe devices, except:

+ The input type must be set to "AVFoundation" rather than Blackmagic or Phoenix.

+ The input will be selected by name (e.g. "iSight Camera") rather than by number.

+ No configuration of the input format is required as this is set automatically when the device is selected.

SYPHON VIDEO INPUT

The Mbox application includes the Syphon framework, which allows Mbox to either send or receive real-time, full-framerate video or stills between applications on the same machine. For example, it is possible to place the video output from Quartz Composer, Unity 3, or other applications onto a layer within Mbox.

Note: For more information on the Syphon framework, refer to the webpage: http://syphon.v002.info

Configuring Syphon Inputs

Without any configuration, Mbox will give Syphon inputs an index number in the order they became active on the computer. This allows for quick use without any setup, but if more than one input is present, it does not guarantee that the same input source will always have the same index number for selection purposes.

Specific Syphon inputs can be assigned to specific index numbers in the Video Inputs section of the Preferences tab in Mbox or Mbox Remote. The Mbox v4 application has automatic discovery of active Syphon sources to aid in the assignment of sources to index numbers.

To assign Syphon sources:

Step 1. Go to the Preferences tab in Mbox or Mbox Remote. In the Video Inputs section, find the Syphon Sources item. Click on the disclosure arrow to the right of the item's name to reveal the configuration pane.

Step 2. Click on the "+" button to add a new Syphon source. A new entry will be added to the pop-up, and given a name including its index number (e.g. "Item 1").

Step 3. Click on the pop-up labeled "Choose..." to reveal a list of active non-Mbox Syphon sources found on the computer. Sources are named using the following syntax: <Application Name>:<Source Name>
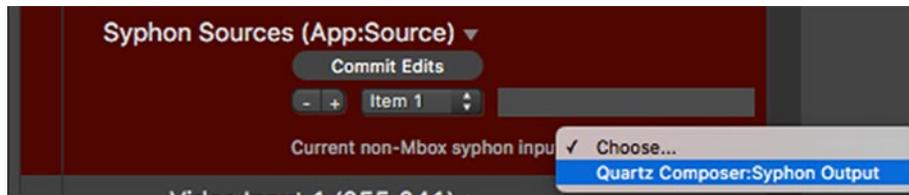
Step 4. Select the source to be assigned.

Step 5. Once the source has been selected, the "Commit Edits" button must be clicked upon to store the configuration.

Note: Although the Mbox application outputs video using Syphon, it cannot receive its own output. Therefore, all Syphon sources must be non-Mbox sources.

Guidelines:

+ Mbox Designer has a limit of 12 Syphon inputs, Studio/Studio+ has 4, and Mini has 2.

+ When the Mbox application launches, it will assign any non-configured Syphon inputs to the next available index number. If no index number is reserved for an input and more then one Syphon source is available then the source may not necessarily be attached to the same index number as the last time the Mbox application launched.

+ Syphon inputs are received at the same size they are rendering in the source application.

Displaying Syphon Input on a Layer

Syphon inputs are recalled on a playback layer just like other 2D media, using a Folder.File number to select them. The table below relates the Syphon source index numbers to the media folder and file that are assigned to the input:

Folder.File	Function
255.201	Syphon Input 1
255.202	Syphon Input 2
255.203	Syphon Input 3
255.204	Syphon Input 4
255.205	Syphon Input 5
255.206	Syphon Input 6
255.207	Syphon Input 7
255.208	Syphon Input 8
255.209	Syphon Input 9
255.210	Syphon Input 10
255.211	Syphon Input 11
255.212	Syphon Input 12

SYPHON VIDEO OUTPUT

Mbox can also use Syphon to output video to other Syphon-aware applications on the same computer (e.g. MadMapper). In this way, Mbox's output can be used as an input to the other application, perhaps for further manipulation, 3D mapping, effects, etc.

The Syphon output from Mbox works automatically. The Mbox application creates and advertises its Syphon sources, making them available to other applications. Simply launch the other application, look for Syphon sources, then select the desired source.

Mbox Designer and Mbox Studio+ creates Syphon sources for the Global Surface, each output, and each layer. Mbox Studio and Mini only create Syphon sources for the Global Surface and each output.

Note: Syphon outputs that use Mbox outputs as their source are rendered without the corresponding output master's effects, RGB+B/C, or camera/geometry/keystone/warp/shutter. Syphon outputs that use Mbox layers as their source are rendered with the layer's effects, RGB+B/C, and other parameter adjustments.

NDI® INPUT

The Mbox application includes NewTek NDI® technology, which allows Mbox to receive real-time, full-framerate video streams over an Ethernet network. For example, it is possible to generate an NDI stream on another computer, transmit that over an Ethernet network, and have Mbox display that stream on a layer. This can be a quick and easy alternative to video input through a capture device.

Note: For more information on NDI®, refer to NewTek's website: https://www.newtek.com

Configuring NDI Inputs

Unlike Syphon inputs, without any configuration, Mbox will <u>not</u> automatically give NDI inputs an index number. This means that NDI sources <u>must</u> be configured before using them for the first time. Mbox helps with this process by finding available NDI sources on the network and displaying them by their device and source name during configuration.

Specific NDI sources can be assigned to specific input index numbers in the Video Inputs section of the Preferences tab in Mbox or Mbox Remote. The Mbox v4 application has automatic discovery of active NDI sources to aid in the assignment of sources to index numbers.

To assign NDI sources:

Step 1.   Go to the Preferences tab in Mbox or Mbox Remote. In the Video Inputs section, find the NDI Sources item. Click on the disclosure arrow to the right of the item's name to reveal the configuration pane.

Step 2.   Click on the "+" button to add a new NDI source. A new entry will be added to the pop-up, and given a name including its index number (e.g. "Item 1").

Step 3.   Click on the pop-up labeled "Choose..." to reveal a list of active NDI sources found on the network Sources are named using the following syntax: <Device Name> (<Source Name>)
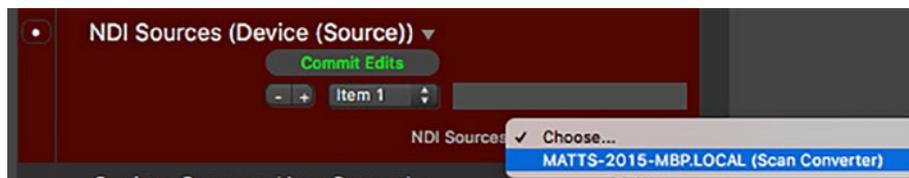
Step 4.   Select the source to be assigned.

Step 5.   Once the source has been selected, the "Commit Edits" button must be clicked upon to store the configuration.

Guidelines:

+ Mbox Designer has a limit of 12 NDI inputs, Studio has 8, and Mini has 4.

+ If an NDI input index is selected on a layer and the source is not sending a stream, nothing will be visible on the layer.

+ If an NDI input index is selected on a layer and no input source is configured:

    - If Diagnostic Images are off, nothing will be visible on the layer.

    - If Diagnostic Images are on, an error image will be displayed on the layer.

+ NDI inputs are displayed at the same size as they are sent from the source device.

+ Mbox can accept either standard YUV or RGB input pixel formats and will switch automatically between the two formats.

+ If using the same NDI input on more than one layer, always use the Layer Copy functionality rather than reselecting the same NDI input index on the additional layer(s).

+ If an NDI source is turned off by the source, any layer using that NDI source will immediately show no imagery. But if the network connection between the source and the Mbox computer fails, the last-received image will remain for two seconds, after which the layer will display nothing.

Note: If the network connection between the NDI source and the Mbox computer fails, even when the connection is restored it may take a minute or more to re-establish the NDI stream(s).

Displaying NDI Input on a Layer

NDI inputs are recalled on a playback layer just like other 2D media, using a Folder.File number to select them. The table below relates the NDI source index numbers to the media folder and file that are assigned to the input:

Folder.File	Function
255.101	NDI Input 1
255.102	NDI Input 2
255.103	NDI Input 3
255.104	NDI Input 4
255.105	NDI Input 5
255.106	NDI Input 6
255.107	NDI Input 7
255.108	NDI Input 8
255.109	NDI Input 9
255.110	NDI Input 10
255.111	NDI Input 11
255.112	NDI Input 12

NDI Audio Input

Mbox does not support NDI audio input at present time.

NDI OUTPUT

Starting with version 4.4.3, the Mbox application supports NDI video outputs, using NewTek NDI® technology. This functionality allows the creation of one of more virtual video outputs that are transmitted over Ethernet from the Mbox computer as NDI streams rather than as normal video outputs.

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CAUTION! In Mbox 4.4.3 the NDI output functionality has been added as a <u>BETA</u> feature. While PRG makes every attempt to provide bug-free Mbox software, no guarantees are made for this feature at present time, and the NDI Output functionality should only be used if you accept the potential risks involved!

Configuring NDI Outputs

In order to successfully create an NDI output stream, the Mbox application must first have at least one "normal" video output configured on the Outputs tab, even if there is to be no actual video output from the Mbox application. Without a normal video output, the Mbox application cannot generate valid rendering timing for the NDI output stream. This normal video output should always be the first output with a mix index of 001.

NDI outputs can be added on the Outputs tab using the following steps:

Step 1.   Press the "add..." button at the bottom of the Outputs tab to add a new output.

Step 2.   Edit the properties of the output as desired - name, origin, size, etc.

Step 3.   Click on the display popup and select the "NDI Output" item below the dividing line.

Once created, NDI outputs will be shown in the same manner as normal video outputs and can be edited in the same ways. As with any output, NDI outputs are given a unique mix index that can be edited if desired.

If the Mbox application is in window mode, Mbox will show separate output window for each NDI output. These output windows follow the same guidelines as normal outputs with regard to onscreen placement, size, and window grouping. When the Mbox application is in fullscreen mode, NDI output windows will not be visible.
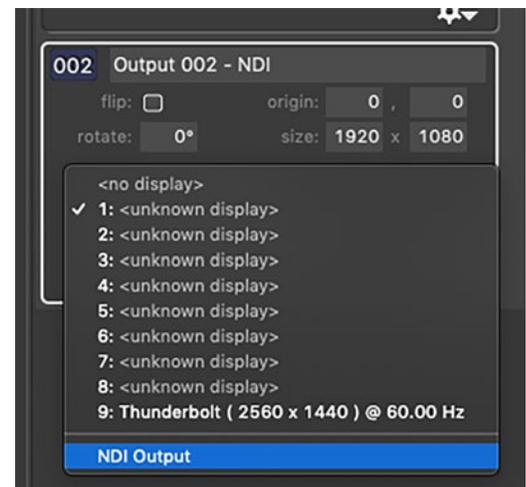
Guidelines:

+ As with any output from Mbox, the imagery in the NDI stream will be sampled from the Global Surface at a specific size and using the output's origin.

   - CAUTION! The NDI output stream will have a width and height equal to that of the output that it is created from. Make sure to use us the correct width and height if the receiving device requires a specific resolution for its NDI input

+ All NDI streams will have an output frequency matching that of the first normal video output. Because the frequency of Mbox's NDI output is controlled by the frequency of the first normal video output, it is important to connect and set up a physical display device with the desired frequency.

   - WARNING! Because the frequency of the Mbox application's rendering loop may be affected by overall performance limits, the output frequency of NDI output streams may fluctuate at times. This may cause some NDI receivers to display a "no input" warning.

+ NDI output streams are given a name based on the OS share name of the Mbox computer and the mix number of the output: e.g. "Mbox NDI on Mbox 001 [002]"

  - Extremely long computer names may result in the name getting truncated, keep share names to 12 characters or less if possible.

+ Each instance of Mbox software will ignore NDI output from itself, but can receive NDI from another instance of Mbox.

+ There is no limit to the number of NDI outputs allowed, except that of performance. Using many large NDI outputs may negatively affect overall playback and output rendering performance.

+ Mbox can send (and receive) NDI on any of the active network interfaces on the computer. Which means that it is possible to use more than one interface for NDI. While using more than one interface for NDI may be desirable in some cases, NDI signals should always be kept on a separate network interface from all other Ethernet protocols - e.g. Art-Net, sACN, and Mbox content syncing - whenever possible.

NDI Audio Output

Mbox does not support NDI audio output at present time.

7.

CONTENT CREATION AND UTILITIES

This chapter contains information on the proper formatting of content for playback on the Mbox server, along with content management and conversion utilities.

+ **CREATING CUSTOM CONTENT**
+ **MEDIA UTILITY APPLICATIONS**

CREATING CUSTOM CONTENT

Movies

As mentioned earlier in this manual, Mbox will try to play any QuickTime movie - no matter what codec it may be - however, movies that are formatted incorrectly may not play at all or may not play as well as movies that are formatted correctly. While Mbox will do the best job possible to play any compatible movie content, if the file is not optimized specifically for Mbox, poor results may occur. There are many elements of movie files that need to be considered when creating content: file extension, codec, compression, frame rate, resolution, and audio.

The Mbox application uses AVFoundation technology instead of QuickTime 7 as the basis for its playback engine, and therefore there are some changes to what content is compatible. The QuickTime Player application on the Mbox computer also uses AVFoundation technology. QuickTime Player will attempt to open any movie file, but will display a prompt when the file has to be converted before playback. As a general rule of thumb, aside from movies that use the Hap codec (which is a special case), Mbox is capable of playing any movie file that the QuickTime application on the Mbox computer can open and play <u>without conversion</u>.

Note: While Mbox can open movies files that use the Hap codec, QuickTime Player cannot. The ProRes and Hap codecs <u>do not</u> need to be installed to allow Mbox to play movie encoded using any version of ProRes or Hap. But they must be installed to allow the Mbox File Convertor app (see page 165) to convert movies into one of those codecs.

File Extension

QuickTime movies can have all sorts of file extensions. But Mbox will only open movie files with the .mov or .mp4 file extensions. Keep in mind that even though Mbox may *try* to open and play a file because it uses one of these two file extensions, this does not guarantee that the movie *will* play! It is a good idea to always test all files in advance.

Note: Mbox can also open and play Quartz Composer (.qtz) files. However, these are not considered QuickTime movie files and follow different rules for file extension and formatting.

Codec

A movie's codec (<u>co</u>der/<u>dec</u>oder) is very important. Mbox will try to play any QuickTime movie with the right file extension, no matter what its codec is. However, only movies using the Apple ProRes, Photo-JPEG, H.264, Hap, or DV codecs will actually play. And within that list of codecs, only the ProRes, Hap, and Photo-JPEG codecs are considered to be "preferred codecs." Movies using one of these preferred codecs are played using Mbox's enhanced playback engine and can take advantage of all Mbox functionality. Movies using non-preferred codecs are handed off to a playback engine (based on AVFoundation) that has slightly less functionality than the enhanced engine.

The ProRes codec should be the first choice when creating content for Mbox. Photo-JPEG and Hap will work well, although there are some additional considerations that must be taken into account when using these two codecs. Movies created using any other codecs may not play as well as movies using a preferred codec:

+ Apple ProRes is a high-quality, spatially compressed, scalable codec that was designed to compress HD content sufficiently to keep bitrates at SD levels. Decompression of ProRes can be multi-threaded, providing better performance on computers with multiple CPU cores. ProRes is usually the best choice of codec for use with Mbox. The bitrate of ProRes content can be very high, and care should be taken when creating movies in this format.

+ Photo-JPEG is a quality, scalable format that uses spatial compression. Photo-JPEG movies can be any resolution and can take full advantage of Mbox's many playmodes. Photo-JPEG is processor-intensive, so care must be taken to use a reasonable quality setting or playback may not be smooth. Typically, a quality setting of Medium or 60%-80% is appropriate. A quality level above 80% will have not improve the quality of the image as displayed by Mbox.

+ H.264 - whether using the mov or mp4 container - is a quality, scalable (up to 2000 x 2000 pixels) codec that uses temporal compression. H.264 can provide high quality at low bitrates. However, because it is temporally compressed, Mbox can't play back H.264 content using its enhanced playback engine. This means that some playmodes may not work with H.264 content. Temporally compressed movies use keyframes and intermediate frames. Keyframes periodically store all image data, while intermediate frames only storing running changes. Adjustments to playspeed and in/out frames can cause jerky playback with H.264 content in Mbox and movie load times can be longer than with other codecs. Therefore, using H.264 is <u>not</u> recommended in most cases.

Note: Rendering an H.264 movie with all frames being key frames may minimize some issues with playback modes, but will make the movie's bitrate significantly higher.

+ DV is a compression format typically used by video cameras. For best results, DV-encoded movies must conform to either NTSC or PAL resolutions, and therefore, should not use any random resolution. The quality of DV is typically not as high as that of Photo-JPEG, although it is less processor-intensive. DV movies from a camera or DVD source will often be interlaced and therefore may look quite bad especially if there is fast motion in the movie. Better quality may result by deinterlacing DV movies before using them with Mbox.

CAUTION! Mbox does not support playback of content using the DVCPro codec, only the DV codec.

+ The Hap codec is decompressed using the GPU rather than the CPU, which is how other codecs are decompressed. Mbox uses special APIs that enable this with Hap movie content. This can allow computers with fewer/slower CPU cores to have better performance than with other codecs, provided they have a powerful discrete graphics card. Hap movies can also have a high bitrate and therefore require a fast disk with good bandwidth.

Compression (Bitrate)

Movie compression can have a large impact on playback performance. There is a balance between quality and performance that can be tipped in either direction by adjusting the amount of compression when a movie is rendered. Typically, compression is labeled as "Compressor Quality" or something similar and the scale goes from "least" to "best" or 0% to 100% - more compression to less compression.

With higher compression, a movie file will be smaller (on disk) and its bitrate (or data rate) will be lower. Exclusive of other performance bottlenecks like decompression and rendering, lower bitrates can help lead to better playback if the Mbox computer's hard-drives are slow. But with too much compression the resulting movie quality may become unacceptable. Reducing the amount of compression can provide a higher quality movie, but due to the higher bitrate, playback performance may suffer unless the computer has a fast hard-drive (SSD or flash-based).

Another factor to consider when thinking about compression is the computer's ability to decompress the movie. Most codecs require the CPU to perform all the work involved in decompression. A computer with a larger quantity of faster CPU cores can make a difference, as can codecs like ProRes that can be decompressed on more than one core at a time. Some codecs (e.g. Hap) can make use of the computer's GPU to perform the decompression task, thereby reducing the load on the CPU. And finally, uncompressed codecs require little or no decompression, but the resulting file size and/or bitrate may be so high as the cause the movie to be unplayable.

Under normal circumstances, when deciding between higher or lower compression, there will be a point of diminishing returns where either quality or playback is unacceptable. Low quality setting might play very well, but look unacceptable to the eye. Very high quality settings may not look noticeably better for the trade-off in performance.

As a rule of thumb, movie bitrates should be kept below 150Mbits/sec in order to play content on multiple layers at the same time. In special circumstances, Mbox can handle bitrates up to approximately 300Mbits/sec.

Frame Rate

Movie frame rate must be considered when creating content for Mbox. For the best results in typical usage, content should be rendered at a frame rate that is exactly one-half of the refresh frequency of Mbox's video output. If the connected display has a 60Hz refresh, movies that play at 30fps will synchronize exactly with the output to the display.

While content with high or lower frame rates can be used, there may be some noticeable effects depending on the frame rate. In the above example, if the movie has fewer than 30fps, then the Graphics card will periodically need to repeat some frames and the movie would appear to play less smoothly. Depending on the frame rate of the movie or the motion in the movie's imagery, this effect may be more or less noticeable.

If the movie's frame rate divides evenly into Mbox's output refresh frequency, then the movie will play more smoothly; 20fps content looks better with a 60Hz output than 24fps content does. If the Mbox output frequency is 50Hz, then it would be best to create content that is rendered at 25fps. If output frequency is 59.94Hz, then content should be rendered at 29.97fps, and so on. The new Enhanced Frame Blending feature in Mbox may be able to improve playback smoothness if the content framerate is not exactly 1/2 the output frequency. This feature is off by default and must be enabled on the Preferences tab.

Refer to "Connected Displays and Fullscreen Mode Interactions" on page 71 for more information the interaction between Mbox's outputs, connected displays, and refresh frequency.

Mbox is able to play content that has a framerate higher than one-half of the output refresh frequency. Within the performance limits of the computer hardware, higher framerates may provide smooth playback if they are exactly the same as, or a multiple of, the refresh frequency. If the output refresh frequency is 60Hz, then movies can have a frame rate of 60fps or 120fps, and so on. However, Mbox can only display a number of frames per second matching the refresh rate of the video output. Therefore, there is little point to attempting to play a movie made with 120fps as a full one-half of the frames will not be displayed if the show output refreshes at on 60Hz.

Note: In most situations, based on the connected display device(s), the maximum refresh frequency for the Mbox computer will be 60Hz. Therefore, the maximum frame rate for movie content should be 60fps.

For best results, all content for a specific event should be rendered using a common framerate; all movies or image sequences for one show might be 30fps, rather than some being 30fps and others being 29.97fps. Therefore, it's important to ensure that all video outputs from the Mbox computer use the same refresh frequency, and that this refresh rate is a multiple of the content framerate. In setups where Mbox has multiple outputs with dissimilar refresh frequencies, video will only be rendered in sync with the first output's refresh. Therefore content displayed on the outputs having dissimilar refresh frequencies may not appear to play as smoothly.

Resolution

Movie resolution - the movie's dimensions in pixels - has an impact on the performance of the Mbox server. To put it simply, the larger the movie's pixel dimensions, the harder it is to play. For best results, always try to play the smallest movie possible. Of course, there are factors outside of Mbox that need to be taken into consideration when choosing a content resolution - type of output signal, display device native resolution, size of projection surface - but for the most part, there is not much point in playing content that has a higher resolution than the display it will be viewed on. But admittedly, sometimes the smallest possible movie is not the one that looks the best with every particular setup, so make sure to test in advance if possible.

Mbox v4 does not have any limit to the resolution of movie content. As long as the Mbox computer's hardware can support reading the movie from the hard drive, decompressing it, and rendering it without dropping frames then that content is fine. In real-world conditions, 4K resolution (3840 x 2160 pixels) is about the largest useful size for content if more than one movie is going to be played at the same time.

Alpha Channel in Movies

It can be useful to add areas of transparency to a layer when using Mbox. Transparency can make it possible to see other layers behind, to create a "knockout" for IMAG, or to properly display a movie that uses green-screen technology.

ProRes 4444 and Hap Alpha Codecs

When creating content, there are quite a few QuickTime codecs that allow an alpha channel (transparency information) to be embedded in a movie. But for the purposes of Mbox, the only useful codecs are ProRes 4444+, Hap Alpha, and Hap Q Alpha. Encoding content using one of these three codecs (especially ProRes 4444) can result in movies having a very high bitrate.

If a movie is created using the ProRes 4444 codec and played on Mbox, the enhanced playback engine will handle it. Mbox is able to use the alpha channel information in the movie and to display transparent areas as transparent. However, unless the movie is quite small and/or has a reasonable bit-rate (< 200mbits/sec), the movie may not play very smoothly, and playback on other layers of the server may be affected to some extent.

Movies that use the Hap codec are encoded in a special way to enable them to be decompressed by the GPU on the computer. Because of this they are a special case, they are not handled by the enhanced playback engine or the default AVFoundation engine. However, this does not mean that they play badly. In fact, movies encoded with the Hap codec have relatively low bitrates for their quality level. It is possible to get the bitrate of a Hap Q Alpha movie to be too high though so try to keep their bitrate below 200Mbits/sec.

Still Images

Mbox can play back several different still image file types. JPEG, PNG, TIFF are the three recommended types, and of those three, PNG is probably the most useful. JPEG has reasonable quality, but does not support an alpha channel. TIFF can have very high quality (uncompressed quality) and supports an alpha channel, but the file size can be very large. PNG manages to have good quality and supports an alpha channel, but also keeps the file size very small.

There are a few guidelines for still images:

+ Resolution - use the smallest image possible that provided the desired quality result when scaled correctly for the show. Using an overly large image and scaling down doesn't provide better results that using a correctly-sized image. And scaling an image up can reduce quality quite quickly.

+ Quality/Compression Level - use a quality that displays the image accurately, but which keeps the file size manageable and which allows Mbox to display the image without any latency between selecting the image on the controller and the image appearing onscreen.

+ Color depth - Mbox can open and display still images using both 8-bit and 16-bit color. However, all still image files are rendered onscreen using 8-bit color. Therefore, for normal purposes, there is no advantage to using 16-bit files.

+ Colorspace - the colorspace profile of still images in Mbox is important. Whenever possible, make sure to use the sRGB profile when saving still images (i.e. assign the sRGB profile to the image and make sure the profile is embedded in the image when saved). If a different color profile is used, the still images will not have accurate color.

Image Sequences

Image sequences can be described as a group of individual image files that are played sequentially, at a specific rate, like frames in a movie. Mbox supports the playback of image sequences, and these image sequences can use any of the still image formats that Mbox supports - JPEG, PNG, or TIFF. The potential for higher-quality images when compared to many movie formats makes image sequences a valuable asset either for high-quality/high-resolution displays or for the purposes of UV mapping when using effect #092 - UV Map from Layer.
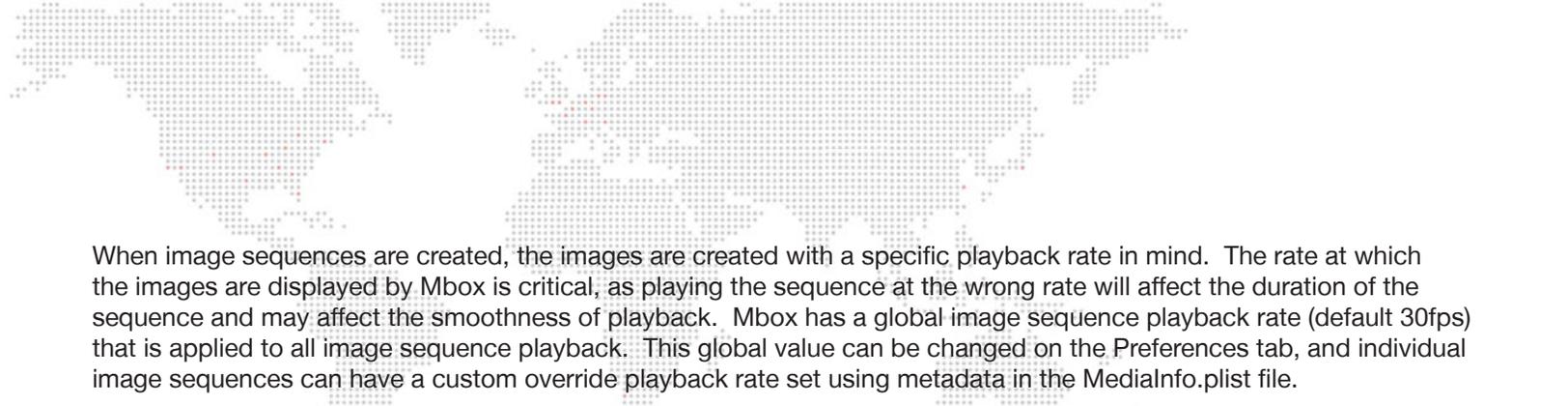
When image sequences are created, the images are created with a specific playback rate in mind. The rate at which the images are displayed by Mbox is critical, as playing the sequence at the wrong rate will affect the duration of the sequence and may affect the smoothness of playback. Mbox has a global image sequence playback rate (default 30fps) that is applied to all image sequence playback. This global value can be changed on the Preferences tab, and individual image sequences can have a custom override playback rate set using metadata in the MediaInfo.plist file.

Image sequences offer quite a few benefits over movies, but there are also some drawbacks:

+ Pro - images can use either PNG or TIFF still image formats at either 8-bit or 16-bit color depth, with or without an alpha channel. This allows for images that are less lossy or lossless (i.e. uncompressed), and that can have transparency. Be aware though that 16-bit color is only useful for UV mapping purposes, as Mbox's onscreen rendering is all 8-bit at present time.

+ Pro - it's possible to make changes to a sequence by only editing and re-rendering affected images rather than having to re-render an entire movie. Thereby reducing transfer time for changes.

+ Pro - the layer's playspeed parameter can adjust the play back rate of the sequence.

+ Pro - like movies, images sequences can have sidecar audio files for synchronized audio playback.

+ Con - a n image sequence at 30fps requires 1800 image files per minute, which can mean a lot of files.

+ Con - high-quality image formats (especially TIFF) have very large file sizes. TIFF requires about 8MB for a single 1080p image, PNG is more compact. 16-bit files will require more disk space than 8-bit files.

+ Con - the conversion of image sequence files to raw .cvbuf files for playback by Mbox, can take time if there are a lot of files to convert. The .cvbuf files take up more disk space.

It is time-consuming for Mbox to open, decompress, and display the individual files that make up an image sequence. Those original files can't be displayed at the correct playback rate, especially if the image sequence is intended to play at more than 30fps. Therefore, image sequences image files are converted to a proprietary format (.cvbuf) before they can be played by Mbox. The converted .cvbuf files are stored in a separate folder from the original images.

The Mbox application automatically converts image files when they are found, and if edits are made to specific images in the sequence, only the modified images get converted and will replace the previous version automatically. The conversion process is quite fast and happens in the background, but it must happen before the image sequence can be played. The conversion process is triggered by a media rescan in the Mbox application.

The .cvbuf files for an image sequence can take up significant additional disk space. But once an image sequence has been finalized, it is possible to lock the image sequence and then delete its original image files, keeping only the .cvbuf files for playback purposes Refer to "MediaInfo.plist" on page 43 for more information on locking image sequences.

Audio

Audio file creation for Mbox can be one of the more complicated tasks in content creation. Mbox can play audio in two separate ways: stand-alone/sidecar audio files or embedded audio within a QuickTime movie. (Refer to "Audio Output" on page 98 for more information)

Mbox's compatibility with different audio file formats has been greatly enhanced with the release of Mbox v4. In Mbox v4, stand-alone and sidecar audio files can use several container types (AIFF, AAC, WAV, M4A, and MP3) and the formatting of the audio (sample rate, endian-ness, etc.) does not matter. Starting with Mbox v4.2, stand-alone and sidecar audio files (with the exception of the MP3 container) can have up to 24 channels.

Audio playback using stand-alone or sidecar files can be sped up or slowed down, and the audio will loop and obey in and out frame values applied to the playback layer. For sidecar audio it is important to make sure that the audio file is exactly the same length as the movie, or the audio may not play completely or with a gap. The best way to keep a sidecar audio file the correct length is to keep the audio and video components of a movie together until the very last

moment - throughout the editing process. Once editing is complete, output the result as two separate files - the movie file and an associated sidecar audio file. Avoid any changes to either file once the two have been separated.

Mbox v4 can play audio directly from a QuickTime movie that has embedded audio. However, there is one important restriction on what kind of embedded audio Mbox v4 can play <u>directly</u> from the file - the embedded audio <u>must</u> use AAC audio encoding, otherwise the audio will not play properly.

Starting with Mbox v4.4.3, if the "Create Auto-Sidecar Files" preference is enabled, when the Mbox application is launched or when it performs a media rescan, it will automatically make a sidecar audio file for any movie having embedded audio using LPCM encoding. Auto-sidecar files are managed by the Mbox application and are stored in a separate folder from the original movie. Refer to <u>"Audio Output"</u> on page 98 for more information.

Note: Mbox v3 required uncompressed LPCM encoding for embedded audio, therefore movies with embedded audio that were made for Mbox v3 need be converted before being used in Mbox v4. The quickest solution is to enable the auto-sidecar preference and let Mbox make a sidecar file. Alternately, separate the audio from the movie to make a sidecar audio file.

Beyond the encoding for embedded audio or the decision of whether to use embedded or sidecar audio, other audio properties are not critical. Depending on the audio encoding used, movies with embedded audio can have up to 24 channels. Many content creation applications (e.g. the Adobe CC suite) do not allow movies to have multi-channel AAC audio. Therefore, sidecar audio is currently a better choice for multi-channel audio output.

Recommendations for embedded audio encoding:

+ Use AAC encoding where possible, otherwise enable the auto-sidecar pref to allow Mbox to make sidecar files.

+ Sample rate = 44.1KHz or 48KHz

+ Bitrate = 320kbps

+ Number of channels = 1 or 2 (mono or stereo), up to 24 channels (multi-channel)

The audio volume control channel on the Global Master fixture can be used to modify the volume of all audio playback. Additionally, the Layer Volume parameter can be used to control audio volume on a per-layer basis. Refer to <u>"Audio Output Volume Control"</u> on page 99 for details.

Applications for Content Creation

There are many applications that can be used to create or edit content for Mbox, varying from the high end (Adobe After Effects®, Apple Final Cut®) to the low end (QuickTime® 7 Pro). Each has different strengths, but there are some guidelines to be observed:

+ Never create a movie with compressed headers or prepare a movie for internet streaming.

+ Avoid using QuickTime 7 Pro to edit movies. It is recommended that editing tasks be performed using some other application, such that the movie's source elements are re-rendered into a new file. This is especially critical if the movie has audio tracks.

+ Mbox can play back H.264 content using either the QuickTime (.mov) or H.264 (.mp4) container formats.

+ Avoid including extraneous tracks (e.g. timecode) in QuickTime movies whenever possible.

+ Mbox renders onscreen with 8-bit color; there is no advantage to creating content with a higher color depth, except for image sequences used for UV mapping.

+ To create and/or play content outside of Mbox using some codecs (e.g. Hap), the corresponding codec component must be installed on the computer, <u>and</u> the application must support the codec. Newer versions of the Adobe suite and most applications on the PC may not support ProRes or Hap. Alternatives like FFMPEG can be used.

MEDIA UTILITY APPLICATIONS

Mbox Media Lock

Note: The Mbox Media Lock utility is only installed on the standard Mbox rental product. All of the stock movie, object and digital gobo content on rental Mbox servers is locked and cannot be used on any other computer or media server.

The Mbox Media Lock application provides a way to lock (copy protect) custom content on the standard rental Mbox server. Media Lock will work on .mov, .obj, and .svg files.

CAUTION! Before going any further, please note that the only original copy of any content should never be locked! Once content is locked, it can only be played on a rental Mbox server and not on any other computer! Only lock content that is placed onto an Mbox!

Media Lock is based upon a username and password system. Once locked, content cannot be unlocked, and will only play on another rental Mbox server that has the same username and password entered into the Media Lock application. This means that content can be locked on one Mbox server and it will always be available to play on any Mbox server as long as the same username and password is entered into the Media Lock application on that machine.
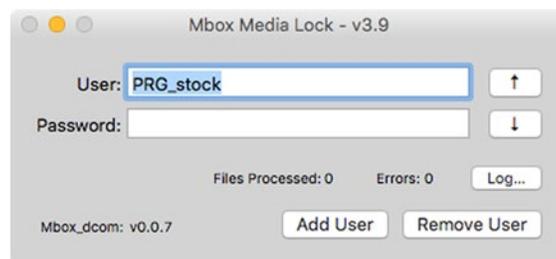
To lock content:

Step 1. Locate the Mbox Media Lock application in the /Applications/Mbox v4 Utilities folder. Double-click icon to launch the application.

Step 2. On the Mbox Media Lock window, existing usernames (but not their passwords) can be viewed by clicking the up/down arrow buttons on the right-hand side of the window.

CAUTION! Do not remove any existing usernames as this may lead to the stock content becoming unplayable. There is no undo function! Also, once content is locked, it cannot be unlocked.

Step 3. To add a username and password to the system, type each into the appropriate box. Do not use spaces or any punctuation marks in either field; use letters and numbers only. Capitalization does matter, so if in doubt, do not capitalize anything.

Step 4. Once a unique username and password has been entered, click the Add User button.
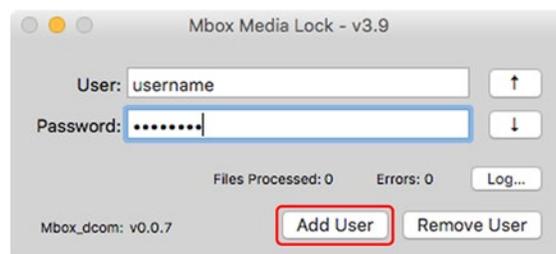
Step 5.   To remove a username, click the up/down arrows until the username appears in the field and click the Remove User button.

Step 6.   Once a username (with password) has been entered, content can be locked with that user's credentials. To lock content, make sure that the correct username is displayed and either choose "Lock Files" from the File menu at the top of the screen or press [⌘L] on the keyboard. This will open a dialog window allowing for file selection.

Step 7.   Navigate to the file(s) to be locked, select, and click the Open button to lock. Select multiple files by using the [Shift] or [⌘] keys while selecting files. All the content in a folder can be locked by selecting a folder rather than files.

Step 8.   After clicking Open button, the dialog window will close and Media Lock will lock the items. If a large number of files are being locked, this process may take a minute. Media Lock will display an indication of how many files were processed and if there were errors in the "Files" and "Errors" fields. If errors occurred, click on the Log button to open the console log for more information about the errors. Errors can occur if content is already locked or if the file type is not compatible.

To make locked content unplayable on a rental Mbox server:

+ Simply remove the username that the content was locked with from the system. To make that content playable again, re-enter the username and password with which the content was originally locked. In both cases it may be necessary to quit and relaunch the Mbox application if it was running.

When an attempting to play locked content on a rental Mbox server that does not have the correct username and password entered, Mbox will display the locked content diagnostic image on the screen. This image will only be seen if the "Show Diagnostics" preference is enabled on Mbox's Preferences tab. Otherwise, Mbox shows nothing on the layer and there is no other notification that the file is locked. (Refer to)

Mbox File Convertor

In some cases, Mbox may not be able to play custom QuickTime movie content. If this happens and the "Show Diagnostics" option is enabled on the Preferences tab, (Refer to "Preferences Table - Categories and Preferences" on page 52) Mbox will display the broken movie image (shown at right). This diagnostic image indicates that there is a problem with the movie file.

If the broken movie image appears or if poor playback is experienced, first confirm that the movie uses one of the Mbox preferred codecs. (Refer to "File Type Specifications" on page 35) If the movie is not using one of these codecs, it can be converted to a preferred codec using the File Convertor application. If the movie is already using the one of the preferred codecs, then the Mbox File Convertor application can be used in an attempt to eliminate the problem.

IMPORTANT! The Mbox File Convertor application uses QuickTime 7 technology to convert movies. **Therefore, it will not work on computers with macOS 10.15 Catalina and future versions of the macOS that have eliminated support for QuickTime 7 technology.** Starting with Mbox v4.4.1, the Mbox File Converter application is <u>no longer included</u> in the Mbox installer package.

About File Conversion

The Mbox File Convertor will accept file drops of more than one file at a time. Movie files must have a file extension of either .mov or .mp4. Up to four files are processed simultaneously with additional files being queued. All converted files are created as new copies of the original file in the same location as the original file. The new files will have the same numerical prefix and name as the original, but will have either ".Mbox or "_PMA" appended to the end of the file name (prior to the file extension). ".Mbox" is appended for movie files, "_PMA" for still image files.

023.My Content.mov would be renamed as **023.My Content.Mbox.mov**

or

011.My Picture.png would be renamed as **011.MyPicture_PMA.png**

After conversion, be sure to (re)move the original file(s), so there are not two files with the same index value in the folder.

File Conversion Settings
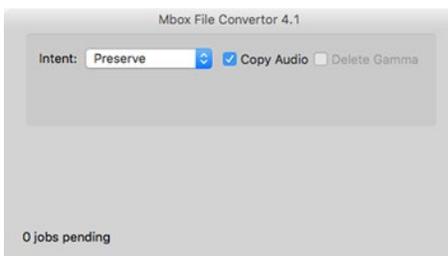
There are four settings that can be modified when using the File Convertor: Intent, Quality, Gamma, and Copy Audio.

+ **Intent:** This setting has eleven possible values: Preserve, Photo-JPEG, five versions of the ProRes codec, and four versions of the Hap codec.

  - If "Preserve" is chosen (not compatible with /mp4 movies), movies will not be converted to another codec, but rather the application will attempt to fix the file so that Mbox can play it. The changes made do not affect the codec or quality of the movie.

- If any other option is chosen, the movie will be converted to the selected codec, using the quality slider's value if applicable. No matter which codec is selected for conversions, the application will always attempt to correct any errors in the file. It may be necessary to test several levels of quality to get the desired results.

+ **Quality:** The Quality slider setting only applies to movie when they are being converted to Photo-JPEG, Hap, and Hap Alpha.

+ **Delete Gamma:** This setting will cause the gamma information saved with the file to be removed. In many cases, this will result in a movie that does not have the same colors as the original, and should therefore be used with caution.

+ **Copy Audio:** By default, the application will strip audio from files it processes. Enabling this setting will cause embedded audio to be retained (copied) when a movie is processed, unless the movie uses the mp4 container - in which case the audio will not be copied.

Pre-Multiplying Alpha

The Mbox File Convertor has one additional function: it can apply pre-multiplied alpha to a TIFF or PNG file that was created using straight alpha. This can help to reduce fringing around the edges of these files if they were created improperly. When pre-multiplying alpha in still image files, there is no conversion of file-type or quality adjustment.

When pre-multiplying alpha, the color (red, green, and blue) value for each pixel is multiplied by that same pixel's alpha value. Each of these values range between 0.0 and 1.0, where 0.0 is none, 1.0 is full. Therefore, when using pre-multiplied alpha, a pixel with an alpha value < 1.0 (i.e. it has some amount of transparency) will be rendered with the intensity of its color values reduced. This is very useful for reducing the white or gray fringe seen around some objects in content that uses an alpha channel.

File Conversion Procedure

Step 1.   Locate the Mbox File Convertor application in the /Applications/Mbox v4 Utilities folder. Double-click its icon to launch the application. Or, simply drag a movie file onto the Mbox File Convertor icon.

a. If the application is launched before files are dropped onto it, the conversion settings can be adjusted. Adjust as required. Refer to

b. If files are dropped directly onto the application's icon when it has not been launched, then they will be processed with the settings from the last time the application was launched.

Step 2.   Adjust setting as desired, then drag and drop one or more movie files onto the application window.

Step 3.   After conversion, manually (re)move the original files from the folder, so there are not two files with the same index value.

IMPORTANT! Movie file conversion to the ProRes or Hap codec with the Mbox File Convertor application requires that the corresponding codec .component file be installed on the computer (in the /Library/QuickTime folder), otherwise the conversion cannot be made.

Notes

A.

NETWORKING FOR MBOX

This appendix provides guidelines for setting up Mbox networks.

+   **MBOX NETWORKING GUIDELINES**

MBOX NETWORKING GUIDELINES

Concepts

The majority of communications to and from Mbox use Ethernet protocols. This means that Ethernet networks route the data into the Mbox server and from the server to other connected devices. Because all of these protocols need to live in harmony, steps need to be taken to avoid interference between protocols, and to maximize the available network bandwidth/speed. Due to these requirements, it is recommended that the computer used as an Mbox server have more than one network interface. For more complex setups, three or four network interfaces may be preferable.

While all the network interfaces on a computer could be connected to the same network to gain some amount of additional bandwidth, doing so would bypass the desire to keep certain protocols separate. Therefore, it is much more useful if each network interface on the computer is configured for and connected to a separate physical Ethernet network. If multiple interfaces must be connected to the same physical network, then the network should have a system of VLANs enabled to help segregate different protocols.

Connecting more than one network interface to different networks is only the first step. Each interface needs to have its IP Address and subnet mask set correctly for the network that it is being connected to. Getting the IP Address and subnet mask correct ensures that communications to and from the computer will leave the computer through the correct interface and arrive at the intended destination without any ambiguity or loss of data.

Concept definitions:

+ **Network Interface** - the physical Ethernet connection (typically RJ-45) on the computer that a cable is connected to in order to connect the computer to a physical network.

+ **Network** - a group of devices connected to each other that can potentially communicate using Ethernet IP protocols The word "network" describes not just the physical connection of multiple devices, but also the "web" of electronic communication between them.

+ **Subnet (subnetwork)** - a logical subdivision of a network such that multiple interfaces can be connected to the same physical network, but are placed on different subdivisions of that network for the purposes of routing or for keeping some communications separate. (Note: a subnet is not the same as a VLAN.)

+ **IP Address** - an interface property using the dot-decimal (e.g., 2.0.0.123) notation, where each of the four numbers separated by decimal points is referred to as an octet (because each is an 8-bit number). In combination with the interface's subnet mask, the octets in the IP address designate either the device's sub-network or the device's unique identifier on that subnet.

+ **Subnet Mask** - a second interface property, also using dot-decimal notation (e.g., 255.0.0.0). The value of each octet in the subnet mask determines which of the octets in the device's IP address specify the sub-network and which specify the interface's unique identifier on that sub-network. The subnet is specified by setting one or more of the octets in the subnet mask to a value other than 0.

Subnet Masking Basics

For pretty much all communication to and from Mbox, each octet in an interface's subnet mask will be set to either 0 or 255. Values other than 0 or 255 can be used for more complicated subnetting, but are typically not needed with Mbox and won't be discussed here.

In order to understand how an interface's subnet mask works, it needs to be viewed together with the interface's IP address. If an octet in the subnet mask has a value of 255, then the corresponding octet in the interface's IP address is used to designate the subnet that the interface belongs to. If an octet in the subnet mask has a value of 0, the corresponding octet in the IP address is used as part of the interface's unique identifier on that subnet. Within the structure of sub-networks and unique identifiers, it is possible to have multiple interfaces on the same subnet, each being uniquely identifiable. Data can be sent to all interfaces in the subnet by broadcasting, to groups by multicasting, or to individual members by unicasting.

How the IP Address and Subnet Mask Work Together

For a device with the IP address of 192.168.0.123 and a subnet mask of 255.255.0.0, the first two octets of the IP address "192.168" are used to specify the sub-network, and the last two octets "0.123" specify the device's unique identifier within that network.

	Network		Unique ID	
Subnet Mask:	255	255	000	000
IP Address:	192	168	000	123

Depending on the number of octets with a value of 255 in the subnet mask, different descriptions may be given to the interface. A subnet mask of 255.0.0.0 leads to a description of "/8" for the interface. Combined with the interface's IP address, this information would be written as "192.168.0.123/8". A subnet mask of 255.255.0.0 gets a description of "/16" and 255.255.255.0 a description of "/24".

Note: There is no such thing as a /32 subnet mask, as the last octet in an interface's IP address must always be used as a unique identifier.

Routing Ethernet Communications

+ **Full Broadcast** - data packets that are sent to the full broadcast destination IP address (255.255.255.255) will be received by all devices on the physical network provided the packets are not blocked by a switch or router between devices. Full broadcast is akin to shouting in a crowded room. Everyone can hear the yelling, but must decide whether to listen or not. Full broadcast is simple and guarantees for the most part that every device on the network can get the data. However, it places a lot of data onto the network, thus using up more of the available bandwidth. Another downside is that receiving devices may need to spend more time than is desirable to filter out data that they don't need to listen to.

+ **Subnet Broadcast** - packets that use a subnet broadcast IP address (x.255.255.255, x.x.255.255, or x.x.x.255) will only be received by interfaces on the matching subnet - i.e., those with a subnet mask that places them into the same subnet. This is one step down from shouting, as subnet filtering allows receiving devices to immediately discard any subnet broadcast data that isn't destined for their subnet.

To obtain the subnet broadcast address for a particular subnet:

Step 1.   Take the IP address for a device on that subnet and the subnet mask for that device.

Step 2.   Line the address and subnet mask up one above the other, in four columns with each octet being a column.

Step 3.   In columns where the subnet mask has a value of 255, write down the value from the IP address' octet.

Step 4.   In columns where the subnet mask a value of 0, write down a value of 255.

IP Address:	192	168	000	123
Subnet Mask:	255	255	000	000
Subnet Broadcast Address:	**192**	**168**	**255**	**255**

+ **Unicast** - packets using a specific, unique destination IP address. This is most comparable to two people having a single face-to-face conversation without anyone else able to hear them. Interfaces can have more than one unicast communication at a time. Unicasting cuts down on network overhead as it places the minimum amount of data on the network and because packets are addressed specifically, it eliminates the requirements that a device filter out data it doesn't need to listen to.

+ **Multicast** - packets that are sent to an IP address belonging to a predetermined range of IP addresses. Interface's may join a multicast group to be able to send and receive packets within the group. This is comparable to a group of listeners who all choose to listen to one speaker, or to other members of the group who take on the role as speaker. The conversation doesn't leave the group.

It is possible for interfaces to send packets to or receive packets sent to a multicast address without joining the corresponding multicast group. But unless the interfaces join the multicast group, switches between the devices may not forward the multicast packets correctly.

Most of the time a /8 subnet mask (255.0.0.0) can be used with Mbox. When using multiple interfaces on the same computer, with each having a /8 subnet mask, a general rule is to make sure that each interface has a different first octet. Otherwise there may be ambiguity when trying to determine which interface to use for various communications. While all interfaces on a computer may receive packets from any source, packets sent by the computer almost always should leave through only one interface. If that interface is not on the correct subnet (or indeed the correct physical network) then the packets will never get to the intended destination.

CAUTION! IP addresses starting with 2 and 192 and having a subnet mask of 255.0.0.0 are actually publicly routable IP addresses. Therefore, if the computer has an interface connected to a router (e.g. connecting to the internet), and also has an interface with a 2./8 or 192./8 then there may be some connection issues with certain websites.

For example, if two interfaces are configured with IP addresses of 2.0.0.1 and 2.1.0.1 and both have a subnet mask of 255.0.0.0. -> Both interfaces are on the same sub-network (i.e. 2.x.x.x), but have unique IDs on that network. Because this is a valid IP scheme, the computer will allow this; but using this setup will cause issues with Mbox software. One or both of these interfaces should use a /16 subnet mask instead of the /8 subnet mask, thereby placing the two interfaces onto different subnets. -> 2.1.x.x and 2.0.x.x

With all protocols, especially those detailed below, it's best that one and only one interface on the computer be on the same subnet as the destination devices. When the computer is told to output data to a specific destination device it avoids confusion if only one interface can "talk" to that device.
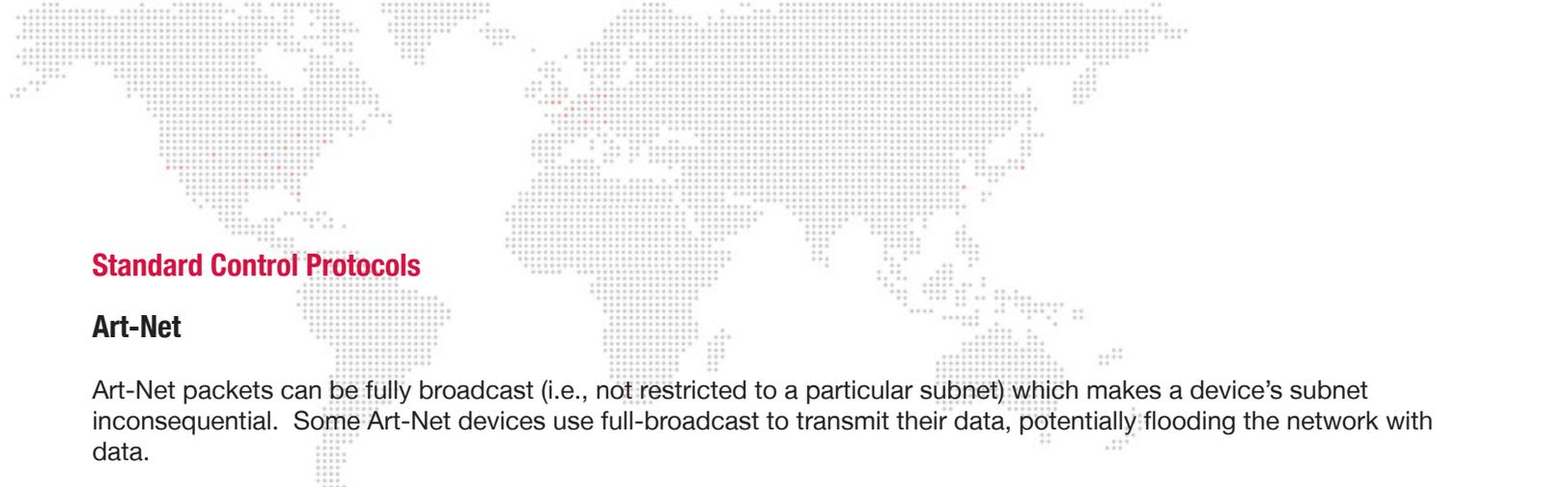
Standard Control Protocols

Art-Net

Art-Net packets can be fully broadcast (i.e., not restricted to a particular subnet) which makes a device's subnet inconsequential. Some Art-Net devices use full-broadcast to transmit their data, potentially flooding the network with data.

To reduce overhead, most Art-Net devices use a subnet mask of 255.0.0.0 and generally use either 002 or 010 as the first octet in their IP address. This places these devices into a specific subnet and they only talk to other Art-Net devices on the same subnet. Art-Net data would be sent to the subnet broadcast IP address - either 2.255.255.255 or 10.255.255.255. While this cuts down on some bandwidth usage vs. a full broadcast, it should be noted that subnet broadcasts still aren't the most efficient use of bandwidth.

For the best efficiency possible, Art-Net can be unicast from device to device. This cuts down on overhead, but means that the IP address for each device must be known in advance and the precise destination for every piece of data must be specified. This can make the hardware configuration and software setup more complex. Additionally, the device to be unicast to must still be on the same subnet as an interface on the Mbox computer, otherwise the packets won't be received at all.

sACN

sACN packets are typically multicast, which sidesteps the restrictions of subnets and subnet masks, meaning that any interface can send or receive data for any multicast group it joins. Of course, the interface <u>must</u> still be on the correct physical network for the multicast group. Joining a multicast group is most important when receiving data. Switches can monitor multicast data on the network, and then filter out data that a connected interface has not elected to receive (i.e. for a multicast group the interface has not joined).

Any interface on the computer can be used for multicast, but as noted earlier, the interface has to be specifically identified and registered as a member of the appropriate multicast group. sACN uses predetermined multicast groups, one for each sACN universe, with each group having a preset IP address. Without registering as a member of all of the necessary multicast groups (for transmitting or receiving), Mbox will not be able to send or receive sACN data. For the purposes of receiving multicast data, it is possible to have all the interfaces on a computer join a multicast group, so that the data is received no matter what interface it arrives on. But for the purposes of outputting multicast data, only one interface should join the group.

sACN does allow for broadcast or unicast but this functionality is not widely used.

KiNET

KiNET is intended to be unicast only. Therefore all packets are addressed to specific IP addresses. This is efficient, but as with Art-Net unicast, the user must know all of the IP addresses of the connected devices that they want to communicate with in advance. And as always, the Mbox computer must still have a interface that is on the same physical network and subnet as the receiving device.

Notes

B.

NOTABLE CHANGES FROM MBOX v3.x

This chapter briefly outlines notable changes between Mbox v3 and v4.

+   QUANTITY OF LAYERS AND OUTPUTS
+   ALIGNMENT RECTANGLES BECOME MIXES
+   LAYER COPY
+   TEXTURE SIZE
+   OUTPUT MODES
+   OUTPUT IDENTITY
+   OBJECT EFFECTS
+   TEXTURE EFFECTS
+   TIMECODE INPUT
+   LINKING FILES TO TIMECODE
+   AUDIO OUTPUT
+   3D CAMERA
+   KEYSTONE CONTROLS
+   OUTPUT GEOMETRY
+   COLOR CONTROLS
+   SYNC STREAMS
+   IMAGE REMAPPING
+   CITP/MSEX
+   AUDIO PLAYBACK
+   PROFILE EMULATION
+   LICENSES
+   HAP CODEC
+   IMAGE SEQUENCE PLAYBACK

NOTABLE CHANGES FROM MBOX V3.X

This section reviews features that have been added, changed, or removed in Mbox v4 as compared to Mbox v3.x

There have been some fairly substantial changes in the Mbox software between Mbox v3.10 and Mbox v4.0. Some of these changes have resulted in adding features and are explained elsewhere. Some of the changes have meant removing outdated features or changing how they work to improve them.

When switching between versions it may be necessary to change the way that certain results are achieved so as to avoid using features that have been removed.

Quantity of Layers and Outputs

Mbox v4 increases the number of playback layers for each version of the software. Mbox Mini increases to six layers, Studio to twelve, and Designer to twenty-four. All three versions of the software may now have more than two outputs. While there is no limitation on the number of physical outputs, there are limitations on the number of output masters and the total number of pixels in the outputs, depending on the version of the software.

Alignment Rectangles become Mixes

Alignment rectangles have been superseded by the new concept of Mixes. Mbox v4 does not read the alignment plist files, therefore information from these files needs to be manually re-entered as mixes within the Mbox application.

Mixes have the same functionality as alignment rectangles, plus more. They allow for cropping and centering of content, plus scale and rotation of content. Mixes can have a parent/child relationship, allowing one mix to be moved and having other mixes move by the same amount.

Mixes can be used as a source for a pixel mapping context. Mixes can also be used as a CITP source without any additional setup (i.e. no more CITP_additions file).

Mbox Daemon

The Mbox Daemon application is mostly the same between v3 and v4. However, the version of Daemon used with Mbox is critical to correct function. i.e. Do not use Daemon v3.x with Mbox v4.x and vice versa. In addition, the formatting of the database that Mbox and Daemon use for content management and synchronization is different between v3 and v4. If switching between versions of the Mbox software it may be necessary to rebuild the content database. Rebuilding the database is accomplished by clicking on the Commands pop-up on the Daemon application and choosing "Rebuild Database." Rebuilding the database can take up to 15 minutes or longer depending on the number of files in the /Media and /Models folders.

Layer Copy

Layer Copy FX- has been removed from the Mbox application. Layer Copy FX+ and Raw remain however. The media locations for these items has changed, with FX+ now being located at 255.1 – 255.24 (depending on the version of Mbox) and Raw being located at 255.31 – 255.54

Output Modes (e.g. Dual Independent, Pan Wide, etc.)

The new configuration tools for outputs in the Mbox v4 software mean that the four outputs modes found in Mbox v3.x are no longer used. Outputs may be set up as desired to be independent or panoramic. Both may be used on the same computer at the same time if desired. Output Masters allow each output to have controls for mastering color, intensity, 3D camera, keystone, etc.
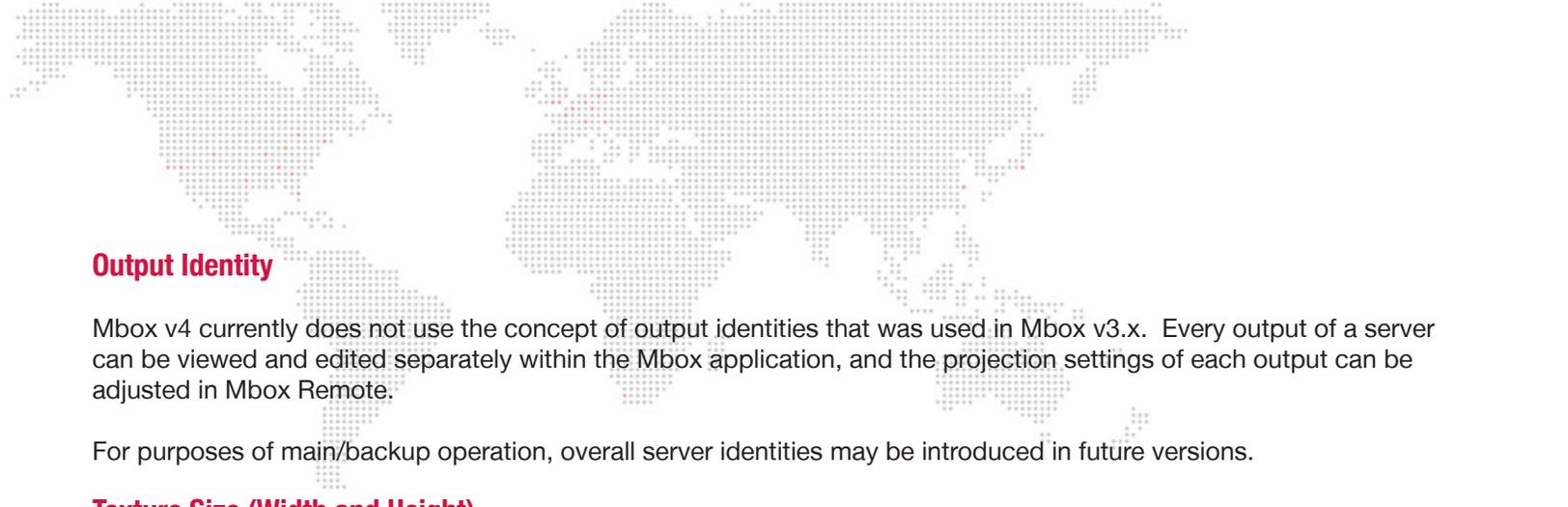
Output Identity

Mbox v4 currently does not use the concept of output identities that was used in Mbox v3.x. Every output of a server can be viewed and edited separately within the Mbox application, and the projection settings of each output can be adjusted in Mbox Remote.

For purposes of main/backup operation, overall server identities may be introduced in future versions.

Texture Size (Width and Height)

Mbox v4 no longer needs to have the texture size values manually entered in advance. The "texture size" for each layer is dynamically adjusted on the fly.

Object (3D) Effects

The majority of the object effects remain in Mbox v4. Some have been removed – Specular Highlight, Allegiance, AutoCrop. The AutoCrop effect's functionality has been replaced by mixes and the mix selection and mix mode parameters on every layer. Meaning that an effect no longer has to be used to get the same result.

The Texture scale, rotate, and x/y position effects do not yet work in Mbox v4.x but may be included in a future version.

Texture Effects

Mbox v4 keeps all the same texture (2D) effects as Mbox v3.x [except for a couple that are broken in El Capitan] but the numbering of effects has been changed to group similar effects. Additionally, the majority of the effects have received some enhancements made possible by the addition of three effect modifier parameters for each effect, giving a total of five per effect. Where possible, effects now have a Mix parameter that allows the effect to be blended in, rather than just on or off as in Mbox v3.x.

CAUTION! Some effects may take a while (2-3 seconds) to load the first time they are used. This appears to be due to delays in the OS. As a safety workaround, it may be necessary to create some pre-show cues that turn on the effects in order to preload them. Alternately, load the effect onto a background layer or a layer with opacity of 0 prior to using it on a visible layer.

CAUTION! Loading some effects may cause a brief click or pop in audio output. As with the previous warning above, preloading the effect is a valid work around.

Timecode Input

Mbox v4 allows an audio input (for timecode) directly into the application. Previously, Mbox v3.x required the use of the TC Reader application or Mbox Remote to receive timecode audio and send that to Mbox over the network. The Mbox application is now able to recognize and automatically compensate for the rate of the incoming timecode.

TC Reader and Mbox Remote are still able to perform the task of receiving timecode and broadcasting it to the Mbox application over the network. This will continue to work for some timecode formats (a notable exception is 29.97ndf). However the recommended practice for Mbox v4 is to input audio directly into the application as this will apply the correct compensation for all timecode formats.

The timecode input preference allows for the selection of the input device and the input channel on that device. The selected device does not have to be the same as the default audio input device selected in the System Preferences.

Note: The Mbox v4 application now supports timecode hours beyond 23:29:59:29. While times above 23 aren't officially kosher, situations have come up where a show uses times beyond 24 hours. Mbox v4 allows times up to 39:59:59:29.

Linking Files to Timecode Values (for timecode playmodes)

Previous versions of Mbox supported two different methods of permanently assigning timecode start times to movie files. These two methods included appending a suffix to the file name (e.g. "TC-01-00-00-00") and also using a separate file, the MediaTimeCodes.plist file.

In Mbox v4, using the TC file name suffix has been eliminated completely and is no longer supported. The MediaTimeCodes.plist can be used to create data in the new format, but has been replaced by the MediaInfo.plist. Mbox v4 has also made the DMX Timecode controls (extra parameters on each layer) a standard patched feature. This means that presetting the timecode start time for files may not be necessary as they can be changed in a live fashion.

The MediaInfo.plist file

Mbox v4 uses a new plist file for metadata for 2D content. The MediaInfo.plist file supports timecode start time assignment, enabling embedded audio playback, and setting the framerate for image sequences. In future versions of Mbox this file will provide additional functionality.

The MediaInfo.plist file is located in the Mbox/Media folder and can be edited using standard plist editing applications. The file's structure is quite simple. The root of the plist holds specifically named dictionaries for each media file that has active metadata, and each dictionary holds the metadata keys and their values.

The "tc_start" key is used to assign a timecode start time to the file, and uses a string value to designate that time.

IMPORTANT! The formatting of both the file index and the start time are critical, and incorrect formatting will lead to the metadata not being applied. The file index must be formatted as Folder.File, using a period between the two numbers and the numbers must have padding zeros - e.g. 001.100. The timecode value must use the HH:MM:SS:FF format, with the numbers separated by colons and all numbers using padding zeros.

If no MediaInfo.plist file exists, Mbox v4 automatically creates an empty file. The empty file can be used as the basis for new metadata by manually adding new items. If a MediaTimeCodes.plist file is placed into the Media folder and no existing MediaInfo.plist file exists, Mbox v4 will automatically create a new MediaInfo.plist file using the data from the MediaTimeCodes.plist the next time the application is launched. Once the data has been copied into the MediaInfo.plist file (or if the file already exists), the MediaTimeCodes.plist is ignored.

DMX Timecode controls

The last four parameters on each layer of Mbox v4 may be used to directly control the timecode start time for content on the layer. The four parameters represent Hours, Minutes, Seconds, and Frames and may be modified at any time - even while a file is playing.

IMPORTANT! Unless all four values are at zero, the DMX Timecode value will always override any timecode start time set in the MediaInfo plist.
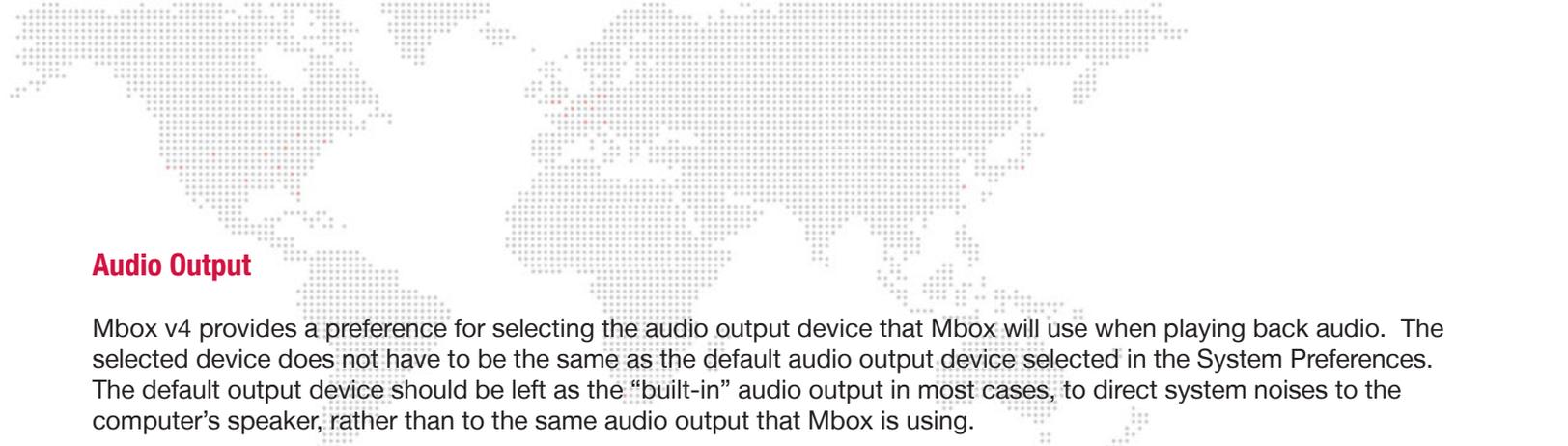
Audio Output

Mbox v4 provides a preference for selecting the audio output device that Mbox will use when playing back audio. The selected device does not have to be the same as the default audio output device selected in the System Preferences. The default output device should be left as the "built-in" audio output in most cases, to direct system noises to the computer's speaker, rather than to the same audio output that Mbox is using.

There is also an audio playback offset preference which allows the audio to be advanced/delayed vs. the video playback when playing a movie. This is a global preference, affecting all audio playback on the server. Typically, this preference will be set to a positive number, indicating that the audio is advanced with respect to the video. This is because sound travels more slowly that light, resulting in an audio delay over longer distances. The preference has a range of -2.0 (delay) to +2.0 (advance) seconds.

Note: Mbox v4 can play eight files with audio at the same time. Beginning with Mbox v4.2 both movies with embedded audio and sidecar audio files will allow for playback of up to 24 channels of audio. Files for Mbox v4.0 and v4.1 can only have two audio channels (stereo).

3D Camera

As in previous versions of Mbox, there is a 3D camera that allows perspective views of 3D objects within Mbox's 3D environment. Mbox Designer has a configurable/controllable 3D camera, but Mbox Studio and Mbox Mini have a default 3D camera that is not configurable.

Mbox Designer v4's 3D camera and its control parameters work differently to the camera and controls in Mbox v3.x. In Mbox v3.x the camera was always pointing towards the center of 3D space (X,Y,Z = 0,0,0) unless the pitch or yaw controls were changed. The v3.x camera could be orbited around the center of 3D space. While these controls were simple, they meant that the camera could not be horizontally or vertically panned, and that the camera position, which used 16-bit controls, couldn't be related to actual 3D coordinates.

In Mbox v4, the camera itself has an adjustable X,Y,Z position (which defaults to 0,0,10) and also has an adjustable lookat position (which defaults to 0,0,0). This allows both the camera and its position to be adjusted, either independently or at the same time – thereby allowing for panning. The orbit, pitch, and yaw controls have been eliminated.

Due to the changes in the 3D camera in Mbox v4, two of the controls have non-typical defaults. The camera Z position default is 42767, which equates to a value of 10 units in 3D space. And the camera FOV has a default value of 71, which equates to 25°, which is the default FOV in the projection editor in Mbox Remote. These defaults allow the camera to be seamlessly switched between DMX and Mbox Remote control without any perspective shift if the values (in both DMX and Remote) are at their defaults.

Keystone Controls

Mbox v4 uses 16-bit controls for DMX keystone corner control – as opposed to the 8-bit controls in Mbox v3.x. Also, the Mbox v4 keystone corners can be moved outwards as well as inwards. The DMX keystone controls also include X and Y linearity parameters.

The DMX keystone controls include a parameter to enable/disable the controls (DMX control is disabled by default) and this parameter has different options for the blend area curve type/mode. The new options match those found in Mbox Remote for vignettes – linear, raised cosine, and sine. For most situations, the linear option is the most appropriate. Each curve also has a grid option, allowing a grid to be overlaid onto the output image. Finally, there is an option to have the DMX keystone enabled but to disable the blending and turn on the grid without the blending.
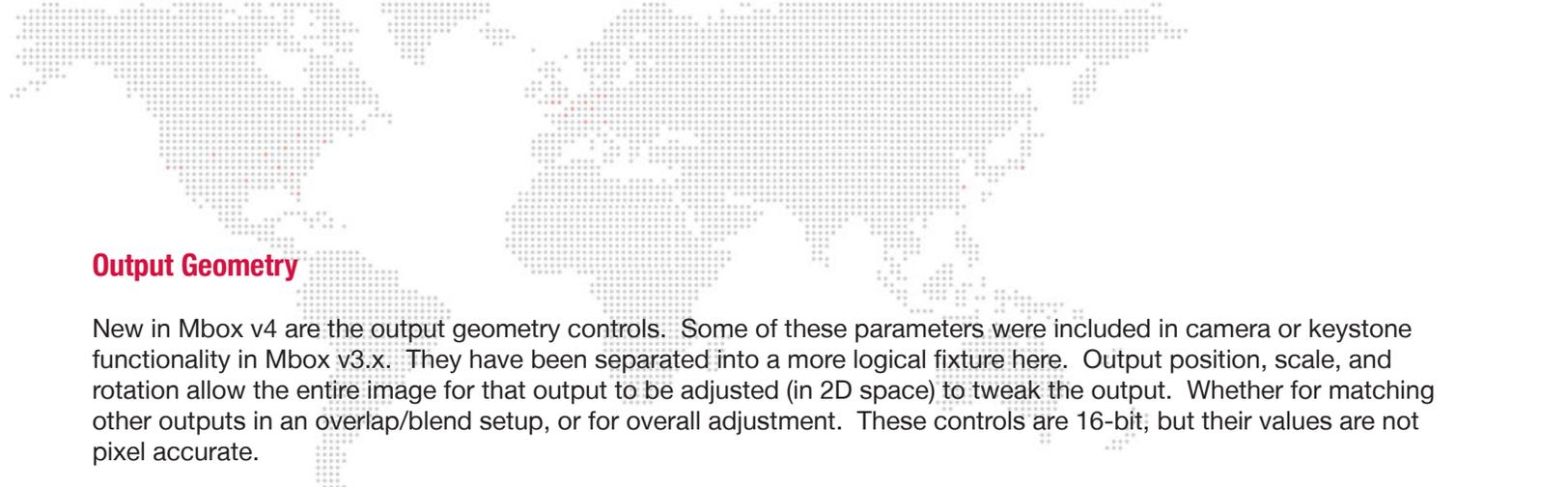
Output Geometry

New in Mbox v4 are the output geometry controls. Some of these parameters were included in camera or keystone functionality in Mbox v3.x. They have been separated into a more logical fixture here. Output position, scale, and rotation allow the entire image for that output to be adjusted (in 2D space) to tweak the output. Whether for matching other outputs in an overlap/blend setup, or for overall adjustment. These controls are 16-bit; but their values are not pixel accurate.

There are also two controls for X and Y mix offset that are pixel accurate. These controls allow the imagery for an output to be moved left/right and up/down on the Global Surface by an exact pixel amount with control from the console/Director. These 16-bit controls have a default of 32767 and therefore allow 32767 pixels of movement. This is far more pixels than is supported by the Global Surface size limits, so care is required. The mix offset controls are exactly that, offsets. They act to offset the output's position on the Global Surface from its position as set up in the initial configuration on the Outputs tab of the Mbox application. Therefore, if an output has an X position of 100 on the Outputs tab, setting the mix offset X parameter to a value of 32867 will move the mix 100 pixels to the right on the Global Surface. Note that this is a live offset and does not affect the stored values on the Outputs tab, and which is not saved when the application quits, nor recalled when the application launches.

Color Controls

Color controls on Mbox's layers and output masters now have both subtractive and additive controls. These controls are still 8-bit, and now have a default of 127. Controls for both brightness and contrast have been added, eliminating the need to use layer/master effects to perform these tasks.

Sync Streams

The number of sync streams available has been increased. All versions are capable of listening to streams 1 – 96, but the number of output streams is limited. Mbox Designer can output 32 streams, Studio 16, and Mini 8. Streams 33-96 are reserved for special purposes.

Image Remapping (Multiscreen gobo)

In Mbox v3.x, the Multiscreen gobo was a discrete item of content (in the Models folder) which was required to be selected on a layer for use. An additional parameter was used to select the individual configuration from with the currently selected image remapping file.

In Mbox v4, the multiscreen gobo "object" is built into the Mbox application itself, and is no longer selected as an actual object on each layer. There is a new Image Remapping parameter that can select the configuration from within the currently selected image remapping file.

Because image remapping needs to be disabled, a value of 0 for the image remapping parameter disables image remapping. This means that image remapping files can no longer have a configuration 0, and now start with configuration 1. Image remapping is now configured in the Mbox and Mbox Remote applications which use this new scheme. The new application also allows a background image to be applies to the editor when creating configurations.

CITP/MSEX

Mbox v4 continues to use CITP/MSEX (v1.1) for the transfer of thumbnails to consoles and the streaming of imagery to consoles and visualizers.

In Mbox v3 only outputs and layers were available as CITP stream sources, but in Mbox v4 mixes can now be used as sources for CITP streams.

Audio Playback

Mbox v4 follows many of the same rules/guidelines that Mbox v3.x did in terms of audio playback. In most cases the audio works better and performance overall is greatly improved. Like Mbox v3.x, Mbox v4 has two playback engines, a preferred engine for movie content that is rendered using spatially compressed codecs (ProRes, Photo-JPEG) and movies without embedded audio, and a secondary engine (AVFoundation player) for movies using temporally compressed codecs (H.264) and movies with embedded audio that have the .audio tag. Use of the AVFoundation player does not mean second class performance as it did in Mbox v3.x but some aspects of playback may be unavailable in the AVFoundation player (see below).

Either separate ("sidecar") audio files or audio that is embedded in the QuickTime movie can be used. Both should produce the same result with regard to performance and sync between audio and video. To use embedded audio, add ".audio" to the end of the file name, before the .mov file extension – the same as with Mbox v3.x.

Prior to Mbox v4.4.3, movies with embedded audio have to use AAC encoding for the audio for correct audio playback. Files with Linear PCM encoding will exhibit audio startup delay and/or playspeed issues in older versions. In these older versions, sidecar audio files should be used as the alternative to LPCM audio encoding. Sidecar audio files can use AAC, MP3, AIF, M4A, or WAV encoding. Sidecar files should have the same index number as the movie they are associated with and should be placed into the same content folder.

Mbox v4.4.3 adds auto-sidecar functionality that can automatically make sidecar audio files from movies having embedded audio that is not of the correct encoding. Thereby eliminating the need to manually make sidecar audio files. Refer to "Auto-sidecar Audio Files" on page 100 for more information.

As with Mbox v3.x some playmodes may not produce useful audio output – e.g. Random, reverse modes, and so on… because the don't play the movie forwards in a sequential manner.

Profile Emulation

Mbox v3 allowed the use of a greater version of the product software in a mode emulating a lesser version of the software. e.g. Running Mbox Studio as if it were Mbox Mini. However, Mbox v3 did not allow a lesser version of the software to emulate a greater version. Mbox v4 has added the ability for a lesser version to emulate a greater version. Of course, if a feature is limited or disabled in the lesser version, it will still be limited not be available for use. However, the emulation mode will allow Mbox to replicate a show programmed in a greater version as correctly as possible given the differences in the product capabilities.

Also, there are emulation modes for the most recent previous version of Mbox software (v3.8 – 3.10.2 footprint) to provide the ability to use a previously programmed show file to control the new Mbox software in some case. Emulation for versions prior to Mbox v3.8 is not supported.

These emulation features are intended as a convenience to allow users to more easily run a show that has been programmed using a different version of the Mbox software. While every attempt has been made to ensure compatibility, some features may not work in emulation modes. Testing the functionality in advance is strongly recommend, and no guarantee of full compatibility is given.

Licenses

Mbox v4 uses a different license than Mbox v3.x. Therefore a soft license or USB license key for Mbox v3.x will not license the Mbox v4 software. A license upgrade is required, contact Mboxsupport@prg.com or a PRG rep for more details.

Hap Codec

Mbox v4.1 adds the necessary frameworks for <u>native</u> playback of movies encoded using the Hap codec. The Hap codec was created by VidVox LLC. and Tom Butterworth to take advantage of hardware-accelerated (GPU) decompression rather than CPU-based decompression. Movies encoded with the Hap codec will provide better performance if the computer has both a good graphics card and a fast disk system (SSD or flash).   For more information, visit http://vdmx.vidvox.net/blog/hap

Image Sequence Playback

Mbox v4.1 added support for the playback of Image Sequences. Image sequences can be used in place of movies and are made up of multiple still image files, numbered sequentially. To play an image sequence as if it's a movie, rather than a still image, Mbox displays the still images one after the other, at a predetermined rate. There are both advantages and disadvantages to image sequences.

+ Pro - images can use still image formats (PNG, TIFF) that are less lossy or lossless (i.e. uncompressed) and which can have alpha channels.

+ Pro - with image sequences it's possible to make changes by only editing and re-rendering the affected frames/images rather than the entire movie. Thereby reducing transfer time for the changes.

+ Pro - image sequences can be played back at any frame rate.

+ Pro - like movies, images sequences can have sidecar audio files.

+ Con - a movie running at 30fps with require 1800 image files per minute of content, which means lots of files.

+ Con - some image formats (especially TIFF) have extremely large file sizes. PNG is relatively compact, but TIFF requires about 8Mb for a single 1080p image.

+ Con - image sequence files must be converted to raw cvbuf files for actual playback, this process can take time if there are a lot of new files, and the cvbuf files take up more disk space.

C.

FIXTURE PROFILE REFERENCE

This chapter talks about changes in fixture profiles

+ FIXTURE DESCRIPTIONS
+ PATCHING NOTES
+ PATCH ORDER SUMMARIES
+ FIXTURE PARAMETER DATA
+ FIXTURE PARAMETER DESCRIPTIONS
+ DISCRETE VALUES FOR SLOTTED PARAMETERS

FIXTURE DESCRIPTIONS

Overview

For control purposes, the various parameters that are used to control an Mbox server are combined into groups. In keeping with generic lighting control terminology, each of these groups is referred to as a "fixture." Each group of parameters has a common function that may be limited in a logical way based on overall mastering, outputs, or playback layers. In this way, the Mbox server can be thought of a complex moving light, and can be controlled like one too.

The following is a brief synopsis of the fixture types in Mbox v4. There are some guidelines to keep in mind:

+ Fixture Profile layouts for Mbox Director or lighting consoles may combine some or all of these fixtures into different fixture groupings depending on the desired layout.

+ Mbox v4.x requires all of the necessary fixture types with all of their sub-fixtures to be patched. Future versions may allow for more custom patching arrangements.

+ The three different versions of Mbox have different fixtures and/or quantities of their sub-fixtures. See the charts in the following pages for more information.

+ Refer to "Fixture Descriptions" on page 12 for more information on individual parameters.

Global Master Fixture

The Global Master Fixture provides controls for mastering overall video output intensity, pixel mapping output intensity, overall volume level. Additionally, the global master's control channel and control selector can be used together to show HUDs or to perform macro actions for things like rescan, enabling backup mode, scripts, etc.

Lighting Fixtures

For Mbox Designer and Studio, the five lighting fixtures provide adjustable lighting for 3D objects displayed within Mbox's 3D environment. Each lighting fixture has adjustable intensity, color, and ambience (i.e. beam spread), and can be moved in 3D space.

Output Master Fixture

The Output Master Fixture base controls provide for mastering intensity, color, brightness, and contrast for the output. Additional functionality provides output effect selection and adjustment, 3D Camera configuration (Mbox Designer only), output geometry, keystone, and shuttering.

Mbox v4 allows for the creation of multiple video outputs, and each output can optionally have Output mastering controls assigned to it. The default patch for an "Mbox Output Master" fixture includes all of the fixtures detailed below.

CAUTION! Fixture Profile layouts for Mbox Director and/or lighting consoles will commonly split some or all of the sub-fixtures of the Output Master fixture into several separate fixtures to make it simpler to manage the number of parameters and the logical separation of their function.

Output Master: Intensity

The Output Intensity parameter allows for mastering of the intensity of the output. It does not affect the opacity of any layers or Global Master Intensity.
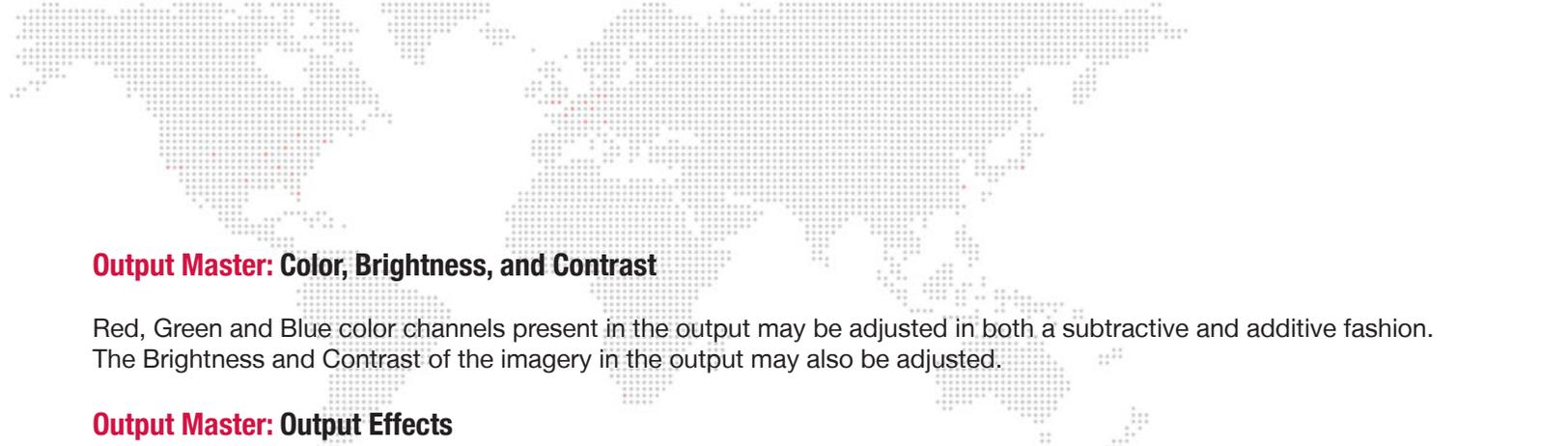
Output Master: Color, Brightness, and Contrast

Red, Green and Blue color channels present in the output may be adjusted in both a subtractive and additive fashion. The Brightness and Contrast of the imagery in the output may also be adjusted.

Output Master: Output Effects

The Output Effects are pulled from the shader-based texture effects (1-220) that may be used on each layer. The effect will be applied only across the imagery in the output, not affecting imagery on layers or other outputs. Mbox v4 expands the flexibility of effects by allowing for up to five modifiers.

Output Master: Camera

The Output Camera modifies the 3D perspective viewpoint for only the output it is applied to, allowing a virtual camera position and look-at point for that camera. 3D objects that are visible within the boundaries of the output will be rendered using the perspective of the camera.

Note: Multiple outputs can each have a camera applied to them, allowing for projection mapping onto multiple objects, or onto the same object but from different perspectives.

Output Master: Geometry

The Output Geometry Fixture controls may be used to modify supplemental 2D rendering parameters for only this output, not affecting any other outputs from the server. None of the output geometry controls affect the 3D perspective of object rendered on the output.

Output Master: Keystone

The Output Keystone Fixture controls are used to enable and modify keystone and edge-blending parameters for only this output, not affecting any other outputs from the server.

Output Master: Shutter

The Output Shutter Fixture may be used to apply 2D shuttering that can obscure portions of the output, but which does not affect any other outputs from the server. The shutters can be thought of as sitting between the composited imagery of the output and the virtual camera that provide the view of the imagery.

Layer Fixture

The Layer Fixture in Mbox is where all playback of 2D and 3D content occurs. Images, movies, and objects are selected and arranged to create the composite imagery that is then output from the server's video outputs. Each Layer's functionality includes a set of base parameters for media selection and composition, plus effects to modify imagery, and also volume control for audio on the layer, plus controls to set the timecode link time for movie content using a timecode sync playmode.

Layer Fixture: Base

The core functionality of each layer is the display of 2D and/or 3D content. Content is displayed in 2D or 3D space appropriately, and various parameters affect its opacity, how it looks (color, brightness, contrast), where it is placed, how it is scaled and rotated. More advanced parameters affect blending between the layer and layers below it in the rendering stack, and also affect assignment to mixes or image remapping configurations.
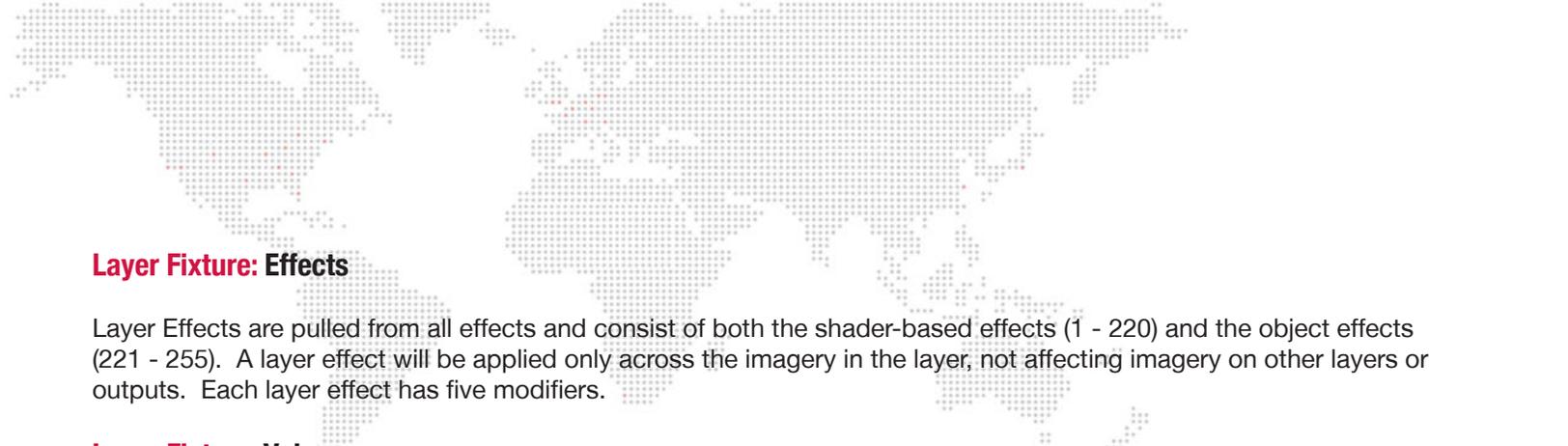
Layer Fixture: Effects

Layer Effects are pulled from all effects and consist of both the shader-based effects (1 - 220) and the object effects (221 - 255). A layer effect will be applied only across the imagery in the layer, not affecting imagery on other layers or outputs. Each layer effect has five modifiers.

Layer Fixture: Volume

The Layer Volume parameter affects the output volume of audio content on the layer, not affecting audio volume on other layers.

Layer Fixture: DMX Timecode

The Layer DMX Timecode parameters are used to apply a live timecode sync value to movie content on the layer. This value applies only when a timecode sync play mode is used.
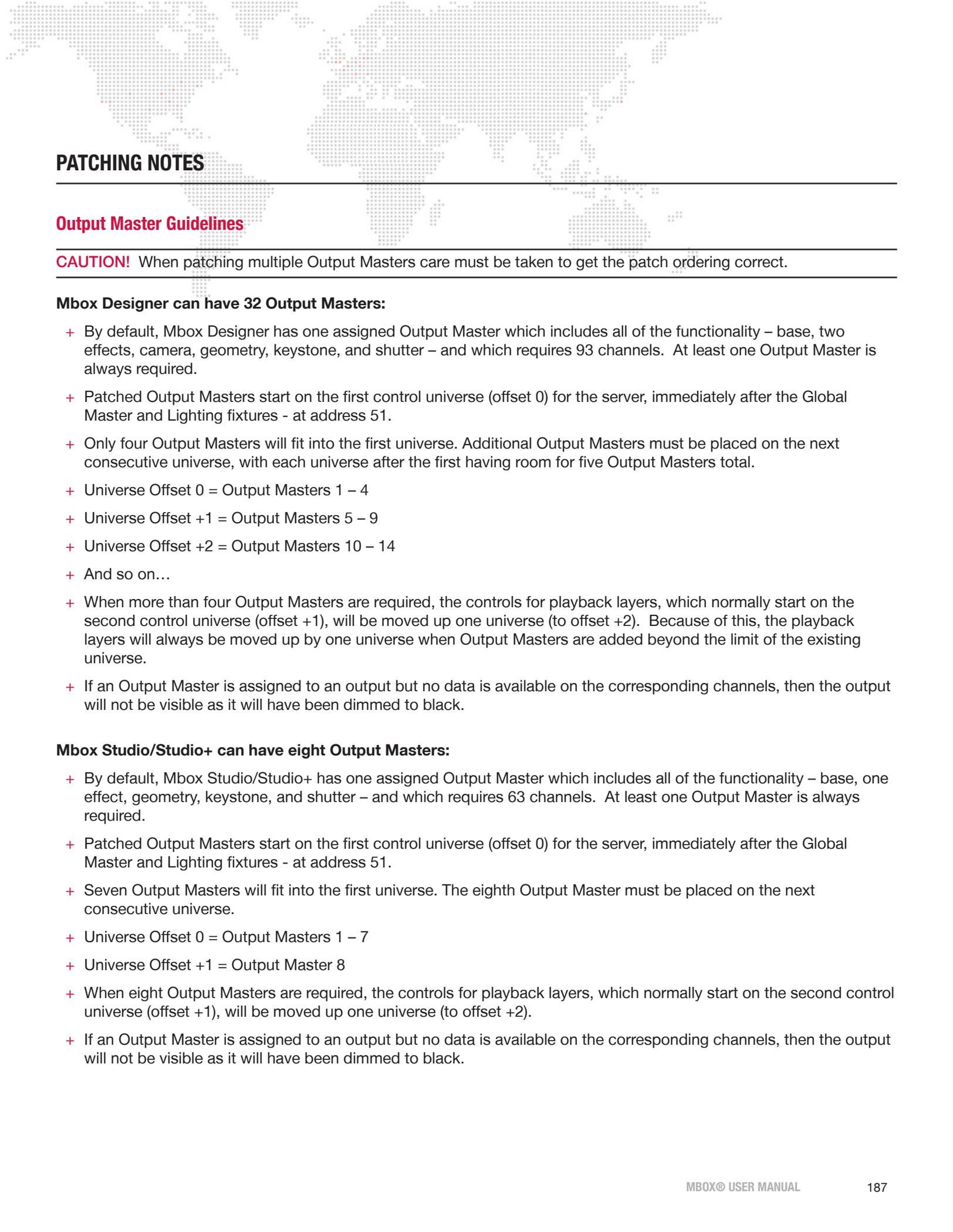
PATCHING NOTES

Output Master Guidelines

CAUTION! When patching multiple Output Masters care must be taken to get the patch ordering correct.

Mbox Designer can have 32 Output Masters:

+ By default, Mbox Designer has one assigned Output Master which includes all of the functionality – base, two effects, camera, geometry, keystone, and shutter – and which requires 93 channels. At least one Output Master is always required.

+ Patched Output Masters start on the first control universe (offset 0) for the server, immediately after the Global Master and Lighting fixtures - at address 51.

+ Only four Output Masters will fit into the first universe. Additional Output Masters must be placed on the next consecutive universe, with each universe after the first having room for five Output Masters total.

+ Universe Offset 0 = Output Masters 1 – 4

+ Universe Offset +1 = Output Masters 5 – 9

+ Universe Offset +2 = Output Masters 10 – 14

+ And so on…

+ When more than four Output Masters are required, the controls for playback layers, which normally start on the second control universe (offset +1), will be moved up one universe (to offset +2). Because of this, the playback layers will always be moved up by one universe when Output Masters are added beyond the limit of the existing universe.

+ If an Output Master is assigned to an output but no data is available on the corresponding channels, then the output will not be visible as it will have been dimmed to black.

Mbox Studio/Studio+ can have eight Output Masters:

+ By default, Mbox Studio/Studio+ has one assigned Output Master which includes all of the functionality – base, one effect, geometry, keystone, and shutter – and which requires 63 channels. At least one Output Master is always required.

+ Patched Output Masters start on the first control universe (offset 0) for the server, immediately after the Global Master and Lighting fixtures - at address 51.

+ Seven Output Masters will fit into the first universe. The eighth Output Master must be placed on the next consecutive universe.

+ Universe Offset 0 = Output Masters 1 – 7

+ Universe Offset +1 = Output Master 8

+ When eight Output Masters are required, the controls for playback layers, which normally start on the second control universe (offset +1), will be moved up one universe (to offset +2).

+ If an Output Master is assigned to an output but no data is available on the corresponding channels, then the output will not be visible as it will have been dimmed to black.
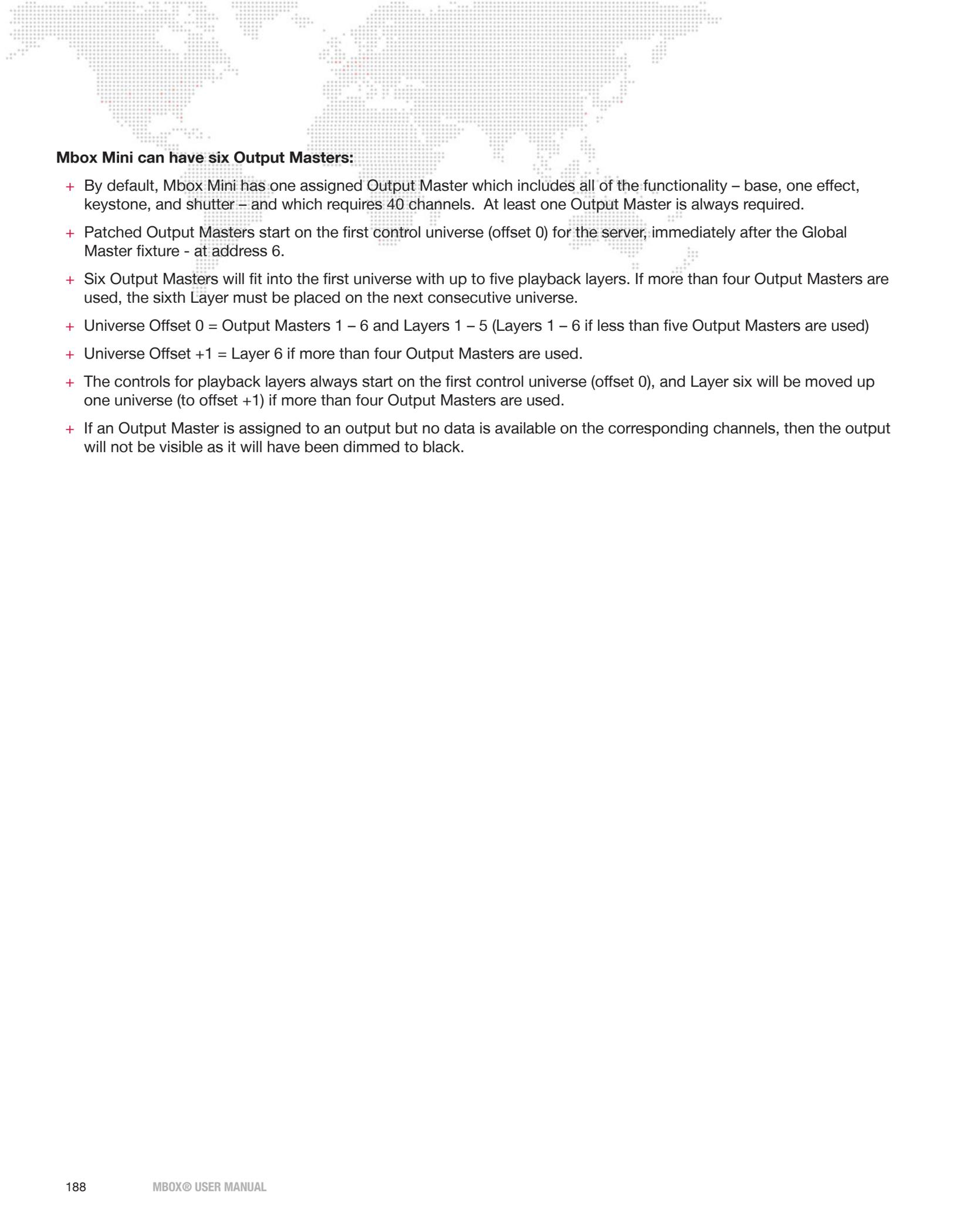
Mbox Mini can have six Output Masters:

+ By default, Mbox Mini has one assigned Output Master which includes all of the functionality – base, one effect, keystone, and shutter – and which requires 40 channels. At least one Output Master is always required.

+ Patched Output Masters start on the first control universe (offset 0) for the server, immediately after the Global Master fixture - at address 6.

+ Six Output Masters will fit into the first universe with up to five playback layers. If more than four Output Masters are used, the sixth Layer must be placed on the next consecutive universe.

+ Universe Offset 0 = Output Masters 1 – 6 and Layers 1 – 5 (Layers 1 – 6 if less than five Output Masters are used)

+ Universe Offset +1 = Layer 6 if more than four Output Masters are used.

+ The controls for playback layers always start on the first control universe (offset 0), and Layer six will be moved up one universe (to offset +1) if more than four Output Masters are used.

+ If an Output Master is assigned to an output but no data is available on the corresponding channels, then the output will not be visible as it will have been dimmed to black.

PATCH ORDER SUMMARIES

Summary: Mbox Designer

Start	Size	Type	Sub-Type	Universe
1	5	Global Master		
6	9	Light 1		
15	9	Light 2		
24	9	Light 3		
33	9	Light 4		
42	9	Light 5		1st
51	6	Output Master 1	Base	143 Total
57	6		FX 1	Channels
63	6		FX 2	(1 Master)
69	16		Camera	
85	12		Geometry	
97	26		Keystone	
123	21		Shutter	
Up to 31 additional Output Masters may be added, 93 channels each, using consecutive universes as necessary.				
1	81	Layer 1	Base	
53	6		FX 1	
59	6		FX 2	
65	6		FX 3	
71	6		FX 4	Next
77	1		Audio Volume	Universe
78	4		DMX Timecode	after Masters
82	81	Layer 2		486 Total
163	81	Layer 3		Channels
244	81	Layer 4		(6 Layers)
325	81	Layer 5		
406	81	Layer 6		
Up to 18 additional Layers may be added, 81 channels each, using consecutive universes as necessary.				

Summary: Mbox Studio

Start	Size	Type	Sub-Type	Universe
1	5	Global Master		
6	9	Light 1		
15	9	Light 2		
24	9	Light 3		
33	9	Light 4		1st
42	9	Light 5		
51	6	Output Master 1	Base	113 Total
57	6		FX	Channels
63	12		Geometry	(1 Master)
75	26		Keystone	
101	13		Shutter	
Up to 7 additional Output Masters may be added, 63 channels each, using consecutive universes as necessary.				
1	41	Layer 1	Base	
42	6		FX 1	
48	6		FX 2	
54	1		Audio Volume	Next
55	4		DMX Timecode	Universe
59	58	Layer 2		after Masters
117	58	Layer 3		
175	58	Layer 4		464 Total
233	58	Layer 5		Channels
291	58	Layer 6		(8 Layers)
349	58	Layer 7		
407	8	Layer 8		
Up to 4 additional Layers may be added, 58 channels each, using the next consecutive universe.				

Summary: Mbox Mini

Start	Size	Type	Sub-Type	Universe
1	5	Global Master		1st
6	6	Output Master 1	Base	
15	6		FX	45 Total
24	16		Keystone	Channels
33	12		Shutter	(1 Master)
Up to 5 additional Output Masters may be added, 40 channels each, using consecutive addresses. Patch before any layers!!				
46	41	Layer 1	Base	
87	6		FX	
93	1		Audio Volume	Same Universe after Masters
94	4		DMX Timecode	
98	52	Layer 2		312 Total
150	52	Layer 3		Channels
202	52	Layer 4		(6 Layers)
254	52	Layer 5		
306	52	Layer 6		
If 5 or 6 Output Masters are used, Layer 6 must be moved to the next consecutive universe.				

Pixel Mapping Group Control Fixture

Start	Size	Type	Sub-Type	Universe
1	5	PixMap Control	n/a	Varies
The Pixel Mapping Control fixture is an optional add-on fixture for all versions of Mbox. Between 1 and 2000 of this fixture may be added and patched wherever desired. Patch location is set in the Mbox Remote application.				

FIXTURE PARAMETER DATA

The data in these charts is organized by fixtures and/or sub-fixture components. See tables beginning on page 48 for information on how sub-fixtures are combined into fixtures. In some cases, PRG recommends combining sub-fixtures (e.g. the Layer fixture) to create one fixture rather than several.

Note: The following tables show combined information for Designer, Studio, and Mini. The applicable version is noted in the title for each table (e.g. [Designer/Studio]) and in the case of effects, the differing quantities of each item per product version are noted in parentheses (e.g. [Designer(2)/Studio(1)/Mini(1)]).

Global Master [Designer/Studio or Studio+/Mini]

Chan	Size	Function	Default	Snap	Notes
1	1	Intensity	255	N	Overall Dimming (in IO Module if present)
2	1	Control	0	Y	See Global Master Control Channel
3	1	Control Selector	0	Y	Modifier for control macros
4	1	Pixel Mapping Intensity	255	N	Master level for pixel mapping output
5	1	Master Volume	255	N	Master level for all audio output
	5	**Total Channels**			

Light [Designer/Studio or Studio+ only]

Chan	Size	Function	Default	Snap	Notes
1	1	Intensity	255	N	
2	1	Red	255	N	
3	1	Green	255	N	
4	1	Blue	255	N	
5	1	Ambience	255	N	
6	2	Horizontal Bearing	32767	N	
8	2	Vertical Bearing	32767	N	
	9	**Total Channels**			

Output Master Base [Designer/Studio or Studio+/Mini]

Chan	Size	Function	Default	Snap	Notes
1	1	Intensity	255	N	Software dimming of output
2	1	Red	127	N	Subtractive 0-126, Additive 128-255
3	1	Green	127	N	Subtractive 0-126, Additive 128-255
4	1	Blue	127	N	Subtractive 0-126, Additive 128-255
5	1	Brightness	127	N	
6	1	Contrast	127	N	
	6	**Total Channels**			

Output Master Effect [Designer(2)/Studio or Studio+(1)/Mini(1)]

Chan	Size	Function	Default	Snap	Notes
1	1	Effect Select	0	Y	See Combined Effects
2	1	Modifier 1	0	N	
3	1	Modifier 2	0	N	
4	1	Modifier 3	0	N	
5	1	Modifier 4	0	N	
6	1	Modifier 5	0	N	
	6	**Total Channels**			

Output Master Camera [Designer only]

Chan	Size	Function	Default	Snap	Notes
1	1	Enable Projection Camera	0	Y	Value of 0 applies DMX controls, 255 applies Projection Mapping Camera matrix from Mbox Remote
2	2	Position X	32767	N	
4	2	Position Y	32767	N	
6	2	Position Z	42767	N	Note: non-standard default
8	2	Lookat X	32767	N	
10	2	Lookat Y	32767	N	
12	2	Lookat Z	32767	N	
14	1	Field of View	71	N	Note: non-standard default
15	2	Roll	32767	N	
	16	**Total Channels**			

Output Master Geometry [Designer/Studio or Studio+ only]

Chan	Size	Function	Default	Snap	Notes
1	1	Output Position X	32767	Y	
3	2	Output Position Y	32767	N	
5	2	Output Scale	32767	N	
7	2	Output Rotation	32767	N	
9	2	Mix Offset X	32767	N	
11	2	Mix Offset Y	32767	N	
	12	**Total Channels**			

Output Master Keystone [Designer/Studio or Studio+]

Chan	Size	Function	Default	Snap	Notes
1	1	Curve	0	Y	See Keystone Blend Mode/Curves
2	1	Gamma	127	N	
3	1	Edge Top	0	N	
4	1	Edge Right	0	N	
5	1	Edge Bottom	0	N	
6	1	Edge Left	0	N	
7	2	Keystone 1x	32767	N	
9	2	Keystone 1y	32767	N	
11	2	Keystone 2x	32767	N	
13	2	Keystone 2y	32767	N	
15	2	Keystone 3x	32767	N	
17	2	Keystone 3y	32767	N	
19	2	Keystone 4x	32767	N	
21	2	Keystone 4y	32767	N	
23	2	Linearity X	32767	N	
25	2	Linearity Y	32767	N	
	26	**Total Channels**			

Output Master Keystone [Mini]

Chan	Size	Function	Default	Snap	Notes
1	2	Keystone 1x	32767	N	
3	2	Keystone 1y	32767	N	
5	2	Keystone 2x	32767	N	
7	2	Keystone 2y	32767	N	
9	2	Keystone 3x	32767	N	
11	2	Keystone 3y	32767	N	
13	2	Keystone 4x	32767	N	
15	2	Keystone 4y	32767	N	
	16	**Total Channels**			

Output Master Shutter [Designer]

Chan	Size	Function	Default	Snap	Notes
1	1	Shape	0	Y	See Shutter Mode/Shapes
2	1	Red	0	N	Additive
3	1	Green	0	N	Additive
4	1	Blue	0	N	Additive
5	1	Edge Softness	0	N	
6	1	Shutter 1a	0	N	
7	1	Shutter 1b	0	N	
8	1	Shutter 2a	0	N	
9	1	Shutter 2b	0	N	
10	1	Shutter 3a	0	N	
11	1	Shutter 3b	0	N	
12	1	Shutter 4a	0	N	
13	1	Shutter 4b	0	N	
14	2	X Position	32767	N	
16	2	Y Position	32767	N	
18	2	Scale	65535	N	
20	1	Rotation	127	N	
21	1	Damping	0	N	
	21	**Total Channels**			

Output Master Shutter [Studio or Studio+]

Chan	Size	Function	Default	Snap	Notes
1	1	Shape	0	Y	See Shutter Mode/Shapes
2	1	Red	0	N	Additive
3	1	Green	0	N	Additive
4	1	Blue	0	N	Additive
5	1	Edge Softness	0	N	
6	1	Shutter 1a	0	N	
7	1	Shutter 1b	0	N	
8	1	Shutter 2a	0	N	
9	1	Shutter 2b	0	N	
10	1	Shutter 3a	0	N	
11	1	Shutter 3b	0	N	
12	1	Shutter 4a	0	N	
13	1	Shutter 4b	0	N	
	13	**Total Channels**			

Output Master Shutter [Mini]

Chan	Size	Function	Default	Snap	Notes
1	1	Red	0	Y	Additive
2	1	Green	0	N	Additive
3	1	Blue	0	N	Additive
4	1	Edge Softness	0	N	
5	1	Shutter 1a	0	N	
6	1	Shutter 1b	0	N	
7	1	Shutter 2a	0	N	
8	1	Shutter 2b	0	N	
9	1	Shutter 3a	0	N	
10	1	Shutter 3b	0	N	
11	1	Shutter 4a	0	N	
12	1	Shutter 4b	0	N	
	12	**Total Channels**			

Layer Base [Designer]

Chan	Size	Function	Default	Snap	Notes
1	1	Opacity	0	N	
2	1	Red	127	N	Subtractive 0-126, Additive 128-255
3	1	Green	127	N	Subtractive 0-126, Additive 128-255
4	1	Blue	127	N	Subtractive 0-126, Additive 128-255
5	1	Brightness	127	N	
6	1	Contrast	127	N	
7	1	Texture Folder	0	Y	Folder 255: see Video and Utility Inputs
8	1	Texture File	0	Y	
9	1	Play Mode	0	Y	See Play Modes
10	1	Play Speed	127	N	See Play Speed
11	2	In Frame	0	N	
13	2	Out Frame	65535	N	
15	1	Sync Stream	0	Y	See Sync Streams
16	1	Sync Offset	0	N	
17	1	Aspect Ratio	0	N	See Aspect Control
18	1	Frame Blending	255	N	See Frame Blending Control
19	1	Texture Xfade Type	0	Y	See Texture Transitions
20	1	Texture Xfade Time	0	Y	See Texture Transition Timing
21	1	Object Folder	0	Y	
22	1	Object File	0	Y	
23	1	Reserved	0	N	
24	1	Reserved	0	N	
25	2	X Position	32767	N	
27	2	Y Position	32767	N	
29	2	Z Position	32767	N	
31	2	Scale	32767	N	
33	2	X Scale	32767	N	
35	2	Y Scale	32767	N	
37	2	Z Scale	32767	N	
39	2	Z Rotation	32767	N	
41	2	X Rotation	32767	N	
43	2	Y Rotation	32767	N	
45	1	Z Spin	127	N	
46	1	X Spin	127	N	
47	1	Y Spin	127	N	
48	1	Mix Select	0	Y	
49	1	Mix Mode	0	Y	See Layer Mix Modes
50	1	Blend Mode	0	Y	See Blend Modes
51	1	Draw Mode	0	Y	See Draw Modes
52	1	Image Remap	0	Y	
	52	**Total Channels**			

Layer Base [Studio or Studio+/Mini]

Chan	Size	Function	Default	Snap	Notes
1	1	Opacity	0	N	
2	1	Red	127	N	Subtractive 0-126, Additive 128-255
3	1	Green	127	N	Subtractive 0-126, Additive 128-255
4	1	Blue	127	N	Subtractive 0-126, Additive 128-255
5	1	Brightness	127	N	
6	1	Contrast	127	N	
7	1	Texture Folder	0	Y	Folder 255: see Video and Utility Inputs
8	1	Texture File	0	Y	
9	1	Play Mode	0	Y	See Play Modes
10	1	Play Speed	127	N	See Play Speed
11	2	In Frame	0	N	
13	2	Out Frame	65535	N	
15	1	Sync Stream	0	Y	See Sync Streams
16	1	Sync Offset	0	N	
17	1	Frame Blending	255	N	See Frame Blending Control
18	1	Texture Xfade Type	0	Y	See Texture Transitions
19	1	Texture Xfade Time	0	Y	See Texture Transition Timing
20	1	Object File	0	Y	
21	2	X Position	32767	N	
23	2	Y Position	32767	N	
25	2	Scale	32767	N	
27	2	X Scale	32767	N	
29	2	Y Scale	32767	N	
31	2	Z Rotation	32767	N	
33	2	X Rotation	32767	N	
35	2	Y Rotation	32767	N	
37	1	Mix Select	0	Y	
38	1	Mix Mode	0	Y	See Layer Mix Modes
39	1	Blend Mode	0	Y	See Blend Modes
40	1	Draw Mode	0	Y	See Draw Modes
41	1	Image Remap	0	Y	
	41	**Total Channels**			

Layer Effect [Designer(4)/Studio or Studio+(2)/Mini(1)]

Chan	Size	Function	Default	Snap	Notes
1	1	Effect Select	0	Y	See Combined Effects
2	1	Modifier 1	0	N	
3	1	Modifier 2	0	N	
4	1	Modifier 3	0	N	
5	1	Modifier 4	0	N	
6	1	Modifier 5	0	N	
	6	**Total Channels**			

Layer Volume [Designer/Studio or Studio+/Mini]

Chan	Size	Function	Default	Snap	Notes
1	1	Layer Volume	255	N	
	1	**Total Channels**			

Layer DMX Timecode [Designer/Studio or Studio+/Mini]

Chan	Size	Function	Default	Snap	Notes
1	1	Hours	0	N	Maximum of 23
2	1	Minutes	0	N	Maximum of 59
3	1	Seconds	0	N	Maximum of 59
4	1	Frames	0	N	Maximum of 29
	4	**Total Channels**			

Pixel Mapping Group Control [Designer/Studio or Studio+/Mini]

Chan	Size	Function	Default	Snap	Notes
1	1	Mode	0	Y	See Pixel Mapping Group Control Modes
2	1	Intensity	255	N	
3	1	Red/Cyan	255	N	
4	1	Green/Magenta	255	N	
5	**1**	**Blue/Yellow**	255	N	
	5	**Total Channels**			

FIXTURE PARAMETER DESCRIPTIONS

The data in these charts is organized by product version. Fixtures are listed in basic patch order and show detail of their component sub-fixtures. Fixture quantities (required or optional) are noted. Parameters are listed in patch order.

Parameter Descriptions: Mbox Designer

Fixture	Sub-Fixture	Parameter	Description
Global Master		Intensity	Master intensity of all video output
		Control	Selects control Macros and HUDs
		Control Selector	Used with Control to select specific modes for macros/HUDs
		Pixel Mapping Intensity	Master intensity of all pixel mapping output
		Master Volume	Master volume for all audio output
Light (5 required)		Intensity	Intensity of the light
		Red	Red Subtractive
		Green	Green Subtractive
		Blue	Blue Subtractive
		Ambience	Beam spread - spot to full ambient
		Bearing	Horizontal orbit around center of 3D space
		Elevation	Vertical orbit around center of 3D space

Parameter Descriptions: Mbox Designer continued...

Fixture	Sub-Fixture	Parameter	Description
Output Master (1 required, up to 32 total)	Base	Intensity	Master intensity of output
		Red	Red subtractive & additive for output
		Green	Green subtractive & additive for output
		Blue	Blue subtractive & additive for output
		Brightness	Brightness for output
		Contrast	Contrast for output
	FX	Effect Select	2D effect applied to the output
		Modifier A	First modifier
		Modifier B	Second modifier
		Modifier C	Third modifier
		Modifier D	Fourth modifier
		Modifier E	Fifth modifier
	Camera	Enable Projection Camera	Enables/Disables DMX control of the 3D perspective camera for output
		Position X	Left/Right position of camera in 3D space
		Position Y	Down/Up position of camera in 3D space
		Position Z	Forward/Backward position of camera in 3D space
		Lookat X	Left/Right aiming point of camera in 3D space
		Lookat Y	Down/Up aiming point of camera in 3D space
		Lookat Z	Forward/Backward aiming point of camera in 3D space
		Field of View	Adjusts the camera lens between narrow and wide
		Roll	Rotates the camera around the axis of its lens
	Geometry	Output Position X	Moves imagery within the output left/right
		Output Position Y	Moves imagery within the output down/up
		Output Scale	Scales imagery within the output
		Output Rotation	Scales imagery within the output
		Mix Offset X	Moves the output's mix left/right on the Global Surface in 1px increments
		Mix Offset Y	Moves the output's mix down/up on the Global Surface in 1px increments

Parameter Descriptions: Mbox Designer continued...

Fixture	Sub-Fixture	Parameter	Description
Output Master continued... (1 required, up to 32 total)	Keystone	Curve	Enables and elects keystone curve/mode
		Gamma	Gamma of edge blend area
		Edge Top	Position/depth of top edge blend area
		Edge Right	Position/depth of right edge blend area
		Edge Bottom	Position/depth of bottom edge blend area
		Edge Left	Position/depth of left edge blend area
		Keystone 1x	Left/right position of top-left corner
		Keystone 1y	Down/up position of top-left corner
		Keystone 2x	Left/right position of top-right corner
		Keystone 2y	Down/up position of top-right corner
		Keystone 3x	Left/right position of bottom-right corner
		Keystone 3y	Down/up position of bottom-right corner
		Keystone 4x	Left/right position of bottom-left corner
		Keystone 4y	Down/up position of bottom-left corner
		Linearity X	Adjusts center of keystone surface left/right
		Linearity Y	Adjusts center of keystone surface down/up
	Shutter	Shape	Enables and selects shutter shape
		Red	Red Additive
		Green	Green Additive
		Blue	Blue Additive
		Edge Softness	Set the soft edge amount for all shutters
		Shutter 1a	Left-bottom | Left Amount
		Shutter 1b	Left-top | Left Angle
		Shutter 2a	Top-left | Top Amount
		Shutter 2b	Top-right | Top Angle
		Shutter 3a	Right-top | Right Amount
		Shutter 3b	Right-bottom | Right Angle
		Shutter 4a	Bottom-right | Bottom Amount
		Shutter 4b	Bottom-left | Bottom Angle
		X Position	Overall left/right position of shutters
		Y Position	Overall down/up position of shutters
		Scale	Overall scale of shutters
		Rotation	Overall rotation of shutters
		Damping	Adds smoothing to shutter motion in 0.33sec increments

Parameter Descriptions: Mbox Designer continued...

Fixture	Sub-Fixture	Parameter	Description
Layer	Base	Opacity	Transparency of the layer
		Red	Red subtractive & additive for layer
		Green	Green subtractive & additive for layer
		Blue	Blue subtractive & additive for layer
		Brightness	Brightness of layer
		Contrast	Contrast of layer
		Texture Folder	Selects numbered 2D content folder
		Texture File	Selects numbered file within Texture Folder
		Play Mode	Selects play mode of movie content
		Play Speed	Selects play speed of movie content
		In Frame	Sets in-frame of movie content
		Out Frame	Sets out-frame of movie content
		Sync Stream	Selects 1 of 32 channels for playback synchronization
		Sync Offset	Adjusts playback sync offset
		Aspect Ratio	Adjusts the aspect ratio of the layer
		Frame Blending	Adjusts the amount of interframe blending for movie content
		Texture Xfade Type	Selects the type of crossfade for 2D content on the layer
		Texture Xfade Time	Adjusts the duration of crossfades for 2D content on the layer
		X Position	Moves the layer left/right
		Object Folder	Selects numbered 3D content folder
		Object File	Selects numbered file within Object Folder
		Reserved	-
		Reserved	-
		Y Position	Moves the layer down/up
		Z Position	Moves the layer away/towards the camera (3D objects only)
		Scale	Adjusts the size of 2D/3D content on the layer
		X Scale	Adjusts the width of 2D/3D content on the layer
		Y Scale	Adjust the height of 2D/3D content on the layer
		Z Scale	Adjusts the depth of 3D content on the layer
		Z Rotation	Adjusts rotation of the content around the Z axis
		X Rotation	Adjusts rotation of the content around the X axis
		Y Rotation	Adjusts rotation of the content around the Y axis

Parameter Descriptions: Mbox Designer continued...

Fixture	Sub-Fixture	Parameter	Description
Layer continued...	Base continued...	Z Spin	Adjusts spin of content around the Z axis
		X Spin	Adjusts spin of content around the X axis
		Y Spin	Adjusts spin of content around the Y axis
		Mix Select	Assigns content on layer to a mix
		Mix Mode	Sets the mode for the selected mix
		Blend Mode	Selects a 2D blending mode
		Draw Mode	Selects a 2D draw mode (stenciling)
		Image Remap	Selects image remapping configuration for the layer
	FX	Effect 1 Select	First 2D effect applied to the layer
		Modifier 1a	First modifier
		Modifier 1b	Second modifier
		Modifier 1c	Third modifier
		Modifier 1d	Fourth modifier
		Modifier 1e	Fifth modifier
		Effect 2 Select	Second 2D effect applied to the layer
		Modifier 2a	First modifier
		Modifier 2b	Second modifier
		Modifier 2c	Third modifier
		Modifier 2d	Fourth modifier
		Modifier 2e	Fifth modifier
		Effect 3 Select	Third 2D effect applied to the layer
		Modifier 3a	First modifier
		Modifier 3b	Second modifier
		Modifier 3c	Third modifier
		Modifier 3d	Fourth modifier
		Modifier 3e	Fifth modifier
		Effect 4 Select	Fourth 2D effect applied to the layer
		Modifier 4a	First modifier
		Modifier 4b	Second modifier
		Modifier 4c	Third modifier
		Modifier 4d	Fourth modifier
		Modifier 4e	Fifth modifier
	Volume	Volume	Audio volume for layer
	Timecode	Hours	Hours value for DMX timecode
		Minutes	Minutes value for DMX timecode
		Seconds	Seconds value for DMX timecode
		Frames	Frames value for DMX timecode

Parameter Descriptions: Mbox Studio or Studio+

Fixture	Sub-Fixture	Parameter	Description
Global Master		Intensity	Master intensity of all video output
		Control	Selects control Macros and HUDs
		Control Selector	Used with Control to select specific modes for macros/HUDs
		Pixel Mapping Intensity	Master intensity of all pixel mapping output
		Master Volume	Master volume for all audio output
Light (5 required)		Intensity	Intensity of the light
		Red	Red Subtractive
		Green	Green Subtractive
		Blue	Blue Subtractive
		Ambience	Beam spread - spot to full ambient
		Bearing	Horizontal orbit around center of 3D space
		Elevation	Vertical orbit around center of 3D space

Parameter Descriptions: Mbox Studio or Studio+ continued...

Fixture	Sub-Fixture	Parameter	Description
Output Master (1 required, up to 8 total)	Base	Intensity	Master intensity of output
		Red	Red subtractive & additive for output
		Green	Green subtractive & additive for output
		Blue	Blue subtractive & additive for output
		Brightness	Brightness for output
		Contrast	Contrast for output
	FX	Effect Select	2D effect applied to the output
		Modifier A	First modifier
		Modifier B	Second modifier
		Modifier C	Third modifier
		Modifier D	Fourth modifier
		Modifier E	Fifth modifier
	Geometry	Output Position X	Moves imagery within the output left/right
		Output Position Y	Moves imagery within the output down/up
		Output Scale	Scales imagery within the output
		Output Rotation	Scales imagery within the output
		Mix Offset X	Moves the output's mix left/right on the Global Surface in 1px increments
		Mix Offset Y	Moves the output's mix down/up on the Global Surface in 1px increments
	Keystone	Curve	Enables and elects keystone curve/mode
		Gamma	Gamma of edge blend area
		Edge Top	Position/depth of top edge blend area
		Edge Right	Position/depth of right edge blend area
		Edge Bottom	Position/depth of bottom edge blend area
		Edge Left	Position/depth of left edge blend area
		Keystone 1x	Left/right position of top-left corner
		Keystone 1y	Down/up position of top-left corner
		Keystone 2x	Left/right position of top-right corner
		Keystone 2y	Down/up position of top-right corner
		Keystone 3x	Left/right position of bottom-right corner
		Keystone 3y	Down/up position of bottom-right corner
		Keystone 4x	Left/right position of bottom-left corner
		Keystone 4y	Down/up position of bottom-left corner
		Linearity X	Adjusts center of keystone surface left/right
		Linearity Y	Adjusts center of keystone surface down/up

Parameter Descriptions: Mbox Studio or Studio+ continued...

Fixture	Sub-Fixture	Parameter	Description
Output Master continued... (1 required, up to 8 total)	Shutter	Shape	Enables and selects shutter shape
		Red	Red Additive
		Green	Green Additive
		Blue	Blue Additive
		Edge Softness	Set the soft edge amount for all shutters
		Shutter 1a	Left-bottom | Left Amount
		Shutter 1b	Left-top | Left Angle
		Shutter 2a	Top-left | Top Amount
		Shutter 2b	Top-right | Top Angle
		Shutter 3a	Right-top | Right Amount
		Shutter 3b	Right-bottom | Right Angle
		Shutter 4a	Bottom-right | Bottom Amount
		Shutter 4b	Bottom-left | Bottom Angle

Parameter Descriptions: Mbox Studio or Studio+ continued...

Fixture	Sub-Fixture	Parameter	Description
Layer	Base	Opacity	Transparency of the layer
		Red	Red subtractive & additive for layer
		Green	Green subtractive & additive for layer
		Blue	Blue subtractive & additive for layer
		Brightness	Brightness of layer
		Contrast	Contrast of layer
		Texture Folder	Selects numbered 2D content folder
		Texture File	Selects numbered file within Texture Folder
		Play Mode	Selects play mode of movie content
		Play Speed	Selects play speed of movie content
		In Frame	Sets in-frame of movie content
		Out Frame	Sets out-frame of movie content
		Sync Stream	Selects 1 of 16 channels for playback synchronization
		Sync Offset	Adjusts playback sync offset
		Frame Blending	Adjusts the amount of interframe blending for movie content
		Texture Xfade Type	Selects the type of crossfade for 2D content on the layer
		Texture Xfade Time	Adjusts the duration of crossfades for 2D content on the layer
		Object File	Selects numbered file within Object Folder
		X Position	Moves the layer left/right
		Y Position	Moves the layer down/up
		Scale	Adjusts the size of 2D/3D content on the layer
		X Scale	Adjusts the width of 2D/3D content on the layer
		Y Scale	Adjust the height of 2D/3D content on the layer
		Z Rotation	Adjusts rotation of the content around the Z axis
		X Rotation	Adjusts rotation of the content around the X axis
		Y Rotation	Adjusts rotation of the content around the Y axis
		Mix Select	Assigns content on layer to a mix
		Mix Mode	Sets the mode for the selected mix
		Blend Mode	Selects a 2D blending mode
		Draw Mode	Selects a 2D draw mode (stenciling)
		Image Remap	Selects image remapping configuration for the layer (Studio 1-8, Studio+ 1-16)

Parameter Descriptions: Mbox Studio or Studio+ continued...

Fixture	Sub-Fixture	Parameter	Description
	FX	Effect 1 Select	First 2D effect applied to the layer
		Modifier 1a	First modifier
		Modifier 1b	Second modifier
		Modifier 1c	Third modifier
		Modifier 1d	Fourth modifier
		Modifier 1e	Fifth modifier
		Effect 2 Select	Second 2D effect applied to the layer
		Modifier 2a	First modifier
		Modifier 2b	Second modifier
		Modifier 2c	Third modifier
		Modifier 2d	Fourth modifier
		Modifier 2e	Fifth modifier
	Volume	Volume	Audio volume for layer
	Timecode	Hours	Hours value for DMX timecode
		Minutes	Minutes value for DMX timecode
		Seconds	Seconds value for DMX timecode
		Frames	Frames value for DMX timecode

Parameter Descriptions: Mbox Mini

Fixture	Sub-Fixture	Parameter	Description
Global Master		Intensity	Master intensity of all video output
		Control	Selects control Macros and HUDs
		Control Selector	Used with Control to select specific modes for macros/HUDs
		Pixel Mapping Intensity	Master intensity of all pixel mapping output
		Master Volume	Master volume for all audio output
Output Master (1 required, up to 6 total)	Base	Intensity	Master intensity of output
		Red	Red subtractive & additive for output
		Green	Green subtractive & additive for output
		Blue	Blue subtractive & additive for output
		Brightness	Brightness for output
		Contrast	Contrast for output
	FX	Effect Select	2D effect applied to the output
		Modifier A	First modifier
		Modifier B	Second modifier
		Modifier C	Third modifier
		Modifier D	Fourth modifier
		Modifier E	Fifth modifier
	Keystone	Keystone 1x	Left/right position of top-left corner
		Keystone 1y	Down/up position of top-left corner
		Keystone 2x	Left/right position of top-right corner
		Keystone 2y	Down/up position of top-right corner
		Keystone 3x	Left/right position of bottom-right corner
		Keystone 3y	Down/up position of bottom-right corner
		Keystone 4x	Left/right position of bottom-left corner
		Keystone 4y	Down/up position of bottom-left corner

Parameter Descriptions: Mbox Mini continued...

Fixture	Sub-Fixture	Parameter	Description
Output Master continued... (1 required, up to 6 total)	Shutter	Red	Red Additive
		Green	Green Additive
		Blue	Blue Additive
		Edge Softness	Set the soft edge amount for all shutters
		Shutter 1a	Left-bottom | Left Amount
		Shutter 1b	Left-top | Left Angle
		Shutter 2a	Top-left | Top Amount
		Shutter 2b	Top-right | Top Angle
		Shutter 3a	Right-top | Right Amount
		Shutter 3b	Right-bottom | Right Angle
		Shutter 4a	Bottom-right | Bottom Amount
		Shutter 4b	Bottom-left | Bottom Angle

Fixture	Sub-Fixture	Parameter	Description
Layer	Base	Opacity	Transparency of the layer
		Red	Red subtractive & additive for layer
		Green	Green subtractive & additive for layer
		Blue	Blue subtractive & additive for layer
		Brightness	Brightness of layer
		Contrast	Contrast of layer
		Texture Folder	Selects numbered 2D content folder
		Texture File	Selects numbered file within Texture Folder
		Play Mode	Selects play mode of movie content
		Play Speed	Selects play speed of movie content
		In Frame	Sets in-frame of movie content
		Out Frame	Sets out-frame of movie content
		Sync Stream	Selects 1 of 8 channels for playback synchro-nization
		Sync Offset	Adjusts playback sync offset
		Frame Blending	Adjusts the amount of interframe blending for movie content
		Texture Xfade Type	Selects the type of crossfade for 2D content on the layer
		Texture Xfade Time	Adjusts the duration of crossfades for 2D content on the layer
		Object File	Selects numbered file within Object Folder
		X Position	Moves the layer left/right
		Y Position	Moves the layer down/up
		Scale	Adjusts the size of 2D/3D content on the layer
		X Scale	Adjusts the width of 2D/3D content on the layer
		Y Scale	Adjust the height of 2D/3D content on the layer
		Z Rotation	Adjusts rotation of the content around the Z axis
		X Rotation	Adjusts rotation of the content around the X axis
		Y Rotation	Adjusts rotation of the content around the Y axis
		Mix Select	Assigns content on layer to a mix
		Mix Mode	Sets the mode for the selected mix
		Blend Mode	Selects a 2D blending mode
		Draw Mode	Selects a 2D draw mode (stenciling)
		Image Remap	Selects image remapping configuration for the layer

Parameter Descriptions: Mbox Mini continued...

Fixture	Sub-Fixture	Parameter	Description
	FX	Effect 1 Select	First 2D effect applied to the layer
		Modifier 1a	First modifier
		Modifier 1b	Second modifier
		Modifier 1c	Third modifier
		Modifier 1d	Fourth modifier
		Modifier 1e	Fifth modifier
	Volume	Volume	Audio volume for layer
	Timecode	Hours	Hours value for DMX timecode
		Minutes	Minutes value for DMX timecode
		Seconds	Seconds value for DMX timecode
		Frames	Frames value for DMX timecode

DISCRETE VALUES FOR SLOTTED PARAMETERS

Global Master Control Channel

Value	Command	Notes	Macro Trigger Action	Master Control Selector
10-19	Output Stats HUD	Shows output size, refresh, rendering stats	n/a	n/a
20-29	Performance HUD (Center 20-21, Top Right 22-23, Top Left 24-25, Bottom Right 26-27, Bottom Left 28-29)	Shows overall performance, layer playback and rendering	n/a	n/a
30-39	Version HUD	Shows build version, share name	n/a	n/a
40-49	Lights/Master/Shutter/Keystone HUD	Shows control input values - v3 format	n/a	n/a
50-54	Texture HUD - Layers 1-6	Shows control input values - v3 format	n/a	n/a
55-59	Texture HUD - Layers 7-12	Shows control input values - v3 format	n/a	n/a
60-64	Layer Effects HUD - Layers 1-6	Shows control input values - v3 format	n/a	n/a
65-69	Layer Effects HUD - Layers 7-12	Shows control input values - v3 format	n/a	n/a
70-71	Raw Control Input HUD Universe A		n/a	n/a
72-73	Raw Control Input HUD Universe B		n/a	n/a
74-75	Raw Control Input HUD Universe C		n/a	n/a
76-77	SADI Stats		n/a	n/a
80-89	Show PixMap Context View	80 = All contexts, 81-89 = contexts 1-9	n/a	n/a
110-119	Timecode HUD (Center 110-111, Top Right 112-113, Top Left 114-115, Bottom Right 116-117, Bottom Left 118-119)		n/a	n/a
201	Run Script		Value then 0	0-255 for script index number
202	Change Pixel Mapping File		Value then 0	0-255 for config index number
204	Enable DMX to OSC output		Value then 0	n/a
205	Disable DMX to OSC output		Value then 0	n/a
220	Cancel Keyboard HUD		Value then 0	n/a
221	Show Object Mesh	Shows mesh on all objects	n/a	0 = all, 1-24 = by layer number
222	Show Edge-blend guides	Shows guides for blend areas	n/a	n/a
224	Show Single Mix	Shows outline of one mix at a time	n/a	Mix index number

Value	Command	Notes	Macro Trigger Action	Master Control Selector
225	Show All Mixes	Shows outlines of all mixes at the same time	n/a	n/a
226	Show Output Mixes Only	Shows outlines of output mixes only	n/a	n/a
227	Show Keystone Mesh	Shows keystone mesh	n/a	0 = all, 1-32 = by output number
228	Show Layer Info	Shows info about layer content	n/a	0 = all, 1-24 = by layer number
230	File Sharing On		Value then 0	n/a
231	File Sharing Off		Value then 0	n/a
232	Remote Management On		Value then 0	n/a
233	Remote Management Off		Value then 0	n/a
234	Backup Mode On	Disables Layer Sync and PixMap output	Value then 0	n/a
235	Backup Mode Off	Enables Layer Sync and PixMap output	Value then 0	n/a
240	Rescan Media Library		Hold 3-sec then 0	n/a
241	Audio Offset	Sets audio playhead offset in relation to video playhead in 20mS increments	Immediate	0-126 = audio late, 127 = default, 128-255 = audio ahead
244	Pixel Mapping Output Enable	Turn ON pixel mapping engine and output	Value then 0	n/a
245	Pixel Mapping Output Disable	Turn OFF pixel mapping engine and output	Value then 0	n/a
246	Pixel Mapping Masking Off	Masked fixtures use normal output values	Value then 0	n/a
247	Pixel Mapping Masking On	Masked fixtures' output forced to 0	Value then 0	n/a
250	Quit Mbox Application		Hold 3-sec then 0	n/a
251	Shutdown Computer		Hold 3-sec then 0	n/a
252	Restart Computer		Hold 3-sec then 0	0-255 for script index number
253	Restart Mbox Application		Hold 3-sec then 0	0-255 for config index number
254	Restart Daemon Application		Hold 3-sec then 0	n/a

Combined Effects

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5
0	NONE	No effect					
1	Hue	Simple hue adjustment	Hue angle				
2	Hue & Saturation	Combines hue and saturation	Hue angle	Saturation (127=def.)			
3	Gamma	Gamma adjustment	Gamma				
4	Exposure	Exposure adjustment	Exposure				
5	Monochrome	Converts to grayscale, adds color	Amount	Red	Green	Blue	
6	Sepia Tone	Converts to sepia tone image	Amount				
7	Invert	Color invert					
8	Highlight & Shadow	Adjusts tonal mapping	Radius	Highlight amount	Shadow amount		
9	Vibrance	Adjusts saturation	Amount				
10	Solarize	Solarize effect	Intensity				
11	X-Ray	Inverted grayscale	Intensity				
12	Color Switch	RGB becomes RBG/BGR/BRG/GBR/GRB	Intensity	Mode			
13	Color Shift	Dynamic color shift (sine function)	Mixer	Range	Speed		
14	Posterize	Reduce color space	Amount				
15	Bloom	Soften edges, add glow	Intensity	Radius			
16	Gloom	Dulls highlights	Intensity	Radius			
17	Sharpen	Increases detail by sharpening	Sharpness				
18	Unsharp Mask	Increases contrast at edges to enhance details	Intensity	Radius			
19	Median	Reduce noise with median calculation					
20	Black Threshold	Renders dark areas as true black	Intensity	Threshold			
21	Color Brightness and Contrast	Can be used instead of built-in controls	Red (127=def.)	Green (127=def.)	Blue (127=def.)	Brightness (127=def.)	Contrast (127=def.)
22	Gradient	Generates a colored gradient[1]	Beginning (0=def.)	End (255=def.)	Red	Green	Blue
23	Cube LUT[2]	Applies a color lookup table to the layer	File index number				
24	CTO/CTB	Basic color temperature adjustment	Mixer	Orange -> blue (127=def.)	Minus Green		
25	HSV Color	HSV color adjustment	Hue (127=def.)	Saturation (127=def.)	Value (127=def.)		

Combined Effects continued...

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5
26-31	Reserved						
32	Blur - Quick	Simple/quick image blur	Mixer	Amount			
33	Blur - Quick X	Quick blue on X axis	Mixer	Amount			
34	Blur - Quick Y	Quick blur on Y axis	Mixer	Amount			
35	Blur - Box	Box-shaped convolution	Radius				
36	Blur - Gaussian	Sophisticated/slow blur	Radius				
37	Blur - Zoom	Blurs outwards from point in image	Size	X position	Y position		
38	Blur - Motion	Blurs along variable axis	Radius	Angle			
39	Blur - Depth of Field	Tilt shift effect	Blur	Saturation	Sharpen radius	Sharpen intensity	
40	Blur - Bokeh	Applies bokeh effect to bright points	Radius	Ring amount	Ring size	Softness	
41-43	Reserved						
44	Key - Black	Dark areas transparent	Intensity	Threshold			
45	Key - White	White areas transparent	Intensity	Threshold			
46	Key - Red	Red areas transparent	Intensity	Threshold			
47	Key - Green	Green areas transparent	Intensity	Threshold			
48	Key - Blue	Blue areas transparent	Intensity	Threshold			
49	Key - Invert White	All but white areas transparent	Intensity	Threshold			
50	Key - Invert Red	All but red areas transparent	Intensity	Threshold			
51	Key - Invert Green	All but green areas transparent	Intensity	Threshold			
52	Key - Invert Blue	All but blue areas transparent	Intensity	Threshold			
53	Key - RGB	Specific RGB color transparent	Intensity	Threshold	Red	Green	Blue
54	Key - HSV	Specific HSV color transparent	Intensity	Threshold	Hue	Saturation	Value
55	Key - XY	Specific XY location color transparent	Intensity	Threshold	X position	Y position	
56	Key - Luma	Brighter areas transparent	Intensity	Threshold			
57	Key - Luma Inverse	Darker areas transparent	Intensity	Threshold			
58	Key - Chroma 2017	Alternate to Key - RGB effect	Intensity	Threshold	Red	Green	Blue
59	Alpha Matte	Creates matte based on transparency of layer	Mode				
60-63	Reserved						

Combined Effects continued...

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5
64	Crop - Circular	Circular image crop with soft edge	Mixer	Size	Edge		
65	Crop - Rectangular	Rectangular image crop with soft edge	Mixer	Size	Edge		
66	Crop - Circular XY	Circular image crop with soft edge & xy position adjust	Mixer	Size	Edge	X position (127=def.)	Y position (127=def.)
67	Crop - Rectangular XY	Rectangular image crop with soft edge & xy position adjust	Mixer	Size	Edge	X position (127=def.)	Y position (127=def.)
68	Crop - Oval XY	Oval image crop with soft edge & xy position adjust	Size	Edge	X position (127=def.)	Y position (127=def.)	Aspect
69	Crop - Horizontal	Horizontal 90° shutters	Mixer	Width	Position (127=def.)		
70	Crop - Vertical	Vertical 90° shutters	Mixer	Height	Position (127=def.)		
71	Crop - Orth Shutter	Horizontal and vertical 90° shutters	Mixer	Horizontal insertion	Vertical insertion		
72	Crop - Slitscan Horizontal	Horizontal 90° shutters	Mixer	Width	Position (127=def.)	Edge softness	
73	Crop - Slitscan Vertical	Vertical 90° shutters	Mixer	Height	Position (127=def.)	Edge softness	
74	Crop - Slitscan Horizontal Swing	Horizontal shutters with motion	Mixer	Width	Scanrate	Swing	Edge softness
75	Crop - Slitscan Vertical Swing	Vertical shutters with motion	Mixer	Height	Scanrate	Swing	Edge softness
76	Crop - Slitscan Horizontal Random Swing	Horizontal shutters with random motion	Mixer	Width	Scanrate	Swing	Edge softness
77	Crop - Slitscan Vertical Random Swing	Vertical shutters with random motion	Mixer	Height	Scanrate	Swing	Edge softness
78	Crop - Softedge LRTB	Four-sided 90° shutters with softedge	Edge	Left	Right	Top	Bottom
79-80	Reserved						
81	Layer Edge Blend Right	Per-layer edge blend on right side	Amount	Edge softness	Angle (127=def.)		
82	Layer Edge Blend Left	Per-layer edge blend on left side	Amount	Edge softness	Angle (127=def.)		
83	Layer Edge Blend Top	Per-layer edge blend on top side	Amount	Edge softness	Angle (127=def.)		
84	Layer Edge Blend Bottom	Per-layer edge blend on bottom side	Amount	Edge softness	Angle (127=def.)		

Combined Effects continued...

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5
85	Layer Edge Blend L/R	Per-layer edge blend on left & right side	Left amount	Left edge softness	Right amount	Right edge softness	
86	Layer Edge Blend T/B	Per-layer edge blend on top & bottom side	Top amount	Top edge softness	Bottom amount	Bottom edge softness	
87-89	Reserved						
90	Mask from File	Creates mask using plugin image[3] with alpha	Mixer	File index number	Flip mode 0-7		
91	Matte from Layer	Creates alpha matte using selected layer and mode	Mixer	1-24 = layer w/o FX, 101-124 = layer w/ FX	Mode[4]		
92	UV Map from Layer	Uses UV Map image/ movie on selected layer to generate texture map	Mode[5]	1-24 = layer	Scale/ Distortion amount[6]	X position	Y position
93-95	Reserved						
96	Distortion - Bump	Bump distortion		Scale	X position	Y position	
97	Distortion - Linear Bump	Linear bump distortion	Radius	Angle	Scale	X position	Y position
98	Distortion - Hole	Hole distortion	Radius	X position	Y position		
99	Distortion - Pinch	Pinch distortion	Radius	Scale	X position	Y position	
100	Distortion - Torus	Torus distortion	Width	Radius	X position	Y position	
101	Distortion - Twirl	Twirl distortion	Radius	Angle	X position	Y position	
102	Distortion - Vortex	Vortex distortion	Radius	Angle	X position	Y position	
103	Distortion - Lozenge	Lozenge distortion	Radius	Refraction	Point 1	Point 2	
104	Distortion - Circular Wrap	Wraps image into tube shape	Radius	Angle	X position	Y position	
105	Distortion - Circular Splash	Clamps image from center outwards	Size	X position	Y position		
106	Distortion - Glass	Applies a glass-like texture	Layer	Scale	X position	Y position	
107	Distortion - Displacement	Applies grayscale of input image to layer to create texture	Layer	Scale			
108	Distortion - Light Tunnel	Twist	Radius	Rotation	X position	Y position	
109-112	Reserved						

Combined Effects continued...

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5
113	Smear - Horizontal	Spread single column over horizontal space	Mixer	Column			
114	Smear - Vertical	Spread single row over vertical space	Mixer	Row			
115-117	Reserved						
118	Pixelate - Square	Pixelates image, square	Radius	Angle	Scale	X position	Y position
119	Pixelate - Hexagonal	Pixelates image, hexagons	Radius	X position	Y position		
120	Crystallize	Break up image into crystal pattern	Radius	X position	Y position		
121	Pointillize	Break image into points	Radius	X position	Y position		
122-126	Reserved						
127	Tile - 1	Image tiling no gaps	Mixer	Divisions			
128	Tile - 2	Image tiling with gaps	Mixer	Horizontal divisions	Horizontal spacing	Vertical divisions	Vertical spacing
129	Tile - Glide Reflected	Rectangular tile effect	Angle	Width	X position	Y position	
130	Tile - 4-fold Rotated	Four-sided tile effect	Angle	Acute angle	Width	X position	Y position
131	Tile - 4-fold Reflected	Four-sided tile effect	Angle	Acute angle	Width	X position	Y position
132	Tile - 4-fold Translated	Four-sided tile effect	Angle	Width	X position	Y position	
133	Tile - 6-fold Rotated	Six-sided tile effect	Angle	Width	X position	Y position	
134	Tile - 6-fold Reflected	Six-sided tile effect	Angle	Width	X position	Y position	
135	Tile - 8-fold Reflected	Eight-sided tile effect	Angle	Width	X position	Y position	
136	Tile - 12-fold Reflected	Twelve-sided tile effect	Angle	Width	X position	Y position	
137	Tile - Parallelogram	Parallelogram tile effect	Angle	Acute angle	Width	X position	Y position
138	Tile - Triangle	Triangular tile effect	Angle	Width	X position	Y position	
139-143	Reserved						
144	Screen - Line	Line patterned halftone screen	Width	Angle	Sharpness		
145	Screen - Circular	Circle patterned halftone screen	Width	Sharpness	X position	Y position	

Combined Effects continued...

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5
146	Screen - Dot	Dot patterned halftone screen	Width	Angle	Sharpness		
147	Screen - Hatched	Hatch patterned halftone screen	Width	Angle	Sharpness		
148	Screen - CMYK Halftone	Color, halftone rendition	Width	Angle	Sharpness	GCR	UCR
149-152	Reserved						
153	Decay	Creates decay trails	Mixer	Amount			
154	Black & White	Converts image to transparent/color	Mixer	Threshold	Red	Green	Blue
155	Mirrors	Various mirror modes	Mixer	Mode			
156	Horizontal Bars	Break image into bars	Mixer	Number	Width		
157	Vertical Bars	Break image into bars	Mixer	Number	Width		
158	Double Vision	Offset image and overlay	Mixer	X offset	Y offset		
159	Rippling	Simple ripple effect	Mixer	Size	Granularity		
160	Flicker	Dynamic flickering effect	Mixer	Size			
161	Shake 2D	Dynamic shaking effect	Mixer	Size	Speed		
162	Wobble	Dynamic wobbling effect	Mixer	Size	Speed		
163	Edge Work	Resampled conversion to white and transparent	Radius				
164	Edge Detect	Edge detection with color	Intensity				
165	Kaleidoscope	Geometric distortion	Angle	Divisions			
166	LED Wall	Break up into dots	Mixer	Dot amount	Dot size		
167	Op Tile	Glass block tile effect	Scale	Width	Angle	X position	Y position
168	Luma Lines	Uses color and luma averaging to create line effect	Mixer	Width	Rows	Gap	
169	Luma Blocks	Uses color and luma averaging to create block effect	Mixer	Width	Rows	Gap	
170	Lattice - Positive	Divides image into squares	Mixer	Divisions	Size		
171	Lattice - Negative	Reverse of lattice - positive	Mixer	Divisions	Size		
172	Duotone - Simple	Two-color duotone effect	Mixer	Mode	Threshold		

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5
173	Duotone - Hue & Saturation	Duotone effect using hue & saturation for color	Threshold	Hue 1	Saturation 1	Hue 2	Saturation 2
174	Channel Shift	Separates RG&B channels	Mixer	Horizontal offset	Vertical offset		
175	ASCII Art	Classic ASCII art effect	Mixer	Scale	Saturation		
176	Meta-Image	Uses plugin image[7] to replaced sampled areas in source	Mixer	File index number	Scale	Saturation	
177	Drop Shadow 1	Drop shadow effect	Intensity	Softness	X offset	Y offset	
178	Drop Shadow 2	Drop shadow effect	Intensity	Offset			
179	Roll - Down	Vertical roll down	Mixer	Speed	Pause		
180	Roll - Up	Vertical roll up	Mixer	Speed	Pause		
181	Roll - Right	Horizontal roll right	Mixer	Speed	Pause		
182	Roll - Left	Horizontal roll left	Mixer	Speed	Pause		
183	Freeze	Freezes image	0-127 = idle, 128-255 = frozen				
184	Droste	Geometric distortion	Strands	Period	Rotation	Zoom	
185	Comic Effect	Posterize/halftone effect					
186	Cartoon	Cartoon effect	Mixer	Line width	Color reduction		
187	Shaded Material	Luma of input creates a relief map	Layer	Scale			
188	Histogram		Height	Low limit	Limit		
189	Roll - XY	Horizontal & vertical roll		X amount (127=def.)	Y amount (27=def.)		
190	Pillow Blocks	Egg-crate mask effect	Mixer	Multiplier	Size	Brightness	Mode[9]
191	Triangle Kaleidoscope	Geometric distortion using triangles	Size	Rotation	Decay	X (127=def.)	Y (127=def.)
192	Chromatic Aberration	Color separated distortion	Mixer	Sample quantity	Vignetting	Blur	
193	Meta-Image 2	Uses smaller copies of layer image to recreate image	Mixer	Scale	Color sample mix		
194	Cartoon2	Revised cartoon effect	Mixer	Line width	Color reduction	Brightness reduction	Smooth-ing
195	Wrap X/Y	Pans image, wrapping around the edges twice	Mixer	X coarse (127=def.)	X fine (127=def.)	Y coarse (127=def.)	Y fine (127=def.)
196	Old Film	Applies vertical scratches	Mixer	Size	Frequency	Speed	

Combined Effects continued...

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5
197	Traffic Sign	Break up image similar to road alert sign pattern	Mixer	Size	Brightness		
198-210	Reserved						
211	Scrolling Gradient	White/rainbow lines or concentrics with animated motion	Mode	Speed	Width	Edge	Scale
212	Radial Gradient	Circular gradient with inner and outer size	Radius 1	Radius 2	Red	Green	Blue
213	Noise Generator	Generative noise effects - perlin, flow, caustic, voronoi	Mode	Speed	Scale	X scroll (127 = def) or density	Y scroll (127 = def) or n/a
214-220	Reserved						
221	LRBT Shutter	Sides of layer	Left	Right	Bottom	Top	
222	Move Center	Offsets rotational center of image	X (127=def.)	Y (127=def.)			
223	Shake 3D	X/Y shake effect	X	Y			
224	Strobe	Strobe effect	Off time	On time			
225-227	Reserved						
228	X/Y Position & Scale Damping	Damps movement of parameters in 1/30sec increments	XY position	Scale			
229	Z Rotation & Scale Damping	Damps movement of parameters in 1/30sec increments	Z rotation	Scale			
230	Texture Flip	Flips texture drawing on objects	mode[8]				
231	Spin With Smooth Stop	Spin effect, allowing the spin to stop at a non-zero angle	Z spin: 0=home, 1-126=rev, 127=stop, 128-255=fwd	X spin: 0=home, 1-126=rev, 127=stop, 128-255=fwd	Y spin: 0=home, 1-126=rev, 127=stop, 128-255=fwd		

Notes for Combined Effects

Note 1: The Gradient effect will only work if the layer has an active image (movie or still). The image will be replaced entirely by the gradient and the gradient will be the same size as the image. It is recommended to use the built in CG Color Black image (Folder 255, File 231) as a starting point.

Note 2: The Cube LUT effect uses numbered 3D LUT (LookUp Table) files from the Mbox/plugins/cubemaps folder. The LUT files must use the .cube file extension and can be up to 32x32x32 in size. LUT files can be created and edited using applications like Blackmagic Design DaVinci Resolve. LUT files are loaded into RAM by the Mbox application at launch, to allow for rapid access.

Note 3: Plugin image for Effect 90 - Mask From File. Plugin image must be located in Mbox/plugins/images/masks and must have an 8-bit index number. File must have transparency (i.e. an alpha channel) and should use the PNG format.

Note 4: Modes for Effect 91 - Matte from Layer

Value	Description
0	Luma
1	Luma Invert
2	Red
3	Red Invert
4	Green

Value	Description
5	Green Invert
6	Blue
7	Blue Invert
8	Alpha
9	Alpha Invert

Note 5: Modes for Effect 92 - UV Map from Layer. This effect has one mode that creates a distortion effect and the other modes use the color (and optionally the alpha) information from each pixel on a separate layer to generate texture coordinates for mapping the pixels on the layer running the effect. Each color mode has four flip modes to accommodate the potential output of different UV mapping applications.

Value	Description
0	UV Distortion Effect
1	8/16-bit RG No Flip
2	8/16-bit RG Flip H
3	8/16-bit RG Flip V
4	8/16-bit RG Flip HV
5	12-bit RGBb No Flip
6	12-bit RGBb Flip H

Value	Description
7	12-bit RGBb Flip V
8	12-bit RGBb Flip HV
9	16-bit RB+GA No Flip
10	16-bit RB+GA Flip H
11	16-bit RB+GA Flip V
12	16-bit RB+GA Flip HV

Note 6: The Scale/Distortion Amount parameter for Effect 92 - UV Map from Layer - acts to scale the UV mapping for Modes 1 - 12 and as the distortion amount for Mode 0

Note 7: Modes for Effect 176 - Meta-Image. Plugin image must be located in Mbox/plugins/images/masks and must have an 8-bit index number. File should be 900x75 pixels, with twelve square areas (75x75 pixels each) in dark to light progression left to right, and should use the PNG or JPEG format.

Note 8: Modes for Effect 230 - Texture Flip

Value	Description		Value	Description
0-31	Flip X		128-159	Flip XZ
32-63	No Flip		160-191	Flip Z
64-95	Flip XY		192-223	Flip XYZ
96-127	Flip Y		224-255	Flip YZ

Note 9: Modes for Effect 190 - Pillow Blocks - Mode 0 renders the negative areas of the effect in opaque black, Mode 1 renders those areas as transparent.

Keystone Blend Mode/Curve

Value	Mode	Blend Curve	Grid Overlay	Controls
0	Disable DMX Keystone controls[1,2]	n/a	N	Keystone/Warp is set from Mbox Remote
1	Use DMX controls	Linear	N	X/Y corner controls
2	Use DMX controls	Raised Cosine	N	X/Y corner controls
3	Use DMX controls	Sine	N	X/Y corner controls
4	Use DMX controls	No Blending	N	X/Y corner controls
11	Use DMX controls	Linear	Y	X/Y corner controls
12	Use DMX controls	Raised Cosine	Y	X/Y corner controls
13	Use DMX controls	Sine	Y	X/Y corner controls
14	Use DMX controls	No Blending	Y	X/Y corner controls

Note 1: A Keystone Mode/Curve value of 0 enables the advances toolset that is accessed through the user interface of the Mbox Remote application

Note 2: When the value is set to 0, settings from the advanced toolset will negate the standard corner, edge-blend, and linearity controls, but not the Output Geometry controls.

Shutter Mode/Shapes

Value	Shape	Notes
0-9	Disabled	
10-19	Moving Light Mode	Separate controls for each end of shutter. If both controls are at 0, the shutter disappears.
20-29	Leko Mode	Distance and angle controls. If distance is zero, the shutter disappears.
30-39	Iris Mode	A round iris. Scale is used to adjust the size of the iris. No other controls.

Video and Utility Inputs (Texture Folder 255)

Texture Folder 255 is reserved for special uses such as selecting video/syphon inputs or copying layers.

Texture Value	Input
0	Patch Info Display
1-24	Copy Layer 1 - Layer 24 FX+
31-54	Copy Layer 1 - Layer 24 Raw
101	NDI Input 1
102	NDI Input 2
103	NDI Input 3
104	NDI Input 4
105	NDI Input 5
106	NDI Input 6
107	NDI Input 7
108	NDI Input 8
109	NDI Input 9
110	NDI Input 10
111	NDI Input 11
112	NDI Input 12
201	Syphon Input 1
202	Syphon Input 2
203	Syphon Input 3
204	Syphon Input 4
205	Syphon Input 5
206	Syphon Input 6
207	Syphon Input 7
208	Syphon Input 8
209	Syphon Input 9
210	Syphon Input 10
211	Syphon Input 11
212	Syphon Input 12

Texture Value	Input
231	CG Black Rectangle
232	CG White Rectangle
233	CG Red Rectangle
234	CG Green Rectangle
235	CG Blue Rectangle
236	CG Cyan Rectangle
237	CG Magenta Rectangle
238	CG Yellow Rectangle
241	Video Input 1
242	Video Input 2
243	Video Input 3
244	Video Input 4
245	Video Input 5
246	Video Input 6
247	Video Input 7
248	Video Input 8
254	CG Color Bars
255	Null Image

Note: Depending on the product version (Designer/Studio/Studio+/Mini) there are limits placed on the number of layers, NDI inputs, Syphon inputs, and number of video inputs. This table represents the full list of available inputs for Mbox Designer. Studio/Studio+ has 12 layers, and Mini has 6. Therefore, the Copy Layer values will be limited to those maximums for each. Studio/Studio+ has 8 NDI inputs and Mini has 4. Studio/Studio+ has 4 Syphon inputs and Mini has 2. Studio/Studio+ has 4 video inputs and Mini has 2.

Play Modes

Value	Play Mode
0	Forward Loop
1	Forward Loop, Pause when Layer Opacity = 0
2	Forward Loop, Pause and Reset to In-Point when Layer Opacity = 0
10	Reverse Loop
11	Reverse Loop, Pause when Layer Opacity = 0
12	Reverse Loop, Pause and Reset to In-Point when Layer Opacity = 0
20	Forward Once
21	Forward Once, Pause when Layer Opacity = 0
22	Forward Once, Pause and Reset to In-Point when Layer Opacity = 0
30	Reverse Once
31	Reverse Once, Pause when Layer Opacity = 0
32	Reverse Once, Pause and Reset to In-Point when Layer Opacity = 0
40	Forward Bounce
50	Reverse Bounce
60	Random
70	Forward Once - Restart on In Frame Change
75	Forward Once - Restart with Crossfade on In Frame Change
80	Scrub - In Frame
90	Scrub - Out Frame
100	Forward Loop - Crossfade on Out Frame
110	Reverse Loop - Crossfade on In Frame
120	Forward Loop - Restart on In Frame Change
125	Forward Loop - Restart with Crossfade on In Frame Change
130	Timecode sync - strict lock
135	Timecode sync - sync then freewheel
136	Timecode sync - jam sync
140	Layer Sync Receiver
150	Layer Sync Sender - Forward Loop
160	Layer Sync Sender - Forward Once
180	Kiosk Mode - play once through folder
181	Kiosk Mode - play once through folder, loop last file
182	Kiosk Mode - play once through folder, fade out last file
185	Kiosk Mode - play through folder then loop
190	Kiosk Mode - timecode
240	Play out Mode - last 5 seconds
241	Play out Mode - last 10 seconds
242	Play out Mode - last 15 seconds
243	Play out Mode - last 20 seconds
244	Play out Mode - last 30 seconds
255	Restart Movie from In Point

Play Speed

Value	Play Mode
0	Paused
1 - 126	Increasing speeds from paused to normal (1x)
127	Normal speed = movie fps
128 - 255	Increasing speeds from normal (1x) to 4x normal

Sync Stream

Value	Stream	Notes
0	Layer to Layer	Used for sending/receiving sync to/from layer of same number on another Mbox server
1	Stream 1	Used for sending/receiving sync to/from any layer which is set to same stream number
2-32	Streams 2-32	As above...
33-96	Streams 33-96	All versions of Mbox can listen to 96 streams, but cannot output above their limit. See note below.

Note: Depending on the product version (Designer/Studio/Studio+/Mini) there are limits placed on the number of sync stream outputs. This table represents the full list of available streams for Mbox Designer. Studio/Studio+ has 16 sync streams, and Mini has 8. Therefore, valid Sync Stream <u>output</u> values will be limited to those maximums for each, but all versions can receive up to 96 streams.

Aspect Control

Value	Mode
0	Square pixels (default)
1-126	Ratios scaling from 1:4 to 1:1
127	1:1 ratio
128-255	Ratios scaling from 1:1 to 4:1

Frame Blending Control

The frame blending in Mbox has been enhanced to better handle situations where the movie framerate does not divide evenly into the overall rendering rate - e.g. 30fps content with a 50Hz output/render. The new system uses proportional interframe blending to deliver a blend between the previous and next frames should the frame delivery time fall in between the normal delivery time for two frames. This system will also provide blending when the movie speed is set above or below normal rate (which also results in a framerate mismatch with the rendering rate).

Note: The enhanced frame blending is off by default. It can be enabled on the Preferences tab, but will also turn on automatically for any movie that is slowed down by 10% and which is < 1/2 the framerate of the Global Surface.

With the preference enabled, a value of 255 enables automatic proportional interframe blending when the movie's framerate is mismatched to the output refresh rate by more than 5%. A value of 254 forces the proportional interframe blending on to 100% in all cases. No matter the state of the preference, a value of 0 = no frame blending. Values from 1 - 253 = variable frame blend time, as a proportion of the normal frame time. This is a square-law control, and 50% blend time is achieved at DMX 210, 25% blend time at DMX 165.

Texture Transitions

Value	Transition	Description
0	Dissolve	Dissolve (a la EX1)
1	Dissolve 2	Dissolve (alternate curve)
2	Wipe Right	Left to right wipe with hard edge
3	Wipe Left	Right to left wipe with hard edge
4	Wipe Down	Top to bottom wipe with hard edge
5	Wipe Up	Bottom to top wipe with hard edge
6	Wipe Diagonal	Diagonal wipe with hard edge
7	Wash Right	Left to right wipe with soft edge
8	Wash Left	Right to left wipe with soft edge
9	Wash Down	Top to bottom wipe with soft edge
10	Wash Up	Bottom to top wipe with soft edge
11	Wash Diagonal	Diagonal wipe with soft edge
12	White Right	Left to right wipe with white bar at edge
13	White Left	Right to left wipe with white bar at edge
14	White Down	Top to bottom wipe with white bar at edge
15	White Up	Bottom to top wipe with white bar at edge
16	White Diagonal	Diagonal wipe with white bar at edge
17	Through Black	Fade to black then back in
18	Through White	Fade to white then back in
19	Through Red	Fade to red than back in
20	Bright First	Transition through bright areas first
21	Dark First	Transition through dark areas first
22	Dots	Fade with small dots
23	Big Dots	Fade with large dots
24	Burst	White star burst transition
25	Flash	White flash transition
26	Slow Dissolve	Dissolve that comes in more slowly
27	Slower Dissolve	Dissolve that comes in even more slowly
28	Rotate Left	Simple 3D rotate effect to left
29	Rotate Right	Simple 3D rotate effect to right
30	Rotate Down	Simple 3D rotate effect downwards
31	Rotate Up	Simple 3D rotate effect upwards
32	Rotate Center Vertical	Simple 3D rotate effect around vertical center
33	Rotate Center Horizontal	Simple 3D rotate effect around horizontal center
34	Zoom Out	Zoom out and back in
35	Zoom In	Zoom in and back out
36	Horizontal Bars	10 horizontal bars, hard edge
37	Horizontal Bars + Blend	10 horizontal bars, soft edge
38	Vertical Bars	20 vertical bars, hard edge
39	Vertical Bars + Blend	20 vertical bars, soft edge

Texture Transitions continued...

Value	Transition	Description
40	Circle Center	Circle out from center
41	Circle Center + Blend	Circle out from center, blended edge
42	Concentric Circles	Circles out from center, blended edges
43	Push Right	New image pushes in left to right
44	Push Left	New image pushes in right to left
45	Push Down	New image pushes in top to bottom
46	Push Up	New image pushes in bottom to top
47	Split Right	Outgoing image splits and slides to the right
48	Split L/R Center	Outgoing image splits and slides left & right from the center
49	Split Down	Outgoing image splits and slides down
50	Split Up	Outgoing image splits and slides up
51	Split U/D Center	Image splits and slides up & down from the center
52	Split XY	Outgoing image splits and slides outwards from the center
53	Bar Swipe Right	Outgoing image slides to the right in strips
54	Bar Swipe Left	Outgoing image slides to the left in strips
55	Bar Swipe Up	Outgoing image slides upwards in strips
56	Bar Swipe Down	Outgoing image slides downwards in strips
57	Page Curl 1	Page corner curls from bottom-right to top-left
58	Page Curl 2	Page corner curls from top-right to bottom-left
59	Dissolve With Pixels	Image pixelates, dissolves to new image, then de-pixelates
60	Circular Wipe CW	Wipe around center of image in clockwise direction
61	Circular Wipe CCW	Wipe around center of image in counter-clockwise direction
101-110	Custom Hard-edge Wipe 1-10[1]	Hard-edge wipe using custom grayscale file
111-120	Custom Soft-edge Wipe 1-10[2]	Hard-edge wipe using custom grayscale file
121-144	Wipe From Layer - Dark First 1-24[3]	Uses image from another layer and transitions through dark areas first to "wipe" to new image
151-174	Wipe From Layer - Light First 1-24[3]	Uses image from another layer and transitions through light areas first to "wipe" to new image
251	Object Dissolve - Alternate 4	New object snaps in, current object fades out
252	Object Dissolve - Alternate 3	Fade in new object, pause, then fade out current object
253	Object Dissolve - Alternate 2	Fade in new object, then fade out current object
254	Object Dissolve - Alternate 1	As with 255, but using fast cosine curve
255	Object Dissolve - Original Version	Linear fade out on current object, fade in on new object

Note 1: The custom hard-edge transitions require JPEG still image files to be placed at Mbox/plugins/images/grayscale with each image having an index number 1 through 10.

Note 2: The custom soft-edge transitions require JPEG still image files to be placed at Mbox/plugins/images/grayscale with each image having an index number 11 through 20.

Note 3: The From Layer transitions use the image from other active layers 1-24, selected by the transition number.

Layer Mix Modes

Value	Mode	Fit	Center	Cropping	Rotation	Description
0	Crop Only	N	N	Y	N	Crops to mix boundary, no fit, no scale, no rotation
1	Center, No Crop	N	Y	N	N	Content center is placed in center of Mix, no scale-to-fit, no rotation, NO CROP to mix boundary
2	Center, Crop	N	Y	Y	N	Content center is placed in center of Mix, no scale-to-fit, no rotation, crops to mix boundary
3	Center, Horizontal Fit, No Crop	H	Y	N	N	Content center is placed in center of Mix, scale-to-fit mix horizontally, no rotation, NO CROP to mix boundary
4	Center, Horizontal Fit, Crop	H	Y	Y	N	Content center is placed in center of Mix, scale-to-fit mix horizontally, no rotation, crops to mix boundary
5	Center, Vertical Fit, No Crop	V	Y	N	N	Content center is placed in center of Mix, scale-to-fit mix vertically, no rotation, NO CROP to mix boundary
6	Center, Vertical Fit, Crop	V	Y	Y	N	Content center is placed in center of Mix, scale-to-fit mix vertically, no rotation, crops to mix boundary
7	Center, Horizontal & Vertical Fit, No Crop	HV	Y	N	N	Content center is placed in center of Mix, scale-to-fit mix horizontally & vertically, no rotation, NO CROP to mix boundary
8	Center, Horizontal & Vertical Fit, Crop	HV	Y	Y	N	Content center is placed in center of Mix, scale-to-fit mix horizontally & vertically, no rotation, crops to mix boundary
9	Center, Fit Best, No Crop	B	Y	N	N	Content center is placed in center of Mix, scale-to-fit mix horizontally or vertically depending on aspect ratio, NO CROP to mix boundary
10	Center, Fit Best, Crop	B	Y	Y	N	Content center is placed in center of Mix, scale-to-fit mix horizontally or vertically depending on aspect ratio, crops to mix boundary
11	Center, Rotate, No Crop	N	Y	N	Y	Content center is placed in center of Mix, no scale-to-fit, rotated to match mix rotation, NO CROP to mix boundary
12	Center, Rotate, Crop	N	Y	Y	Y	Content center is placed in center of Mix, no scale-to-fit, rotated to match mix rotation, crops to mix boundary
13	Center, Horizontal Fit, Rotate, No Crop	H	Y	N	Y	Content center is placed in center of Mix, scale-to-fit mix horizontally, rotated to match mix rotation, NO CROP to mix boundary
14	Center, Horizontal Fit, Rotate, Crop	H	Y	Y	Y	Content center is placed in center of Mix, scale-to-fit mix horizontally, rotated to match mix rotation, crops to mix boundary
15	Center, Vertical Fit, Rotate, No Crop	V	Y	N	Y	Content center is placed in center of Mix, scale-to-fit mix vertically, rotated to match mix rotation, NO CROP to mix boundary

Layer Mix Modes continued...

Value	Mode	Fit	Center	Cropping	Rotation	Description
16	Center, Vertical Fit, Rotate, Crop	V	Y	Y	Y	Content center is placed in center of Mix, scale-to-fit mix vertically, rotated to match mix rotation, crops to mix boundary
17	Center, Horizontal & Vertical Fit, Rotate, No Crop	HV	Y	N	Y	Content center is placed in center of Mix, scale-to-fit mix horizontally & vertically, rotated to match mix rotation, NO CROP to mix boundary
18	Center, Horizontal & Vertical Fit, Rotate, Crop	HV	Y	Y	Y	Content center is placed in center of Mix, scale-to-fit mix horizontally & vertically, rotated to match mix rotation, crops to mix boundary
19	Center, Fit Best, Rotate, No Crop	B	Y	N	Y	Content center is placed in center of Mix, scale-to-fit mix horizontally or vertically depending on aspect ratio, NO CROP to mix boundary
20	Center, Fit Best, Rotate, Crop	B	Y	Y	Y	Content center is placed in center of Mix, scale-to-fit mix horizontally or vertically depending on aspect ratio, rotated to match mix rotation, crops to mix boundary
21	Horizontal Fit, No Crop	H	N	N	N	Content is not centered in Mix, scale-to-fit mix horizontally, no rotation, rotated to match mix rotation, NO CROP to mix boundary
22	Horizontal Fit, Crop	H	N	Y	N	Content is not centered in Mix, scale-to-fit mix horizontally, no rotation, crops to mix boundary
23	Vertical Fit, No Crop	V	N	N	N	Content is not centered in Mix, scale-to-fit mix vertically, no rotation, NO CROP to mix boundary
24	Vertical Fit, Crop	V	N	Y	N	Content is not centered in Mix, scale-to-fit mix vertically, no rotation, crops to mix boundary
25	Horizontal & Vertical Fit, No Crop	HV	N	N	N	Content is not centered in Mix, scale-to-fit mix horizontally & vertically, no rotation, NO CROP to mix boundary
26	Horizontal & Vertical Fit, Crop	HV	N	Y	N	Content is not centered in Mix, scale-to-fit mix horizontally & vertically, no rotation, crops to mix boundary
27	Fit Best, No Crop	B	N	N	N	Content is not centered in Mix, scale-to-fit mix horizontally or vertically depending on aspect ratio, NO CROP to mix boundary
28	Fit Best, Crop	B	N	Y	N	Content is not centered in Mix, scale-to-fit mix horizontally or vertically depending on aspect ratio, crops to mix boundary

Layer Mix Modes continued...

Value	Mode	Fit	Center	Cropping	Rotation	Description
31	Horizontal Fit, Rotate, No Crop	H	N	N	Y	Content is not centered in Mix, scale-to-fit mix horizontally, rotated to match mix rotation, NO CROP to mix boundary
32	Horizontal Fit, Rotate, Crop	H	N	Y	Y	Content is not centered in Mix, scale-to-fit mix horizontally, rotated to match mix rotation, crops to mix boundary
33	Vertical Fit, Rotate, No Crop	V	N	N	Y	Content is not centered in Mix, scale-to-fit mix vertically, rotated to match mix rotation, NO CROP to mix boundary
34	Vertical Fit, Rotate, Crop	V	N	Y	Y	Content is not centered in Mix, scale-to-fit mix vertically, rotated to match mix rotation, crops to mix boundary
35	Horizontal & Vertical Fit, Rotate, No Crop	HV	N	N	Y	Content is not centered in Mix, scale-to-fit mix horizontally & vertically, rotated to match mix rotation, NO CROP to mix boundary
36	Horizontal & Vertical Fit, Rotate, Crop	HV	N	Y	Y	Content is not centered in Mix, scale-to-fit mix horizontally & vertically, rotated to match mix rotation, crops to mix boundary
37	Fit Best, Rotate, No Crop	B	N	N	Y	Content is not centered in Mix, scale-to-fit mix horizontally or vertically depending on aspect ratio, rotated to match mix rotation, NO CROP to mix boundary
38	Fit Best, Rotate, Crop	B	N	Y	Y	Content is not centered in Mix, scale-to-fit mix horizontally or vertically depending on aspect ratio, rotated to match mix rotation, crops to mix boundary

Blend Modes

Value	Blend Mode	Description
0	Standard	No blending
1	Additive	Layer's colors are added to underlying colors (blacks appear transparent)
2	Screen	Similar to Additive, with less of underlying color (blacks appear transparent)
3	Multiply	Multiplies layer's color with underlying color (blacks appear opaque)
4	Subtractive	Layer's colors are subtracted from underlying colors (blacks appear transparent)
5	Exclusion	Underlying colors are inverted where layer color is lighter; layer's colors are then added to underlying colors (blacks appear transparent)
6	Invert Subtractive	Underlying colors are subtracted from layer's colors (blacks appear opaque)
7	Invert Additive	Layer's colors are inverted and are added to inverse of underlying colors (blacks appear transparent)
8	Darken	Underlying dark areas darken layer's colors (light areas appear transparent)
9	Lighten	Underlying light areas lighten layer's colors (blacks appear transparent)
10	Psychedelic	Colors are blended in a psychedelic fashion

Draw Modes

Value	Draw Mode	Description
0	None	No effect
1	Light/Trim	Automatic ambient lighting of object/trims edge of backgrounds
2	Cut	Cuts holes in stencil mask, based on opacity of layer
3	Cut + Light	As above w/ lighting
4	Cut & Draw	As mode 2 but texture is drawn on object too
5	Cut & Draw + Light	As above w/ lighting
6	Draw Thru Stencil	This layer's texture is drawn where holes have been cut in stencil
7	Draw Thru Stencil + Light	As above w/ lighting
8	Draw Onto Stencil	This layer's texture is drawn where stencil is not cut
9	Draw Onto Stencil + Light	As above w/ lighting
14	Opacity Fades to Black	Opacity parameter causes layer to fade to black rather than transparent

Pixel Map Group Control Modes

Value	Mode	Description
0	Off	No effect
1	IRGB Master	RGB controls act as inhibitive submasters for Mbox's RGB data on all fixtures in the group and Intensity control masters the final output
2	IRGB Replace	RGB controls generate a color that replaces Mbox's RGB data for all fixtures in the group and the Intensity control masters the final output
3	IRGB Master, Merge Replace	Merge data replaces Mbox's output and is then mastered by the group IRGB controls
4	IRGB Master, Merge Multiply	RGB controls act as inhibitive submasters for incoming merge data. Mbox data is then multiplied by the result of the first operation and the Intensity control masters the final output
5	RGB Master, Merge XFade	RGB controls act as inhibitive submasters for Mbox's RGB data on all fixtures in the group, and the intensity control is used to crossfade between that result and the merge data
6	RGB Replace, XFade	RGB controls generate a color that replaces Mbox's RGB data for all fixtures in the group, and the intensity control is used to crossfade between that result and the Mbox data
7	IRGB Master, Merge HTP	Merge data and Mbox data are merged using HTP, the result is then mastered by the group IRGB controls
8	RGB Replace, HTP	RGB controls generate a color that is HTP merged with Mbox's data and the result is mastered by the group intensity control
101	ICMY Master	RGB controls act as inhibitive submasters for Mbox's RGB data (using CMY inversion) on all fixtures in the group and Intensity control masters the final output
102	ICMY Replace	RGB controls generate a color (using CMY inversion) that replaces Mbox's RGB data for all fixtures in the group and the Intensity control masters the final output
103	ICMY Master, Merge Replace	Merge data replaces Mbox's output and is then mastered by the group IRGB controls (using CMY inversion)
104	ICMY Master, Merge Multiply	RGB controls (using CMY inversion) act as inhibitive submasters for incoming merge data. Mbox data is then multiplied by the result of the first operation and the Intensity control masters the final output
105	CMY Master, Merge XFade	RGB controls (using CMY inversion)act as inhibitive submasters for Mbox's RGB data on all fixtures in the group, and the intensity control is used to crossfade between that result and the merge data
106	CMY Replace, XFade	RGB controls (using CMY inversion) generate a color that replaces Mbox's RGB data for all fixtures in the group, and the intensity control is used to crossfade between that result and the Mbox data
107	ICMY Master, Merge HTP	Merge data and Mbox data are merged using HTP, the result is then mastered by the group IRGB controls (using CMY inversion)
108	CMY Replace, HTP	RGB controls (using CMY inversion) generate a color that is HTP merged with Mbox's data and the result is mastered by the group intensity control
255	Group Force OFF	All output for the group is suppressed, i.e. sent to 0

Texture Transition Timing

The Mbox v4 software features a built-in transition for 2D content on every layer. This transition is controlled by two parameters: the Transition Type and the Transition Time.

+ Transition Type: Selects the type of transition. e.g. Dissolve, Wipe, Slide, Object Dissolve, etc. (Refer to the "Texture Transitions Table" on page 230 for information on transition types)

+ Transition Time: Determines the length of the transition in seconds and/or fractions of seconds. The Transition Time parameter is an 8-bit parameter with values or ranges that are used to select specific discrete transition times from 0.00 to 310.00 seconds. The table below details the 8-bit values used to select each discrete transition time.

Value	Seconds	Value	Seconds	Value	Seconds	Value	Seconds	Value	Seconds	Value	Seconds
0	0.00	1	0.10	2	0.17	3	0.34	4	0.75	5	1.00
6	1.20	7	1.40	8	1.60	9	1.80	10	2.00	11	2.20
12	2.40	13	2.60	14	2.80	15	3.00	16	3.20	17	3.40
18	3.60	19	3.80	20	4.00	21	4.20	22	4.40	23	4.60
24	4.80	25	5.00	26	5.20	27	5.40	28	5.60	29	5.80
30	6.00	31	6.20	32	6.40	33	6.60	34	6.80	35	7.00
36	7.20	37	7.40	38	7.60	39	7.80	40	8.00	41	8.20
42	8.40	43	8.60	44	8.80	45	9.00	46	9.20	47	9.40
48	9.60	49	9.80	50	10.00	51	10.20	52	10.40	53	10.60
54	10.80	55	11.00	56-57	12.00	58-59	13.00	60-62	14.00	63-64	15.00
65-67	16.00	68-69	17.00	70-72	18.00	73-74	19.00	75-77	20.00	78-80	21.00
81-82	22.00	83-85	23.00	86-87	24.00	88-90	25.00	91-92	26.00	93-95	27.00
96-97	28.00	98-100	29.00	101-103	30.00	104-105	31.00	106-108	32.00	109-110	33.00
111-113	34.00	114-115	35.00	116-118	36.00	119-120	37.00	121-123	38.00	124-126	39.00
127-128	40.00	129-131	41.00	132-133	42.00	134-136	43.00	137-138	44.00	139-141	45.00
142-143	46.00	144-146	47.00	147-148	48.00	149-151	49.00	152-154	50.00	155-156	51.00
157-159	52.00	160-161	53.00	162-164	54.00	165-166	55.00	167-169	56.00	170-171	57.00
172-174	58.00	175-177	59.00	178-179	60.00	180-182	65.00	183-184	70.00	185-187	75.00
188-189	80.00	190-192	85.00	193-194	90.00	195-197	95.00	198-199	100.00	200-202	110.00
203-205	120.00	206-207	130.00	208-210	140.00	211-212	150.00	213-215	160.00	216-217	170.00
218-220	180.00	221-222	190.00	223-225	200.00	226-228	210.00	229-230	220.00	231-233	230.00
234-235	240.00	236-238	250.00	239-240	260.00	241-243	270.00	244-245	280.00	246-248	290.00
249-250	300.00	251-254	310.00	255	0.01						

Note: The 8-bit value of 255 is special. This value represents the fastest possible transition that forces an actual switch between movie players on the layer. This is important if using the Object Dissolve transition. A time of 0.00 (parameter value of 0) causes the layer to ignore the selected transition type and just snap between outgoing and incoming media - effectively there is no transition.