SOFTWARE VERSION v5.4

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MBOX® MEDIA SERVER

USER MANUAL (rev. K)

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Mbox makes use of the Syphon Framework. Syphon was created by bangnoise (Tom Butterworth) & vade (Anton Marini).

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Mbox® Media Server v5.4 User Manual
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REVISION HISTORY

This manual has been revised as follows:

Version	Release Date	Notes
5.0 (revA)	October 2, 2023	Initial Release
5.0.1 (revB)	December 1, 2023	In/Out Frame absolute mode and Sync Offset corrections
5.0.2 (revC)	February 20, 2024	NDI format switch note, text and image edits, license notes
5.1 (revD)	May 20, 2024	5.1 release, remove visualiser mode, fix PRG Dallas address
5.2 (revE)	September 6, 2024	5.2 release
5.2.1 (revF)	October 11, 2024	Remove Blackmagic “Show Diagnostic”
5.2.2 (revG)	January 8, 2025	Amend effect info, Blackmagic duplex devices
5.3 (revH)	March 24, 2025	5.3 Release, Blackmagic compatibility warning
5.3.1 (revJ)	June 11, 2025	5.3.1 Release, add Jam Sync Fade playmode, TC HUD info
5.4 (revK)	August 18, 2025	5.4 Release

INTRODUCTION

About This Guide

This user manual provides necessary information regarding the operation of the Mbox v5 Media Server software. This guide is provided to explain the features in the Mbox v5 software in detail. Unlike Mbox v4, which had three software versions (Designer, Studio/Studio+, and Mini), Mbox v5 is a single application where the activation of a specific license level unlocks the features associated with that license level. Differences between the operation of the three different licenses and operating modes of the software are noted wherever applicable.

Studio+

The Mbox software has an available license upgrade package called “Studio+” in this manual and others. The Studio+ license upgrade adds the following to an existing Studio license:

+ Additional video output pixels to a maximum of 8192x2160 (from 4096x2160)
+ Additional Pixel Mapping pixels to a maximum of 20,000 (from 10,000)
+ 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 v5 software is designed to work with either the Mbox Director software or moving-light consoles. The default patch layouts for Mbox v5 are different than those found in Mbox v4, but the v5 software can be placed into a v4 control mode that is compatible with controllers using an Mbox v4 patch. There is a new version of the Mbox Director software for controlling the Mbox v5 software. Mbox v5 will also work with moving-light consoles having compatible profiles.

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

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1.

OVERVIEW

This chapter provides an overview of Mbox features and operations

+ IMPORTANT DIFFERENCES BETWEEN MBOX V5 AND PRIOR VERSIONS
+ GENERAL OVERVIEW
+ MBOX ENVIRONMENT
+ FIXTURE AND LAYER OVERVIEW
+ FIXTURE DESCRIPTIONS

IMPORTANT DIFFERENCES BETWEEN MBOX V5 AND PRIOR VERSIONS

Compatibility

The Mbox v5 media server software has been updated extensively from the prior Mbox v4 software. These updates have been made to extend the compatibility of the application with newer Apple computer hardware and to replace older APIs with newer, better-performing APIs.

Mbox v5 is what Apple terms a “Universal Binary,” meaning that the application has been compiled to be able to run natively on multiple processor types. With Apple’s current hardware offerings, the two pertinent processor types are Intel 64 and Arm64, found on Intel CPU and Apple Silicon CPU computers respectively. Prior versions of the Mbox software were compiled for Intel processors only and therefore required the use of the Rosetta2 translation tool to run on Arm processors (i.e. on Apple Silicon hardware). While this was not a significant issue, Mbox v5 is able to run natively, without the Rosetta2 translation, on newer Apple hardware. This provides both better performance and ensures future compatibility.

Mbox v5 and its supporting applications (Mbox Daemon, Mbox Director, Mbox Remote) require at least macOS 10.14.6 - Mojave.

Application Structure

The Mbox v4 media server software was a family of three software applications - Designer, Studio, and Mini. Each application, or “version,” encapsulated the functionality of a specific license level. The Mbox Designer application, with an Mbox Designer license, was required to be able to take advantage of the Mbox Designer functionality. And the same was true for Mbox Studio and Mbox Mini.

Mbox v5 changes from this prior system in that there is now only one, single Mbox application. Mbox v5 is a single application that includes all of the possible functionality of the Mbox software. The functionality available for use is dictated by the license level that has been activated within the Mbox application. In other words, the active license sets which “version” of Mbox the application acts like.

This new structure simplifies the distribution of the Mbox v5 software, meaning that users only need to download one application installer, rather than different installers for each version of Mbox. When the Mbox v5 software launches, it will find the highest level of activated license on the computer and allow the use of all of the corresponding functionality.

CAUTION! When configuring the Mbox v5 software, the UI on the Patch tab will always allow the selection of the maximum number of layers (24) and maximum number of output masters (32) no matter what the active license level is. However, only the allowed quantity of layers and output masters can be used - dictated by the active license.

The Mbox v5 application has patch modes that allow it to be controlled by a parameter set that matches any one of the three versions - Designer/Studio/Mini. This allows a show to be programmed using any lesser license type and then replayed using a higher license type. And in the opposite sense, if a show is programmed using a higher license type, it can be replayed - without any functionality restricted to the higher license - using a lesser license type.

Note: Mbox v5 has three new patch modes for the revised 16-bit color control parameter layout and also has three legacy patch modes that use the 8-bit color controls found in Mbox v4. These legacy modes allow Mbox v5 to correctly respond to control data created for the Mbox v4 software.

Licensing

Licensing Model

Mbox v5 uses a subscription-based licensing model. All licenses for Mbox v5 are time-limited and when they expire must be renewed to retain full functionality. An active subscription license allows the use of all functionality of the corresponding license level of Mbox v5.

The standard subscription license period for Mbox v5 is one year, and depending on the license type, the subscription can be set to renew automatically. Soft-license subscriptions will default to auto-renew when they are purchased, using the same payment method used when the subscription was initially purchased. Subscriptions using USB keys (dongles) cannot auto-renew and must be managed by the license holder. Prior to the expiration of the dongle subscription, the license holder must contact PRG to arrange for the subscription to be renewed.

Additional notes:

+ **Subscription licenses cannot be terminated for a refund prior to expiring, and will run to completion.**
+ Some countries may have legal restrictions placed on the length of automatic-renewal subscriptions, therefore the subscription renewal terms may be different in some locations. Currently this applies to Germany only.
+ The splash screen that appears when the Mbox v5 application launches provides information on the current license status, including expiration warnings. Additionally, the Mbox v5 application may provide notifications in the macOS Notification Center - notifications must be enabled/allowed for the Mbox application.
+ When using a soft-license subscription, the Mbox v5 software must periodically check license validity. If the periodic check does not happen within 14 days the license will be invalidated and must be revalidated to restore full functionality. This periodic check requires a connection to the internet and happens each time the application is launched and once a day while the application is running. A successful validation will reset the period to 14 days. When validation is required within 8 days, a message will be shown on the splash screen and Preferences tab.
+ Mbox v5 subscription licenses do not license older versions of the Mbox software.

License Types

Mbox v5 can be licensed by either a soft-license or a dongle. Both forms of license use a subscription model:

+ **Soft-license** - Mbox v5 uses the QLM licensing system, with a subscription mode as noted above. Soft-license subscriptions may be purchased through the online portal and will be delivered as a license key that can be activated on up to two computers. The terms of this license restrict the usage to only one “active” computer, with the second activation for a backup computer.
+ **Dongle** - Mbox v5 uses a new version of dongle hardware that allows for the subscription model. Any user wanting a dongle-based subscription must purchase a new dongle from PRG, existing Mbox dongles are not compatible. Dongle subscriptions can only activate one computer, the computer that the dongle is physically connected to.

License Expiration and Renewal

When a subscription license for Mbox v5 expires:

+ When a soft-license subscription expires, Mbox v5 provides a four-day grace period. During this period, the software retains the expired license’s functionality, allowing the user a little extra time to renew the subscription if they have missed the expiration date. **Dongle subscriptions do not provide a grace period!**
+ After a soft-license subscription has expired, the software retains the output master and layer quantities allowed by the expired license. However, if the expired license is fully removed from the computer, these quantities will revert to the maximum allowed by the unlicensed demo limits.
+ After a soft-license subscription has been renewed, the computer must be connected to the internet and the license’s renewed status applied. This will happen automatically if the Mbox application is launched with an active internet connection or can be accomplished manually by activating the software in the normal manner.

GENERAL OVERVIEW

Features

The Mbox media server software allows advanced video playback and effects to be integrated into an automated lighting system. 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 in several ways - by projector, LED wall, and display screen, or pixel mapped to LED lighting fixtures.

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 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 depends on connected hardware.)
+ Accepts live video input with optional Blackmagic Decklink and UltraStudio devices, or USB devices.
+ 4K+ Video playback. (Playback resolutions may be limited by OS or hardware limitations)
+ Adjustable camera perspective for 3D objects. (Designer license only). Adjustable virtual 3D lighting for 3D objects. (Designer and Studio license levels)
+ Up to 24 interactive, scalable layers that can be configured as 2D textures or 3D objects.
+ Digital gobos that can be used as textures, 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+/Studio/Mini

	Mbox Designer	Mbox Studio+	Mbox Studio+	Mbox Mini
Playback Layers	24	12	12	6
Output Masters	32	8	8	6
Maximum Output Size*	Unlimited	17.6 million pixels	8.8 million pixels	4.6 million pixels
Video Inputs	8	4	4	2
Syphon In/Out	12/Layers & Outputs	4/Layers & Outputs	4/Outputs Only	2/Outputs Only
Pixel Mapping Pixels	Unlimited	20000	10000	5000
Effects: Master/Layer	2/4	1/2	1/2	1/1
Image Remapping	255 Configurations	16 Configurations	8 Configurations	2 Configurations
2D/3D Content	65535/65535	65535/255	65535/255	65535/255

* Actual output size limit may depend on hardware performance

Concepts of Operation

Basic Function

The function of the Mbox software is to dynamically control media - such as movies, 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 seen immediately. This eliminates the need to modify media in advance, which can take considerable time.

Control

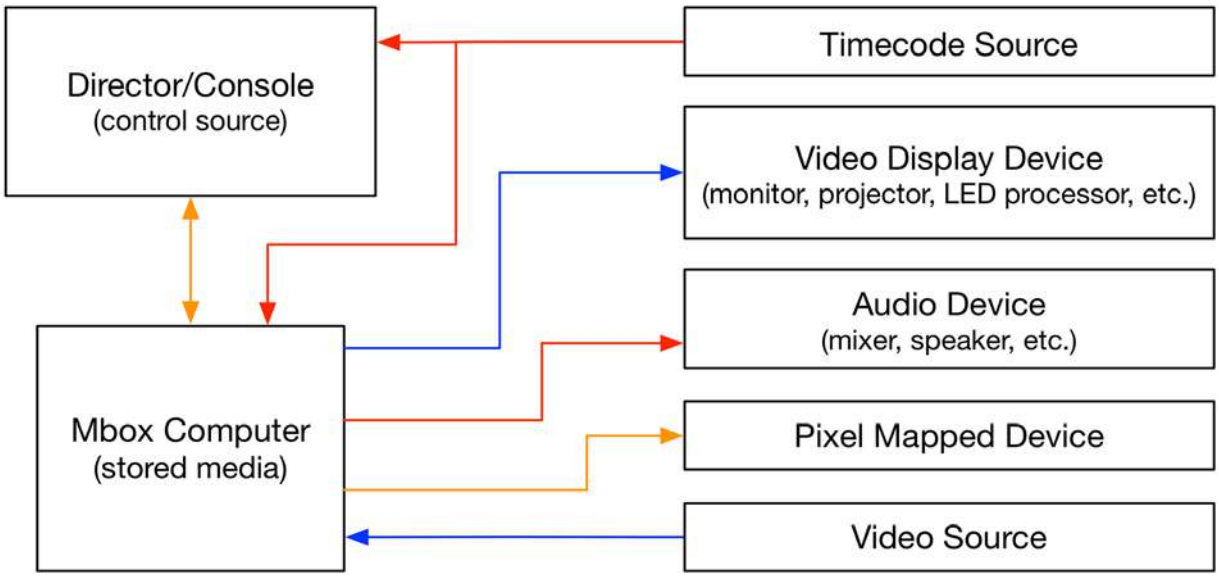
Mbox can be controlled by either a lighting console or a computer running Mbox Director software. The console or computer can be used to configure and control all aspects of Mbox's playback and composition parameters.

+ **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 the Mbox software from a Macintosh computer - either the same computer that is running Mbox, or a separate, networked computer.

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

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: macOS 10.14.6 Mojave or newer, macOS 12 Monterey is recommended.
+ Video Card (GPU): Better GPUs will allow for higher content/output resolutions without performance issues.
+ Hard Drive Configuration: Flash-based storage (e.g. NVMe or M.2) or SATA SSDs (in RAID 0 configuration) provide the best performance. Rotational drives (e.g. 5400/7200rpm SATA drives) should be avoided.
+ Processor Type, Number of Cores, and Speed: Mbox requires an Intel 64-bit (Core 2 or better) or Apple Silicon (M1 or M2) processor. For best results, an Intel processor should have at least six cores total, running at a speed of 2.5GHz or better, Apple Silicon processors should be of the "Pro," "Max," or "Ultra" specification.

MBOX ENVIRONMENT

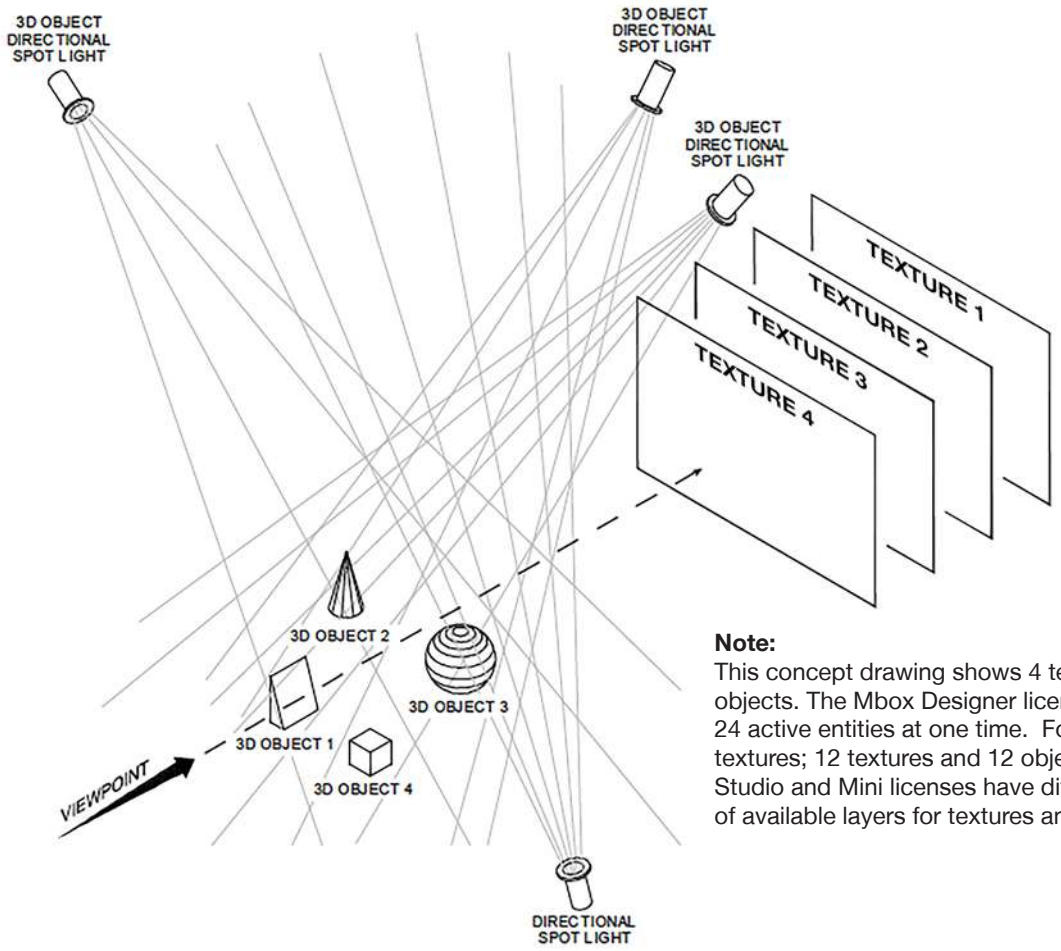
Environment

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 2D textures 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 layer.

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 textures and 4 objects. The Mbox Designer license allows up to 24 active entities at one time. For example, 24 textures; 12 textures and 12 objects; etc. Mbox Studio and Mini licenses have different quantities of available layers for textures 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 “2D texture” and cannot move backwards or forwards on the Z axis If an object is used on a layer, that object 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 lower-numbered layers that are 2D textures, of in front of higher-numbered layers that are 2D textures.

The layer with the 2D texture would have to use a 3D object to overcome this limitation. Therefore, if a layer is a 2D texture and it becomes necessary to move it along the Z axis to place it in front of a 3D object, the layer must have a 3D 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 into an individual rendering context. After a frame of imagery has been loaded into 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. Finally, all layers are then composited into a single context called the Global Surface, using the stacking order explained above, with individual outputs being generated from designated areas of the Global Surface.

Effects

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

Shader-based Effects

When applied to a layer, Shader-based effects 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 an Output Master, shaders work within the boundaries of the entire output and will affect everything visible on that output.
+ Shaders can modify the color, opacity, and position of individual pixels in the source content.
+ Shaders can be created by anyone and compiled for use on the Mac platform. They can then be imported for use with Mbox. This is not a simple process though, and it is recommended to contact PRG’s Mbox Development team for advice on the creation of shaders for use with Mbox.
+ Some shaders have a limit on the texture size that they work with. These limits are noted (where applicable) in the “Combined Effects Table” starting on page 232.

Matrix-based Effects

Whereas shader-based effects work on individual pixels, Matrix-based Effects work on the entire composition of a layer. This means that Matrix-based Effects can work outside the original pixel boundaries of content, allowing them to affect the content without the result being cropped to the content's pixel boundaries. Matrix-based Effects can move, flip, or crop the content, and can also add other manipulations to the 3D aspects of the layer.

Note: Matrix-based 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, and six versions of 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: The use of built-in transitions between different sizes of content may produce unexpected results due to shader limitations imposed by the contents' differing pixel boundaries.

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 independent playback/rendering engines on each layer. When an Object Dissolve transition is initiated, Mbox automatically begins an opacity crossfade between the two independent playback/rendering engines, each with its own content and properties. This makes the Object Dissolve transitions just like what might be performed manually using two different layers, but requiring only one layer.

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.

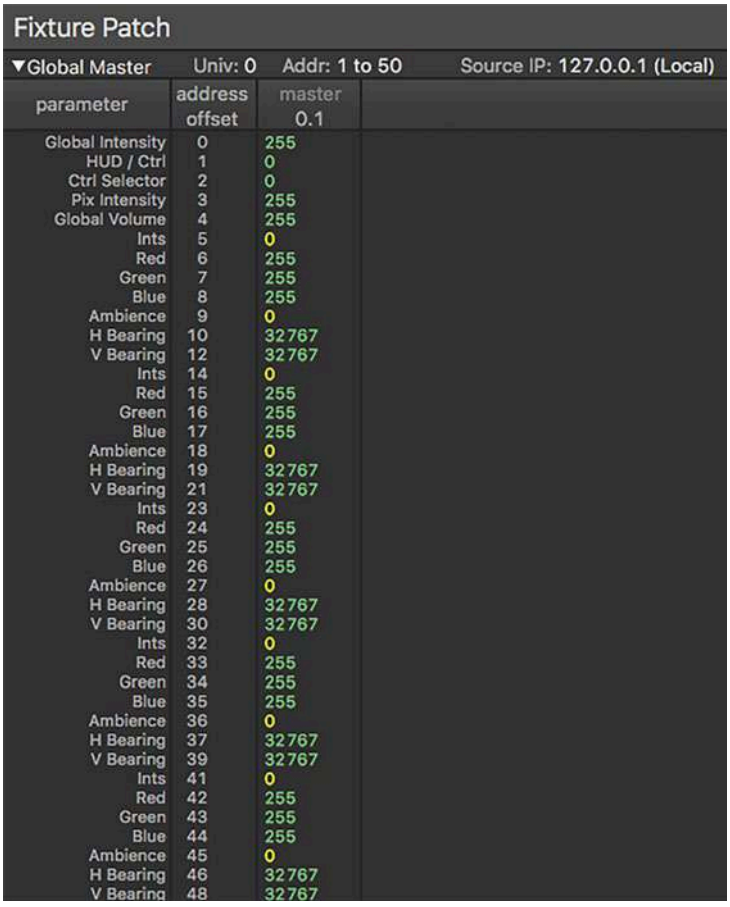
For typical control purposes, component parts of Mbox are grouped first by fixture and then function. Profiles for lighting consoles may choose to group each fixture's functions in different ways than what is listed below. An appendix at the end of this manual contains tables for all parameters used with the Mbox software.

The standard fixtures and their controllable parameters (in functional groups) 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 license levels of Mbox. Refer to "Appendix C: Fixture Parameter Data" on page 208 for information on supported parameters.

Global Control

+ Fixture: Global Master
  - Global Intensity
  - HUD/Macro Control
  - Control Selector
  - Pixel Map Intensity
  - Global Volume
+ Fixture: 3D Light (Designer/Studio only)
  - Intensity
  - Red
  - Green
  - Blue
  - Ambience
  - Horizontal Bearing
  - Vertical Bearing

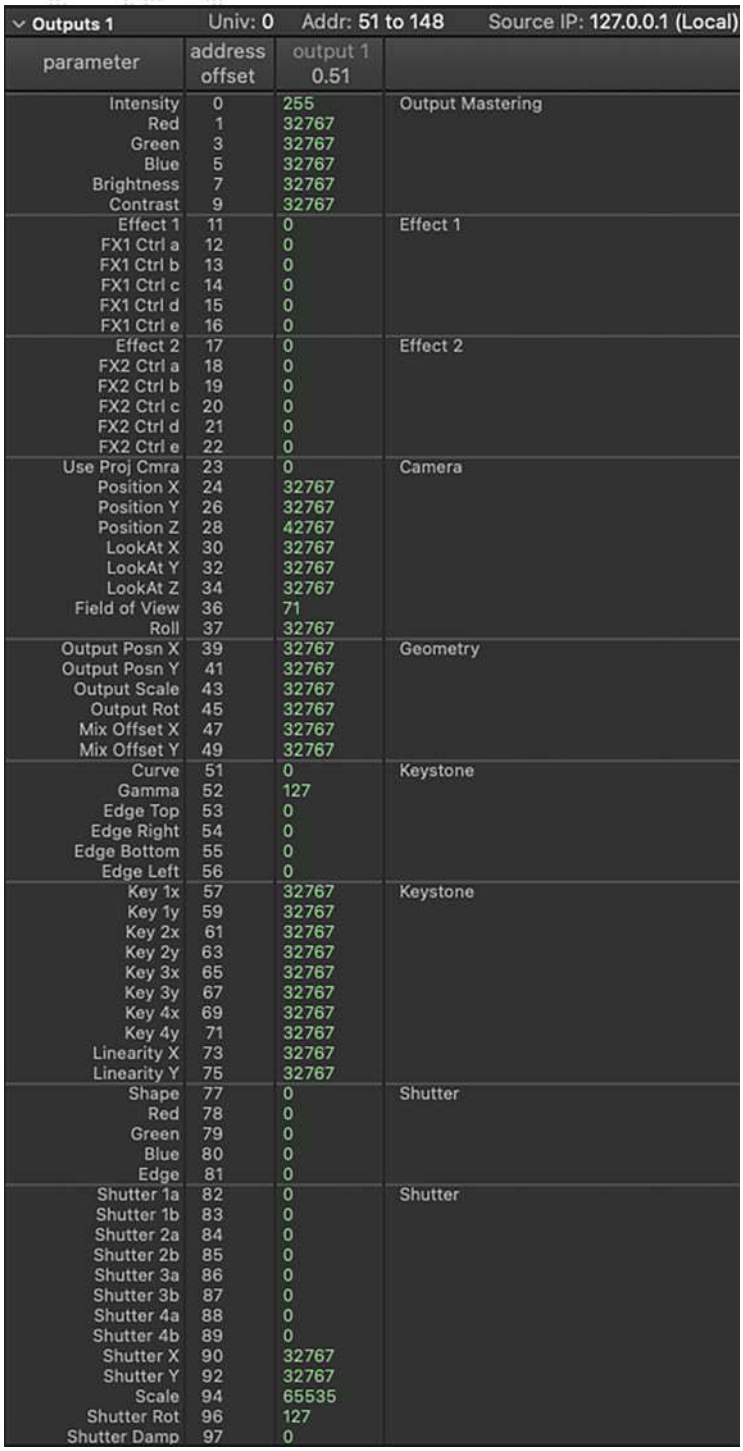


Color Indications:

+ Green - at default value
+ Yellow - not at default value

Output Master Control

+ Fixture: Output Master
  - Output Intensity
  - Color Mix - Red, Green, Blue
  - Brightness and Contrast
+ Function: 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 148 — Source IP: 127.0.0.1 (Local)

parameter	address offset	output 1 0.51	
Intensity	0	255	Output Mastering
Red	1	32767	
Green	3	32767	
Blue	5	32767	
Brightness	7	32767	
Contrast	9	32767	
Effect 1	11	0	Effect 1
FX1 Ctrl a	12	0	
FX1 Ctrl b	13	0	
FX1 Ctrl c	14	0	
FX1 Ctrl d	15	0	
FX1 Ctrl e	16	0	
Effect 2	17	0	Effect 2
FX2 Ctrl a	18	0	
FX2 Ctrl b	19	0	
FX2 Ctrl c	20	0	
FX2 Ctrl d	21	0	
FX2 Ctrl e	22	0	
Use Proj Cmra	23	0	Camera
Position X	24	32767	
Position Y	26	32767	
Position Z	28	42767	
LookAt X	30	32767	
LookAt Y	32	32767	
LookAt Z	34	32767	
Field of View	36	71	
Roll	37	32767	
Output Posn X	39	32767	Geometry
Output Posn Y	41	32767	
Output Scale	43	32767	
Output Rot	45	32767	
Mix Offset X	47	32767	
Mix Offset Y	49	32767	
Curve	51	0	Keystone
Gamma	52	127	
Edge Top	53	0	
Edge Right	54	0	
Edge Bottom	55	0	
Edge Left	56	0	
Key 1x	57	32767	Keystone
Key 1y	59	32767	
Key 2x	61	32767	
Key 2y	63	32767	
Key 3x	65	32767	
Key 3y	67	32767	
Key 4x	69	32767	
Key 4y	71	32767	
Linearity X	73	32767	
Linearity Y	75	32767	
Shape	77	0	Shutter
Red	78	0	
Green	79	0	
Blue	80	0	
Edge	81	0	
Shutter 1a	82	0	Shutter
Shutter 1b	83	0	
Shutter 2a	84	0	
Shutter 2b	85	0	
Shutter 3a	86	0	
Shutter 3b	87	0	
Shutter 4a	88	0	
Shutter 4b	89	0	
Shutter X	90	32767	
Shutter Y	92	32767	
Scale	94	65535	
Shutter Rot	96	127	
Shutter Damp	97	0	

Layer Control

+ 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 Frame 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 (not available in Mbox v5)
  - Image Remapping Configuration
+ Function: Layer Effect
  - Effect Selector
  - Modifiers - A, B, C, D, E
+ Function: Layer Volume
  - Volume
+ Function: Layer DMX Timecode
  - Hours
  - Minutes
  - Seconds
  - Frames

Layers 1-4 Univ: 1 Addr: 1 to 336 Source IP: 127.0.0.1 (Local)

parameter	address offset	layer 1 1.1	layer 2 1.85	layer 3 1.169	layer 4 1.253	
Opacity	0	0	0	0	0	Layer Mastering
Red	1	32767	32767	32767	32767	
Green	3	32767	32767	32767	32767	
Blue	5	32767	32767	32767	32767	
Brightness	7	32767	32767	32767	32767	
Contrast	9	32767	32767	32767	32767	
Library	11	0	0	0	0	Media
File	12	0	0	0	0	
Play Mode	13	0	0	0	0	
Play Speed	14	127	127	127	127	
In Frame	15	0	0	0	0	
Out Frame	17	65535	65535	65535	65535	
Sync Stream	19	0	0	0	0	Sync
Sync Offset	20	127	127	127	127	
Aspect	21	0	0	0	0	Aspect
Frame Blend	22	255	255	255	255	
xFade Type	23	0	0	0	0	
xFade Time	24	0	0	0	0	
Obj Library	25	0	0	0	0	Object
Object	26	0	0	0	0	
X Position	27	32767	32767	32767	32767	Geometry
Y Position	29	32767	32767	32767	32767	
Z Position	31	32767	32767	32767	32767	
Scale	33	32767	32767	32767	32767	
X Scale	35	32767	32767	32767	32767	
Y Scale	37	32767	32767	32767	32767	
Z Scale	39	32767	32767	32767	32767	
Z Rotate	41	32767	32767	32767	32767	
X Rotate	43	32767	32767	32767	32767	
Y Rotate	45	32767	32767	32767	32767	
Z Spin	47	127	127	127	127	
X Spin	48	127	127	127	127	
Y Spin	49	127	127	127	127	
Mix Select	50	0	0	0	0	Image Control
Mix Mode	51	0	0	0	0	
Blend Mode	52	0	0	0	0	
Draw Mode	53	0	0	0	0	
Image Remap	54	0	0	0	0	
Effect 1	55	0	0	0	0	Effect 1
FX1 Ctrl a	56	0	0	0	0	
FX1 Ctrl b	57	0	0	0	0	
FX1 Ctrl c	58	0	0	0	0	
FX1 Ctrl d	59	0	0	0	0	
FX1 Ctrl e	60	0	0	0	0	
Effect 2	61	0	0	0	0	Effect 2
FX2 Ctrl a	62	0	0	0	0	
FX2 Ctrl b	63	0	0	0	0	
FX2 Ctrl c	64	0	0	0	0	
FX2 Ctrl d	65	0	0	0	0	
FX2 Ctrl e	66	0	0	0	0	
Effect 3	67	0	0	0	0	Effect 3
FX3 Ctrl a	68	0	0	0	0	
FX3 Ctrl b	69	0	0	0	0	
FX3 Ctrl c	70	0	0	0	0	
FX3 Ctrl d	71	0	0	0	0	
FX3 Ctrl e	72	0	0	0	0	
Effect 4	73	0	0	0	0	Effect 4
FX4 Ctrl a	74	0	0	0	0	
FX4 Ctrl b	75	0	0	0	0	
FX4 Ctrl c	76	0	0	0	0	
FX4 Ctrl d	77	0	0	0	0	
FX4 Ctrl e	78	0	0	0	0	
Layer Volume	79	255	255	255	255	Layer Volume
Hours	80	0	0	0	0	Timecode
Minutes	81	0	0	0	0	
Seconds	82	0	0	0	0	
Frames	83	0	0	0	0	

For complete parameter maps, refer to "Fixture Parameter Data" on page 208.

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.

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.

3D Lighting Fixture

The five virtual 3D Lighting Fixtures can be used to provide adjustable lighting for 3D objects within Mbox's 3D environment. Only Mbox Designer and Studio/Studio+ license levels support adjustable lighting. The Mbox Mini license level only allows default lighting for 3D objects, which is not adjustable.

Intensity

Each 3D lighting fixture has adjustable intensity.

Color

Each 3D lighting fixture has Red, Green, and Blue subtractive color mixing.

Ambience

The beam spread ("ambience") of each 3D lighting fixture is adjustable from fully ambient to tight spot.

Horizontal and Vertical Bearing

The location of each 3D lighting fixture is adjustable in a 360° arc around the center of the 3D environment. 3D lighting fixtures always point at the center of the 3D environment.

Output Master Fixture

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

Intensity

The Output Master Intensity masters 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 Controls: RGB + Brightness and Contrast, HSV, or CIE Yxy

Starting with Mbox 5.4 there are three possible Color Control modes:

+ RGB+BC provides five parameters: Red, Green, Blue, Brightness, and Contrast all of which may be adjusted in both additive and subtractive fashion.
+ HSV provides three parameters: Hue, Saturation, and Value. Hue adjusts the hue angle. Saturation and Value may be adjusted in both additive and subtractive fashion. In this mode the fourth and fifth parameters have no effect.
+ CIE Yxy provides three parameters: Y, x, and y. The Y parameter equates to brightness or luma and may be adjusted in both additive and subtractive fashion. The x and y parameters effectively shift the color on the X or Y axis of the CIE 1931 chromaticity graph. In this mode the fourth and fifth parameters have no effect.

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

With an Mbox Designer license, 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 provides 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 inward or outward) 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’s layers. The Texture element affects 2D textures such as stills and movies, while the Object element affects 3D content such as digital gobos and objects. Layers can combine 2D and 3D functionality to create the final image on the layer. Mbox Studio/Studio+ and Mini licenses have reduced layer functionality compared to a Designer license.

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/or 3D) displayed on the layer.

Color Controls: RGB + Brightness and Contrast, HSV, or CIE Yxy

Starting with Mbox 5.4 there are three possible Color Control modes:

+ RGB+BC provides five parameters: Red, Green, Blue, Brightness, and Contrast all of which may be adjusted in both additive and subtractive fashion.
+ HSV provides three parameters: Hue, Saturation, and Value. Hue adjusts the hue angle. Saturation and Value may be adjusted in both additive and subtractive fashion. In this mode the fourth and fifth parameters have no effect.
+ CIE Yxy provides three parameters: Y, x, and y. The Y parameter equates to brightness or luma and may be adjusted in both additive and subtractive fashion. The x and y parameters effectively shift the color on the X or Y axis of the CIE 1931 chromaticity graph. In this mode the fourth and fifth parameters have no effect.

Texture Folder and File

The Texture Folder and File parameters select the index (using two 8-bit values) 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 ending points for movie content playback, allowing only the desired portion of a movie to be played, rather than its entirety. By default, the 16-bit range of the In and Out Frame parameters is mapped proportionally to the entire length of the movie - i.e. a value of 0 is the first frame and a value of 65535 is the last frame. When the Absolute In/Out Frame Numbers preference is enabled and if the movie has fewer than 65536 frames, these parameter values are mapped 1:1 to frames in the movie. e.g. A value of 0 is the first frame and a value of 99 is the 100th frame.

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 only to be adjusted independently of the layer's X and Y Scale parameters, both of which 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 has optional Enhanced Frame Blending for better playback when the content framerate does not match the output frequency. Refer to "Frame Blending Control" on page 245 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 index (using two 8-bit values) 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 58.

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.

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 matrix-based effects. The effect will be applied only across the imagery in the layer, not affecting imagery on other layers. Each layer effect has up to 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!

Mbox requires at least macOS 10.14.6 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 this should be the same user!**

Note on Gatekeeper

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 Settings > Security & Privacy pref pane and scroll down to the Security section. Make sure that the setting for "Allow applications downloaded from:" has either the "App Store and identified developers" button or the "Anywhere" button selected.

Important Compatibility Warning for Blackmagic Design devices

Please refer to the "IMPORTANT COMPATIBILITY WARNING" for Blackmagic devices, found on page 166.

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 or https://www.prg.com/en/support

Installing Mbox Software

Overview

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

+ The Mbox content folder will be located at /Applications/Mbox. The configuration and content files for Mbox are always stored in this folder
+ The Mbox software will be placed in the /Applications/Mbox Software folder
+ Utility applications will be placed in the /Applications/Mbox Utilities folder
+ Thumbnail and web images will be placed in the /Library/Application Support/Mbox folder and its sub-folders
+ Support and preference files will be placed in the ~/Library/Application Support and ~/Library/Preferences folders

IMPORTANT!! The location of the default Mbox content folder cannot be changed. However, this item can be an alias to an actual Mbox content folder stored elsewhere on the computer or even on an external drive.

Note: This manual refers to file paths formatted in the manner of "Mbox/Media" or "Mbox/plugins". Paths using the 'Mbox' prefix resolve to the Mbox content folder - i.e. /Applications/Mbox. The path "Mbox/Media" resolves to /Applications/Mbox/Media and the path "Mbox/plugins" resolves to /Applications/Mbox/plugins.

Mbox Content Folder Location

The Mbox application requires the creation of the 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.

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

When installing the Mbox v5 software or upgrading the version of macOS to Catalina or beyond, the Mbox content folder must be moved first if it is at the root location! If the computer is upgraded beyond Mojave with the old /Mbox content folder or an alias at this old location, that folder/alias cannot be deleted due to restrictions in the new OS! To enforce this change, when the Mbox v5 installer runs, it checks for an existing Mbox content folder or alias at the root and will halt and cancel the installation if it finds one. Therefore, it is mandatory to move or delete the folder from this old location before using the Mbox v5 installer.

The revised location for the Mbox content folder is the /Applications folder on the computer's boot drive. Older Mbox installations may have an Mbox content folder or alias at the root of the boot drive. Use the Mac Finder to move the Mbox content folder or alias prior to upgrading to Catalina or beyond or before installing the Mbox v5 software:

+ If the Mbox item at the root of the boot drive is a real folder (not an alias), 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.

If possible, it is 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.

Installation

As noted above, the Mbox content folder must be in the /Applications folder on the computer's boot hard-drive, or in an alternate location with an alias to that alternate 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. If desired, this folder can then be moved elsewhere after the install completed, and an alias created. With subsequent installs, the Mbox content folder (no matter whether 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 alternately set aside without being deleted.

The Mbox installer does not place any video content in the Mbox/Media folder. A limited amount of demo content may be 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 Apache HTTP Server functionality to be installed and enabled on the Mbox computer. The Mbox installer will enable the Apache server on the computer.

CAUTION! If the operating system of the Mbox computer is upgraded, it is very likely that the Apache server settings required for Mbox will be overwritten and the thumbnails will no longer be available to Mbox Director or a browser. To fix this condition, there is a script that is included with the Mbox installer. It is called "FixApache.command" and can be found in the /Applications/Mbox Utilities/Scripts folder. Double-click on the script to run it. The script must be run by a user with admin privileges.

Suggested Hardware Configurations

Mbox performance options:

+ **Highest performance** - 64GB+ RAM. Apple Mac Studio/Mac Pro 2023 with M2 Ultra, or Mac Pro 2019 with: 8+ CPU cores, separate SSD/flash drives for OS and content, Afterburner card, Radeon Pro W6800X GPU.
+ **Medium performance** - 32GB+ RAM Apple Mac Studio with M2 Max or MacBook Pro with M2/M3/M4 Max/Pro, separate SSD/flash drives for OS and content.
+ **Portable system** - 16GB+ RAM. Apple MacBook Pro with M1/M2/M3/M4 or Intel i7/i9 6-core CPU or Mac mini with M1/M2/M4, flash/SSD/fusion drive for OS and content, optional separate drive for content (Thunderbolt SSD/flash recommended).

Mbox computer minimum requirements:

+ MacOS 10.14.6 or newer macOS versions, macOS 12 Monterey/Sonoma preferred
+ Apple Silicon: any variant, Intel: Core 2 processor (64-bit)
+ 8GB RAM

GPU hardware guidelines:

+ For best performance with an Intel computer purchase/use the best possible discrete GPU available.
+ eGPUs provide little/no advantage when used with Mbox and do not work with Apple Silicon computers. Mbox does not support the use of multiple GPUs. 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:

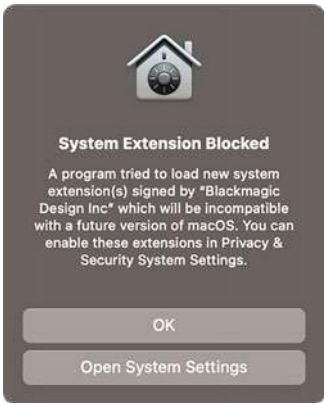
a. If “Rename existing” is selected, the existing Mbox content folder or alias will be renamed as Mbox####.old before a fresh Mbox content folder or alias is created in the same location. After the installation, files can be manually moved into the new Mbox content folder as needed.

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. Decide whether to install or reinstall the dongle drivers for Mbox’s supported USB license keys. If the dongle drivers are not installed during Mbox installation, they can be installed later by finding the install script in the /Applications/Mbox Utilities/Mbox Dongle Drivers folder.

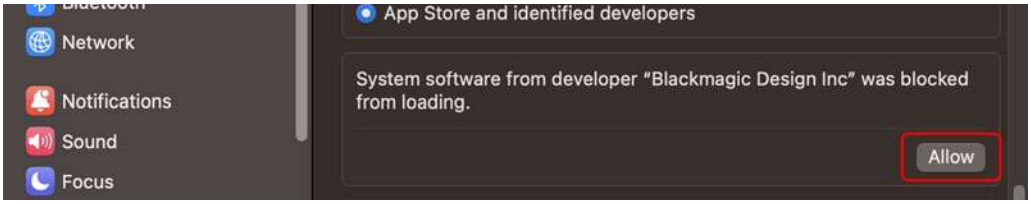
Step 5. Acknowledge settings and then agree to the License Agreement to begin the installation.

Step 6. Make sure to agree to (click the “Yes” or “OK” button) any other prompts that appear during the install process.



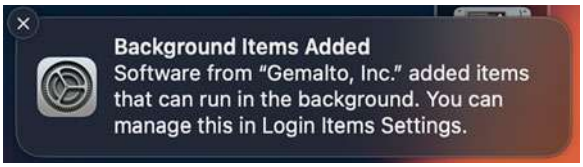
Depending on the version of macOS that is on the computer that the Mbox software is installed on, the use of the dongle drivers may require explicit permission. In these cases, an alert with the title “System Extension Blocked” will appear offering two buttons: “OK” and “Open System Settings.”

If this alert appears, the most expedient option is to click on the “Open System Settings” button. This will open the System Preferences > Security & Privacy (Privacy & Security in new versions of macOS) preference pane. You may need to click on the “General” tab or scroll down to find the button to allow the blocked extension to run. The extension must be allowed to run for a dongle to work with the Mbox application.

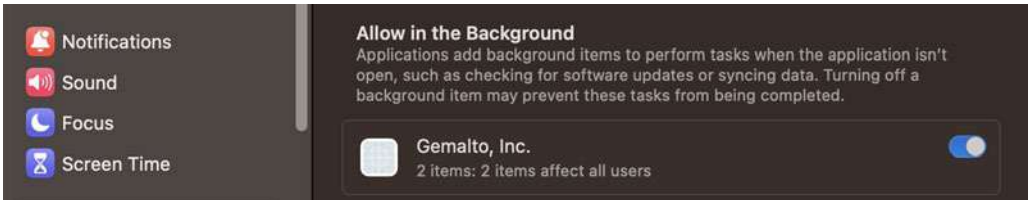


On some Apple Silicon computers, it may be necessary to set the system security policy to Reduced Security to allow the user to agree to the use of blocked extensions. Please refer to this URL for more information: https://support.apple.com/en-us/HT210999

Additionally, on macOS Ventura, when the dongle drivers are installed for the first time, a notification will appear onscreen and which says “Background Items Added.” The notification will look like the image below and references “Software from ‘Gemalto, Inc.’ “



If the notification is clicked on, the System Preferences > General > Login Items preference pane will open, where the Allow in the Background settings can be used to enable or disable the background activities. For Mbox dongles to work, the Gemalto, Inc item (the dongle driver software) must be allowed to run in the background! Do not disable this item.



Licensing Mbox Software

CAUTION! Perform a full installation of the Mbox software before attempting to apply any license for the first time!

Hardware USB License Key (Dongle)

Dongles for the Mbox software can be purchased by contacting a PRG sales office. Dongles provide one activation at a time - for whatever computer the dongle is plugged into. Dongles do not require a connection to the internet for activation or validation, but they do require drivers to be installed.

When the Mbox software is installed, the installer will provide the option to (re)install the dongle drivers as well. If the current drivers are too old, they must be updated for the dongle to work. If a dongle isn't being used, the drivers don't need to be installed. If a dongle is purchased after the original Mbox software installation, then the drivers can be installed by either reinstalling the Mbox software or by using the "Install Dongle Drivers" script found in the /Applications/Mbox Utilities/Mbox Dongle Drivers folder.

IMPORTANT! When used on computers with Apple Silicon processors, the dongle drivers require the use of Apple's Rosetta translation. If Rosetta is not installed, it can be installed using the "Install Rosetta" script found in the /Applications/Mbox Utilities/Mbox Dongle Drivers folder.

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

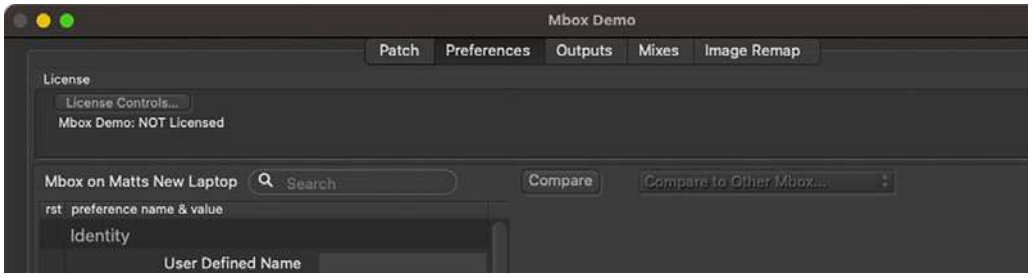
Soft-license (QLM)

Soft-license subscriptions for the Mbox software are purchased online and not through PRG sales offices. Soft-licenses provide two concurrent activations, with the terms of the license limiting the two activations to one "active" computer and one "backup" or offline computer. Soft-licenses require a connection to the internet to activate or deactivate the license. Soft-licenses must also be validated periodically (at least once every 14 days) which also requires an internet connection.

Soft-license subscriptions are purchased through the Mbox website - http://mbox.prg.com. Go to the product page for the desired license level of Mbox and click on a purchase button. This opens a new browser tab for the MyCommerce purchasing portal. Once the subscription 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.

Note: It is strongly recommended to create a MyCommerce user account when purchasing an Mbox soft-license subscription. This user account greatly aids in the management of the subscription license renewal.

To activate a soft-license for 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:



On the window that opens, use the Product pop-up to select the license level and type of soft-license subscription purchased - e.g. Studio -> QLM - and then select Activate License on the Operation pop-up. Enter the activation key in the Activation Key field below the pop-ups. Finally, press the OK button to activate the license on the machine.

To deactivate a soft-license, first make sure the computer is connected to the internet. Go to the Preferences tab and click on the License Controls button. On the window that opens, select the license to be deactivated using the Product pop-up and confirm that the soft-license activation key appears in the Activation Key field. Select Release License on the Operation pop-up and press the OK button to deactivate the license.

Soft-license activations can be moved from one computer to another as often as desired. To move an activation, first make sure that both computers are connected to the internet. Release the soft-license on the first computer and then enter the activation key on the second computer and activate the license.

Soft-license Validation

Soft-licenses for the Mbox software require a periodic check with the license server to make sure that the license is valid. Validation checks require an internet connection and must happen at least once every 14 days. If a validation is successful, this resets the validation period to 14 days.

Validation checks are automatically attempted every time the Mbox application is launched and once every 24 hours while the application is running. The simplest way to guarantee that the validation check succeeds is to keep the computer connected to the internet at all times. If keeping the computer connected to the internet is not possible, then a schedule should be established to connect the computer to the internet so that the validation can happen before the 14-day validation period expires.

While still within the 14-day validation period, if a soft-license cannot be validated because no internet connection is available, the Mbox software will remain licensed. If notifications for the Mbox application are enabled, a message will be posted to the computer's OS notification center. If the soft-license still cannot be validated once the 14-day validation period has been exceeded, the soft-license will be invalidated and must be revalidated.

WARNING! Soft-license invalidation is immediate, there is no grace period!

The splash screen shown at Mbox application launch, notifications, and the license status text on the Preferences tab will all provide information on the remaining time before a validation is required.

If a soft-license is invalidated because the 14-day validation period has passed, the soft-license can be revalidated by connecting the computer to the internet and then either quitting and relaunching the application, or by going to the License controls window, selecting the soft-license on the Product pop-up, and then selecting Validate License on the Operations pop-up.

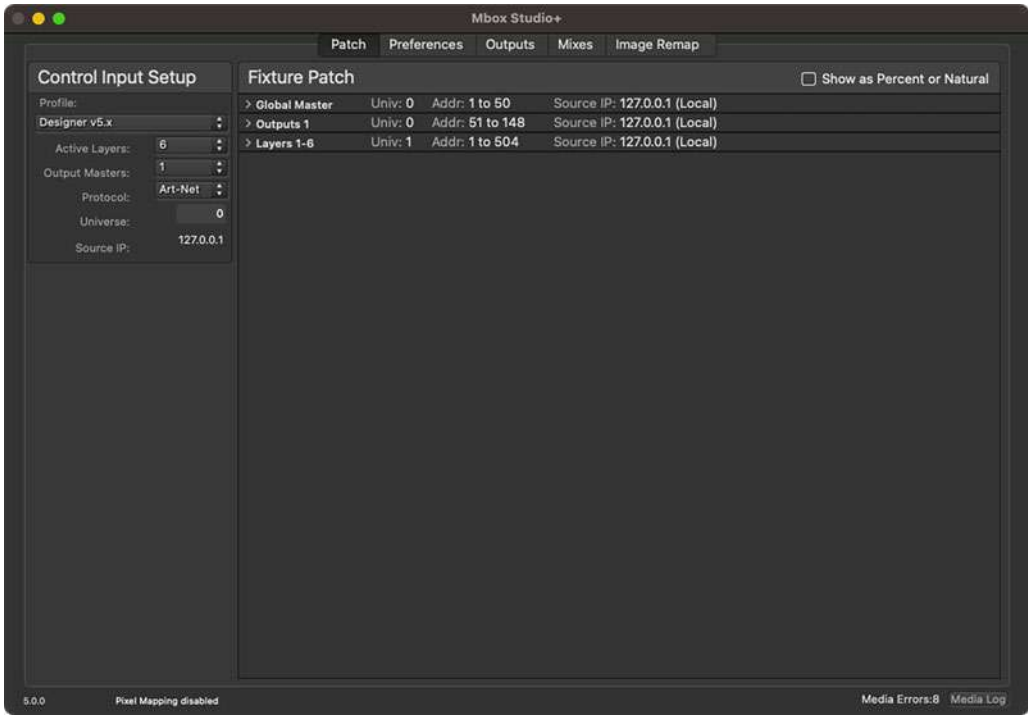
Licenses can also become invalid if the subscription has expired and not been renewed, or if the license has been revoked. In the case of the former, the soft-license must be renewed (or a new soft-license purchased). In the case of the latter, contact mboxsupport@prg.com for more information.

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 49 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].

Note: Starting with Mbox v5.2, a new setting, "Hold ⌘Q to Quit," can be found in the application's main menu bar under the Mbox item. When enabled, a short press of [⌘Q] will not quit the Mbox application, but holding those keys for at least one second or pressing those keys twice in quick succession will quit the Mbox application

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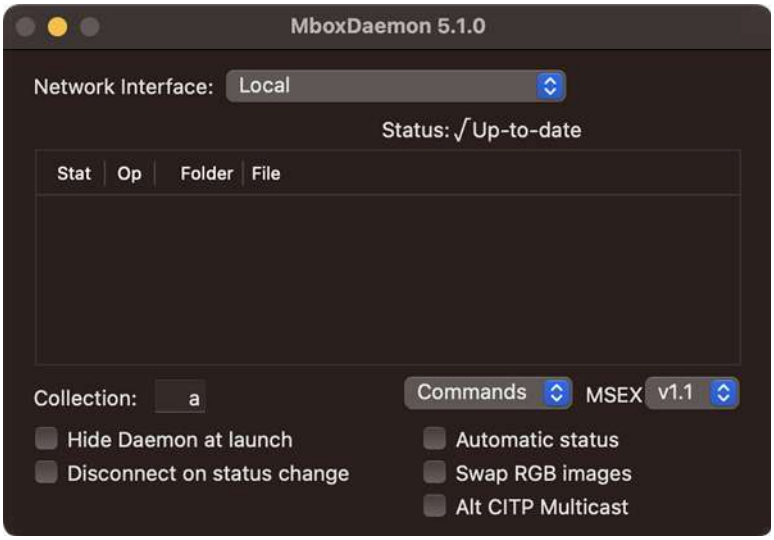
Mbox Daemon

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 80 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 41 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:

+ Using Mbox with either of the Designer or Studio patch modes requires at least two universes for control. Mini requires at least one universe.
+ 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 32767, which control with sACN allows for the selection of universes 1 through 63999.

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 by License Type

Mbox Designer License

The Mbox Designer license 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 and is configured with two output masters and twelve layers, the output masters will be on universe 0, the first six layers will be on universe 1, and the next six layers will be on 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+ License

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

+ The use of more than six output masters requires an additional universe of control data for the seventh and eighth output masters. The seventh and eighth output masters must be patched to the next sequential universe after the first six output masters but before any layers. Layers cannot be on the same universe as output masters. Therefore, adding a seventh output master will increment the universe number for layers.
+ Eight layers will fit onto a single universe. Layers must be patched to the next sequential universe after any 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 and is configured with eight output masters and twelve layers, the first six output masters will be on universe 0, the next two output masters will be on universe 1, the first eight layers will be on universe 2, and the last four layers will be on universe 3..
+ 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 that require a new universe 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 License

The Mbox Mini license 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 four output masters are used. But if six output masters are used, then the fifth and sixth layers 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 and is configured with six output masters and six layers, the six output masters and first four layers will be on universe 0, and the fifth and sixth layers will be on 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 that require a new universe 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 may require additional control universes. These quantities 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		1st 148 Total Channels (1 Master)
6	9	3D Light 1		
15	9	3D Light 2		
24	9	3D Light 3		
33	9	3D Light 4		
42	9	3D Light 5		
51	11	Output Master 1	Base	
62	6		FX 1	
68	6		FX 2	
74	16		Camera	
90	12		Geometry	
102	26		Keystone	
128	21		Shutter	
Up to 15 additional Output Masters may be added, 98 channels each, using consecutive universes as necessary.				
1	55	Layer 1	Base	Next Universe after Masters 504 Total Channels (6 Layers)
56	6		FX 1	
62	6		FX 2	
68	6		FX 3	
74	6		FX 4	
80	1		Audio Volume	
81	4		DMX Timecode	
85	84	Layer 2		
169	84	Layer 3		
253	84	Layer 4		
337	84	Layer 5		
421	84	Layer 6		
Up to 18 additional Layers may be added, 84 channels each, using consecutive universes as necessary.				

Mbox Studio/Studio+

Start	Size	Type	Sub-Type	Universe
1	5	Global Master		1st 118 Total Channels (1 Master)
6	9	3D Light 1		
15	9	3D Light 2		
24	9	3D Light 3		
33	9	3D Light 4		
42	9	3D Light 5		
51	11	Output Master 1	Base	
62	6		FX	
68	12		Geometry	
80	26		Keystone	
106	13		Shutter	
Up to 7 additional Output Masters may be added, 68 channels each, using consecutive universes as necessary.				
1	46	Layer 1	Base	Next Universe after Masters 504 Total Channels (8 Layers)
47	6		FX 1	
53	6		FX 2	
59	1		Audio Volume	
60	4		DMX Timecode	
64	63	Layer 2		
127	63	Layer 3		
190	63	Layer 4		
253	63	Layer 5		
316	63	Layer 6		
379	63	Layer 7		
442	3	Layer 8		
Up to 4 additional Layers may be added, 63 channels each, using the next consecutive universe.				

Mbox Mini

Start	Size	Type	Sub-Type	Universe
1	5	Global Master		1st 50 Total Channels (1 Master)
6	11	Output Master 1	Base	
17	6		FX	
23	16		Keystone	
39	12		Shutter	
Up to 5 additional Output Masters may be added, 45 channels each, using consecutive addresses. Patch before any layers!!				
51	46	Layer 1	Base	Same Universe after Masters 342 Total Channels (6 Layers)
97	6		FX	
103	1		Audio Volume	
104	4		DMX Timecode	
108	57	Layer 2		
165	57	Layer 3		
222	57	Layer 4		
279	57	Layer 5		
336	57	Layer 6		
If more than 3 Output Masters are used, Layers may need to be moved to the next consecutive universe.				

DISPLAYING CONTENT

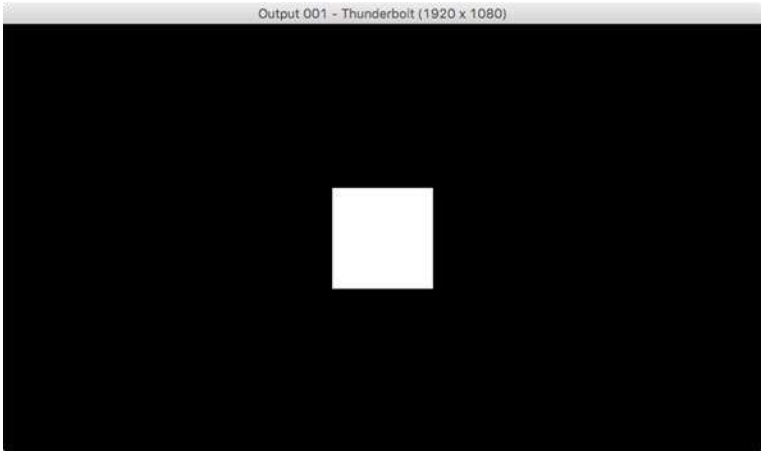
Quickstart

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.

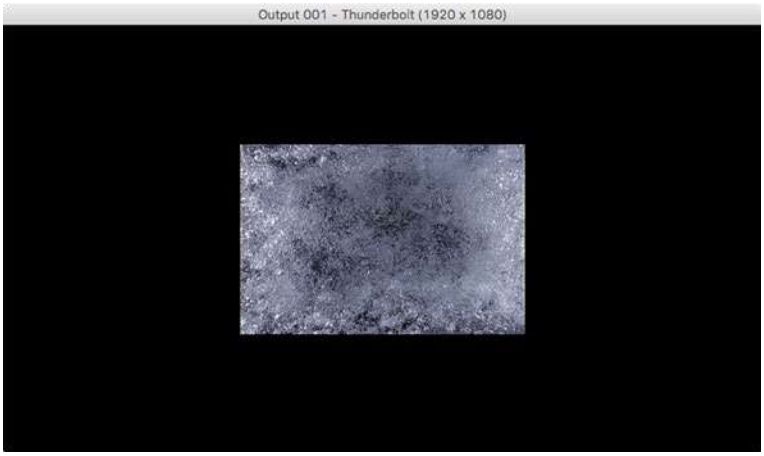
To immediately display content:

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:



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.



Note: The Mbox software does not come with any content files, content must be supplied by the user.

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
+ HEADS UP DISPLAYS (HUDS)
+ CONNECTED DISPLAYS AND FULLSCREEN MODE INTERACTIONS
+ NETWORK INTERFACES FOR MBOX

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.
+ Hardware decoding can help performance significantly, e.g Afterburner card in the 2019 Mac Pro or built into Apple Silicon processors. Hardware decoding is strongly recommended for best possible 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 CPU cores.
+ The OS will let Mbox and its associated tasks use as much RAM as the computer has. More RAM (at least 32GB for best results) is 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 12 Monterey or macOS 13 Ventura if possible. Sonoma provides no known 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, only enable **SMB** file sharing. You should not use/enable AFP file sharing, as AFP is not available when using macOS 10.14 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.
+ 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

Early versions of the Mbox software used Apple's QuickTime® technology for image and movie rendering and playback. The Mbox v5 software uses Apple's AVFoundation® technology. AVFoundation offers modern APIs with better performance than QuickTime. The following file types are supported in AVFoundation:

Still Image Files

PNG (.png), JPEG (.jpeg or .jpg), TIFF (.tiff or .tif).

+ 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

While Mbox uses AVFoundation for playback, the movie files it plays continue to use the QuickTime container format (.mov) for most movie files and can also use the MPEG4 container format (.mp4) for H.264 movie files. Spatially-compressed codecs (Apple ProRes, HAP, and Photo-JPEG) will usually provide better playback results than temporally-compressed codecs like H.264.

+ Apple ProRes - Mbox supports the five most common formats of the ProRes family of codecs. 422 Proxy has the lowest bitrate, but consequently the lowest quality. 422 Light and 422 Normal are the recommended codecs for movies. 422 High Quality can be used if the resulting bitrate is not too high (800Mb/sec or lower) and the computer is powerful enough. ProRes 4444 may be used if transparency is required in the movie file, but as with 422 HQ, keep the bitrate below 800Mb/sec if possible. All modern Mac computers can play ProRes movies and many include hardware decoders, which significantly improve performance when playing these movies.
+ Photo JPEG – Medium-High (60-80%). The quality of Photo-JPEG is typically not equal to that of ProRes, but it may have a lower bitrate and therefore can place a lighter load on the system in some cases.
+ HAP - The HAP family of codecs includes five standard versions: HAP, HAP Q, HAP Alpha, HAP Q Alpha, and HAP Alpha Only. The HAP codecs, 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 codecs do not need to be installed to play HAP movies in Mbox, but HAP movies will not play in the QuickTime Player application.
+ H.264/mp4 - H.264 and mp4 movies work with Mbox v5, 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 for use with Mbox. Mbox 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 audio embedded 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 102 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 format/level of ProRes to match quality and performance requirements. Mbox may play movies that use other codecs, if the appropriate codec is compatible with AVFoundation. Movies using non-preferred codecs 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 180 for more information)

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

Movie files that don't require audio playback should not have embedded audio, but embedded audio in movies can be played (see "Audio Output" on page 102). To completely remove audio from movies, use an application to re-render or export the movie without its audio tracks or try dropping the file onto the AVF Batch Converter application, making sure the "Strip audio tracks from files" button is selected (see "AVF Batch Converter" on page 186).

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 beyond 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 computers internal storage or on external storage devices connected to the computer. Using separate external devices is recommend in many cases, but may result in poor playback performance if the external device or connection is slow.

IMPORTANT! The storage and folder structure on some computers may be set up differently to that of PRG's rental Mbox server. The Mbox content folder can be placed on any storage device connected to the computer, but there must be an alias to the Mbox content folder placed in the /Applications folder of the boot device 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 boot device of the Mbox computer. External media can be placed inside these folders using aliases, provided the following guidelines are observed:

+ It is better to place the entire Mbox folder on an external drive, rather than only selected content.
+ Aliases must link to folders on the external device; they cannot link directly to files.
+ An alias cannot refer to another alias.
+ The Mbox/Media, and Mbox/Models folders themselves cannot be aliases, only files inside them can be.

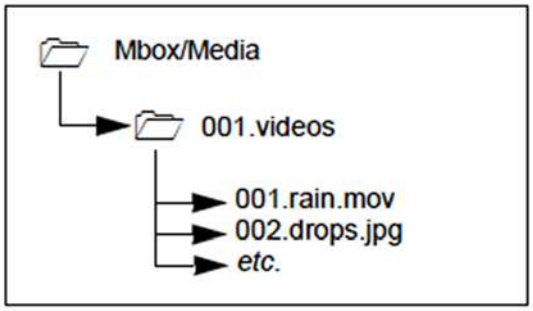
Each time the Mbox server completes a media scan, a text file is created with all media files found and their corresponding combined file numbers. This text file can be found at Mbox/Media_Report.txt

---

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 8-bit control parameters are 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. Avoid using folders 000 and 255 in the Media folder and folder 000 in the Models folder, as these folders hold some default content.

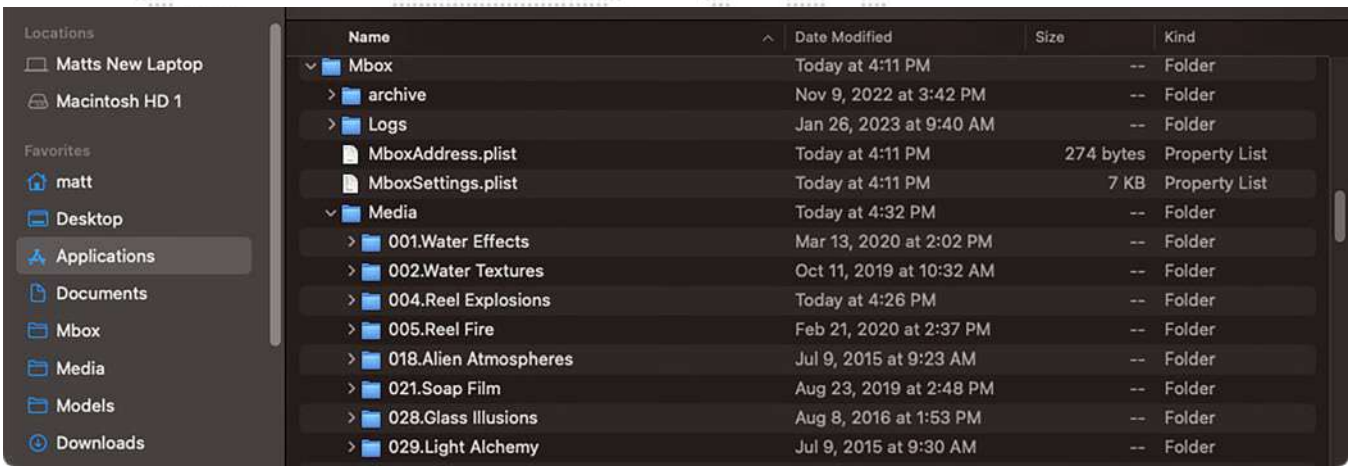


Image sequences require a different folder and file structure:

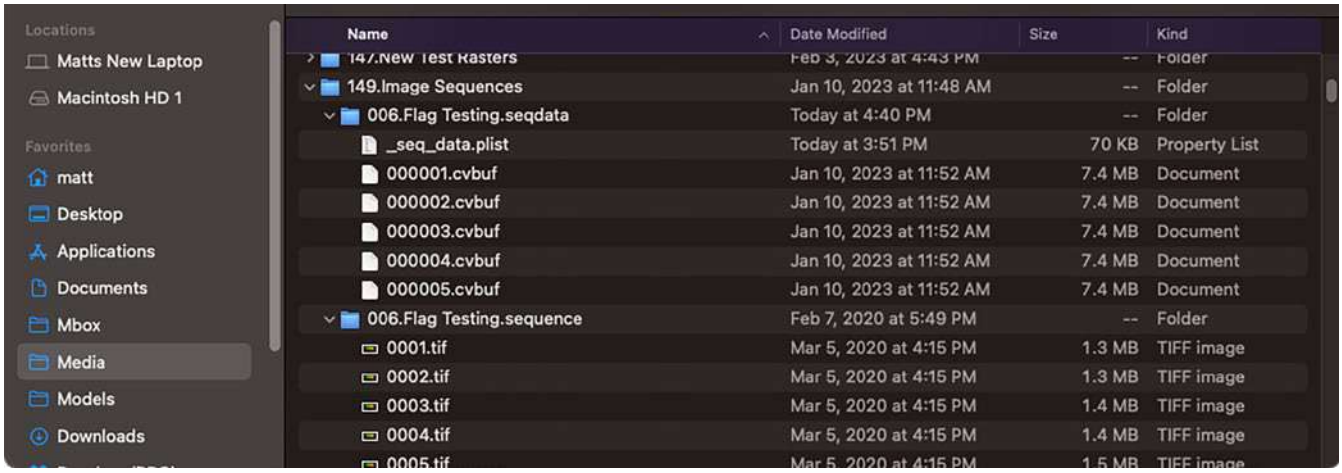
+ Image sequences should not be placed in the same content folder as normal movies or still images.
+ Within a content folder for image sequences, each image sequence must be placed into a numbered folder (000 - 255). This folder's number is the equivalent to the file number used as a prefix to normal movies or images.
+ Every image sequence folder name must 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

+ 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 computer keyboard or from the console or Mbox Director by using the control channel on the Global Master fixture. Complex object files and image sequences require some pre-processing and may not be available for immediate display.
+ 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 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 image 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®, a product of Vizrt Group, is a royalty-free standard enabling IP video workflows across standard Ethernet networks. It allows Mbox to transmit and receive video streams over a 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 Design Decklink and UltraStudio devices, and AVFoundation-compatible USB cameras connected directly to the computer. The Preferences tab allows assignment of up to eight video inputs.
+ 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 97)
    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 175)
    201-212: Syphon inputs 1-12 respectively (Refer to “Syphon Video Input” on page 170)
    231-238: Built-in 1080p images in primary and secondary colors
    241-248: Video inputs 1-8 respectively (Refer to “External Video Signal Input” on page 166)
    254: Default CG Color Bars image
    255: Default zero alpha image

Media Conflicts and Versioning Guidelines

+ When adding content files, it is best to NOT duplicate existing file indices as this may lead to file conflicts. Conflicts may result in the wrong file being played, and are noted in the Mbox/Media_Report.txt file. In such cases, the file that sorts first alphabetically in a Finder window will be the file that plays.
+ Mbox v5 allows a version suffix to be added to file names, thereby allowing multiple files to have the same index, but ensuring that the file with the “latest” version will play. The suffix added must include “_v” which would then be followed by a version number. For example, if the following files are both in folder 023, the second file will play, since it has the later (“_v3” vs. “_v1”) version suffix:

    017.My Movie_v1.mov and **017.My Movie_v3.mov**

+ Version suffixes can use both numbers and letters, and the determination of “latest” file is by alphanumerical sort.
+ When using dates as suffixes, use a format of “YYYYMMDD” to ensure sorting by year, then month, then day.
+ Files with the same index but “earlier” version suffixes are still noted as conflicts.

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:

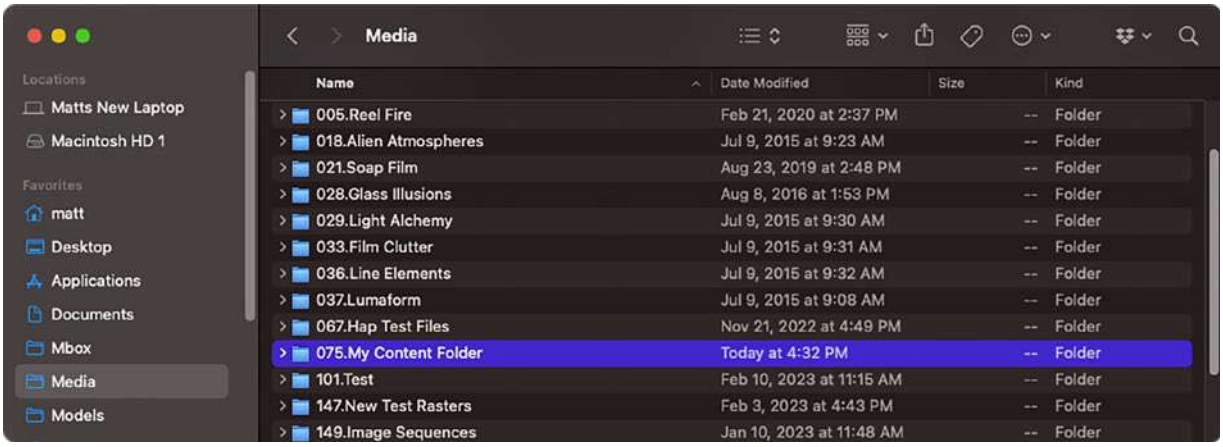
A file at this location: ***Media/022.Water/BlueWater/001.SomeWater.mov*** - will be assumed to be in folder 000, because the immediate parent of the numbered file has no numerical prefix.

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:

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

Refer to “Audio Output” on page 102 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

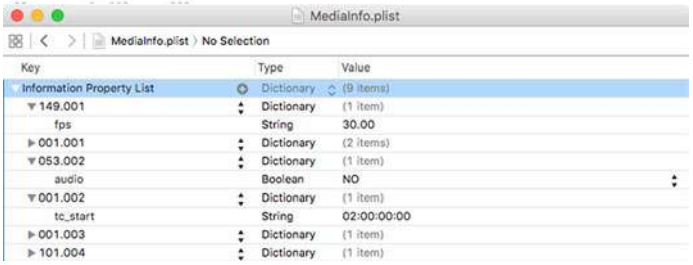
Mbox uses metadata to apply certain properties to content files (2D and 3D) when they are displayed onscreen. The metadata can include properties such as:

+ Enabling embedded audio playback in a movie file. Refer to “Audio Output” on page 102.
+ Linking a movie to timecode start times for timecode sync playmodes. Refer to “Timecode Synchronization” on page 107.
+ Setting the playback rate (in fps) for individual image sequences, overriding the global preference. Refer to “Image Sequences” on page 183.
+ Setting the scaling factor or axis flipping properties for objects. Refer to “Compiling Vertex Array Files” on page 90.
+ Configuring a consistent, pre-set crop for a specific piece of content. Refer to “Pre-set Cropping for Video Inputs” on page 170.

The metadata for Mbox is placed into two separate Property List (plist) files. For 2D textures, 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. 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 can have 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 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 sequence'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 content or a video input and re-center the visible portion.
+ **colorspace** - add this key with a value (e.g. "rgb", "rec709", "rec2020", "display-P3", "aces") to override the default sRGB colorspace used for image sequences when converting to the .cvbuf format.

ModelInfo plist

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

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 "0.004106" is equal to using the ".pixels" compile-time switch. (Refer to "Normalization" on page 90)
+ **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 virtual 3D lighting situations.
+ **emissive** (boolean) - add this key with a value of "YES" to cause the object to always have full ambient virtual 3D lighting. This overrides all lighting provided by the custom 3D lighting fixtures.

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 the Mbox computer 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 a browser, Mbox Director, or Mbox Remote.

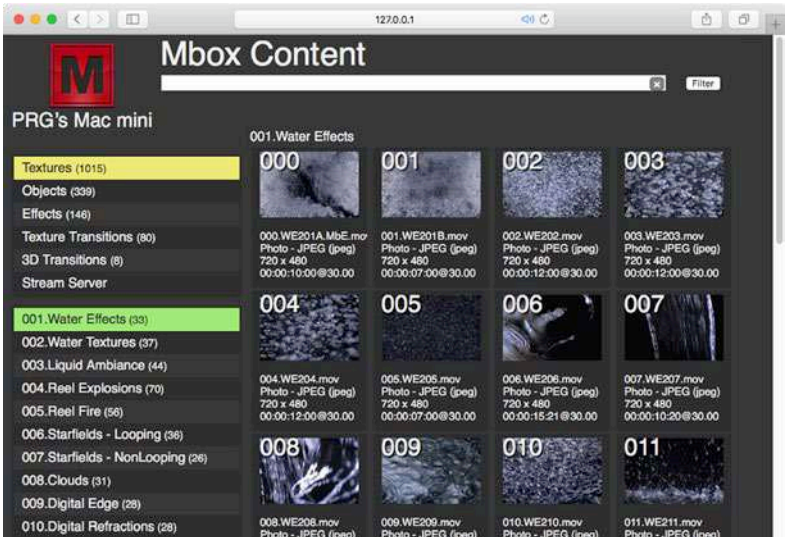
Viewing Thumbnails in a Browser

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

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

WARNING! If the computer running the Mbox software is using macOS 10.12 Monterey or newer, then Mbox v4.4.5 or newer must be installed on that computer for the thumbnails to be available in a browser or to Mbox Director. Furthermore, Mbox Director v4.4.5 or newer must be used to be able to receive thumbnails in this case.



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 video outputs. In this mode, each video output will be visible in a separate window, with all windows being positionable and scalable (by percentage) to allow for arrangement and fit onto the desktop.
+ **Fullscreen** - While in Fullscreen mode, each of the video output windows will cover the entire screen of the display that the output is assigned to. If all connected displays are used for outputs, then the main Mbox window's user interface will not be visible. However, if the computer has additional displays not used for fullscreen output, then the main Mbox window can be placed onto an additional display and various settings viewed or edited.

Note: The colors displayed 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

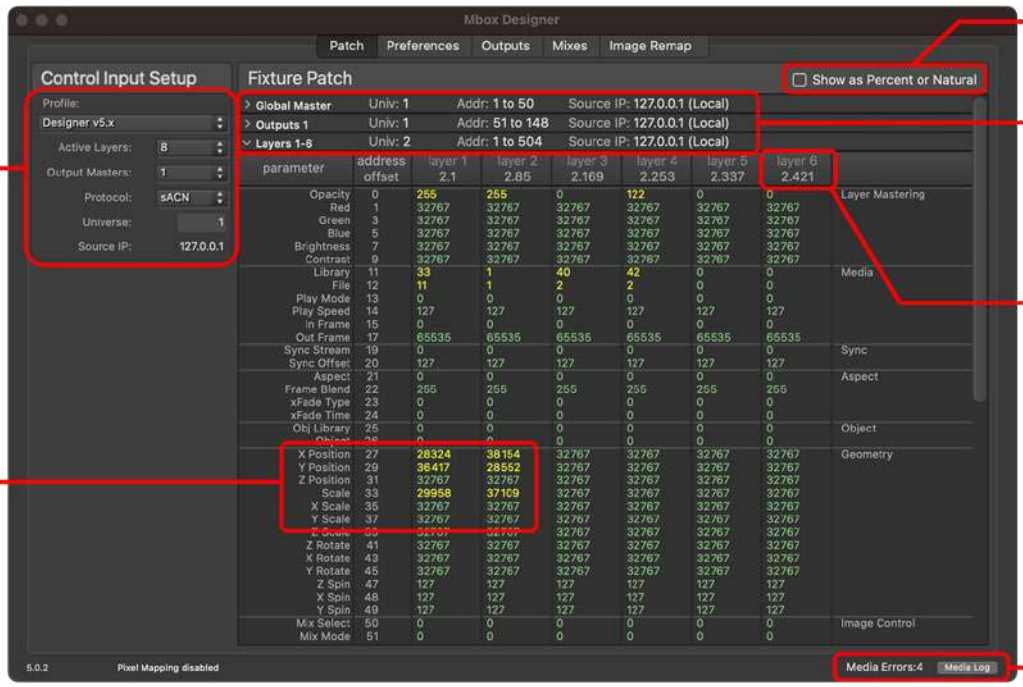
The Mbox application has five tabs, each having different functionality within the application: Patch, Preferences, Outputs, Mixes, and Image Remap.

+ **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.
+ **Image Remap tab** - used for creating and editing Image Remapping configurations.

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 32767 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 these components.



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

Toggles parameter values between natural and percent notation.

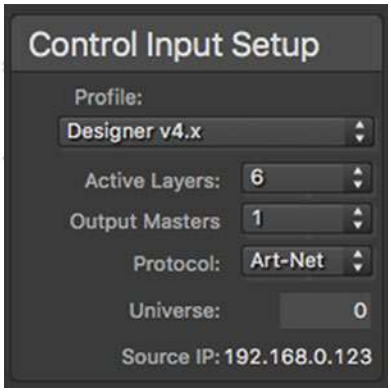
Component item rows show universe, address, and IP. Disclosure arrow reveals parameter names and values.

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

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.

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 v5 supports the control profiles for every other version, allowing for control of any version with a patch for one of the other versions. Three legacy emulation modes are provided for compatibility with v4 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.

CAUTION! The Active Layers and Output Masters pop-ups limit their allowed quantities based on the current license level. The only exception to this is when a license expires or is released while Mbox is running, at which point these pop-ups continue to show the maximum quantities allowed by the previous license level. However, usable layers and output masters are always limited by the license level, and also when no license is active.

+ **Protocol** - this pop-up specifies whether Mbox uses Art-Net or sACN as the default control protocol. Mbox uses this protocol for all normal control and for functionality like Image Remapping controls or Pixel Map Group controls, unless a preference like Remap/ModelInfo Protocol selects a specific protocol (i.e. for that function only).
+ **Universe** - this field refers to the first universe that Mbox is "listening to" for control data. Mbox v5 will always use consecutive universes if more than one universe is required. Mbox uses decimal notation for universe numbers: 0 being the first universe for Art-Net, and 1 being the first universe for sACN. Because some consoles may use different notation for universe numbers, conversion between numbering systems may be required! Allowable universe values are 0-32767 for Art-Net and 1-63999 for sACN. Keep in mind that when Mbox needs to listen to more than one universe, setting the start universe to a value that would cause Mbox to require a universe greater than 32767 (for Art-Net) or 63999 (for sACN) will not work! If this happens, an error message will be displayed and the universe number will be 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.

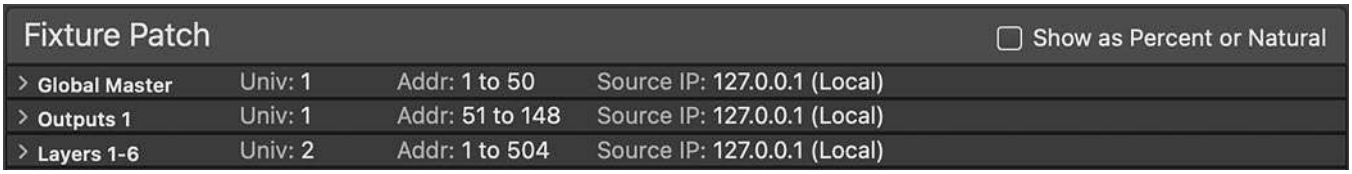
+ **Source IP** - this field shows the IP address of the device that Mbox is currently receiving control data from on the universe that is set in the Universe field. This IP address is shown to help confirm that Mbox is receiving data on the selected universe, and as an aid in troubleshooting. In the 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! Mbox can be configured to listen to control data intended for Mini/Studio/Designer no matter which license level is active. But the Mbox software ignores parameter values for features not supported by the current license level. e.g. The Mini and Studio license levels don't have an Object folder parameter, so will always use Object folder 000, even if the control data is set up for a Designer profile. Higher license levels will always work with control data intended for a lower license level - and have all features work.

CAUTION! All v4 features (except Draw Mode) are handled in an identical manner in Mbox v5 and can be controlled by the v5 software using legacy emulation. Always test the entire show in advance if attempting to use a pre-programmed legacy mode. In some cases, it may be better to reprogram the show using the new Mbox v5 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 v5 and the individual parameters that make up each fixture. While Mbox v5 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 v5 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 3D lighting), Outputs (intensity/color, 3D camera, geometry, keystone, shutter, effects), and Layers (texture plus object).

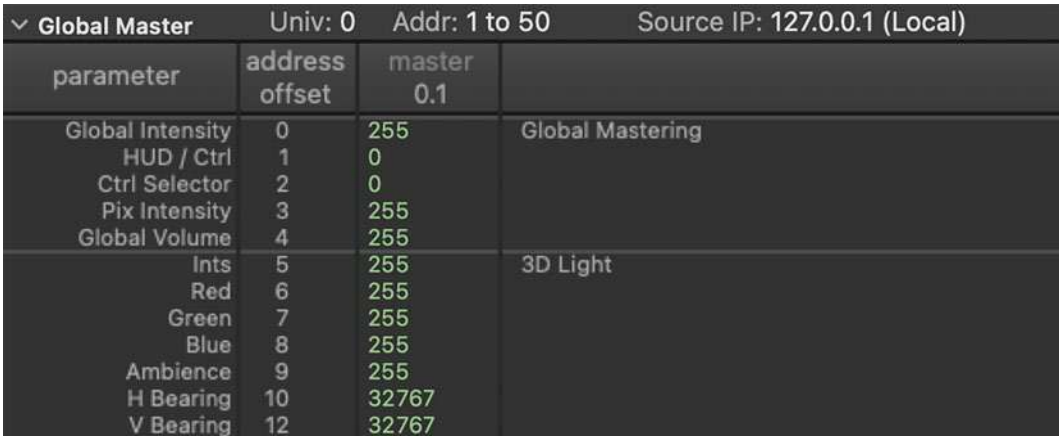


Each of the header rows for the three major fixture groups shows the name of the group, the universe it is patched to, the range of channels on that universe that it is using, and the IP address of the source that is sending that universe to Mbox at present. Each of these header rows has a disclosure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

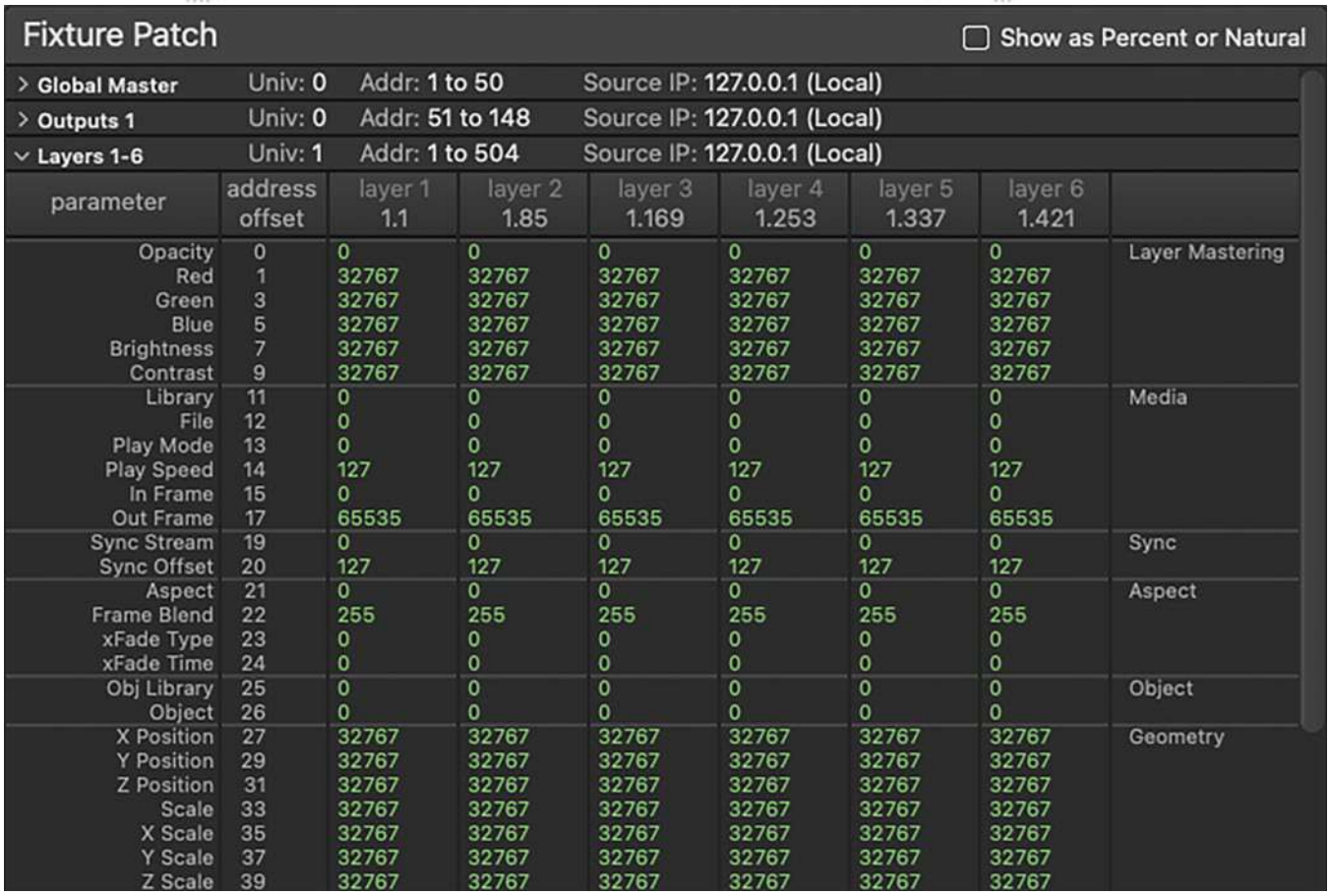
At the top-right of the table is a checkbox that allows the parameter values in the table to be shown using percent or “natural” notation rather than the default decimal notation. When this is checked, parameters like intensity, color, or opacity will show percentage values (e.g. 100%), while parameters 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 3D lights.



Note: 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.

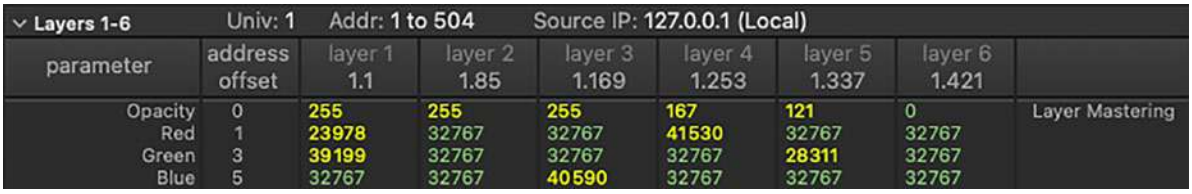
For repeated items like the Outputs and Layers, the table will show multiple columns, with items side by side. The unique name of the each repeated item is shown in the column header, plus its universe and start address (in univ.address notation). The left-most column shows the list of parameter names 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 1.85, and the first parameter (opacity) has an offset of 0, then the address for opacity is 1.85. The aspect parameter has an offset of 21, therefore its address would be 1.103 (i.e. 82+21).



Fixture Patch — Show as Percent or Natural

> Global Master	Univ: 0	Addr: 1 to 50	Source IP: 127.0.0.1 (Local)					
> Outputs 1	Univ: 0	Addr: 51 to 148	Source IP: 127.0.0.1 (Local)					
v Layers 1-6	Univ: 1	Addr: 1 to 504	Source IP: 127.0.0.1 (Local)					
parameter	address offset	layer 1 1.1	layer 2 1.85	layer 3 1.169	layer 4 1.253	layer 5 1.337	layer 6 1.421	
Opacity	0	0	0	0	0	0	0	Layer Mastering
Red	1	32767	32767	32767	32767	32767	32767	
Green	3	32767	32767	32767	32767	32767	32767	
Blue	5	32767	32767	32767	32767	32767	32767	
Brightness	7	32767	32767	32767	32767	32767	32767	
Contrast	9	32767	32767	32767	32767	32767	32767	
Library	11	0	0	0	0	0	0	Media
File	12	0	0	0	0	0	0	
Play Mode	13	0	0	0	0	0	0	
Play Speed	14	127	127	127	127	127	127	
In Frame	15	0	0	0	0	0	0	
Out Frame	17	65535	65535	65535	65535	65535	65535	
Sync Stream	19	0	0	0	0	0	0	Sync
Sync Offset	20	127	127	127	127	127	127	
Aspect	21	0	0	0	0	0	0	Aspect
Frame Blend	22	255	255	255	255	255	255	
xFade Type	23	0	0	0	0	0	0	
xFade Time	24	0	0	0	0	0	0	
Obj Library	25	0	0	0	0	0	0	Object
Object	26	0	0	0	0	0	0	
X Position	27	32767	32767	32767	32767	32767	32767	Geometry
Y Position	29	32767	32767	32767	32767	32767	32767	
Z Position	31	32767	32767	32767	32767	32767	32767	
Scale	33	32767	32767	32767	32767	32767	32767	
X Scale	35	32767	32767	32767	32767	32767	32767	
Y Scale	37	32767	32767	32767	32767	32767	32767	
Z Scale	39	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.



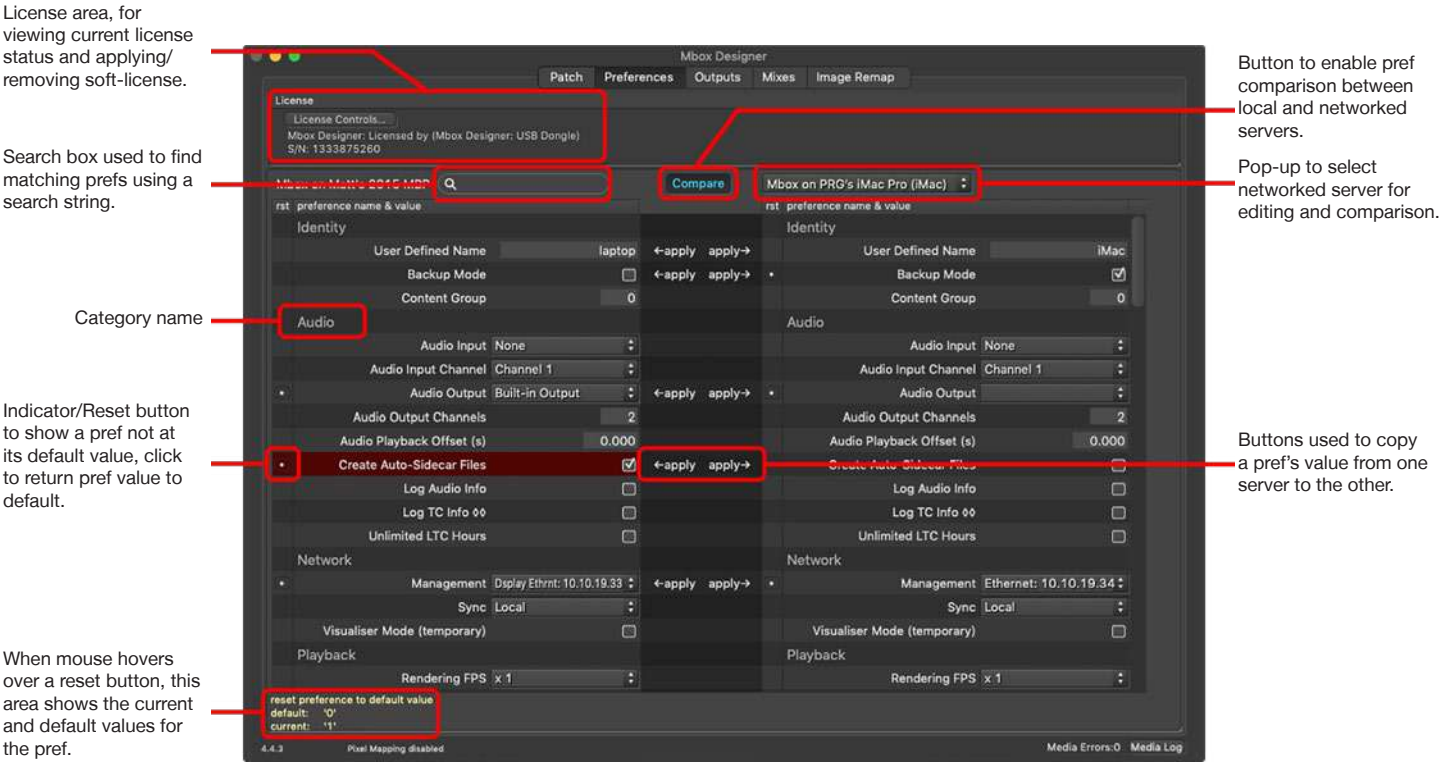
v Layers 1-6	Univ: 1	Addr: 1 to 504	Source IP: 127.0.0.1 (Local)					
parameter	address offset	layer 1 1.1	layer 2 1.85	layer 3 1.169	layer 4 1.253	layer 5 1.337	layer 6 1.421	
Opacity	0	255	255	255	167	121	0	Layer Mastering
Red	1	23978	32767	32767	41530	32767	32767	
Green	3	39199	32767	32767	32767	28311	32767	
Blue	5	32767	32767	40590	32767	32767	32767	

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 on networked Mbox servers.



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

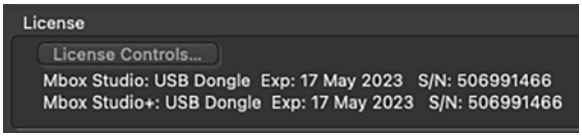
Preferences can be on/off checkboxes, pop-up lists, text fields for text or numeric entry, or more advanced edit tools for multi-item preferences (e.g. video inputs). All preferences have a name which may include a hint to show the required formatting or units for their text or numerical values.

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

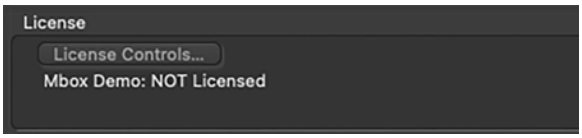
Preferences Tab: Licensing

The licensing area of the Preferences tab displays the current product version and state of the license for the application. Mbox v5 may be licensed by an Mbox USB license key (dongle), by a soft-license, or by a temporary override (sometimes created for evaluation purposes).

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



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.



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 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 any change to 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 44)
+ **Audio**
  - **Audio Input:** selects which CoreAudio input device is used for timecode input, selecting "None" causes Mbox to listen for network timecode (TC Reader or ArtTimeCode)
  - **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 minimum 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
  - **OSC Heartbeat:** enables OSC Heartbeat output (Refer to "OSC Heartbeat" on page 127)
  - **OSC Heartbeat Dest:** sets destination IP address and Port for OSC Heartbeat
  - **Log dmx2osc Info:** enables logging of information related to the dmx2osc functionality
  - **NDI Discovery Server IP:** shows current NDI Discovery Server IP and allows edit or removal (Refer to "NDI Input" on page 175)
+ **Playback**
  - **Rendering FPS:** selects x1 or div2 modes to set rendering rate to full or half output frequency
  - **Still Image Buffer:** sets buffer size for still images, still images with a file size larger than this will not be displayed
  - **Absolute In/Out Frame Numbers:** enables mode where the In Frame and Out Frame parameters' values are set directly by the incoming control value, rather than being scaled to fit a 16-bit range
  - **Deep Color:** enables 16-bit color depth for rendering
  - **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
  - **Playback Ease**: sets ease curve parameters for ease in/out playmodes. The parameters are: curve exponent (0.1 - 2.0), % remaining/elapsed time at which the ease starts/stops (1 - 25), minimum playback speed % (0.5 - 100)
  - **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
  - **Network Timecode Source:** selects source of received network timecode - TC Reader/Director or ArtTimeCode
  - **TC Reader v3.x 29.97ndf:** enables 29.97ndf compensation (for use with TC Reader application only!)
  - **ArtTimeCode Stream:** selects ArtTimeCode stream (0 - 255) to listen for
  - **ArtTimeCode 23.98/29.97ndf:** enables 23.98 and 29.97ndf compensation (for use with ArtTimeCode 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)

- **NDI Output Format:** selects YUV or RGBA format. RGBA supports an alpha channel. (Refer to "NDI Output" on page 177)
- **NDI Output Rate:** sets maximum output rate; same as the computer's primary display or other fixed rates
- **Color Control Mode:** selects one of the three color control modes (RGB+BC, HSV, or Yxy) for adjustment of color on both layers and output masters.
- **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 to full when the Mbox application has no control input, so as to allow onscreen HUDs to be visible
- **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; set to 16.3835 for 1:1 positioning between one "point" of control and one pixel onscreen
  - **Content Management Archive:** sets percentage of available disk space to use for content management archiving when files are deleted/replaced
  - **Image Remap Automatic Backup:** causes Image Remapping configuration files to be saved automatically while editing. (Refer to "Image Remap Automatic Backup Preference" on page 131)
  - **3D Emissive Models:** enables full ambient 3D lighting on all 3D models
  - **3D Fixed Models:** locks the position of all 3D models such that the layer X/Y/Z position controls have no impact on the model's position

+ **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
  - **Remap/ModelInfo Protocol:** selects control protocol for image remapping screen object and 3D object modelinfo controls

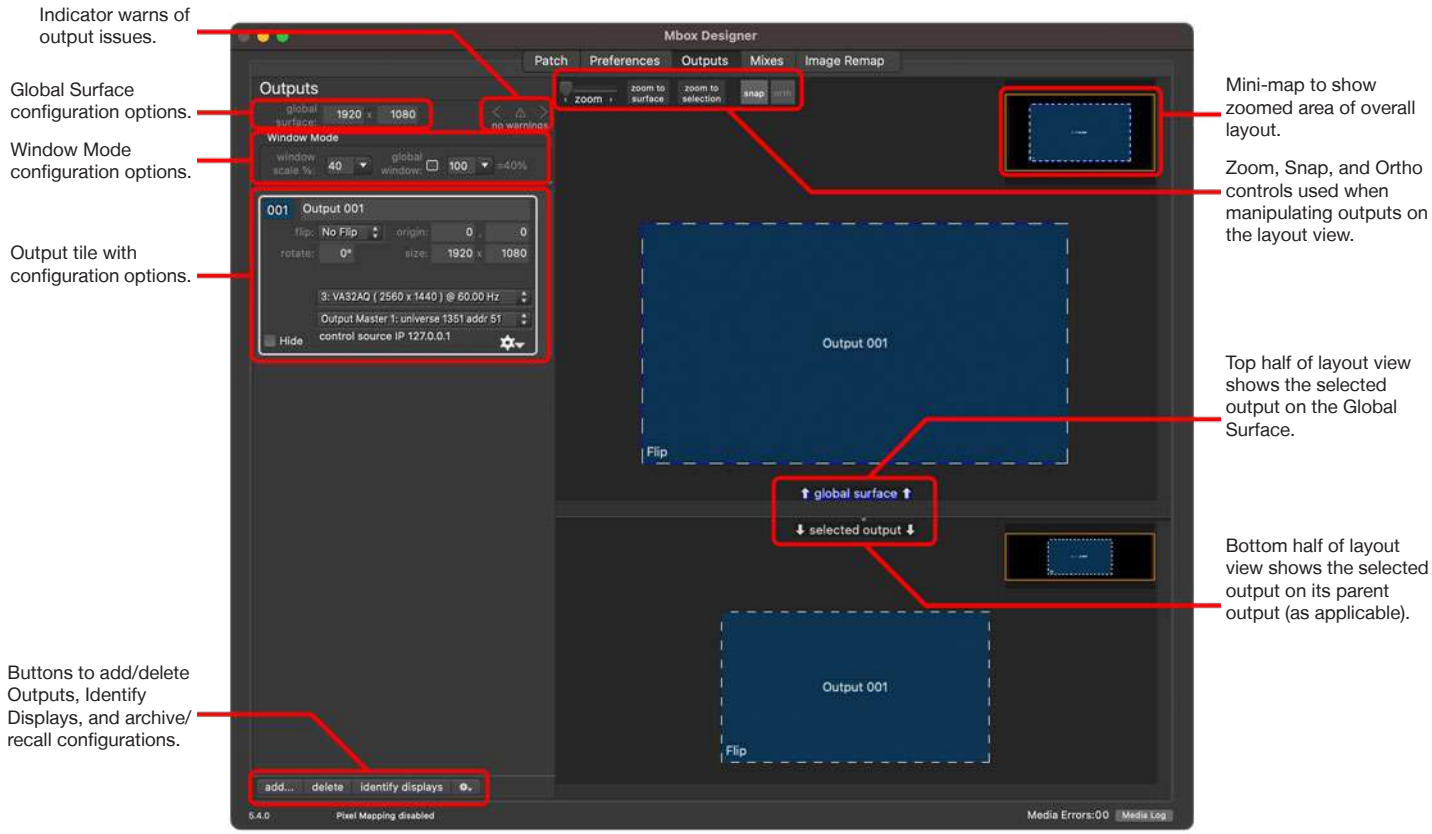
+ **Pixel Mapping**
  - **PixMap Enable:** enables all pixel mapping processing and output
  - **PixMap File Index:** selects active pixel mapping file by index number
  - **PixMap Constant Update:** enables constant maximum rate output rather than the default rate which may be reduced if content doesn't change
  - **PixMap Delay:** sets the interpacket gap time for pixel mapping universe output, pixel mapping must be disabled then re-enabled for changes to take effect; lower values can improve performance with a large number of pixel mapping universes
  - **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
  - **RGBLime White Point:** sets the custom white point used for the RGBLime pixel type; value is entered as R,G,B with values from 0-255; the value for Lime is automatically set to 255
  - **RGBW_2 White Tuning:** sets a custom additive color balance for white output for the RGBW_2 pixel type; value is entered as R,G,B with values from 0-255; values above 0 add color to the pure white output

+ **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
  - **Hold Dropped NDI Source:** enables the “hold last received frame” feature when an NDI source stops sending frames; when not enabled, dropped sources are cleared after two seconds
  - **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, custom color, name, origin, size, rotation, and flip mode 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



Note: Keystone and Warp for outputs are not configured on the Outputs tab. 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.

Mbox renders video imagery that is ultimately delivered to the video outputs of the computer. Imagery from playback layers 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 display devices for actual viewing. Positioning an output on the Global Surface determines which pixels will be sampled from the Global Surface, rendered on the output, and ultimately sent to the output's assigned display.

Outputs are also mixes. By strict definition, a mix is a rectangular area on the Global Surface. In fact, the Global Surface is a mix as well.

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

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 49, 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 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 mode, 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.

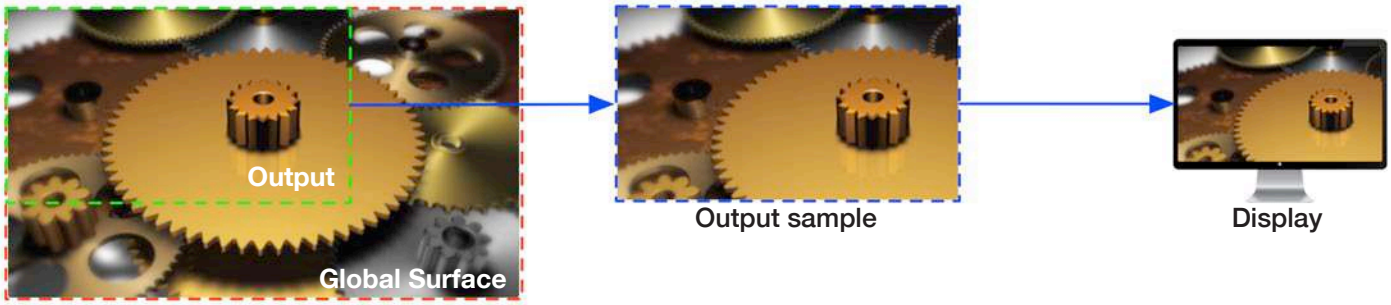
The two graphical views on the right side of the Outputs tab show the layout of the outputs and sub-outputs. The top layout view shows all outputs and sub-outputs in their position on the Global Surface. The bottom layout view shows sub-outputs in their position on their parent output. Both outputs and 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.

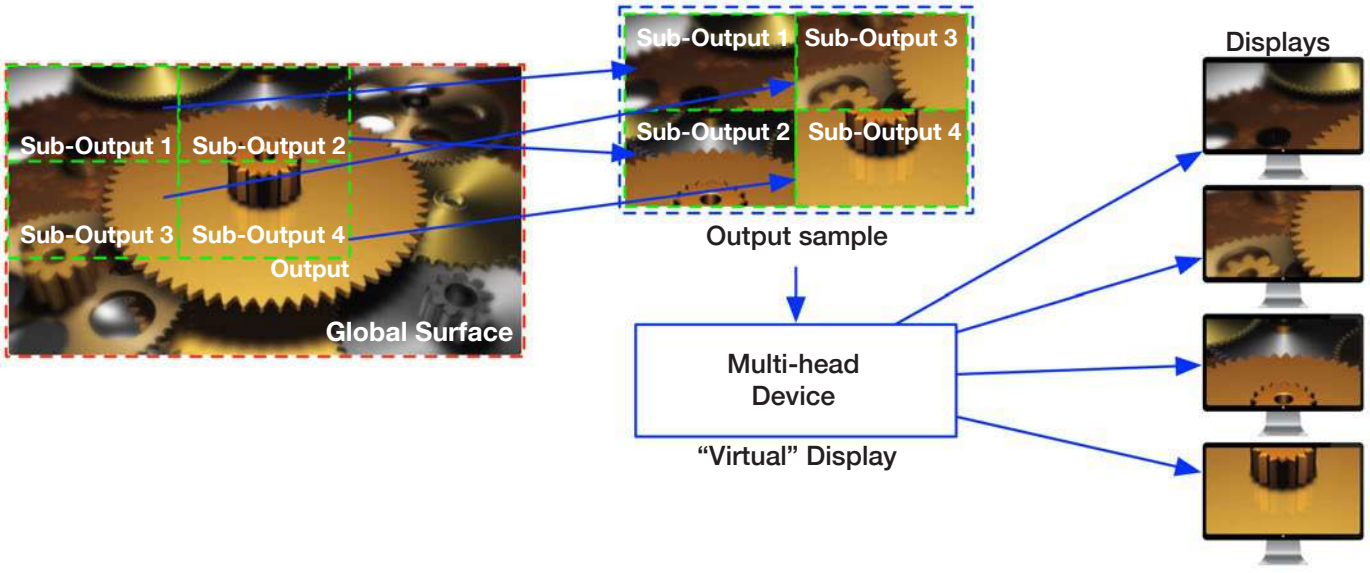
The top layout view represents the output's position on the Global Surface. The position on the Global Surface dictates where the pixels for that output will be sampled from. Essentially, an output is a viewport of an area of the Global Surface; any imagery in that area will be sampled and copied to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



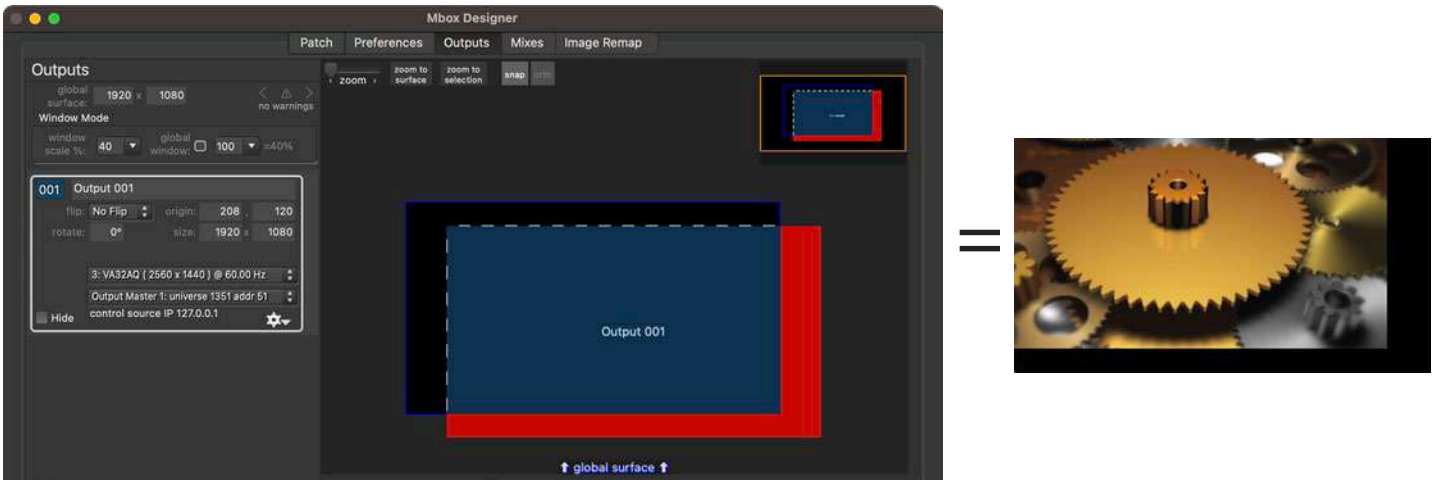
On the bottom layout view, sub-outputs' positions may be moved relative to their parent output. This positioning allows each sub-output's pixels to be copied to a very specific place when they are sent to the output device. Sub-outputs are often used for video outputs that are part of a multi-head output 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.



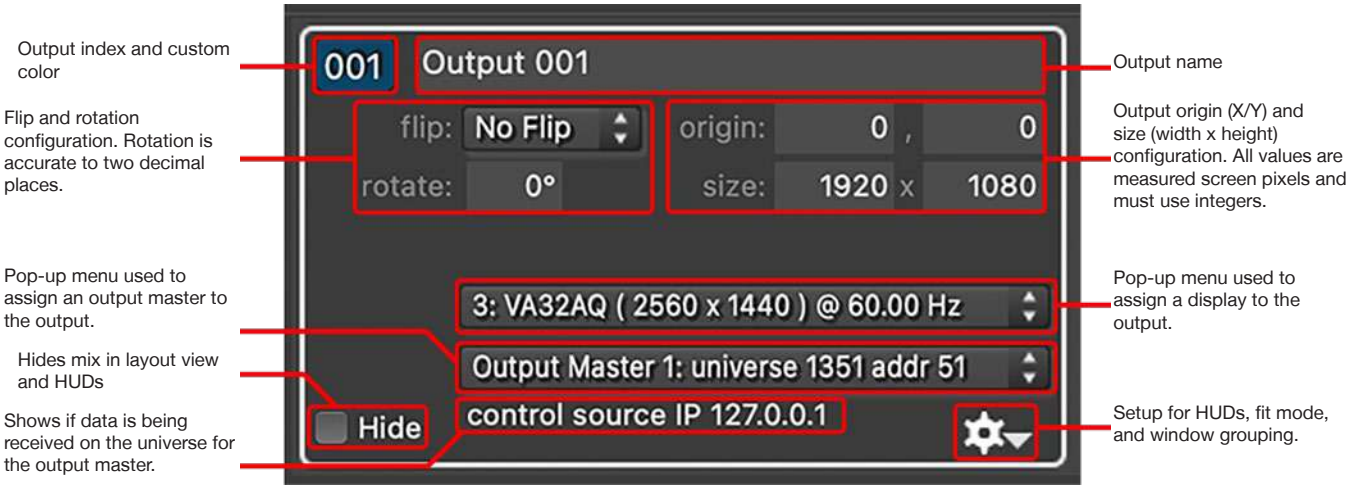
In this manner, imagery from anywhere on the Global Surface can be sampled and sent to the desired display device, whether that display is a single device or a multi-head device. Being able to move outputs on the Global Surface or sub-outputs on both the Global Surface and on their parent output is critical 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 and Custom Color

Outputs have a unique index number with a default range of 001 - 032. This index number is used both for organizational purposes and also for assigning layers to the output when programming. (Refer to "Using Outputs and

Mixes for Layers" on page 82) When an output is added, it is given the next available index number in the default range. Output index numbers may be changed at any time, 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.

By default, outputs and mixes are given a color and their corresponding rectangle in the layout view UI is filled with this color. If desired, outputs and mixes can be given a custom color. The custom color replaces the default color in both the layout view and also when the output or mix is drawn using the Mix HUD. (Refer to "Heads Up Displays" on "Heads Up Displays (HUDs)" on page 75)

To change the index number or to enable and select a custom color for an output or mix, first select the output or mix, then click on the colored index number button at the top-left of the configuration area. This will open a window that allows the index to be edited and for the custom color to be enabled and selected.

To edit only the index number, simply enter a new number in the corresponding text field then press the "Close" button. To enable the custom color, click the checkbox. Then click on the colored rectangle to select the color. Clicking on this rectangle opens a standard color-selection tool where the color can be specified in several ways.

Name

Outputs 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 Mode, and Rotation

Outputs have configuration parameters that affect how large they are (width and height in pixels) and where they are located (based on a top-left origin) on the Global Surface. Flip mode and rotation parameters allow an output's imagery to be flipped and/or rotated 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, rather than from the Global Surface's origin..

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, by dragging the output on the top layout view, or by first selecting the output then hovering the mouse over the layout view and using keyboard arrow keys to adjust the position. When using the arrow keys the output moves in 1-pixel increments unless the [shift] key is held down, in which case the output moves in 10-pixel increments. 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 Global Surface to be resized in advance.

Hide

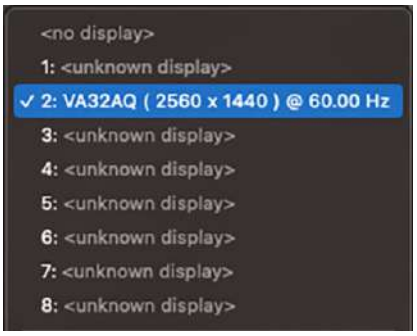
When many outputs or mixes are being used, it can be helpful to temporarily hide the output or mix from view in the UI or when using the Mix HUD. Every output (and mix) has a checkbox in its configuration area to enable the hide property. When hidden, mixes still exist, and can still be used in the normal fashion with mix selection and modes on layers, they just won't be drawn on the layout view, and when a Mix HUD is enabled, they won't be shown there either.

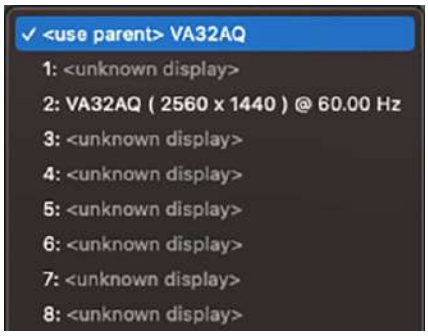
Display

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's rendering will not be updated 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, Blackmagic Design Decklink or Ultrastudio devices with output capabilities, and NDI outputs. Every display device connected to the computer has a name. But because display names may not be unique, connected displays also receive a unique index number based on where or how they are connected to the computer. Display devices connected directly to the computer using Thunderbolt/USB-C, HDMI, or DisplayPort will have an index in the range of 1 – 8. Blackmagic output devices will have an separate index number based on the order in which they are found.





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 the option: "<use parent>".

The menu item for each connected display will also show the display's current resolution and frequency. A display's resolution and frequency can only be modified in the computer's System Preferences > Displays pref pane. Mbox will always use this resolution and frequency for a display when going into Fullscreen mode, as Mbox makes no attempt to modify these settings. (Refer to "Connected Displays and Fullscreen Mode Interactions" on page 78)

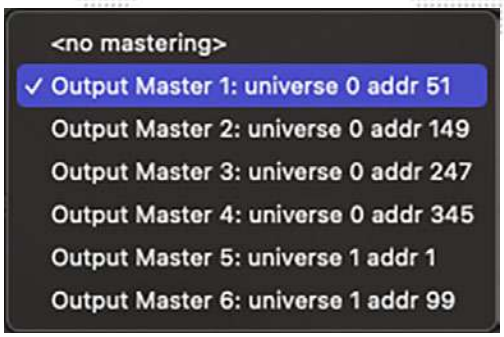
Assigning an output to an display will cause the output's imagery to be placed on that display when Mbox enters Fullscreen mode. Choosing "no display" or "unknown display" for an output means the output will have a window with rendered imagery when Mbox is in Window mode, but when Mbox enters Fullscreen mode, that window's imagery will stop rendering until Mbox returns to window mode. For sub-outputs, the "use parent" option causes that sub-output's imagery to be copied into its parent output (which would then be assigned to a display).

By default, sub-outputs use their parent output as a display, which allows their imagery to be copied into their parent 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 rather than using the parent output.

Connected displays can be identified by name in the list. However, if multiple displays with the same name are connected this may be confusing. 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 connected displays. (Refer to "Outputs Tab: Add, Delete, Identify, and Archive" on page 69)

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 "Output Master Fixture" on page 200) 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 "Patch Tab: Control Input Setup" on page 51), and the total number of available output masters is limited depending on the license level of Mbox (Designer/Studio/Mini/none). 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. Mbox has the option to enable or disable HUDs for each output. 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 Groups

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 Mini and Studio/Studio+ licenses have limits on the total pixel count for outputs. Mini supports up to 4.6 millions pixels (3840x1200). Studio supports up to 9.2 million pixels (3840 x 2400). Studio+ supports up to 18.4 million pixels (7680 x 2400). With no license, Mbox is limited to 2 million pixels (1920 x 1080). If the output pixel limit is exceeded, 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 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.

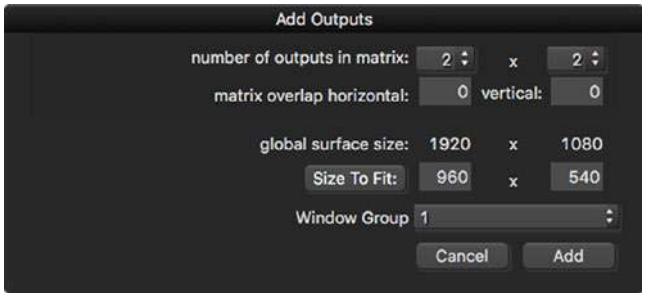
Therefore, the Global Surface needs to be sized to be at least as large as the combined area of all outputs plus any area devoted to pixel mapping. The rendering area for one or more outputs (and the pixel mapping) can be overlapped or combined however.

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 unique 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 automatically sizes its playback engine no matter the resolution of the content, and therefore the size of the content doesn’t need to be factored into the configuration of the Global Surface. 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. There is a maximum size for 2D content, which is 16,384px x 16,384px.

The Global Surface’s width and height can be independently adjusted keeping the size limit 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.

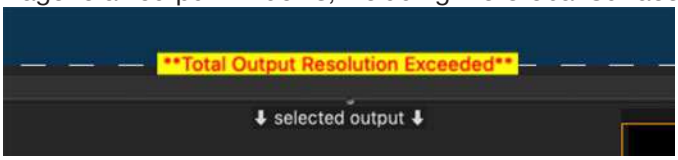


CAUTION! In most cases, the Global Surface should not be larger or smaller than the total area required by the outputs. Making the Global Surface too large affects performance, and making it too small means that some portions of outputs may be unable to show any imagery.

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). This property only affects the windows shown in Window mode, and doesn’t affect anything when Mbox is in Fullscreen mode.



+ Checking the global window checkbox causes an additional, separate window to be drawn that shows the full Global Surface.
+ Because the Global Surface window might be a very large window, there is an additional scaling factor pop-up for this window. The size of the global window is scaled by both the window scale and global scale values. e.g. 50% and 50% = 25%
+ Turning on the Global Surface window will impact performance, and therefore it should be used with care.

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 options - “Add One Output” and “Add Matrix of Outputs...” - will be available. If an output is selected in the pane above, 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 parent output and the sub-outputs will be given index numbers in sequence based on the lowest unused output index number.

WARNING! If outputs are added and the output pixel limit for the current license level is exceeded, any outputs that exceed the limit will not be rendered!

Based on the Mbox software license level, the total number of output pixels may be limited. Designer has no limit, Studio+ is limited to 18,432,000 pixels (7680 x 2400), Studio to 9,216,000 pixels (3840 x 2400), Mini to 4,608,000 pixels (3840 x 1200), and no license to 2,073,600 pixels (1920 x 1080).

If the limit is exceeded, any outputs that exceed the limit will not be rendered. A warning message will be displayed on the Outputs tab, just above the divider between the Global Surface and Selected Output layout views.

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, resolution, and unique index 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 only 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, but 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.

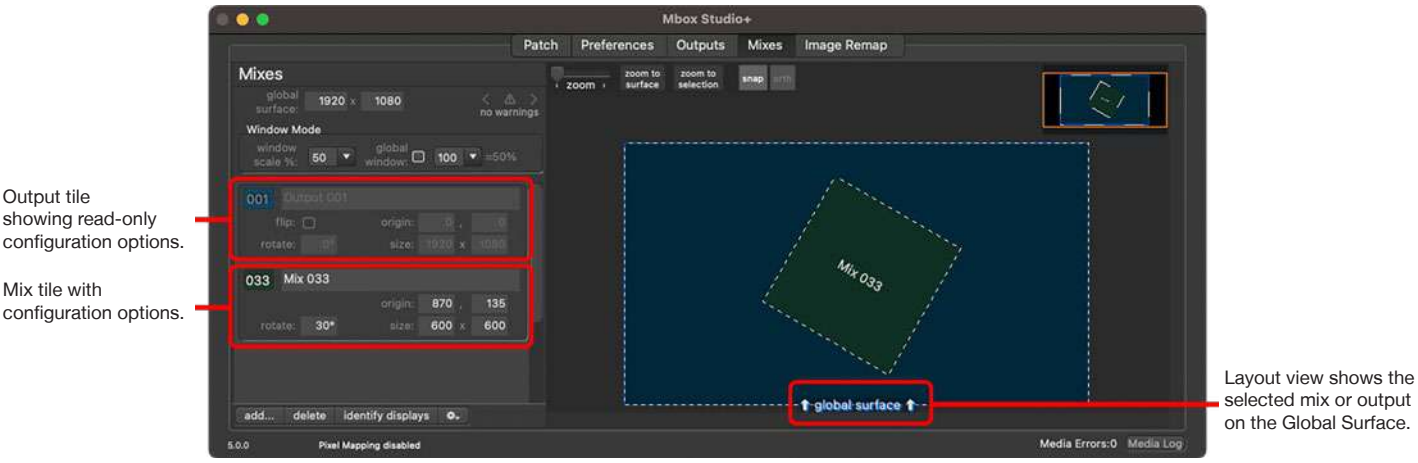
Mixes Tab xx new image?

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, similar to the Outputs tab:

+ View (but not add or edit) the configuration of 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



Mixes Tab: Overview

The Mixes tab of the Mbox 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. By strict definition, a mix is a rectangular area on the Global Surface. 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.

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 typically Mixes 1 - 32, and “arbitrary” mixes and multi-mixes are Mixes 33 - 255.

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 combination of more than one mix. 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 69) 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 69 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 and Custom Color XX

Mixes use unique index numbers with a default range 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 82) 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.

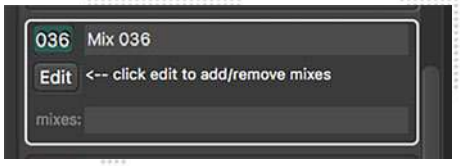
Note: Outputs are shown on the Mixes tab for reference. But their properties are only editable on the Outputs tab.

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.

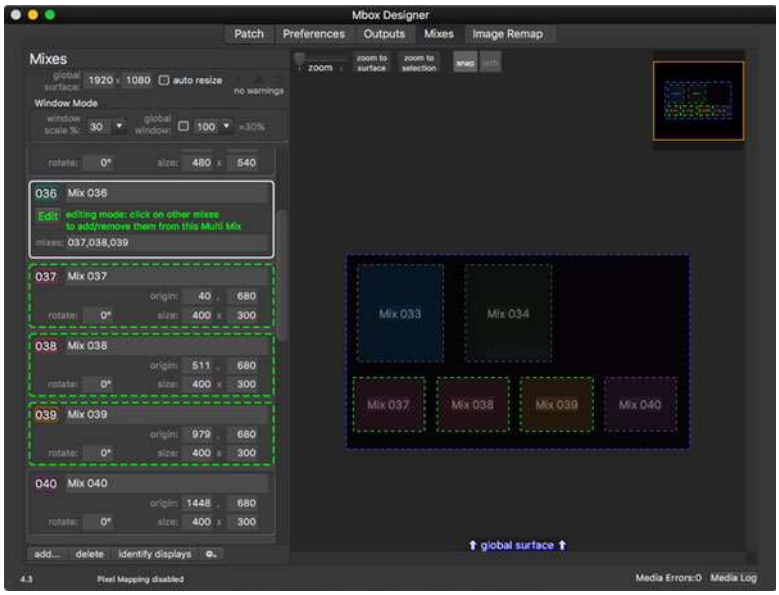
When a multi-mix is first created, it is empty and needs to have one or more mixes added to it. The mixes that make up a multi-mix can be added or deleted at any point in time, and can be added to or removed from the multi-mix at any point in time too. Multi-mixes are not shown on the layout view as 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.

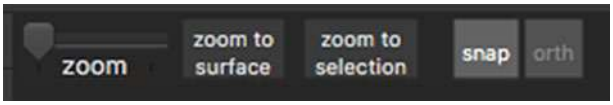


The mixes in the multi-mix can also be added or deleted by index number in this textfield. Their stacking order can be edited by rearranging the order of the index numbers in the field.

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.

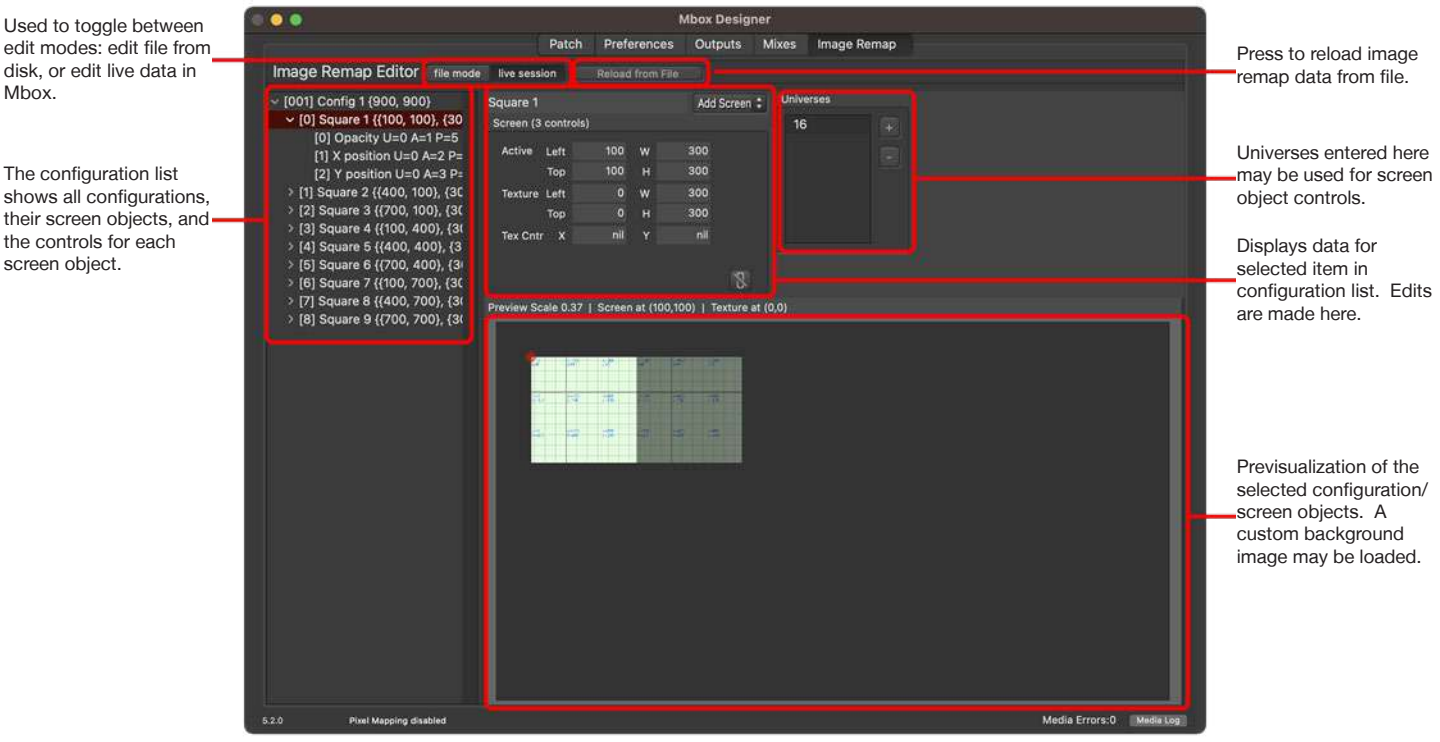
Note: When an output or mix is selected by clicking on it on the top layout view, the arrow keys on the keyboard may be used to nudge the output's position one pixel at a time. Holding down the [shift] key while using the arrow keys will nudge the output/mix's position ten pixels at a time.

Image Remap Tab

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

+ View and edit image remapping data.
  - Open any image remapping plist file from disk or live edit the current MultiScreenData.plist file.
  - Add, delete, or edit image remapping configurations, screen objects, and controls for screen objects.

Refer to "Chapter 5. Image Remapping" on page 129 for detailed information on the use and configuration of image remapping in Mbox.



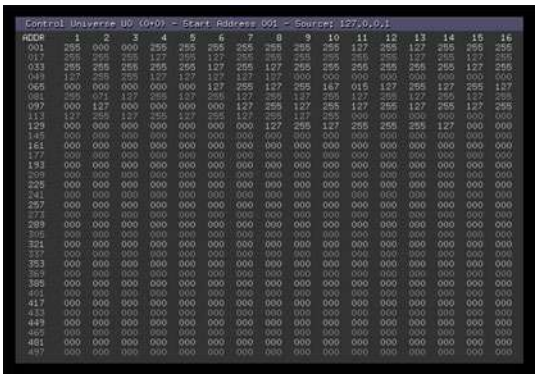
HEADS UP DISPLAYS (HUDS)

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 230 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:

- **F4** - Control Input Universe HUD
- **F6** - Version Information HUD
- **F7** - Mix Overlay
- **F8** - Output Statistics HUD
- **F9** - Performance HUD
- **F10** - Timecode/Activity HUD



Example of the F4 HUD

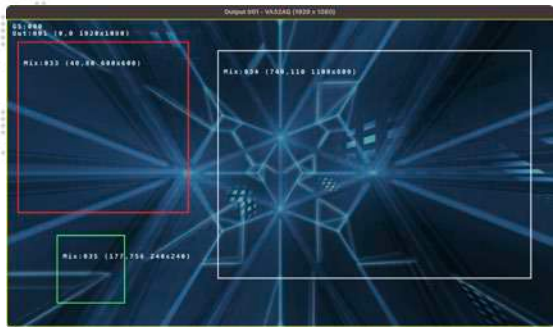
Note: On some keyboards it may be necessary to press a combination of the [fn] key and the function [F1 - F12] keys since the function keys are mapped to OS-specific tasks.

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’s control channel.
- Press [esc] to clear any keyboard HUD or press the activating key multiple times to cycle through options.
- HUDs activated from the keyboard can also be cleared from the control console through the use of the Global Master’s control channel.
- [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, the fourth press is for the fourth universe. A fifth press turns the HUD off.
- [F7] may be added on top of any of the other HUDs and has a three-way toggle. The first press is for Mix outlines, the second press is for Mix outlines with diagonal lines (an “X”) drawn between the corners, the third press is for filled Mixes. A fourth press turns the HUD off.

Mix Overlay

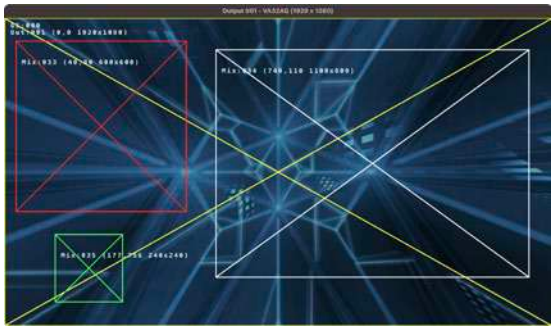
When setting up a configuration of outputs and/or mixes in advance, or performing the same tasks onsite, it can be helpful to temporarily view the position and size of mixes on Mbox's actual video outputs. These rectangular areas indicated mixes can be used a helpful guide when adjusting the configuration of LED processor sampling, or when trying to identify important onscreen regions for mix setup. The Global Surface and all outputs are mixes and these items will be represented on the Mix Overlay HUD along side arbitrary mixes.



Mix Outlines Only

Pressing [F7] will toggle through three different versions of the HUD, with each representing the mixes in a slightly different way:

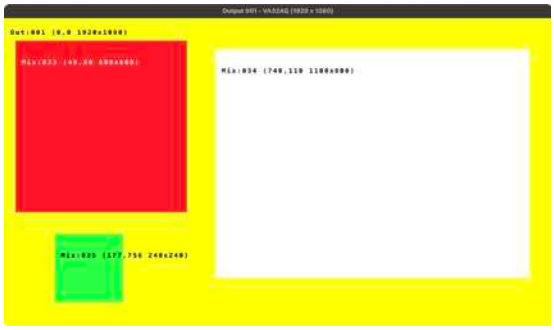
+ The first version shows all mixes as outlines only.
+ The second version shows all mixes as outlines with added diagonal lines drawn between the corners of each mix.
+ The third version shows all mixes as filled rectangles.



Mix Outlines with X

Any output or mix that has its hide property turned on will not be shown in the HUD. The thickness of the mix outlines can be adjusted between 1 and 10 pixels through the use of the Mix HUD LineWeight preference, with the default being 4 pixels.

The color of mix outlines, X, and fill can be affected by enabling the custom color property of the mix. If the mix has not had a custom color enabled (Refer to "Index Number and Custom Color" on page 63) then the color is based on the type of mix: the Global Surface (the GS is a mix!) is blue, all output mixes are yellow, and all other mixes are white. If any mix has had custom color enabled, then its color is based on the custom color selected for that mix.



Mixes Filled

Outputs and mixes will display a name and index value (e.g. "Out:001" or "Mix:034") in their top-left corner, followed by the output or mix's origin and dimensions (e.g. "(0,0 1920x1080) as (Origin X, Origin Y Width x Height)). Origin and dimensions are shown in pixels, using the standard top-left origin of the Global Surface as 0,0.

Note: The mixes in the HUD are drawn in numerical order, the Global Surface is drawn first, then outputs, then arbitrary mixes. Because of this, mixes drawn later in the process may partially obscure mixes drawn earlier in the process. The use of the mix custom color property can be useful to help distinguish between individual mixes. Similarly, the use of the mix hide property can be useful to temporarily remove a mix from the HUD, to better allow other mixes to be visible.

Timecode/Activity Monitoring XX image db level XX

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

timecode, or by showing a trace that moves across the HUD's notification area when no timecode is being received. The green activity trace (the # symbol) moves from left to right across the gray notification area when timecode is not being received, thereby indicating program activity. When timecode is being received, the activity trace disappears.

Repeatedly pressing [F10] will cycle the Timecode/Activity HUD through five display positions: center, top-right, top-left, bottom-left, and bottom-right. The HUD can also be displayed and have its position changed using the "Global Master Control Channel" (page 230).

The color of the timecode numerals and format indicator (e.g. 01:03:26:16 29DF) can be used to determine the state of the timecode:

- When good timecode is being received, the timecode value is colored green and updates to match the incoming timecode. The timecode format will be shown after the value - e.g. 30NDF or 29DF.
- When timecode is not being received, the timecode value is colored yellow and shows the last-received value. While timecode is stopped, the green activity trace will be visible, moving from left to right.
- When the timecode input has errors or is unstable, the timecode value is colored red. While in this state, Mbox attempts to freewheel timecode to match the incoming timecode. If the unstable timecode is only present for a short time, Mbox can continue to sync playback, but long periods of unstable timecode or bad timecode will affect sync.

The format indicator portion of the Timecode/Activity HUD (e.g. 29DF) shows the format that Mbox is using to interpret the incoming timecode. When LTC (audio) timecode is being received, this value shows the actual interpreted format. When timecode is coming from a network source, the reported format can be affected by the state of the 29.97ndf compensation preferences for TC Reader and ArtTimeCode.

The level indicator portion of the Timecode/Activity HUD (e.g. -21dB) shows the peak audio level of LTC (audio) timecode only. For other types of timecode input - from Director, TC Reader, or ArtTimeCode - the level is shown as 0dB and is irrelevant.

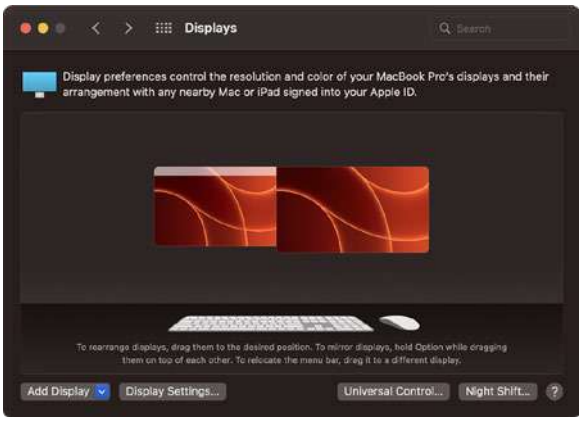
A good audio level for LTC input to Mbox is anywhere between -25dB and 0dB. Although levels below -25 or above 0 *may* work, such levels are not recommended. Levels below -25db can be so low/quiet as to be unreliable, and those above 0dB may result in distortion and similar unreliability.

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 - monitors, projectors, LED processors and the like. Display devices communicate their possible input formats via EDID (Extended Display Identification Data). The EDID data provides the computer with information on preferred formats and available alternate formats.

Note: The images on the following pages are from macOS 12 Monterey. Other versions of macOS have a different look to the controls on the Displays pref pane and may require a slightly different process to set up display devices.

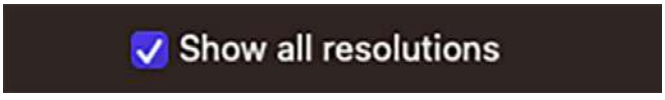


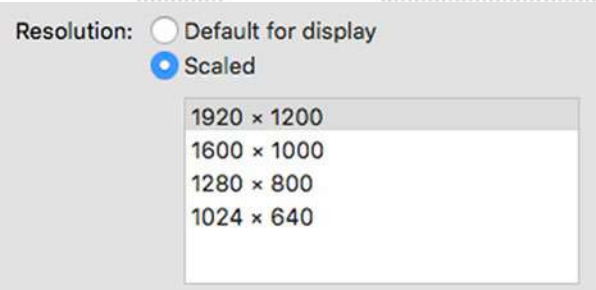
When connecting the video outputs of the Mbox server to a display device, confirm that the display device appears in the computer's System Preferences > Displays pref pane. On most Macs, the computer will automatically read the EDID of displays when they are first connected. It is possible to force the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

Note: The Detect Displays button is not visible unless the [option] key is pressed and in newer versions of macOS may not be visible at all unless at least two displays are connected.

Once EDID has been read from the display, if there is more than one display connected to the computer, press the "Display Settings..." button and select the display to be configured. The Displays pref pane will controls to allow the setup of the purpose, resolution, color profile, and in some cases, the rotation.

+ For any/all displays used with Mbox, the "Use as" pop-up must always be set to "Main Display" or "Extended Display" and never to "Mirror for *<name of other display>*."
+ By default, the preferred format for the display will be selected. This may be indicated by the "Default for Display" radio button being selected or by a reduced set of format options for resolution and frequency being shown. Clicking on the "Scaled" radio button or on the "Advanced... " button and then turning on the "show resolutions as list" option will allow the selection of additional formats. Some formats allow a selection of alternate refresh frequencies, but this will depend on the display device.
+ Even after clicking on the "Scaled" radio button or showing the resolutions as a list, all possible formats for the display may not be shown. On older versions of macOS, holding down the [option] key and clicking on the radio button may reveal more possible formats. On newer versions, the "Show all resolutions" checkbox or switch results in the same expanded list of formats.





Clicking on “Scaled”

Option-clicking on “Scaled” or with Show all resolutions checked

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Note: The arrangement of display devices is not important for the Mbox application when it enters Fullscreen mode. But the arrangement of display devices can provide a useful working environment when the Mbox 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 device does not support the desired format. In which case, the display device could be replaced with one that does support the desired format. In some cases it may be necessary to use a device between the Mbox computer and a display device to “spoof” EDID. Spoofing EDID allows the computer to output formats that may not be supported by the display device. 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.

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.

CAUTION! All displays should be connected and configured (in System Preferences > Displays before the Mbox application is launched. Reconfiguring displays while the Mbox application is running is generally OK, but only if the Mbox application is in window mode. **Never reconfigure or connect/disconnect displays that Mbox is using while the Mbox application is in fullscreen mode!**

Mbox v5 will never attempt to change the display format from the current setting 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 on the Outputs tab of the Mbox application.

This manner of operation makes it possible to ensure that a selected output format is supported by the display device 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 exactly 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.

CAUTION! Some computers have built-in displays that support “ProMotion” and “True Tone.” These features affect only the built-in display, but the refresh rate of the built-in display can affect rendering performance if it is used by Mbox. Therefore, ProMotion should always be turned off. To avoid differences in color rendition between the built-in display and any external displays, True Tone should also be disabled and all displays set to the same color profile - ideally sRGB.

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 always 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 190 for more information.

4.

OPERATION

This chapter provides operating instructions for the Mbox software

+ USING OUTPUTS AND MIXES WITH LAYERS
+ PLAYMODES
+ COLOR CONTROL FOR OUTPUTS AND LAYERS
+ 3D OBJECTS AND DIGITAL GOBOS
+ LAYER COPY
+ LAYER BLENDING
+ TEXT FILES
+ SCRIPTS
+ AUDIO
+ PLAYBACK SYNCHRONIZATION
+ EFFECTS AND TRANSITIONS
+ PIXEL MAPPING
+ PROJECTION MAPPING
+ VIDEODUST (AND DMX2OSC)
+ OSC HEARTBEAT

USING OUTPUTS AND MIXES WITH LAYERS

Overview

Mbox uses Mixes for the purposes of centering and cropping content to rectangular areas of the Global Surface. Mixes can be edited live within the Mbox application itself. Mbox has dedicated tabs on the primary window for the creation and configuration of both outputs and mixes. Once created, the Global Surface, outputs (which are also mixes), plus any other mixes can be used as destinations for layers. (Refer to "Mixes Tab: Overview" on page 71 for more information on output and mix properties and setup)

Outputs and Mixes in Mbox

In Mbox every layer has two parameters – Mix Select and Mix Mode. Mix Select allows the selection of the mix (remember that the Global Surface and outputs are also mixes!) using its numerical index, and Mix Mode selects the cropping, centering, rotation, and scaling of the layer's content with respect to the selected 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 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, layers are centered on 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 so there should always be a mix 1. Output mixes can have Output Masters assigned to them (the Global Surface and mixes 33-255 cannot) which allows them to have independent mastering of certain properties from the control console. While Mbox can have up to 32 physical outputs, the different licenses of Mbox (Designer, Studio/Studio+, and Mini) have different limits for the allowed number of output masters (32/8/6). Depending on the software license level, outputs may also have 3D Cameras, keystone/warp, and vignettes assigned to them using Mbox Remote. The assignment of 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 remaining 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 with an Mbox Designer license, mixes 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 mix mode crops 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 since there is no rendering outside the boundaries of the Global Surface, there is no content outside those boundaries to crop 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 the union 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 may be 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, with an Mbox Designer license, 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: With Mbox Studio/Studio+ and Mini licenses, only the Global Surface can have a 3D camera, which cannot be configured

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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.

With an Mbox Designer license, 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 output. 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 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

With an Mbox Designer license, 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 default 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

The 3D camera available with an Mbox Designer license 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 only 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 the camera position, which used 16-bit controls, couldn't be related to actual 3D coordinates.

With an Mbox Designer license, the camera 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) in coordinate space. This allows both the camera and its position to be adjusted, either independently or at the same time – thereby allowing for panning.

Note: The DMX camera controls available for use with an Mbox Designer license share the same core parameter set as the camera controls available in Mbox Remote.

Due to these properties of 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 coordinate 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 the same.

COLOR CONTROL FOR OUTPUTS AND LAYERS

Overview

Mbox software versions prior to 5.4 provided color control on outputs and layers using an RGB model with additional brightness and contrast controls. Starting with Mbox 5.4 there are two new Color Control modes: HSV and CIE Yxy. The Color Control Mode preference selects the mode used for all outputs and all layers. Each of the three modes allows the color and brightness of imagery on outputs and layers to be adjusted, with each mode achieving this in a different manner with a different control paradigm.

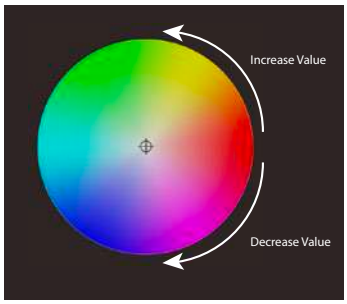
The standard output master and layer DMX control footprints include five 16-bit parameters for color control. These five parameters originally corresponded to the Red, Green, Blue, Brightness, and Contrast parameters. Mbox 5.4 does not introduce new DMX control footprints, it simply uses the same footprint with the same five parameter "slots" but re-purposes the first three parameters in HSV and CIE Yxy modes to become the controls for that mode. The fourth and fifth parameters are not active in either the HSV or CIE Yxy modes.

RGB+BC

This is the default mode and corresponds to the existing Mbox fixture profiles for Mbox Director and various lighting consoles. This mode includes five parameters: Red, Green, Blue, Brightness, and Contrast. Each of the five parameters works in an additive/subtractive manner with values higher than the default increasing the amount of that parameter (e.g. increasing Red makes the image redder) and values lower than the default decreasing the amount of that parameter (e.g. decreasing Brightness makes the image darker).

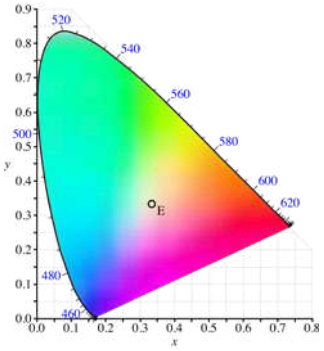
HSV

The HSV mode allows for the manipulation of the Hue, Saturation, and Value of the color of imagery. Hue being the color/tint, Saturation being the vibrancy/intensity of the color, and Value being the brightness. Hue can be represented using a color circle or wheel, with the parameter's default value resulting in no shift in hue. As the hue value increases the hue "rotates" CCW around the circle (e.g. increasing the value for red imagery makes it yellow, then green, then cyan), and decreasing the value rotates CW around the circle. Increasing Saturation makes the imagery's color deeper or more intense, while decreasing is removes color, eventually leading to grayscale imagery. Increasing Value makes the imagery brighter and decreasing it makes the imagery darker.



CIE Yxy

The CIE Yxy mode allows for color manipulation based on the CIE 1931 color model and its chromaticity diagram. In the CIE 1931 color model, all visible color is represented as an area under a curve (actual, representable color is a smaller portion of this). The axes of the diagram are labeled as "x" and "y" and the x and y parameters in Mbox correspond to these axes. Increasing the x parameter value shifts the color of imagery rightwards on the chromaticity diagram (e.g. if the imagery was white, increasing x makes it redder) and decreasing the x value shifts the color to the left. Likewise, adjusting the y parameter value shifts the color of imagery up or down on the chromaticity diagram (e.g. if the imagery was blue, increasing y makes it greener). Increasing the Y parameter makes the imagery brighter and decreasing it makes the imagery darker.



While the CIE Yxy color mode is intended for very specific color specification via accurate x and y values, the color mode in Mbox does not allow for specific x or y color values to be entered, it merely allows the color to be shifted in the desired direction on the chromaticity diagram.

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 Frame and Out Frame 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 Loop - Used with the Layer Sync Sender Forward Loop mode 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.

Receiver Once - Similar to Receiver Loop above, but for use with a layer using the Sender Forward Once mode.

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 Once 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 107) 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.

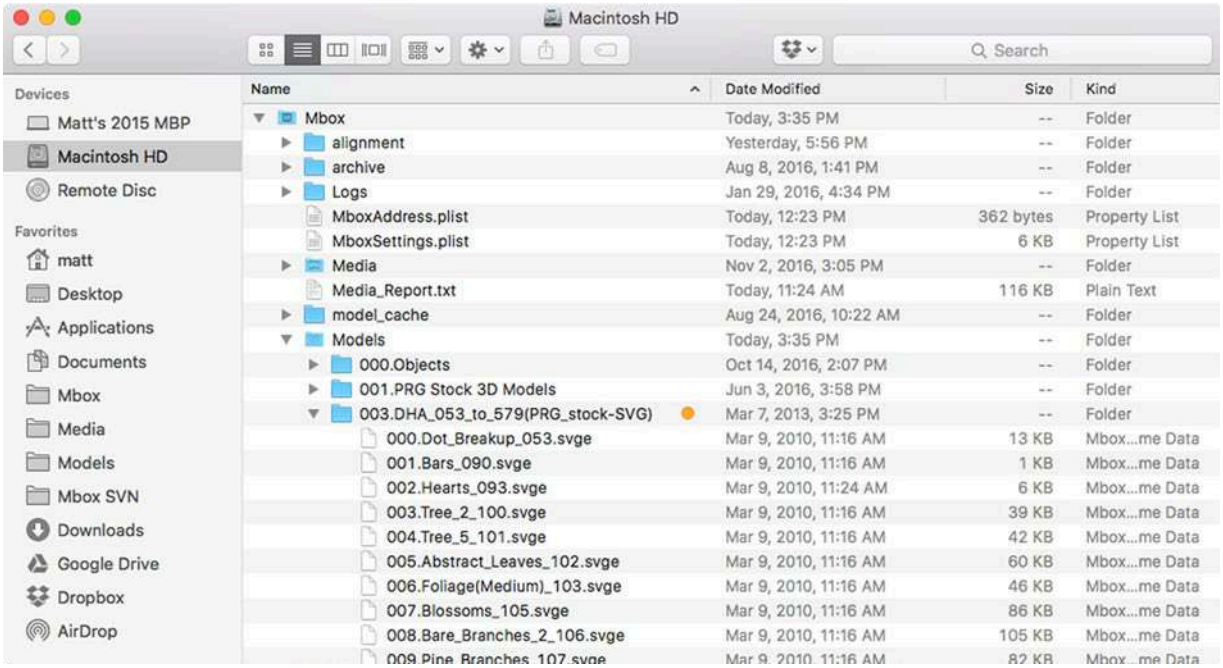
IMPORTANT! Some movie types will not work well with certain playmodes. For example: Movies that use either H.264 or mp4 encoding cannot use the Random playmode (and others). This is due to their temporal compression scheme. Content that uses Spatial compression (e.g. ProRes, HAP, Photo-JPEG) can be used 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 40 for information on adding 3D content and supported file formats.



3D Lighting

All 3D models and digital gobos require virtual lighting to be properly visible. If an object file is used without turning on at least one of the 3D lighting fixtures, then the object will appear on the screen as a black silhouette.

Guidelines:

+ 3D models without a texture look best when using the 3D lighting fixtures with their ambience value reduced. The resulting shadows help enhance the 3D nature of the model.
+ When an object has a texture applied, an increased ambience value is typically required in order to properly see the texture.
+ Digital gobos respond best to 3D lighting fixtures with a higher ambience value.

Refer to “Fixture Parameter Data” on page 208 for information on control parameters for the 3D lighting fixtures.

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 new or modified files in the Models folder will be compiled automatically either when the Mbox application is launched or when a rescan is performed. 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.

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

Single file - **001.Object.preload.obj** Entire folder - **002.LargeObjects.preload**

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, load time is reduced when the object is used, but it may 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 – 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 units tall when saved as an .obj file. An identically sized unit that uses feet for scale will be 3.28 units tall. Even though the objects have the same intended height, their resulting .obj versions have drastically different heights.

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

When Mbox performs a rescan and finds object and digital gobos files, the vertex array compiler's default action is to normalize any objects and digital gobos that are found. Normalization scales these items so they fit into a bounding cube that is 2 generic units on each side. Objects are scaled up or down so that their largest dimension (along the X, Y, or Z axis) is two generic units. Their other dimensions are scaled by the same factor to keep the intended proportions.

Normalization converts all objects to a similar size, but in many cases, it is important to have objects be different sizes - i.e. intentional difference in size. 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.

Note: Each generic unit in an object or digital gobo is approximately 240 screen pixels within Mbox's rendering environment. Therefore, an object that is 1 unit tall and which uses the "noscale" file suffix would be 240 pixels tall and any object that is normalized to the 2x2x2 bounding cube would be at most 480 pixels wide, tall, or deep.

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 the noscale suffix were used), 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.noscale.svg** would be renamed as - **023.DigiGobo.scale_0.50.svg**

For objects or digital gobos that need to have their 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 object that is 200 generic units tall would appear as 200 pixels tall within Mbox. With default scale parameter values on the layer and default camera settings the object would appear onscreen as 200 pixels tall.

Using the .pixels suffix with .obj objects results in as close to 1:1 scaling - generic units to pixels - as possible. However, some slight adjustment of the layer's scale, or if the layer is assigned to a mix with an Output Master, adjustment to that Output Master's 3D Camera Position, may be required to be precise. While 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 47 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 smoothing for the virtual 3D lighting on a object, the suffix ".smooth" can be added to the file name or to the object's metadata.. The smooth function affects the lighting on the object by averaging adjacent face normals for lighting, and can result in a smoother looking object under certain lighting conditions.

Note: 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

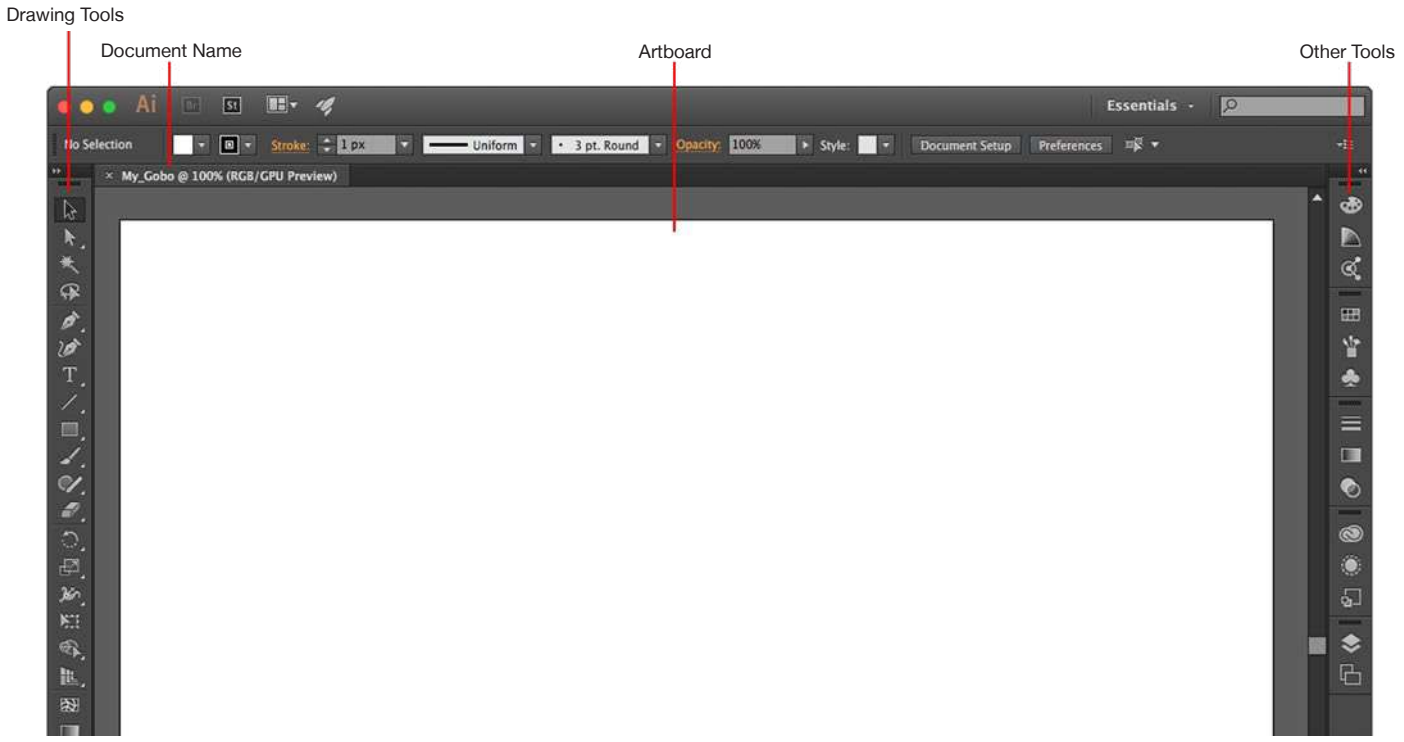
Before beginning, determine the intent of the digital gobo. When creating an SVG gobo file, there are two options for how a layer's texture will be mapped to the digital gobo:

+ 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.

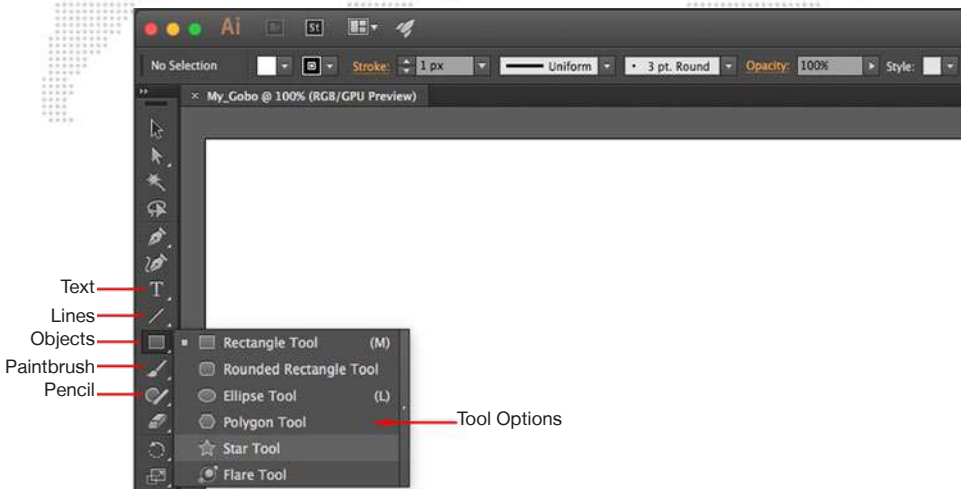
Creating a Digital Gobo with Adobe Illustrator CC 2015.3

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.

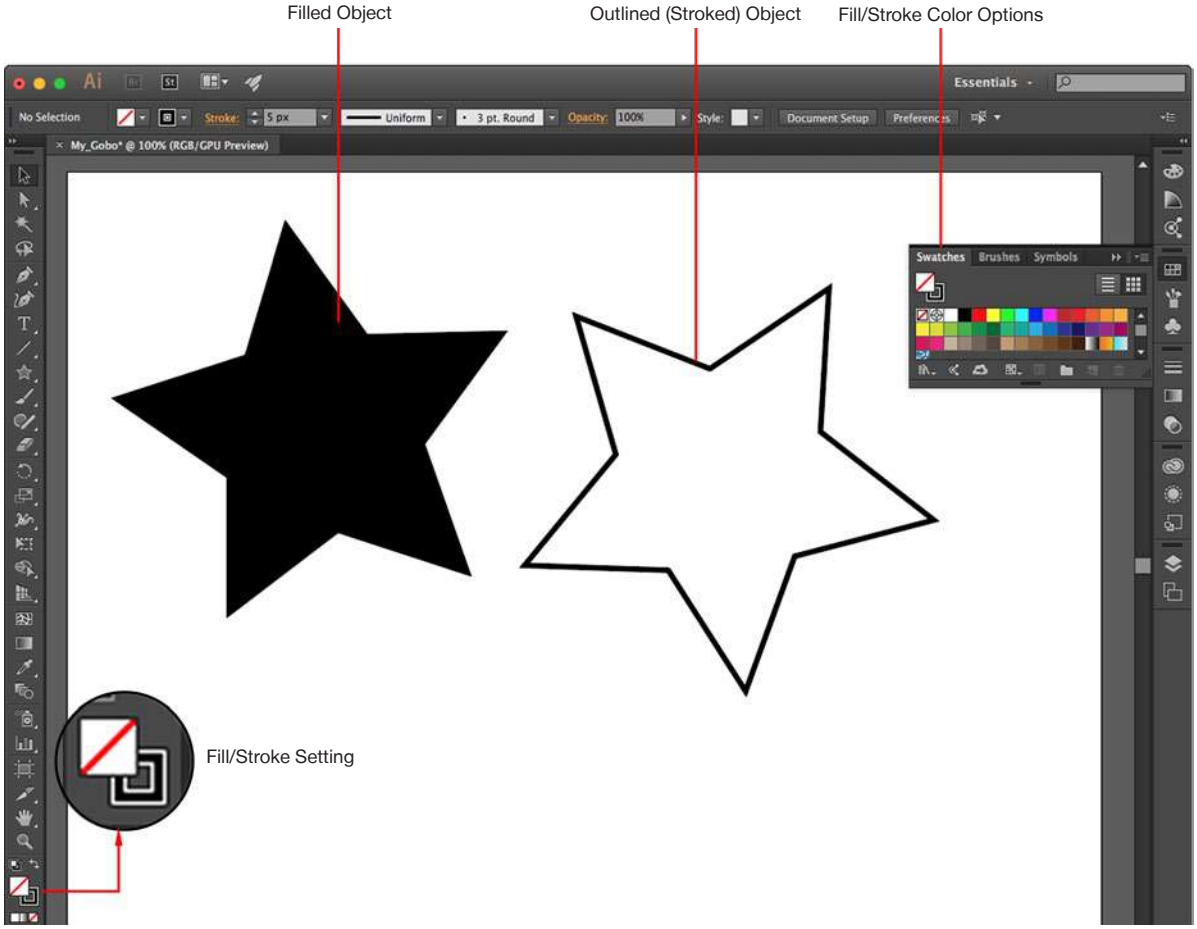
Step 1. Start a new document and name it appropriately. The orientation of the document are not critical at this point, nor is the color space (RGB or CMYK). While the size of the artboard is also not critical at this point (see Step 7), to keep things simple there should only be one artboard. For now, just make sure the artboard is large enough to hold all of the objects.



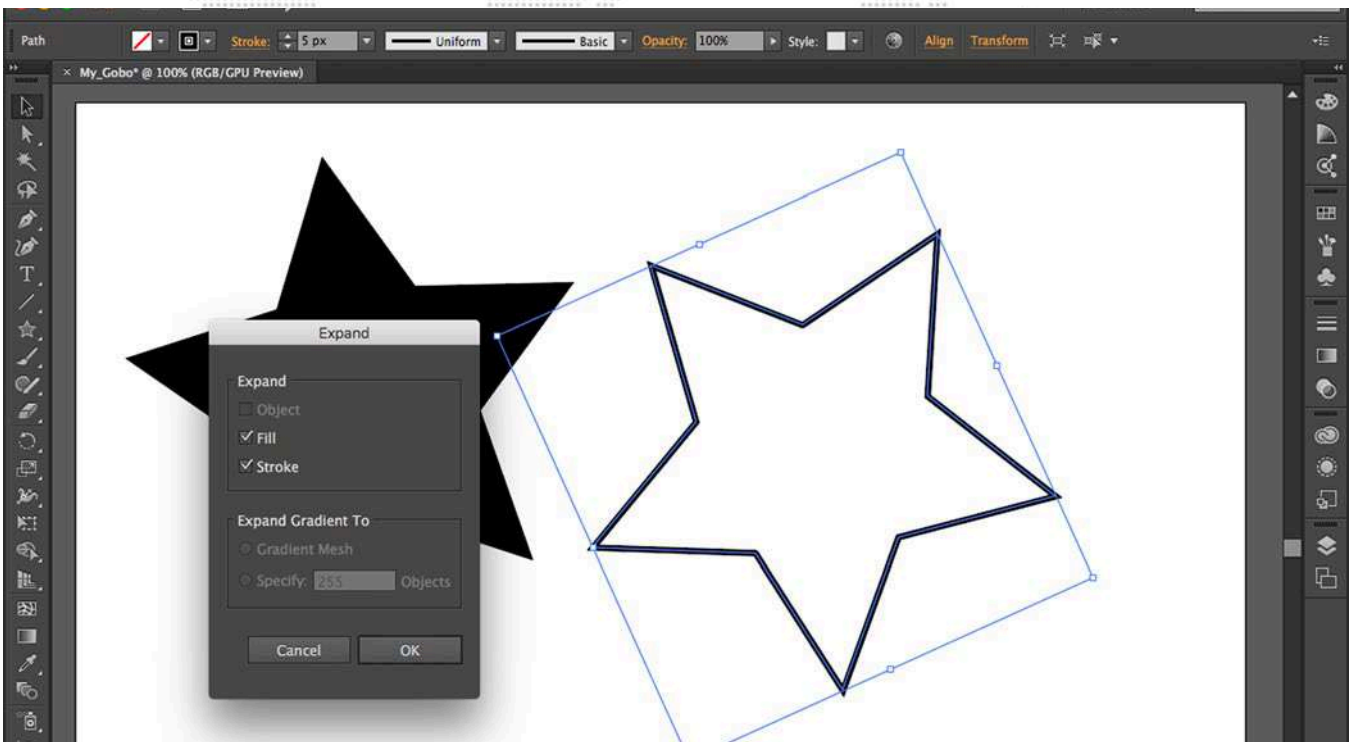
Step 2. Use the various drawing tools to compose the gobo. The most useful tools are the objects (ellipse, rectangle, polygon, or star), the paintbrush, the linear tools (line, arc, spiral), text tool, and the pencil. All of these tools, except the line tool, will create a filled object. Filled objects will be compiled as solid areas in Mbox and will be the areas that accept a texture, if one is applied.



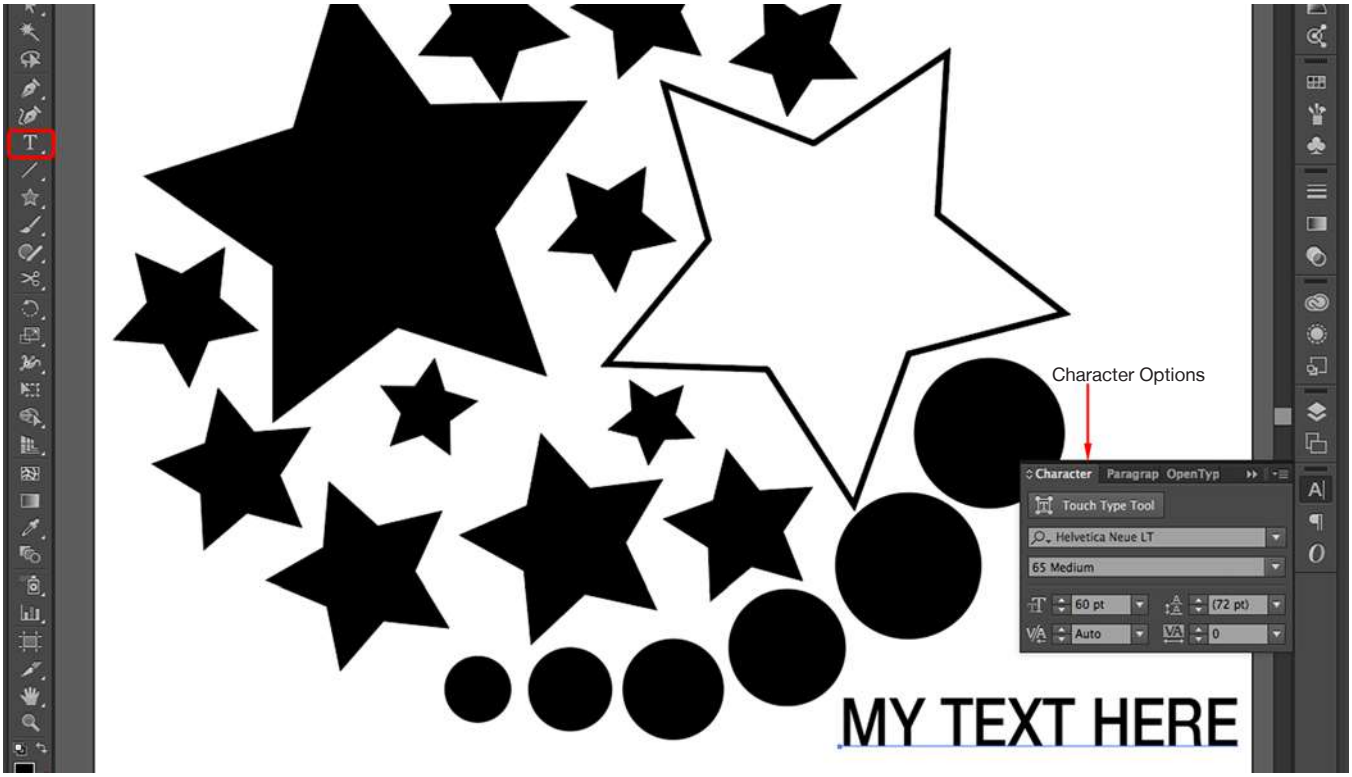
Step 3. To make an outline of an object, turn off the object's fill, adjust the thickness of its stroke, and then expand the object. To turn off the fill, select the object in question and then make sure the Fill/Stroke portion of the toolbar looks like the example below.



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.)



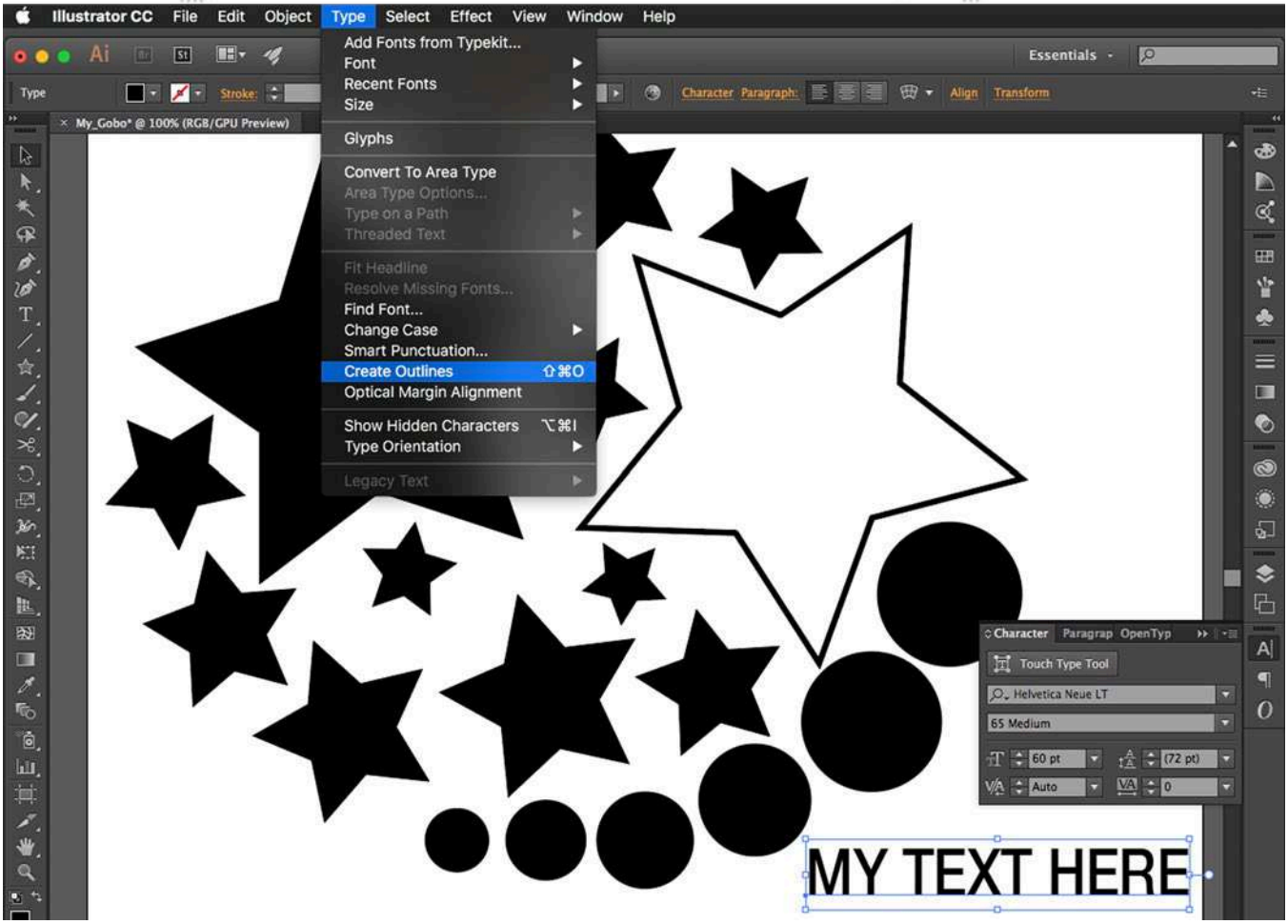
Step 5. Use the text tool to create text as desired. Use the Character options to set font and size.



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)



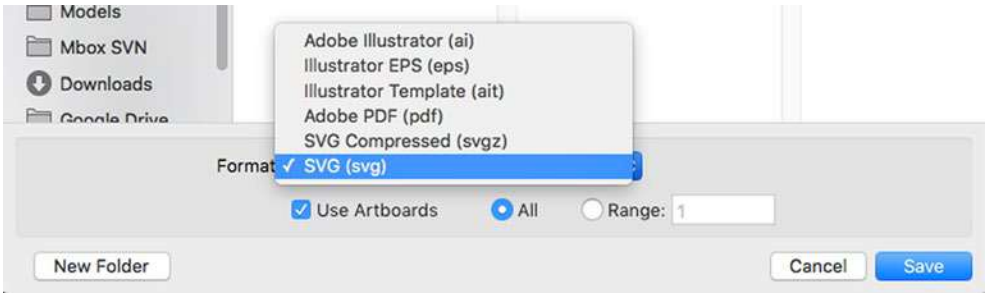
Step 7. Before saving the SVG gobo, the document’s artboard may need to be adjusted. The size of the artboard will determine whether the digital gobo will fall under Option 1 or Option 2. The texture applied to the gobo will fill the artboard when the gobo is used in Mbox. Note: It is not recommended 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.

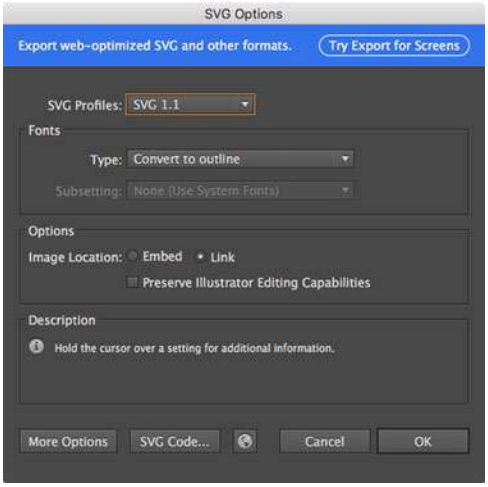
b. Option 2: If the texture should not be scaled (or scaled to a specific size), make the artboard the same size as the texture (in pixels) and arrange the objects in the file on the artboard in the desired layout.

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 shader-based effects and transitions, or to ignore the source layer's shader-based effects and transitions.

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

+ FX+ is a layer copy where the source layer sends its shader-based effects and transitions to the destination layer. The destination layer can add more shader-based effects via its own controls (allowing up to eight shader-based effects to be visible on a destination layer).
+ Raw is a layer copy where the source layer does not send its shader-based 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 may not always work as desired with transitions 250 - 255 (Object Dissolves). Care must be taken to leave the layer being copied exactly the same in both the cue fading out and the cue fading in.
+ 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 Unity or other applications on a layer within Mbox. Refer to "Syphon Video Input" on page 170 for more information about this feature.

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 some of the texture effects that use one layer's imagery to affect another's, the actual content on one layer doesn't affect other layers. But Mbox includes Layer Blending modes that allow the color or alpha values on a layer to blend with or affect the color on underlying layers.

The default "overlay" layer blend mode disables any blending, and there are fifteen 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.

The modes, their values, and descriptions are as follows. Refer to the pictures on the following page for visual examples of each mode:

+ 0 = Overlay - layer's colors completely obscure underlying color; no blending.
+ 1 = Additive - layer's colors are added to underlying colors (layer's black areas appear transparent).
+ 2 = Screen - similar to above, with less of underlying color (layer's black areas appear transparent).
+ 3 = Multiply - multiplies a layer's color with underlying color (layer's black areas appear opaque).
+ 4 = Subtractive - layer's colors are subtracted from underlying colors (layer's black areas appear transparent).
+ 5 = Exclusion - underlying colors are inverted where layer color is lighter; layer's colors are then added to underlying colors (layer's black areas appear transparent).
+ 6 = Subtractive Invert - underlying colors are subtracted from layer's colors (layer's black areas appear opaque).
+ 7 = Additive Invert - layer's colors are inverted and are added to inverse of underlying colors (layer's black areas appear semi-transparent).
+ 8 = Darken - similar to Multiply, but with brighter color from underlying layer (layer's black areas appear opaque).
+ 9 = Lighten - similar to Additive and Screen, but with better color definition from underlying layer (layer's black areas appear transparent).
+ 10 = Subtractive 2 - similar to Subtractive, but with more contrast/better color definition (layer's black areas appear transparent).
+ 11 = Subtractive Invert 2 - similar to Subtractive Invert, but with more contrast (layer's black areas appear opaque).
+ 12 = Hard Light - a combination of Screen and Multiply that enhances the brightness/color of the layer, using the underlying layer's brightness/color (layer's black areas appear opaque).

Note: The last three blend modes will only provide useful results if the layer has some portion that is transparent. This transparency can be part of the original content (alpha channel) or caused by the application of an effect on the layer (e.g. luma key effect)

+ 13 = Alpha Matte - layer's opaque areas are colored black, if layer has any transparency, those areas remain transparent.
+ 14 = Alpha Matte Invert - if layer has any transparency, then layer's opaque and transparent areas are inverted (layer's opaque areas become black).
+ 15 = Alpha Channel Off - if layer has any transparency, this is disabled (layer's transparent areas become opaque black).

Overlay (No Blend)

Additive

Screen

Multiply

Subtractive

Exclusion

Subtractive Invert

Additive Invert

Darken

Lighten

Subtractive 2

Subtractive Invert 2

Hard Light

Alpha Matte

Alpha Matte Invert

Alpha Channel Off

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'

001.Apple Script.scpt or **123.Shell Script.sh** or **201.Shell Script.command**

Scripts are considered metadata within the Mbox Content Management system. Metadata files can also 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

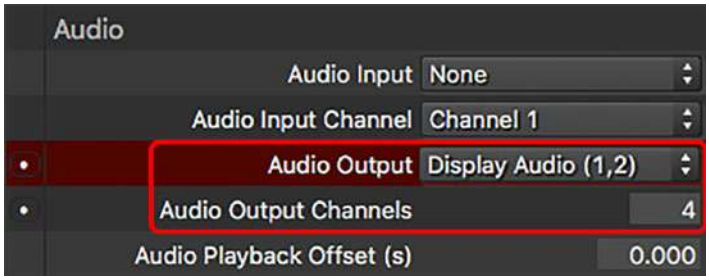
In addition to movies, still images, and 3D objects, Mbox can also play audio files. Audio can be output from the computer using any of the following interfaces or devices:

+ The current OS default output device.
+ The computer's internal speaker.
+ The computer's line out or headphone audio jacks.
+ USB 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 only 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 208)
+ 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 "MediaInfo plist" on page 47 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 must 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.

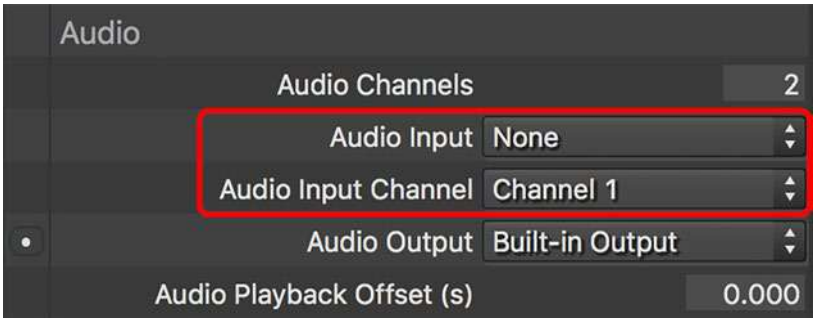
CAUTION! Beginning in 2019, Adobe apps no longer create/export QuickTime movies with embedded audio that uses AAC encoding. Because of this, the use of embedded audio with Mbox may not be possible unless an alternate movie encoding method (e.g. FFMPEG) is used, and therefore sidecar audio should be used instead.

Audio Input

In addition to be able to output audio, the Mbox application can receive audio for synchronization purposes. Mbox v5 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 transmit 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 v5. 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 “Timecode Synchronization” on page 107 for information on using the timecode input to synchronize playback.

Refer to “MboxTime” on page 113 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 106) or into the TC Reader application (explained later in this section). ArtTimeCode (Art-Net TimeCode) cab be received via a network connection. 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 is 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 a timecode sync playmode (see below) and then receive a timecode clock signal starting at 01:00:00:00.

Note: The default timecode setting can be changed on the Preferences tab of the Mbox and Mbox Remote applications. 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 57)

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. This can only happen once, and thereafter, all edits must be made in the MediaInfo.plist file.

3) Using Layer DMX Timecode Controls. (Refer to "Fixture Parameter Data" on page 208 for info on these controls)

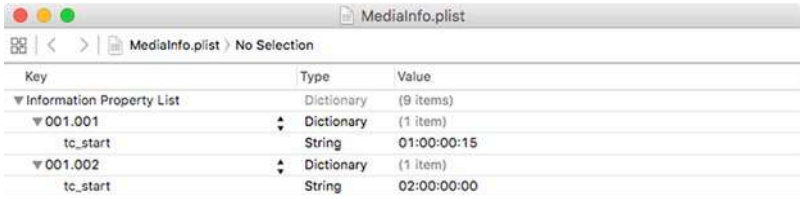
Deprecated Feature: The MediaTimeCodes.plist is deprecated and will be eliminated in a future version of Mbox.

Guidelines:

+ The MediaInfo.plist and Layer DMX controls timecode linking methods can be used at the same time. But start times generated by the Layer DMX Timecode method will override times generated by entries in the MediaInfo.plist file.
+ If a MediaTimeCodes.plist file is placed into the Mbox/Media folder, Mbox will automatically create the required entries in a MediaInfo.plist file only if no MediaInfo.plist file already exists. Otherwise no entries are created.

Linking Files to Timecode - MediaInfo.plist file

Refer to "MediaInfo plist" on page 47 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:

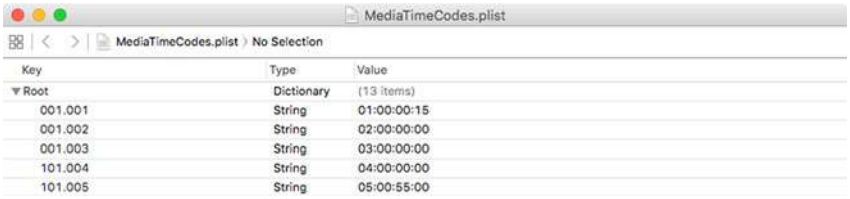


Linking Files to Timecode - MediaTimeCodes.plist file

The MediaTimeCodes.plist file can be used to create a MediaInfo.plist. This can be useful to translate an old MediaTimeCodes.plist file from Mbox v3 for use with Mbox v5. As noted above, this method is deprecated and only results in the information being copied into a new MediaInfo.plist file only if the MediaInfo.plist file 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 image to the right, 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 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 specific content using the one of the .plist methods, the timecode start time for a movie on a specific layer can be modified by using the Layer DMX Timecode parameters on each layer.

There are four Layer DMX Timecode parameters for 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 for any content on any layer.

Note: When valid, 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 these 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 playback rate. All other functions (e.g. opacity, folder, file) must still be programmed separately. If layer is set to one of the four Timecode Sync playmodes, the movie on the layer will sit, paused on its in frame until the linked start 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.

There are five Timecode Sync playmodes, each with their own benefits:

+ 130 - 132 = TC Sync Strict Lock - movie waits for appropriate timecode to start playback. If timecode stops or drops out, the movie playback stops leaving the movie paused on a visible frame.
+ 133 = TC Sync Strict Lock with Opacity Fade - as above, but layer opacity is automatically reduced to 0 when timecode stops or is not present (has not started or drops out) and increases to set level when timecode starts.
+ 135 = TC Sync then Freewheel - movie waits for appropriate timecode to start playback, and then ignores timecode for the remainder of that movie's playback.
+ 136 = TC Jam Sync - movie waits for appropriate timecode to start playback. If timecode stops or drops out, the movie freewheels. If timecode jumps by ~5 frames or returns after dropping, the movie re-syncs to the timecode.
+ 137 = TC Jam Sync with Opacity Fade - as above, but layer opacity is automatically reduced to 0 when timecode stops or is not present (has not started or drops out) and increases to set level when timecode starts.

Note: When using a timecode sync playmode on a layer, If the in frame parameter value is modified, the movie will start from the modified in frame when the linked start time is reached, rather than from the movie's first frame.

The Sync Offset parameter 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 LTC (Audio) Timecode

LTC timecode input to Mbox may be achieved in two ways. The preferred method is through a direct audio input to the Mbox computer, which can be received by the Mbox application. (Refer to "Audio Input" on page 106 for more information) LTC timecode can be also be received as a direct audio input to a computer running the TC Reader or Mbox Director application, both of which can send a network timecode stream to the Mbox application.

Receiving audio timecode directly into Mbox 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 when both applications are on the same computer. Additionally, Mbox 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 may not automatically detect timecode format and do not compensate for 29.97ndf timecode.

Receiving ArtTimeCode - Art-Net Timecode

ArtTimeCode input to Mbox is achieved through a network stream, from either hardware or software. ArtTimeCode is convenient, but may suffer from similar issues with network traffic to network timecode streams from TC Reader and Director. ArtTimeCode only explicitly supports four timecode formats: 24, 25, 29.97df, and 30.

Receiving MIDI Timecode

MIDI timecode (MTC) input is achieved through a MIDI/USB interface connected to a computer. When using a MIDI/USB interface, the TC Reader application must be used to convert the MTC to a network timecode stream, Mbox cannot directly receive MTC.

CAUTION! MIDI/USB devices may require the installation of drivers in order to work.

Setup for Timecode Input

To receive LTC directly into Mbox, follow the guidelines for audio input on page 106. If Mbox is LTC, then no other steps need be taken aside from selecting the audio interface and channel for input. However, if Mbox is receiving a network timecode stream from TC Reader, Mbox Director, or via ArtTimeCode, follow the guidelines below. Make sure to refer to "Configuring Mbox to Receive Network Timecode" on page 111.

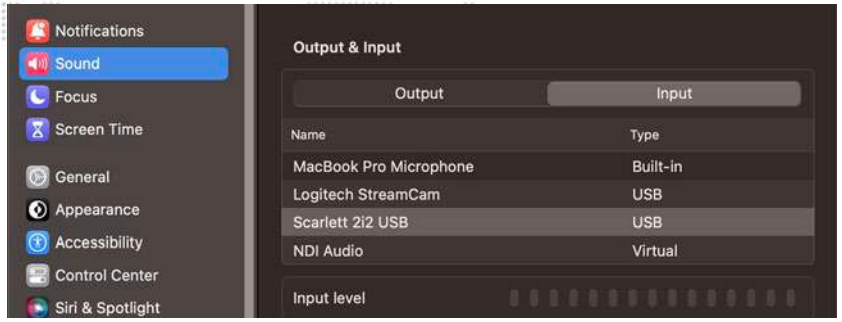
Note: Timecode input can be monitored using the [F10] Timecode HUD. Refer to "Activity/Timecode Monitoring" on page 76.

TC Reader

The TC Reader application can be used to receive timecode on either a separate computer or the Mbox computer. The TC Reader application reads the actual timecode signal (LTC or MTC) and then retransmits it over the network to the Mbox application.

When using TC Reader to receive a LTC audio signal, the computer's audio input must be configured correctly. TC Reader can only use the default audio input source on the computer as its input and allows the selection of up to eight channels from that source.

The default audio input to the computer is set in the System Settings > Sound pref pane of the computer.



CAUTION! For TC Reader, the default audio input needs to be selected before the application is launched. If changes are made to the default audio input, then the TC Reader application must be quit and relaunched.

The TC Reader application has a single window. This window displays the incoming timecode and has several settings and buttons:

+ Source – choose the appropriate source for timecode: Generator, MTC, or Audio. TC Reader has separate selections for 8 audio channels.
+ Output – Local (internal routing only), or an Ethernet interface (for sending a timecode stream to Mbox via 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/Restart – if the selected source is Generator starts generating code from Start Time value, otherwise will start listening for external timecode. When the Stop button has been pressed, pressing Restart either restarts the generator from the Start Time value or starts listening for external timecode once again.
+ Stop/Resume – stops/resumes generating timecode or listening for external code. Generated timecode does not restart from the Start Time value but instead continues from the current value.
+ Start – specifies a time where the internal timecode generator will start.
+ End – specifies a time where the timecode 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 timecode data via Ethernet, a timecode source can be connected to any computer and then retransmitted to one or more networked Mbox computers.
+ 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 "TC Reader v3.x 29.97ndf" on page 57)

+ For receiving timecode for show purposes, the use of LTC directly into the Mbox application (as an audio input) is always 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 LTC 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 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.

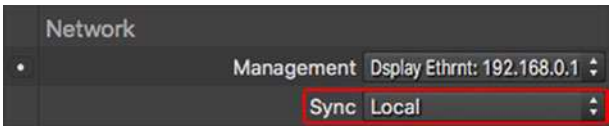
Mbox Director

The Mbox Director application can send a network timecode stream to Mbox. Refer to the Mbox Director manual for information on the output of network timecode from Director.

Configuring Mbox to Receive Network Timecode

ArtTimeCode can be received on any network interface and no interface needs to be selected in advance. But when receiving network timecode from either TC Reader or Mbox Director, Mbox must be told which Ethernet interface is being used for the timecode stream.

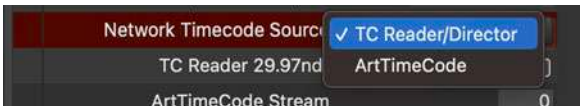
The Network section of the Mbox application's Preferences tab can be used to select the interface for receiving timecode. Use the Sync pop-up to select the interface. Only currently connected interfaces will be shown in the pop-up menu.



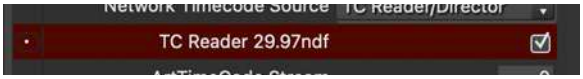
To receive network timecode, Mbox must be told to ignore audio input for timecode. To do this, go to the Audio Input pop-up in the Audio section of the Mbox application's Preferences tab, and select the option for "None."

Additional settings for network timecode are found in the Playback section of the Mbox application's Preferences tab:

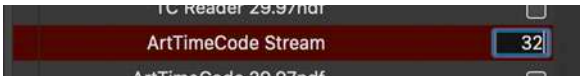
+ Network Timecode Source - select either TC Reader/Director or ArtTimeCode as the source.



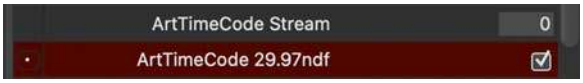
+ TC Reader 29.97ndf - enables compensation in Mbox when the TC Reader application is receiving 29.97ndf timecode.



+ ArtTimeCode Stream - set the ArtTimeCode stream to listen to, using values 0 - 255. 0 is the default.



+ ArtTimeCode 29.97ndf - enables compensation in Mbox when the ArtTimeCode source is sending a stream that has been marked as 29.97 drop frame, but where the stream does not skip the required frame numbers as normally dictated by the timecode specification for 29.97df.



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 same numbered layer on another 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 "MboxTime" on page 113 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 through 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 same 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 Sync 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 v5 software, the Mbox v3 software must be the sender of the sync. Mbox v3 will not respond to layer sync sent from Mbox v5. Mbox v4 and Mbox v5 use the same sync protocol and therefore the sender and receiver versions do not matter.

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 "Configuring Mbox to Receive Network Timecode" on page 111.

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.

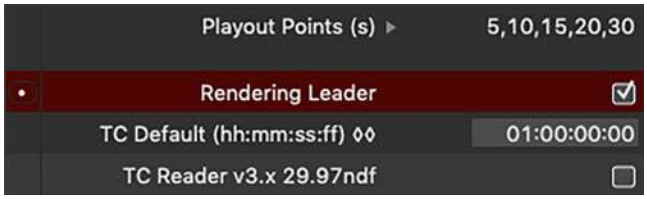
MboxTime

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 Director or layer sync streams from Mbox, but is intended to be used with some form of playback sync.

Guidelines:

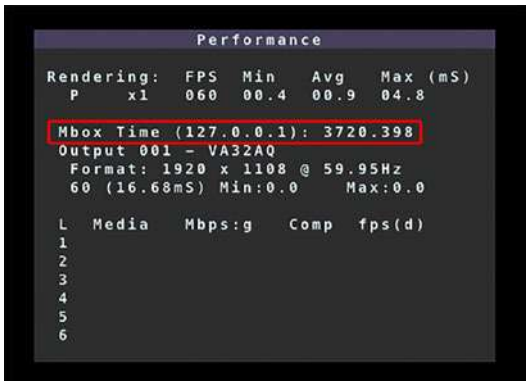
+ All Mbox servers must receive only one MboxTime reference, from a single source, whether it is timecode or network-based.
+ When MboxTime is used, Mbox servers MUST use a synchronization playmode - layer sync or timecode sync, otherwise the MboxTime reference will be ignored because no attempt is being 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 must 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.

Mbox Network Clock

  - 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.
  - 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.

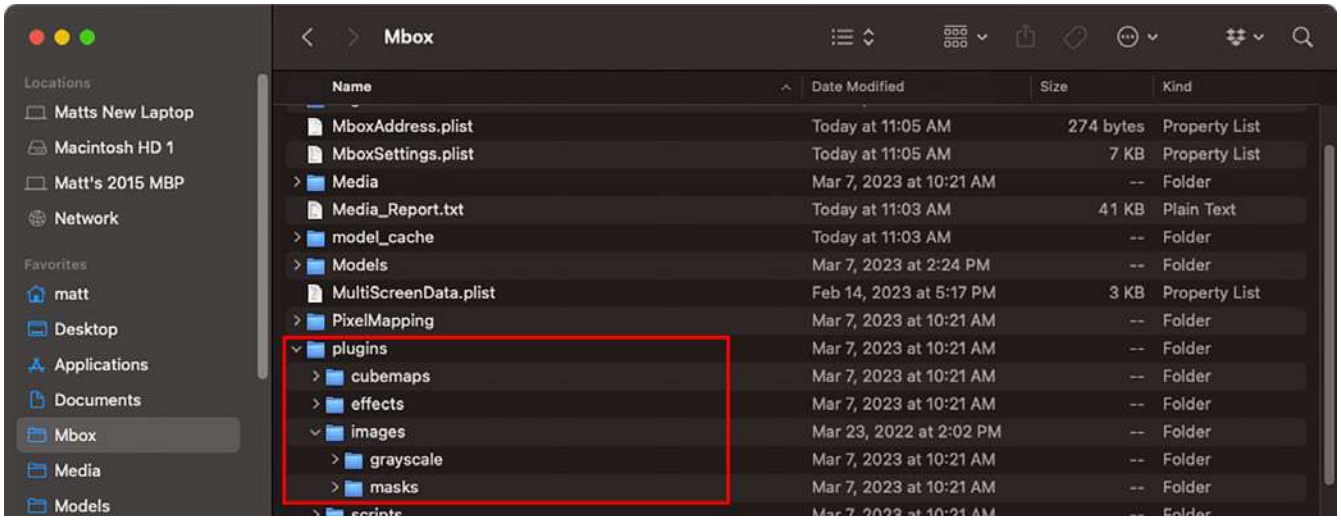
+ When using MboxTime from either a SMPTE source or the Mbox Network Clock application, it is possible to check that the Mbox application is receiving MboxTime by bringing up the [F9] HUD. The MboxTime value and type (Network or LTC) will be reported in the HUD:



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/
+ Bayer Dither Effect - Mbox/plugins/images/masks/



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 Xcode or one of several commercially available property list editing applications can be used. Changing the file extension to ".plist" temporarily may be required in order to be able to open the file.

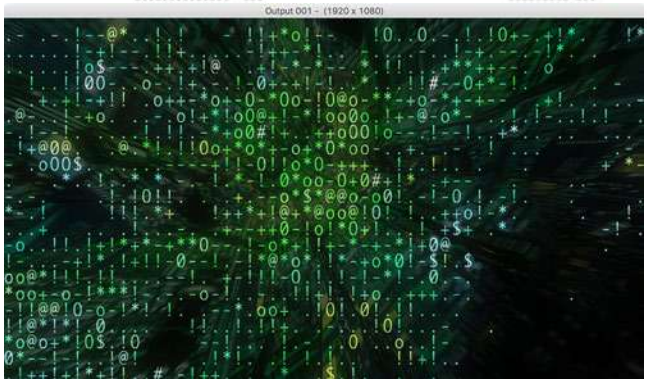
This is what the data in the txfx file looks like:

Key	Type	Value
Root	Dictionary	(4 items)
Filter Name	String	ME_ASCII_Art
Parameters	Dictionary	(6 items)
inputImage	Dictionary	(1 item)
ImageIn	Number	0
inputMixer	Dictionary	(1 item)
Channel	Dictionary	(3 items)
Max	Number	1
Min	Number	0
Number	Number	0
inputScale	Dictionary	(1 item)
Channel	Dictionary	(3 items)
Max	Number	100
Min	Number	1
Number	Number	1
inputColour	Dictionary	(1 item)
Channel	Dictionary	(3 items)
Max	Number	1
Min	Number	0
Number	Number	2
inputString	Dictionary	(1 item)
String	String	.0123456789
outputImage	Dictionary	(1 item)
ImageOut	Number	1
Thumbnail	Data	<FFD8FFE000104A46494600010101004800
UserVisibleName	String	ASCII Art

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.

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. "201.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 pre-existing 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

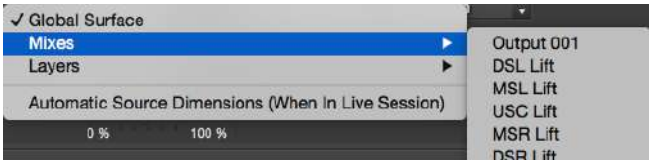
Pixel Mapping is an advanced Mbox feature that allows mapping of specific functions of sACN, Color Kinetics KiNET, or Art-Net-controlled fixtures (RGB, Intensity, CMY, etc.) to each of the pixels in the composite video image that Mbox creates. Pixel mapping data is generated from the onscreen imagery 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 was enhanced over that in Mbox v3 in that individual contexts could use different sources for their sampling. In Mbox v3, 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) were available to be a source for sampling. Mbox v5 uses the same engine as Mbox v4 - with the addition of the Global Surface and Mixes - and therefore the pixel mapping engine can use a variety of sources: the Global Surface, Mixes (which include outputs), and Layers.

Each context 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 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 certain cases, the sources for pixel mapping in Mbox may change size, and that change in size may affect the sampling for pixel mapping. While the result of pixel mapping can change if the source size changes, enabling the auto resize option still means that there will always be a result, rather than no output.

When pixel mapping sources change size, they typically change size because they have been intentionally reconfigured. e.g. the Global Surface is resized to accommodate an additional output or a different layout. Resizing of the Global Surface, outputs, and mixes is always user-initiated. However, 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 one 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 significantly. 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.

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 170 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 100 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.

Starting with Mbox v4.4, additional capability was 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

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.

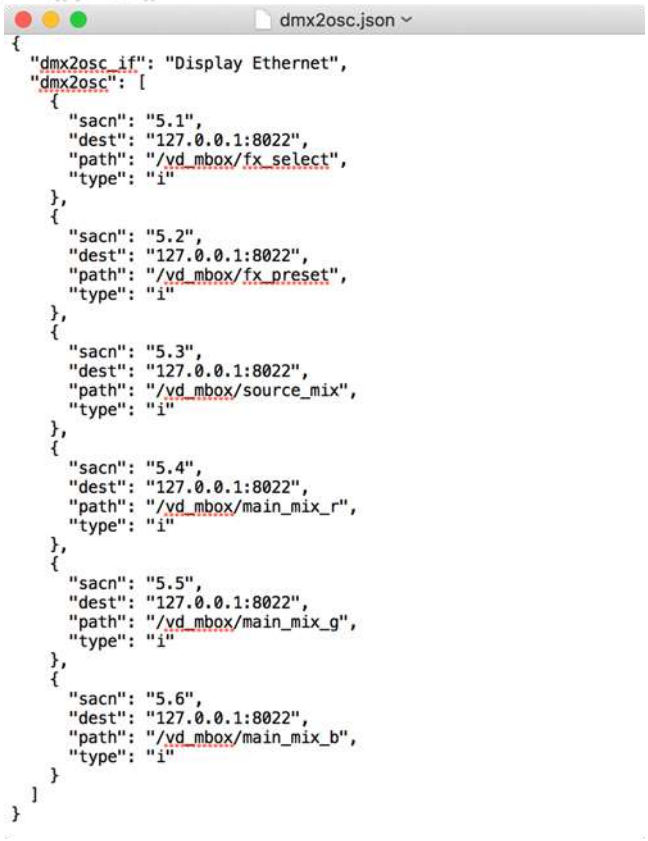
WARNING! If there is a dmx2osc.json file found when the Mbox application launches, it will always be read and used. If matching universe and address control data is received, then the conversion to OSC will always happen and OSC data will be output. There are two ways to stop this: a. quit Mbox, remove 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.



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

OSC HEARTBEAT

Overview

The OSC protocol allows messages to be sent between devices that can send and receive OSC. Starting with Mbox v5.2, the Mbox application can send a simple “heartbeat” message via OSC. This message can be used by a receiver to know that the Mbox application is online and functioning.

When enabled, the heartbeat message is sent continuously at one-second intervals.

Configuration

The OSC Heartbeat functionality is enabled using two preferences on the Mbox applications’ Preferences tab:

+ **OSC Heartbeat:** enables the output of the heartbeat message.
+ **OSC Heartbeat Dest:** sets the destination IP address and port for the heartbeat message. The default IP address is “127.0.0.1” and the default port is “8001”.

The appropriate destination IP address and port will depend on the configuration of the network and configuration of the device intended to receive the heartbeat message.

WARNING! The default IP address means that the OSC heartbeat message is only routed internally and will never leave the computer! When a non-local IP address is used, Mbox routes the OSC messages via the first network interface that has a compatible network configuration (IP and subnet mask). If no interface is configured to be on the same subnet as the intended receiver, the heartbeat message may not be transmitted.

Message Formatting

The OSC Heartbeat message has a simple structure, with three components:

1) A string value with the Mbox computer’s User Defined Name (if one has been set) or the computer’s share name.
2) A string value with the current time (in 24-hour format) and timezone
3) An integer value of “1”.

These three values can be used by a receiver as part of a simple check for the presence of a specific Mbox application being both online and active. It is up to the receiver to determine how to process and use this data appropriately.

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5.

IMAGE REMAPPING

This chapter provides instructions for the Mbox image remapping feature.

+ IMAGE REMAPPING
+ IMAGE REMAPPING QUICK SCREENS BUILDER
+ TRIANGLE-BASED SCREEN OBJECTS
+ IMPORT AND EXPORT FOR IMAGE REMAPPING
+ SCREEN OBJECT CONTROLS
+ IMAGE REMAPPING TUTORIAL
+ SCREEN OBJECT CONTROL GLOSSARY

IMAGE REMAPPING

Overview

The Image Remapping functionality of the Mbox software allows the creation of one or more configurations of two-dimensional “screen objects” that may be used to reposition, copy, or otherwise alter pixels on a layer, while keeping everything absolutely pixel-accurate. Screen objects within a configuration receive the texture provided by 2D content applied to the layer. Each screen object can have control parameters added, allowing for further, live 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 used by Mbox (Mbox/MultiScreenData.plist) can hold up to 255 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: An Mbox Designer license allows 255 Image Remapping configurations, Studio+ 16, Studio 8, and Mini 4.

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.

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. Any image remapping .plist file can be opened for editing, but the file that the Mbox application uses must be called MultiScreenData.plist and must be located in the Mbox content folder.

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 "Network Interfaces for Mbox" on page 80 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 from the Mbox application on that computer 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.

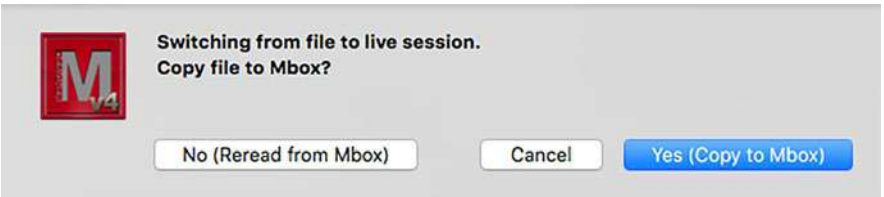
Step 4. Edit the data as desired, all edits will automatically be saved to the default Mbox/MultiScreenData.plist file. The data can also be manually saved to a file on disk other than the default by using the file save-as option.

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, or multiple instances of Mbox Remote, open with both applications editing the image remapping data. **This is strongly discouraged and may cause the loss of data!** If both applications are in a live session, changes made to the data in one should immediately be reflected in the other, but if both are editing the same element, changes may be lost. If one application is editing the MultiScreenData.plist file in file mode, those changes will not be reflected in the other application. If the application in file mode then switches to a live session and copies data to Mbox, any changes made by the other application will be lost!

Image Remap Automatic Backup Preference

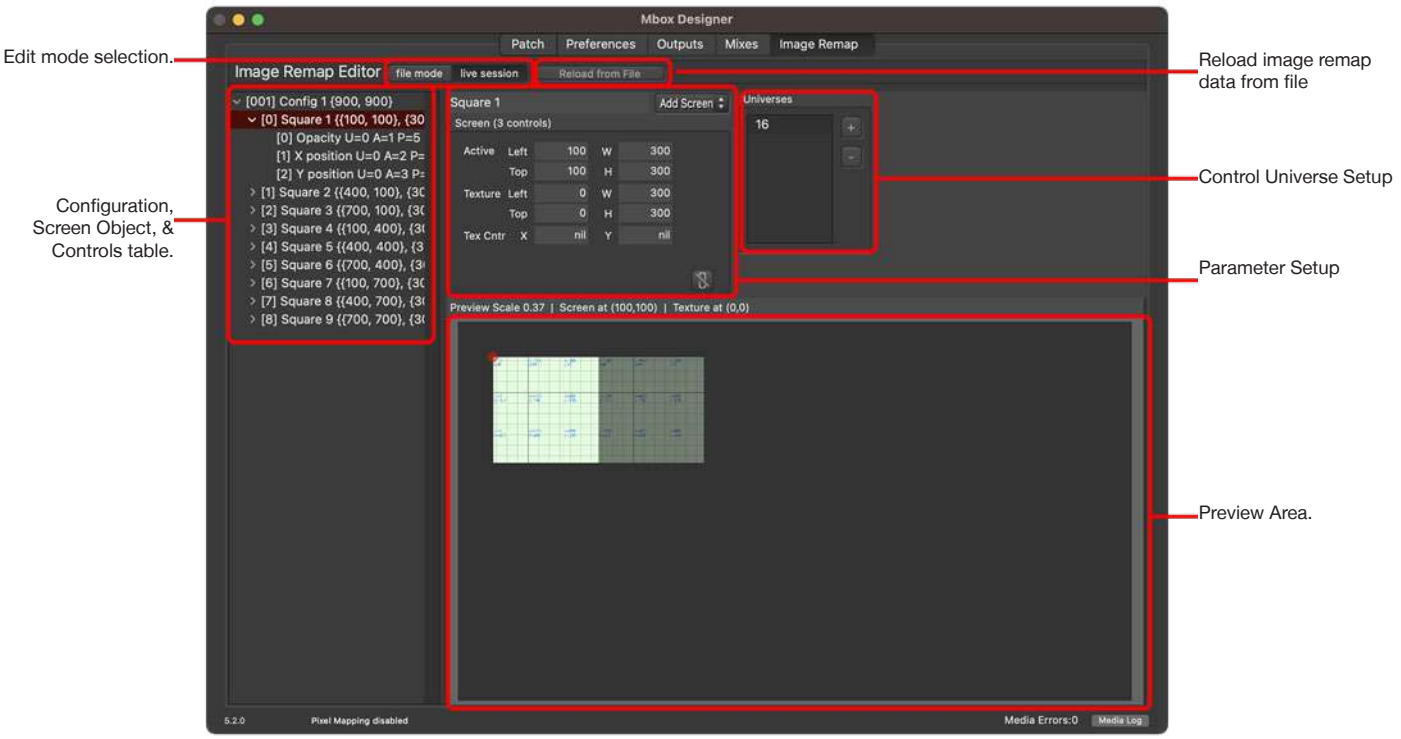
When this preference is enabled (on Mbox's Preferences tab), Mbox automatically saves backup copies of the current image remapping file (the MultiScreenData.plist file) in the /Applications/Mbox/archive/Image Remap Backups folder. New backup copies are made at one minute intervals if the image remapping data has changed since the last backup. Up to sixty (60) backups will be made and once the total reaches 60, the oldest backup copy will be deleted each time a new backup is made. The names of backup files are given a prefix with the date and time they were made.

Restoring an image remapping backup file requires the Mbox application to be quit and the backup file manually renamed (as MultiScreenData.plist) and put in place of the current /Applications/Mbox/MultiScreenData.plist file.

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 configurations, their screen objects, and controls 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 > Set Background Image menu item, and then selecting a JPEG or PNG image file. PNG background images support transparency.

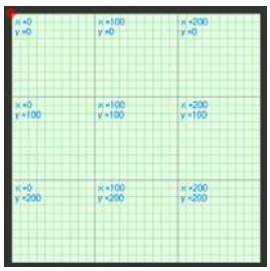


The information shown in the parameter setup area above the preview area will change depending on what type of item is selected in the table at the left:

+ 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. This value should not be changed.
+ 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.

Preview Area

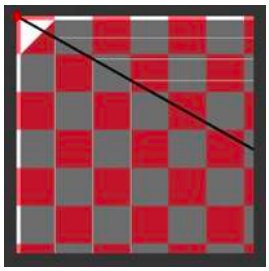
The preview area below the parameter setup area is used to show a preview of the screen objects in the current configuration. These screen objects are drawn on a dark gray background that represents Mbox's Global Surface. In order for the preview be displayed using the correct aspect ratio, the configuration's Global Surface size parameters must be edited to match those of Mbox itself.



Screen objects are represented by polygonal shapes on the background. When first added, all screen objects are rectangular, but can be edited to be triangle-based. All screen objects show a gridded and labeled representation of graph paper as their texture, with major divisions at 100 pixel intervals, minor divisions at 10 pixel intervals, and coordinate labels at the intersection of major divisions.

When a configuration is selected in the configuration table, all screen objects for that configuration will be highlighted in the preview area. When a screen object is selected in the table, only that screen object will be highlighted. Individually-highlighted screen objects show a red diamond on their origin if a standard rectangular object or their first vertex if a triangle-based vertex array object.

Either menu commands or keyboard shortcuts can be used to zoom/scale the preview, the entire preview can be moved by clicking and dragging anywhere within its frame. The scale of the preview is shown above the frame, with a scale of 1.00 meaning that the preview is being drawn pixel accurately.



The preview area can apply a static background image as the texture on all screen object, in place of the graph paper image. Menu items to set a background image or remove one (if set) can be found in the Image Remap menu. Background images can be either JPEG or PNG images. For the most accurate representation when configuring image remapping, the background image size should match that of the configuration's Texture size. This may necessitate loading different background images when editing configurations that have differing Texture sizes. Failure to use an image of correct size will result in an x/y offset to the background image when shown on screen objects in the preview area.

Creating/Adding Configurations and Screen Objects

When first used (i.e. no pre-existing data), the image remapping interface will show only one default configuration, which will have no screen objects. Up to 255 configurations may be added, and each configuration may have one or more screen objects.

To add a configuration:

Step 1. In the configuration table, either select an existing configuration or click on the empty area below all existing configurations to deselect the current selection.

Step 2. Click on the pop-up button labeled "Add Cnfg..." in the Parameter Setup area and select the option "Add Configuration."

To add a screen object:

Step 1. In the configuration table, select the existing configuration to add the screen object to.

Step 2. Click on the pop-up button labeled "Add Cnfg..." in the Parameter Setup area and select the option "Add Screen."

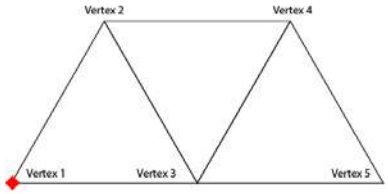
Screen Object Types

There are three types of screen objects that can be created for use with image remapping: rectangles, triangle strips, and triangle fans. Rectangles are simpler, orthogonal constructs that cover the majority of image remapping needs. Triangle-based screen objects can be used to create non-rectangular polygonal shapes such as triangles and irregular shapes. Every screen object added using the standard UI in Mbox and Mbox Remote begins as a rectangle and may then be converted into either a triangle strip or a triangle fan.

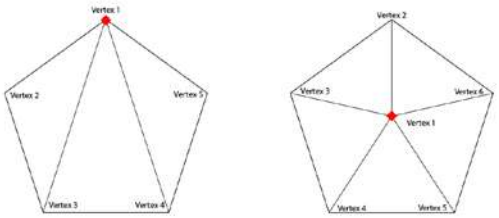
WARNING! Once a screen object has been converted from one type to another, it cannot be converted again, or returned to its original type

Rectangle:

Triangle Strip:



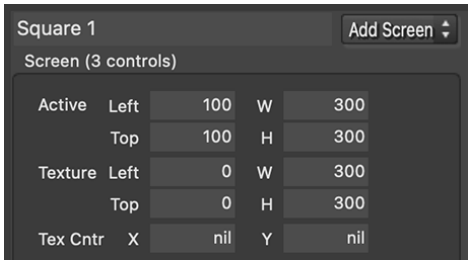
Triangle Fan:



Note: Triangle strips and triangle fans are covered in more detail later in this section (refer to "Triangle-based Screen Objects" on page 137 for more information).

Screen Object Parameters

Image remapping configurations are made up of screen objects. The simplest of the screen object types, the rectangle, has parameters that define where on the Global Surface it will be drawn, what portion of the layer's imagery it gets textured with, and optionally, a center point for that imagery - used when the texture on the screen object is rotated via screen object controls. More complex screen objects use parameters that define rotational centers. The available parameters are split into three categories: Active, Texture, and Rotational Center.



Active parameters define the location and size of the screen object on the Global Surface. The Left and Top values define the origin of the screen object, 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 that location on any output; the offset between output and Global Surface must be factored in.

Texture parameters define how a layer's texture gets applied to the screen object. 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 fit onto the screen object.

Note: If every Texture parameter uses the same value as the corresponding Active parameter there will be a one-to-one relationship between the screen object's coordinates/scale and those of the texture being applied.

Screen Object Rotational Center Parameters

Screen objects have parameters for Texture Center that are used when texture rotation is applied via screen object controls. A screen object's Texture Center defines the point in the layer's texture that the texture will rotate around if a Tex Rotate control (refer to "Screen Object Control Types" on page 162) is used. Triangle-based screen objects (refer to "Triangle-Based Screen Objects" on page 137 for more information) add parameters for Position Center - which define the point on the Global Surface that the entire screen object rotates around if the X, Y, or Z Rotate controls are used.

By default, both parameters in each pair are shown with a value "nil," which is not the same as a value of "0". Both values remain nil until *either* value is edited, at which point the unedited value is given a value of 0. If both parameters have non-nil values and *either* value in the pair is edited and set to nil, both values are set to nil. Nil values are treated in the following manner:

+ **Texture Center** - The texture applied to the screen object rotates around the point in the texture at the center of the screen object. This is not the center of the texture if the texture and the screen object are not the same size.
+ **Position Center** - The entire screen object rotates around its first vertex. If the screen object is a triangle strip, the first vertex is usually the top-left corner. If the screen object is triangle fan, this vertex may be the center of the screen object or a vertex on its perimeter.

The interaction between these X/Y center values means that when editing these values, both values should be edited at the same time. And if any value is intended to be "0" then that needs to be explicitly entered.

CAUTION! Once either of these paired center parameters has been modified from their default nil values, their values can be returned to nil by typing "nil" into either of the values in the pair.

Note: It is possible to enter a numerical value that is equivalent to nil, such that the screen object or texture rotates around the default point as mentioned above. 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.

Editing Screen Object Parameter Values

All screen object parameters use numerical values, and these values are measured in pixels. Keep in mind that while some parameters refer to pixels on the Global Surface and some to pixels in the texture provided by a layer, as long as no scaling is taking place on the layer, one pixel in the texture is the same as one pixel on the Global Surface.

To edit screen object parameter values:

+ Click on the value to be adjusted and enter a new value. Press [tab] or [return] to apply the new value.
+ With the cursor hovering over the textfield that holds the value to be edited, hold down [⌘] on the keyboard and scroll the mouse or trackpad up or down to adjust the value. Hold down [shift] to speed up or [option] to slow down.
+ In the main menu bar for the Mbox and Remote applications, under the Image Remap item, there are two menu items: "Copy Active to Texture" and "Copy Texture to Active." These menu items will copy all of the screen object's active parameters to the texture parameters, and vice-versa.

Note: While there is no significant benefit for values measured in pixels to have accuracy beyond one decimal place, the fields for these parameters do allow float values - digits after a decimal point. To keep the values shown in the UI's text fields to a reasonable length, all float values are rounded to one decimal place and tinted yellow to indicate the rounding. The actual values applied when rendering happens do retain their level of accuracy.

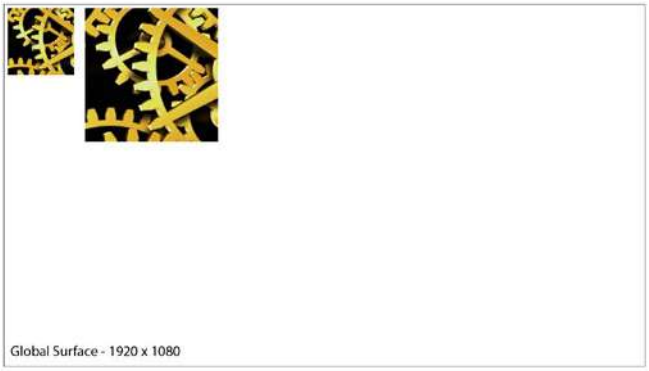
When editing individual active and texture parameter values, it may be desirable to change one active/texture value and also make its corresponding texture/active value identical. The link button at the bottom of the screen object parameter setup area can used to cause all single-value edits to be copied to the corresponding parameter. The button has two states: Linked: and Unlinked:

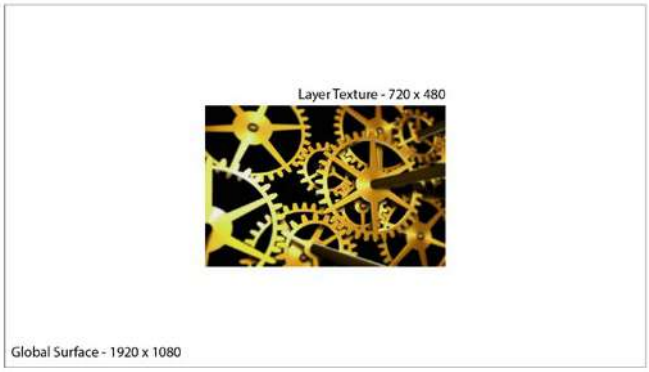
Example: Setting screen object parameter values to obtain the desired result:

When image remapping is used, the intended result is typically to either move/copy some subset of pixels from a position in the layer's texture to a place on the Global Surface where they wouldn't appear normally, and/or to scale those pixels when that move/copy operation happens. This typical usage requires knowledge and planning to determine which pixels in a texture need to be copied/moved, where to copy/move them to, and whether the scale needs to be adjusted based on many factors.

When screen object parameters are edited, the values edited are used to create a "formula" that results in the copy/move of pixels from texture onto the Global Surface, with scaling if desired. The following example shows a combination of copying, moving, and scaling pixels from a layer's texture to the intended arrangement on the Global Surface. While this example uses simple rectangle screen objects, the concept applies to all screen objects.

Setup: Mbox is configured with a Global Surface size of 1920 x 1080 and a piece of content that is 720 x 480 is applied to a layer. Without using image remapping or making any other adjustments to the layer, the layer's texture will appear in the center of the Global Surface.





Desired Result: Rather than showing all of the content in the center of the Global Surface, the intention is to show two identical portions of it, side-by-side, near the top-left of the Global Surface, and to scale the imagery in the second portion to be twice the size of that in the first portion.

While it would be possible to use two layers playing the same content and some combination of layer parameter adjustment or mixes to get this result, the use of image remapping allows this to happen on one layer, with pixel-accurate positioning and scaling. To achieve this result two screen objects would need to be created, and given screen object parameter values like this:

	Active Left	Active Top	Active Width	Active Height	Texture Left	Texture Top	Texture Width	Texture Height
Screen Object 1	10	10	200	200	260	140	200	200
Screen Object 2	250	10	400	400	260	140	200	200

+ Screen Object 1's Active Width and Height cause it to be drawn at a size of 200 x 200 on the Global Surface.
+ Screen Object 2's Active Width and Height cause it to be drawn at a size of 400 x 400 on the Global Surface, twice the size of Screen Object 1.
+ The screen objects use identical Texture parameter values, thereby causing both to show the same identical portion of imagery from the source texture.
+ Because the Active width and height values for Screen Object 1 are the same as its Texture width and height values, this screen object shows the imagery at normal size.
+ But because the Active width and height values for Screen Object 2 are double its Texture width and height values, this screen object shows the imagery at twice normal size.

IMAGE REMAPPING QUICK SCREENS BUILDER

Overview

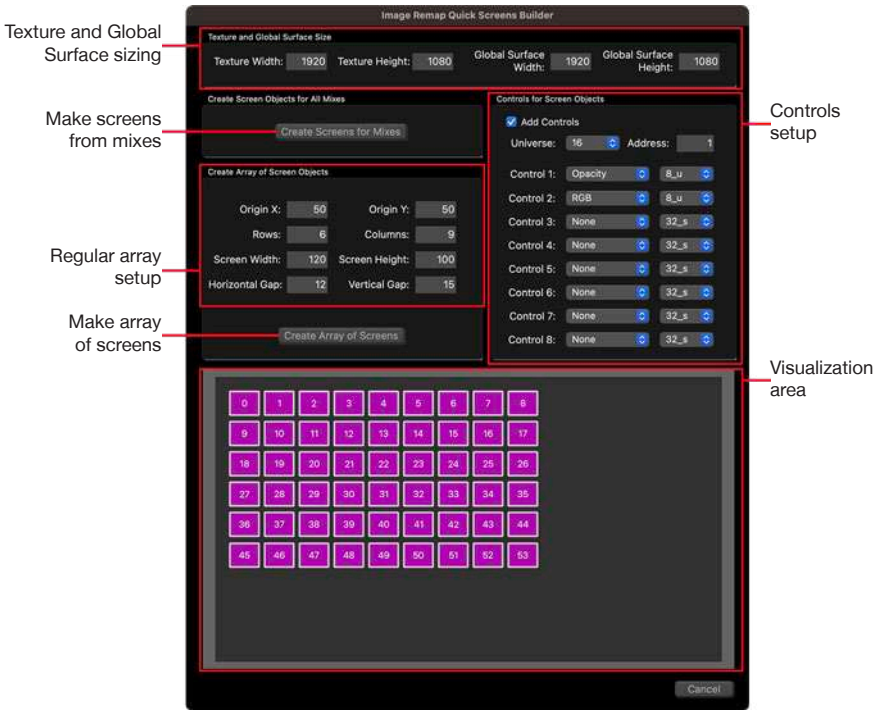
The Image Remapping editor provides a convenient way to quickly create a new image remapping configuration with screen objects for either all current outputs and mixes, or a regular array of screen objects. The Quick Screens Builder can be opened by selecting the “Quick Screens Builder” item from the Image Remap menu. The dialog allows the configurations texture and global surface sizes to be adjusted, and for controls to be added to the screens that are created. The new configuration will be placed after the currently-selected configuration or at the end of the configuration list.

When first opened, the Texture and Global Surface Width and Height parameters will be pre-filled with values that match those for the currently-selected configuration, or the first configuration if none is selected. These values can be edited as required.

Making screens for all current outputs and mixes is simple, and only requires the “Create Screens for Mixes” button to be pressed. Making a regular array of screens requires setting up that array - origin, rows, columns, etc. - and then pressing the “Create Array of Screens” button.

The visualization area at the bottom of the dialog shows the current arrangement for the array. For regular arrays, the screens are ordered in row-major order and will be labeled with their index (if large enough).

Whether making screens for mixes or as a regular array, an identical set of controls can be added to every screen that is created. This feature is enabled by checking the “Add Controls” checkbox. Up to eight separate controls may be added to each screen - their parameter and format must be set using the pop-ups. Controls will be patched sequentially, using the selected universe and start address, starting with the first screen.



Note: The available universes for controls are taken from the universe table in the main image remapping editor’s UI. Universes must be added there first in order to be available in the Quick Screens Builder dialog. If adding controls exceeds the number of addresses in that universe, the next universe in the universe table will be used, or “no universe” should there be no subsequent universes in the table.

Screens and their configuration are not added to Mbox and to its image remapping file until either the “Create Screens for Mixes” or “Create Array of Screens” buttons are pressed. At this time, the dialog will close and the new configuration will be added. Pressing the “Cancel” button will close the dialog without adding a new configuration.

TRIANGLE-BASED SCREEN OBJECTS (VERTEX ARRAYS)

Overview

Triangle Strips and Triangle Fans allow the creation of image remapping screen objects with more-complex shapes, and limited 3D functionality - X and Y rotation of the screen object. In order to support non-rectangular shapes, rectangle screen objects must be converted to triangle strip or triangle fan screen objects. Standard rectangle screen objects are referenced by their origin and their width and height. Triangle strips and fans are referenced by their vertices.

To convert a rectangle screen object to a triangle strip or fan, select the screen object in the configuration table, then click on the “Add Cnfg...” button at the top-right of the parameter setup area and select “Convert to Strip” or “Convert to Fan” from the list.

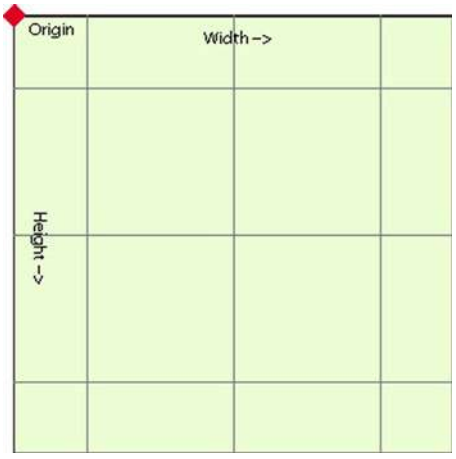
CAUTION! Once a screen object has been converted to a triangle strip or triangle fan, the change cannot be undone. To revert to a non triangle-based screen object, create a new screen object with the original properties of the object, then delete the triangle strip or fan version of the object.

The use of triangle-based screen objects goes beyond typical rectangle screen objects and can be confusing. If unsure about how to use these features, please contact Mbox Support for assistance.

Triangle Strips

Triangle strips are the simpler of the two triangle-based screen objects. A standard rectangle screen object converted into a triangle strip becomes a screen object comprised of two triangles, placed side by side. The conversion results in the creation of four vertices, one for each corner of the triangle strip screen object. These vertices and their respective parameters replace the Active and Texture parameters of a standard rectangle screen object.

The two illustrations below show the layout of a standard rectangular screen object on the left and the result when it is converted to a triangle strip screen object on the right:

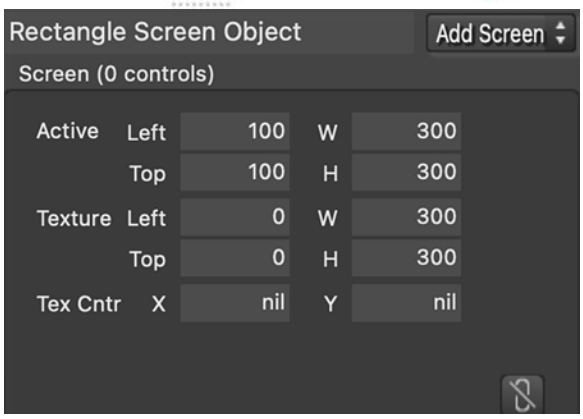


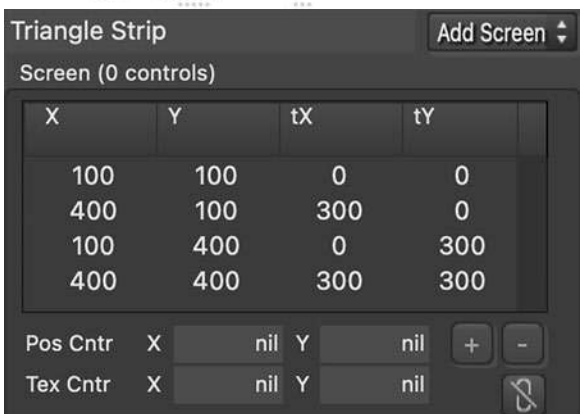
Rectangular Screen Object

Equivalent Triangle Strip Screen Object

A rectangle screen object only requires one pair of coordinates, the “top” and “left” parameters that specify the active and texture origins. The remaining active/texture coordinates for the rectangle’s other three corners are implied by its width and height parameters. The equivalent triangle strip object has four vertices, one for each corner. Each vertex has both active and texture coordinates. Active coordinates are labeled as “X” and “Y” and locate the vertex’s position on the Global Surface. Texture coordinates are labeled as “tX” and “tY” and are used to define the specific point in the layer’s texture that will be pinned to the vertex.

When a rectangle screen object is converted to a triangle strip, the converted screen object will have an array of exactly four vertices which are used to define two adjacent triangles. 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. The vertex data in that array is shown in a specific order which may not be a naturally clockwise or counter-clockwise order. The converted screen object retains the Texture Center parameters and adds the Position Center parameters.





The four vertices of this triangle strip are not ordered in a circular fashion around the perimeter the overall rectangle, but are ordered such that each triplet of three consecutive vertices describes a closed triangle. In the right-hand illustration on the previous page, the first, second, and third vertices create the first triangle, and the second, third, and fourth vertices create the second triangle. The two triangles share vertices - in this case the second and third vertices.

Editing the X and Y coordinates of each vertex in the table modifies the position, shape, and size of the triangles on the Global Surface. Editing the tX and tY coordinates adjusts the texture mapping to the corresponding vertices. 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.

CAUTION! Be careful when adjusting the tX and tY coordinates with triangle-based screen objects, as improper values will cause the texture to be distorted! The nature of the triangles means that the edges between triangles may become apparent if texture coordinate values are incorrect.

As with standard, rectangle screen objects, the Texture Center 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.

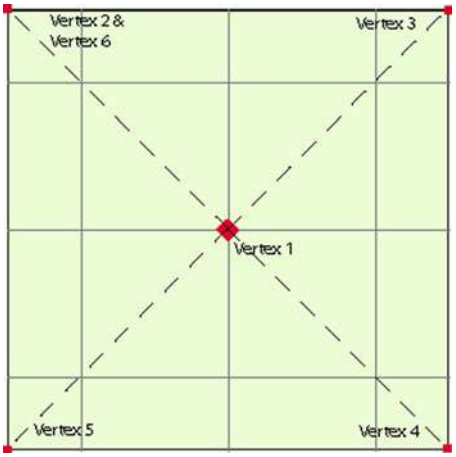
The Position Center coordinates are used to adjust the rotational center of the screen object itself, which is taken into account when X/Y/Z Rotation controls are used. Position Center is not available with the standard, rectangular screen objects, and the object must be converted to a triangle strip or fan to take advantage of it. By default, all triangle-based screen objects rotate around their first vertex. This is the top-left corner of a Triangle Strip object, and can be any point (but often the center point) of a Triangle Fan object. Modifying the Position Center values allows that rotational center to be moved.

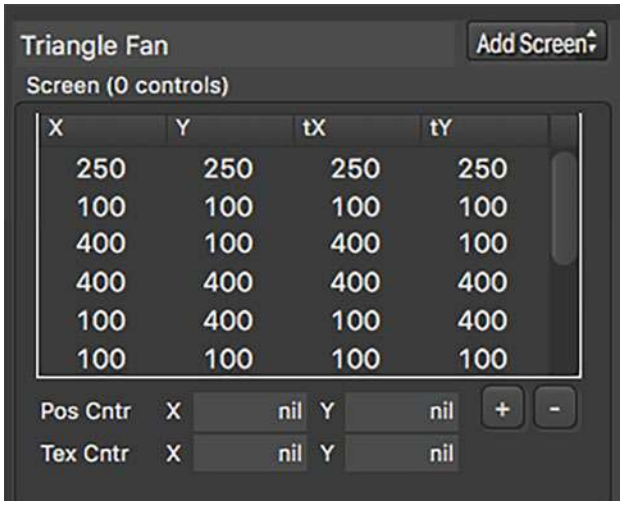
When a triangle-based screen object is created, the Position Center X and Y values will be noted as being “nil.” This means that they are defaulted to the first vertex’s coordinates. Once either of these coordinates has been modified from the default “nil” values, those values can only be returned to 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 actual coordinates of the 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 - triangle or polygons. Each vertex that is added will cause a new triangle to be created.

Triangle Fans

Triangle Fan screen objects are similar to triangle strip objects in that they can create a shape by creating vertices from a rectangle screen object, and are a combination of triangles to make the final result. But with triangle fans the ordering of the vertices is different to that for triangle strips - every triangle that makes up the object shares the first vertex in the list. In other words, the first vertex is used as one vertex in every triangle. The same rectangle screen object from the illustration on the previous page becomes more complex when converted into a triangle fan, and requires six vertices rather than only four. Instead of being only two triangles, the object is now four triangles. Each triangle is comprised of the first vertex and two other adjacent vertices.

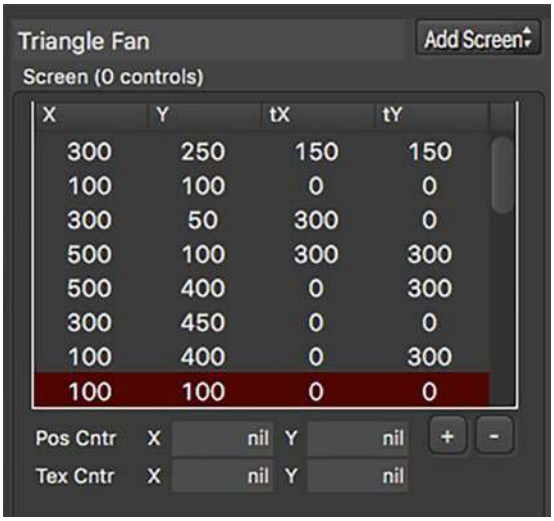


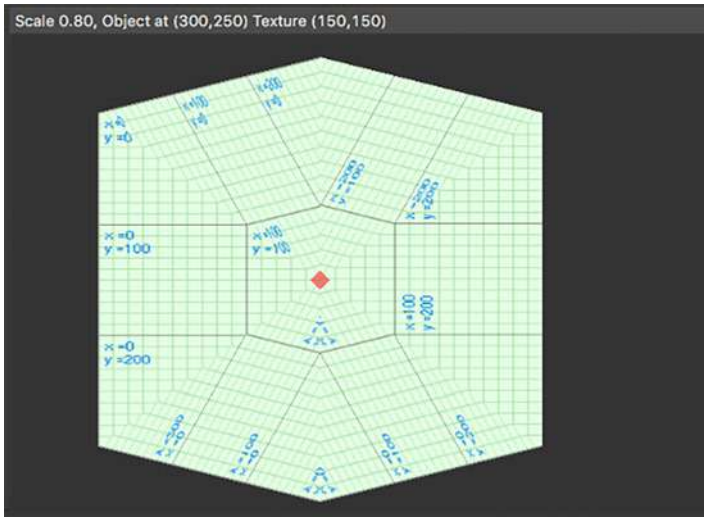


+ Triangle 1 uses the 1st, 2nd, and 3rd vertices. Triangle 2 uses the 1st, 3rd, and 4th vertices. Triangle 3 uses the 1st, 4th, and 5th vertices. Triangle 4 uses the 1st, 5th, and 6th vertices.

Note that two of the vertices have identical coordinate values. This is because the same vertex is used in two triangles and must therefore be repeated.

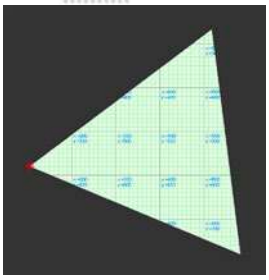
Using triangle fan screen objects it is possible to make an object with radial symmetry, or quite-complex geometry. If enough vertices/triangles are added, a relatively smooth curve, arc, or circle can be made.



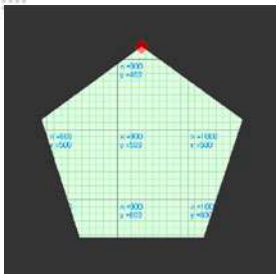


While the default when converting a rectangle screen object to a triangle fan screen object is to make the first vertex in the array the center point of the converted screen object, this is not a requirement when editing the vertices of triangle fan screen objects. Nor is it required that triangle fan screen objects be radial. They can be any polygonal shape.

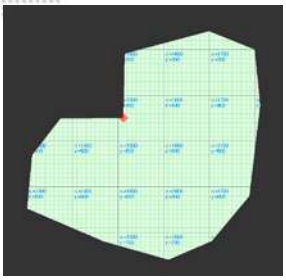
Triangle:



Regular Polygon:



Irregular Polygon:



Care must be taken though, as some complex shapes are impossible to describe using the triangle fan system and have to be created using a combination of multiple screen objects. The process for importing and exporting image remapping configurations in the SVG format (Refer to "Import and Export for Image Remapping" on page 142 for more information) provides helpful tools for both simple and especially for more complex shapes.

Editing Triangle-based Screen Object Parameter Values

All triangle-based screen object vertex coordinates and parameters use numerical values. As with rectangle-based screen objects, these values are measured in pixels. Rather than being shown as discrete values in text fields, the vertex coordinates for triangle-based screen objects are shown in a table, in a specific order. Each row in the table represent the Active and Texture coordinates for one vertex in the object's array of vertices. The order of vertices cannot be changes, but vertices can be added or removed.

CAUTION! Removing vertices from a triangle-based screen object can dramatically alter the object. Because there is no undo functionality, it may be best to make a copy of the object and edit the vertices in the copy, rather than editing the only copy of the object.

There are three ways to edit triangle-based screen object vertex coordinate values:

+ Double-click on the coordinate to be adjusted in the table and enter a new value. Press [tab] or [return] or an arrow key to apply the new value. The [tab] and [return] keys move sequentially through the coordinates in the table. The arrow keys allow non-sequential movement.
+ With the cursor hovering over the coordinate to be edited, hold down [⌘] on the keyboard and scroll the mouse or trackpad up or down to adjust the value. Hold down [shift] to speed up or [option] to slow down.
+ In the main menu bar for the Mbox and Remote applications, under the Image Remap item, there are two menu items: "Copy Active to Texture" and "Copy Texture to Active." These menu items will copy the active parameters to the texture parameters (or vice-versa) for the selected vertex in the table.

When editing active and texture parameter values for a vertex, it may be desirable to change either of the active/texture values and also make the corresponding texture/active value identical. The link button at the bottom of the vertex array table area can used to cause all single-value edits to be copied to the corresponding parameter. The button has two states: Linked: and Unlinked:

IMPORT AND EXPORT FOR IMAGE REMAPPING

Overview

While the standard user interface for image remapping configuration creation and editing in both Mbox and Mbox Remote provides all the tools necessary to make any sort of image remapping configuration, these standard methods of editing the configuration data may become repetitive or tedious if many configurations, screen objects, or controls are used, or need to be edited. It can also be cumbersome to manually edit vertex data for triangle-based screen objects.

Starting with Mbox/Mbox Remote v5.2 the image remapping editor allows the import and export of data for image remapping screens and controls. Data can be imported or exported in either of the .csv or .svg formats, depending on what is being imported or exported. There are two available methods for import and export: Standard Import and Export, which covers all types of import and export from both .csv and .svg files, and Live .svg Import, which covers only screen data importing from .svg files. Standard import works in both live and file mode, but Live .svg import only works in live mode.

Standard Import and Export

Standard Import or Export is initiated by either pressing [⌘I] on the keyboard (when the application is on the Image Remap tab) or by selecting the “Standard Import/Export” item from the Image Remap menu. If an inappropriate item is selected in the image remapping configuration table, a warning message will be presented when attempting to open the import/export dialog.

Before importing or exporting image remapping data, the decision of what to import or export must be made. Either screen data or control data can be imported or exported. Due to the hierarchical nature of the image remapping data structure File > Configuration > Screen Object > Control, data can only be imported or exported for one type/item at a time.

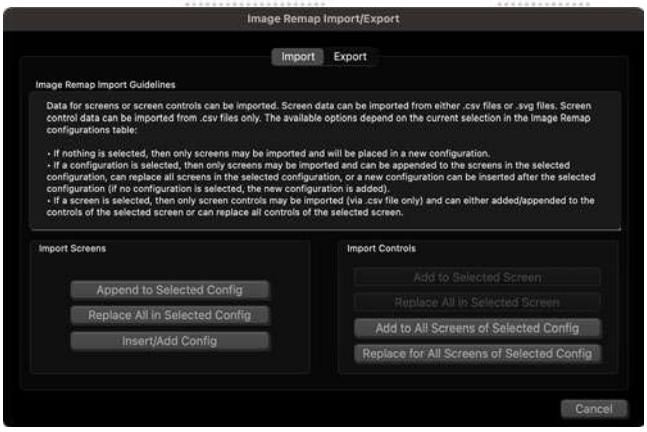
Note: Configuration data cannot be imported or exported. Because configurations are simple to create and edit, there is no significant benefit to being able to import or export the limited amount of data required. In some cases (importing screens) the import process will automatically create a new configuration to hold the imported screens.

There is only one dialog for the setup and activation of standard import and export, but the options presented when the dialog is opened will depend on what is selected in the image remapping configuration table when the dialog is opened:

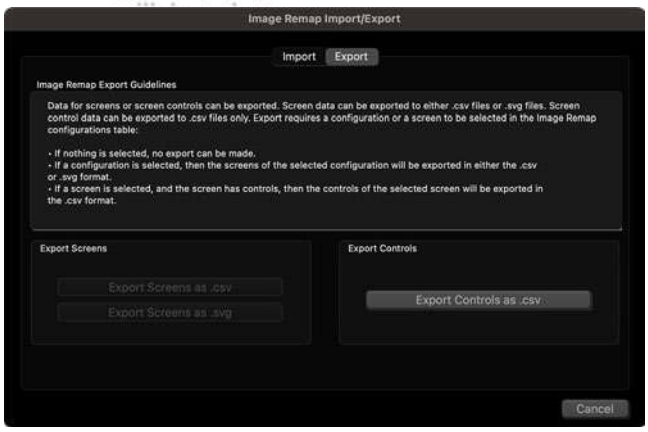
+ If nothing is selected, the only available option is to import screens, making a new configuration to hold those screens. This new configuration will be placed at the end of the existing array of configurations.
+ If a configuration is selected, screens may be imported or exported, and controls may be imported
  - Import screens: append new screens to existing screens in the selected configuration, replace all screens in the selected configuration, or create a new configuration that is inserted after the selected configuration.
  - Export screens: the screens of the selected configuration can be exported as either .csv or .svg data.
  - Import Controls: add the same controls to all screens of the selected configuration or replace all controls of all screens of the selected configuration with the same controls.
+ If a screen is selected, controls may be imported or exported
  - Import Controls: add controls to existing controls for the selected screen or replace all controls for the selected screen.
  - Export Controls: controls for the selected screen may be exported as .csv data.

+ If a control is selected, no import or export is allowed and a warning message is shown.

Import Options with a Configuration selected



Export Options with a Screen selected



When the button for the desired import/export option is clicked, a file dialog will appear. If importing, use the dialog to select the file (.csv or .svg) to import. If exporting, the file type will be pre-set based on the export option, but the file name and location can be specified.

Guidelines for Image Remapping import and export:

+ When importing, the import file type is set based on the file extension of the file chosen for import. This file selection happens after selecting the options for the import. Because only screens may be imported or exported using .svg data, attempting to import control data from an .svg file results in a warning message and the cancellation of the import.
+ When importing from either .csv or .svg file, all numerical values with the exception of the control > scale value will always be converted to integers. While it is possible to have coordinate values that are floats (e.g. 100.523), presenting and representing float values can be problematic. Therefore any non-scale float values found while importing will be “trimmed” (not rounded) to their integer value. e.g. “100.523” would be trimmed to be “100”
+ When an import creates a new configuration, that new configuration is given Texture Width and Height values and Global Surface Width and Height values. If the import is from an .svg file, the Texture width and height are taken from the viewBox property in the file. However, when importing from a .csv file this is not possible. And neither file type holds data for the Global Surface width and height. When the corresponding data is not available, the Texture width and height and the Global surface width and height will be set to the corresponding values from the last pre-existing image remapping configuration, and if no configuration exists both will be set to default values of 1920 x 1080.

Data formatting for .csv

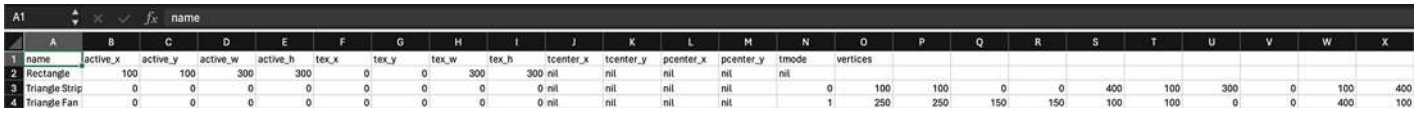
Image remapping data import and export in the .csv format follows strict guidelines. The guidelines will be automatically followed when exporting screen or control data. But if these guidelines are not followed, the import of data may fail. The guidelines are different depending on if the import/export is for screens or controls. The guidelines apply to both the first line (the header) of the .csv file and to the data placed in the following lines (data for individual screens or controls).

Guidelines:

+ All files must have a first line, the “header,” which must contain the names of all properties for the import/export type.
  - Screens header properties: name, active_x, active_y, active_h, active_w, tex_x, tex_y, tex_w, tex_h, tcenter_x, tcenter_y, pcenter_x, pcenterY, tmode, vertices
  - Controls header properties: name, univ_idx, address, parameter, format, scale, layerstride, offset, min, max

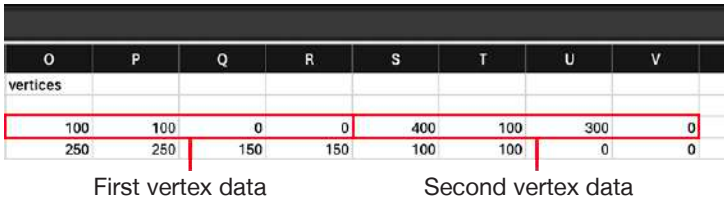
+ Subsequent lines hold the property values, one line for each item being exported and one property for each of the names in the header.
  - The only exception to this is for the vertices of a triangle-based screen object. In this case, while there is only one header item (vertices), but vertex parameter values are listed sequentially. Refer to the following images for an example of this.
+ All properties must have a value. In some cases this value will be 0 or “nil.”
+ If the required header values or screen/control properties are missing, an import will fail or result in incorrectly created items.

Example .csv file with screen data for standard rectangle, triangle strip, and triangle fan screen objects:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	name	active_x	active_y	active_w	active_h	tex_x	tex_y	tex_w	tex_h	tcenter_x	tcenter_y	pcenter_x	pcenter_y	tmode	vertices									
2	Rectangle	100	100	300	300	0	0	300	300	nil	nil	nil	nil	nil										
3	Triangle Strip	0	0	0	0	0	0	0	0	nil	nil	nil	nil	0	100	100	0	0	400	100	300	0	100	400
4	Triangle Fan	0	0	0	0	0	0	0	0	nil	nil	nil	nil	1	250	250	150	150	100	100	0	0	400	100

+ In the image above, there is only one “vertices” item in the header, but the triangle strip and fan screens have more than one value, starting in that column of data.
+ The image to the right highlights the groups of four values - X, Y, tX, tY - for each vertex. Note: All triangle-based screen objects must have at least three vertices, i.e. at least twelve vertex values! This image only shows two of those vertices.



O	P	Q	R	S	T	U	V
vertices							
100	100	0	0	400	100	300	0
250	250	150	150	100	100	0	0

First vertex data — Second vertex data

+ Screen data includes a property called “tmode.” This property represents the triangle mode - strip or fan of the object. A value of “nil” means that the screen is a rectangle screen and all following vertex data will be ignored. Only values of “0” for a triangle strip, and “1” for a triangle fan will cause vertex data to be imported.

Example .csv file with control data:

	name	univ_idx	address	parameter	format	scale	layerstride	offset	min	max
2	Texture_X	0	1	Texture_X	32_u	1	0	0	0	0
3	Texture_Y	0	5	Texture_Y	32_u	1	0	0	0	0
4	Position_X	0	9	Position_X	32_u	1	0	0	0	0
5	Position_Y	0	13	Position_Y	32_u	1	0	0	0	0
6	Opacity	0	17	Opacity	8_u	0.00392157	0	0	0	0

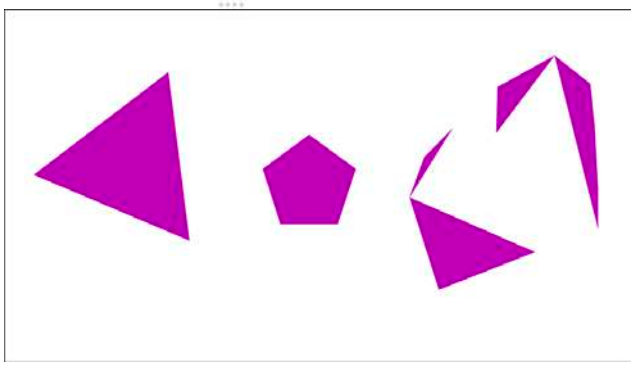
+ The “univ_idx” value represents the index of a universe in the image remapping editor’s control universe setup table. This is not the actual universe number! The indexes use a 0-based counting system, meaning that the first universe has an index of “0.” Care must be taken to use the correct value.
+ Parameter and format values must use only allowed string values to be read avoid errors. The allowed values for each are detailed in “Screen Object Control Types” and “Screen Object Control Formats” starting on page 162.
+ The scale value is the only value that is allowed to use a non-integer value. While this value can be displayed as “counts” in the image remapping editor’s UI, the value must be stored as “scale” for import and export. For any value “x” displayed as scale, the equivalent count value is 1/x, and vice-versa.

Tip The simplest way to get the correct formatting for .csv importing is to first manually create a configuration with the desired screen object types and/or controls, and to then export that data. Use the resulting file as a template for making edits.

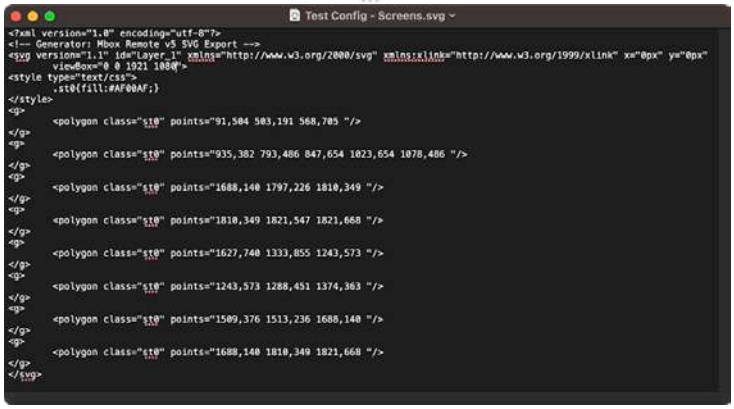
Data formatting for .svg

Image remapping data import and export in the .svg format follows the standard formatting of SVG files as defined by the World Wide Web Consortium. This standard supports far more functionality than Mbox requires for image remapping, therefore the data that can be imported or exported for image remapping purposes is limited.

SVG file when opened with Adobe Illustrator



SVG file when opened using text editor



+ SVG files use specific prefix information to provide information about the XML formatting and svg data in the file. Much of this information is ignored when importing data, but will be created when exporting data, to allow other editors to open and read the file. Mbox follows svg version 1.1 for formatting.
+ The “viewBox” property in the .svg file is used to set the Texture Width and Height properties when a new configuration is created. If no “viewBox” property is available a default of 1920 x 1080 will be applied.
+ Style information in the SVG file is ignored when importing. When exporting, a default style with a dark purple fill color is created and applied to all objects in the file. This causes the screen objects to be displayed as solid-filled, purple polygons when the file is opened in some other editor.
+ When importing, the only SVG object types that are supported are: “rect” for rectangles, and either “polygon” or “polyline” for polygons. Imported “rect” objects will create a standard rectangle screen object. Both “polygon” and “polyline” objects will create triangle-based screen objects.
+ When exporting, only “rect” and “polygon” objects are created.

WARNING! Polyline objects are <u>not</u> the same as polygon objects in SVG editors. Mbox treats polyline objects as if they are polygons, and therefore when a polyline object is imported, the resulting image remapping screen object may not be identical to the object in the SVG editor.

+ The grouping of objects is ignored when importing objects from an .svg file. When exporting complex triangle-based screen objects, if those screen objects must be exported as individual triangles (see below) the resulting polygons in the .svg file will be grouped.
+ Both Mbox and SVG editors are able to create complex polygonal objects. In some cases, Mbox must treat these complex objects as multiple individual triangle screen objects, both when importing and exporting, so that the resulting object(s) may be correctly displayed. The process of converting a complex object into multiple triangles is automatic.

WARNING!: When importing .svg screen data, the imported coordinates are applied to <u>both</u> the active and texture parameters of the screen object created. When exporting screen object .svg data, <u>only</u> the active parameter data of the screen object is exported. This is because it is not practical to import/export separate, unique, active and texture data from/to the same file given the constraints of the SVG format.

Note: Testing and validation of .svg import and export has been performed using Adobe Illustrator 2023.

Live .svg Import

Live .svg Import is only available when using live mode in the image remapping editor. It is initiated by selecting the "Live .svg Import" menu item. Live .svg Import can only import screen object data and is intended to continuously update the screen object data in an existing configuration, therefore a configuration must be selected (the receiver of live edits) when starting the live import. If an inappropriate item is selected in the image remapping configuration table when attempting to start the live import, an error message will be presented.

Upon starting the live import, a file open dialog will be presented to allow the selection of the SVG file. When the file is opened, an alert will appear on the screen to indicate that a live import session is in progress. Clicking the "Stop Live Import" button on this alert will stop the live import session.
The intended usage for live import is for an SVG file to be open in an external editor (i.e. not Mbox/Remote) and for edits made in that application to be immediately imported and active in Mbox..This avoids the need to constantly perform a manually import when multiple changes are required and need visual confirmation.

Guidelines for live .svg import:

+ If the selected import file is moved, deleted, or renamed during the import session, the import will fail.
+ When a live import session is active, Mbox/Remote will check the selected file once every second, and if the file modification date is more recent than the last import, the data in the file will be imported again.
+ In order to change the modification date of the file being imported, the external editing application must re-save the file after edits are made. In some cases this may require a manual save action in the external editor.
+ Each import will immediately replace all screen object data in the selected configuration, it will not add new screens.
+ No screen object control data can be imported as part of this process, and if any screens have existing controls prior to the live import session, those controls will be eliminated.
+ Data formatting requirements are identical to those for standard .svg import of screen data

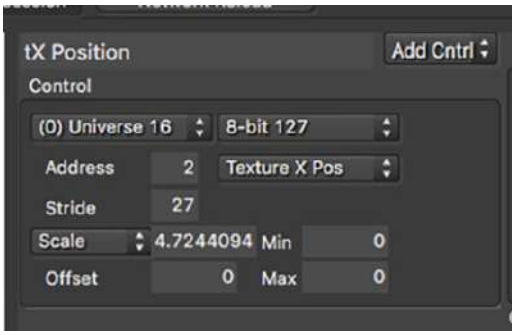
SCREEN OBJECT CONTROLS

Overview

Each screen object in a configuration can have controls that may be used to modify properties of the screen object in either a static or live manner. The properties that can be modified by controls are detailed in the table starting on the following pages and include things like opacity, color, texture position, and active (onscreen) position.

Controls are added by selecting a screen object and then using the Add button and selecting “Add Control,” or by copying and pasting a control from another screen object.

Configuration



Screen object controls have properties used to configure what external control data the control responds to, and how that data is interpreted.

The first step to setting up a control are to select the screen object parameter being controlled. There are 30+ parameters that can be controlled, but not all will work or will be needed depending on the type of screen object. The table on the following pages provides details for these parameters. The most commonly-used control parameters are: Texture X/Y Position, X/Y Position, Opacity, and color adjustments.

After selecting the parameter, the next step is to determine how that parameter will be controlled. A control can be configured to be a static/constant value by setting the Scale/Counts value to 0, and then entering a value in the Offset field. All other external control properties are then ignored. But the typical use for screen object controls is to receive data from an external controller - a lighting console or scenic tracking system. When using external control, other properties must be configured correctly to get the desired results.

For external control, the data format must be set to a value matching the resolution and ranging of the external data:

+ 8-bit unsigned: 0 thru 255 with 0 being the default. Uses one channel/address.
+ 8-bit 128: 0 thru 255 with 128 being the default. Uses one channel/address.
+ 8-bit 127: 0 thru 255 with 127 being the default. Uses one channel/address.
+ 16-bit unsigned: 0 thru 65535 with 0 being the default. Uses two channels/addresses.
+ 16-bit offset: 0 thru 65535 with 32767 being the default. Uses two channels/addresses.
+ 32-bit signed: -2,147,483,648 thru 2,147,483,648 with 0 being the default. Used exclusively for highly-accurate position with scenic tracking systems. Uses four channels/addresses.

The Universe and Address properties set what control data the control receives. These values respect the normal ranges for universe and address that are imposed by the protocol used: Art-Net or sACN. The universe property selects a universe from those that have been added to the pool of universes in the Universes listbox.

IMPORTANT! By default, controls use the control protocol (Art-Net or sACN) that Mbox is using for overall control. The Remap/ModelInfo Protocol preference can be used to override this and manually select a protocol.

Once the data format, universe, and address have been set, the Scale/Counts property is used to convert the incoming data value to a value that makes sense for controlling the screen object property. Incoming values may apply to texture positioning which is counted in pixels, or to opacity which is a value from 0 to 1, or to rotation which is also a value from 0 to 1 with 1 being a full 360° rotation.

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Scale and counts are reciprocals of each other, meaning that scale is 1/counts and counts is 1/scale. Depending on the parameter being controlled and other factors it may make sense to use one or the other, but it is easiest to use counts.

Examples for setting the scale/counts value for different control parameters:

+ Opacity/Color - Range is 0 - 1, therefore with an 8-bit unsigned data format, the counts value would be 255 and the scale value would be 0.0039215627 (i.e. 1/255)
+ Texture Position - Range is in pixels. If the intention is to move the texture one pixel per “point” of control data change, then the counts value would be 1. For scenic tracking this value must be derived using the measurement scale of the scenic system and the pixel pitch of the screen being tracked.
+ Texture Rotation - Range is 0 to 1 which represents 0° to 360°. Therefore, with an 8-bit 127 data format, the counts value could be 127 to allow a 360° CW rotation with incoming values 128 - 255 and a 360° CCW rotation with incoming values 126 - 0.

The Min and Max properties can be used to limit the range of adjustment of the control and are entered using the unit range of the control parameter type. For example, a min value of -0.5 for a rotation parameter would limit the CCW rotation to -180°. Note that a value of 0 for min or max is a limiting value, but if both min and max are set to 0, then no limits are applied.

The Offset property can be used to apply a static value to a control as noted on the previous page, or to apply a static offset to a control even when it is controlled by external data.

The Stride property is used to cause the control to have a unique address on a per-layer basis. With no stride value, a screen object will use the specified address no matter which layer the remapping configuration is used on. With a stride value, the address for the control will be automatically incremented if the configuration is used on layers above layer 1.

For example, imagine a remapping system with a screen object which has opacity and RGB controls, and which also receives external tracking data for the texture X and Y positions:

Parameter	Data Format	Address	Stride
Texture X	32-bit unsigned	1	0
Texture Y	32-bit unsigned	5	0
Opacity	8-bit unsigned	9	4
Red	8-bit unsigned	10	4
Green	8-bit unsigned	11	4
Blue	8-bit unsigned	12	4

No matter which layer the configuration is used on, it is typically the case that the screen object uses the same address for tracking - i.e. has no stride value. Which means that no matter which layer the screen object is used on, the texture position is affected by the same amount. But it can be desirable to create a composite image with multiple layers each using the screen object. In which case, adjusting the opacity or color of the image independently on each layer’s copy of the screen object on may be necessary. The stride value of four for each of these controls means that if the configuration is used on Layer 1, the opacity parameter uses address 9, if the configuration is used on Layer 2, the opacity parameter uses address 13, on Layer 3 it uses address 17, and so on.

Depending on the number of screen objects in the configuration, and the controls each has, the stride values would be adjusted to allow unique control over each parameter for each control, on each layer.

The tutorial on the following pages provides practical examples of the use of screen objects and their controls.

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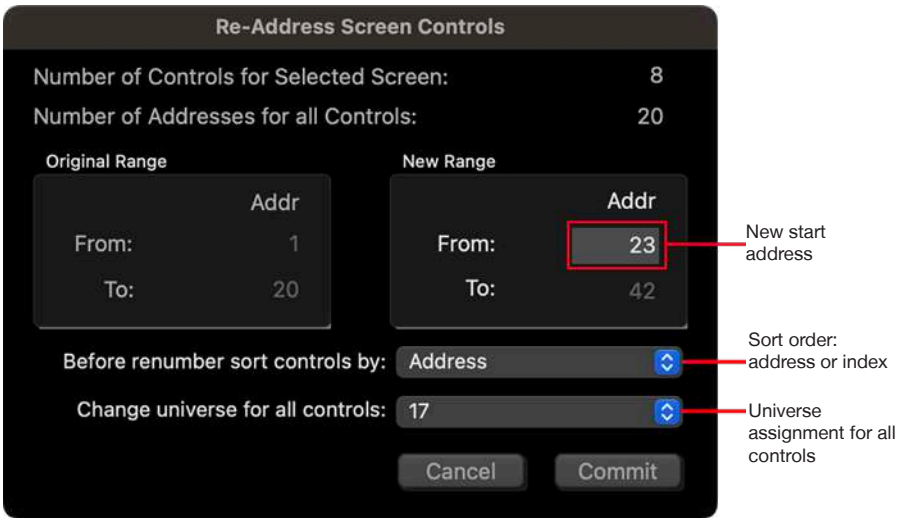
Re-addressing Screen Controls

At times is may be necessary to re-address screen controls. This task can take place in the image remapping editor, by selecting each control and editing its universe or address using the universe pop-up or the text field for the address. When more than a few controls on a limited number of screens need to be re-addressed, or when all controls need to re-addressed because a control was added or deleted, it can be much faster to use the re-addressing dialog.

The screen controls re-addressing dialog can be opened pressing [⌘⇧R] on the keyboard or by selecting the "Re-Address Screen Controls" item from the Image Remap menu. When attempting to re-address screen controls, there must be a screen selected and the selected screen must already have at least two controls.



When the dialog opens, it shows the number of controls for the selected screen, and the number of addresses used by those controls. The address range of the controls based on their current address is shown below in the Original Range box.

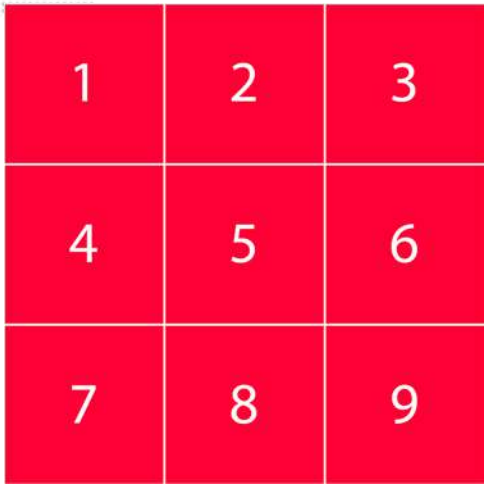
A new start address (the "From" value) for the first control can be set in the New Range box. The "To" value in this box will update when the edit of the "From" value ends.

A pop-up allows the controls to be sorted by address or by their index. This does not affect the controls' index. A second pop-up allows the universe assigned to all controls to be changed to any other universe already present in the image remapping editor's universe table.

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 x 3 x 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.

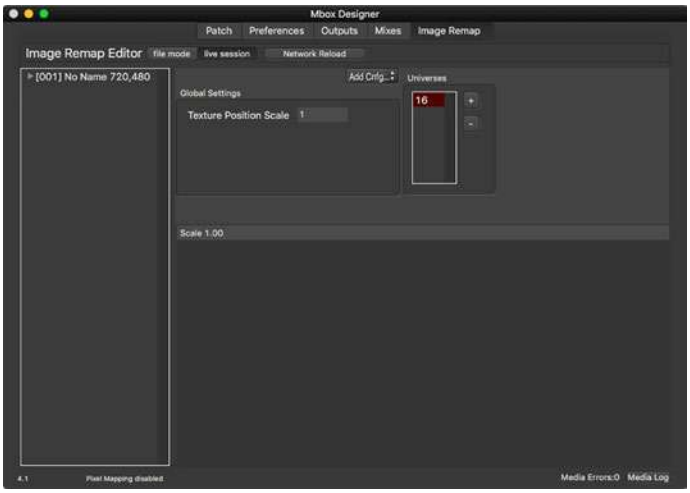
Note: To eliminate all Image Remapping data, quit Mbox, then delete the MultiScreenData.plist file and relaunch Mbox.

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.

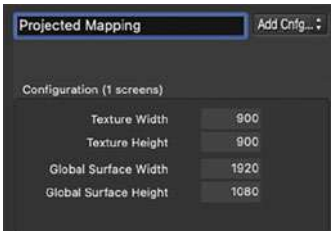
Step 1. Click on the Image Remapping tab, then double-click on the “0” in the Universes area - the default universe 0 - and type in a new number (this tutorial uses universe 16) that is not one of the current control universes for the Mbox server. Press [return] to accept the change.

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. An Mbox Designer license 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 any 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 Global Surface 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 several nearly identical configurations, each with 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.

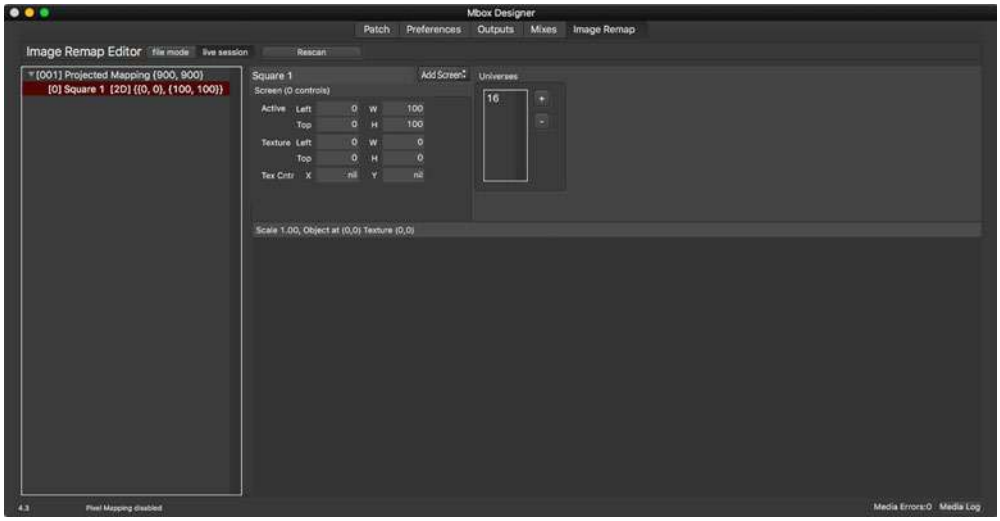
The Global Surface width and height value are used by the Image Remapping editor's UI to correctly draw the screen objects within the Preview area. These values need to be pre-set to maintain a pixel-accurate relationship between the screen object configuration data and how it appears on the UI's representation of the Global Surface. However, the values don't directly affect the actual image remapping output from the Mbox software.

CAUTION! When editing the image remapping configuration session, make sure that the Global Surface size in the editor is the same as the Mbox application's Global Surface width and height and vice versa! If these two items are not the same size, the preview area in the Image Remapping user interface will not show the correct size or aspect ratio.

Note: Pre-setting a configuration's Global Surface size doesn't mean that the configuration cannot be used with a different Global Surface size in the Mbox application. However, in such cases either the image remapping editor UI will not appear correct or portions of the remapping configuration may not be rendered.

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.

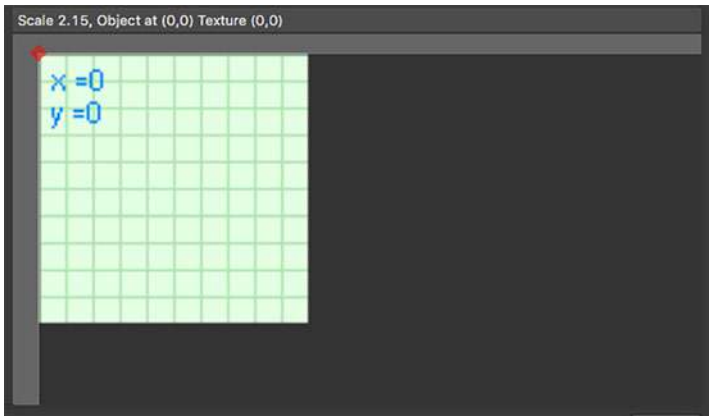
Step 5. With configuration [001] still selected, click on the Add button again and choose Add Screen from the list. There will be a small disclosure arrow visible to the left of the configuration's entry in the listbox. Click on this arrow to expand it. The configuration now has one screen (Screen index [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.

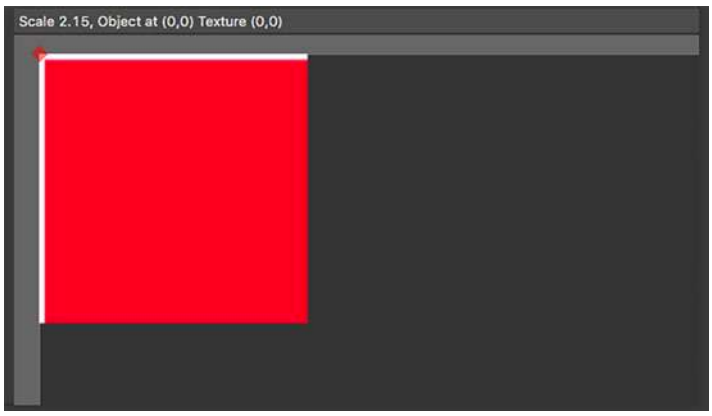
Note: The text field at the top of the Preview area shows the current scale of the view and information about the selected screen object.

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 used in the image remapping editor are based on the top-left corner having coordinates of 0,0 - this related to the Mbox Global Surface, any outputs in Mbox, any screen objects, and any textures used.

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 to the right of the control property editing box. 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 <u>not</u> 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!

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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 layer 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 162 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 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 200/65535 = 0.00305180.

   2) As an alternative to scale, counts - which are most often 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 unit of total travel. With the above example, since 65535 steps of data will move the screen object 200 pixels (the units in this case), the Counts value ends up being 65535counts/200px = 327.675 counts per pixel.

   3) The two methods are just the same information presented in a different way, one is the reciprocal of the other: 200px/65535counts = 0.00305180 (pixels per count = scale) and 65535counts/200pixel = 327.675 (counts per pixel = count). 1/0.00305180 = 327.675 and 1/327.675 = 0.00305180

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 both min and max are set to 0, then no limit is applied.

CAUTION! When either of the Min or Max values are edited, both 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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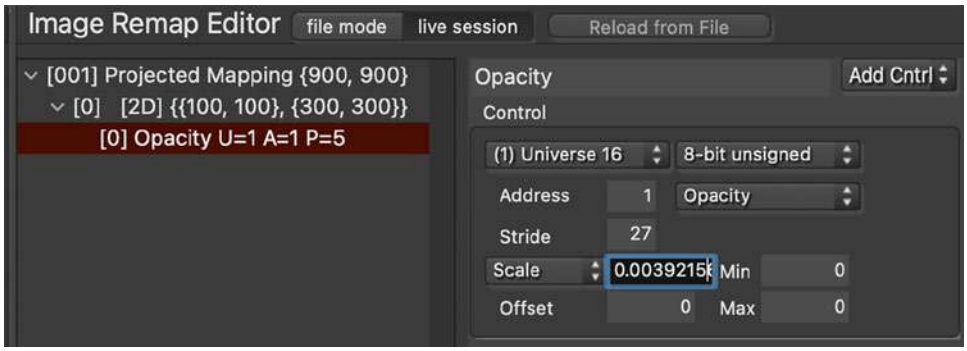
e. **Offset:** The Offset value is used to set a value for a control that does not respond to external data. Offset is typically used with the Repeat controls, but can be used to move or rotate a screen object by a fixed amount. When using an offset value the Scale value should be set to zero (0).

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, and the opacity parameter has a range of 0.0-1.0 so divide 1 by 255 = 0.003921526. 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.

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.

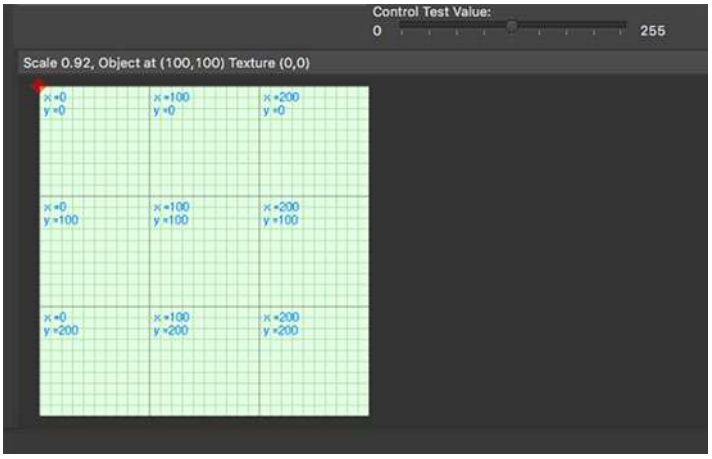
Regarding the accuracy of scale values. The more accurate the resulting values scale/counts calculations are, and the more decimal places used when entering those values, the more accurate the screen object's responses to input will be. For linear movements, use at least 4 digits after the decimal point.

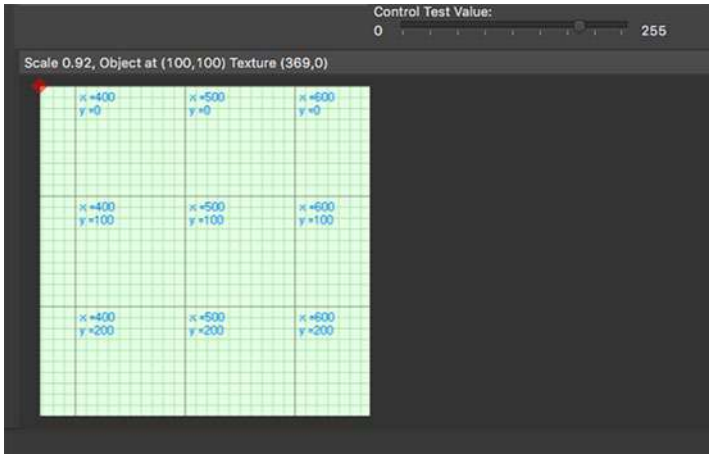
Step 16. Copy and paste the X Position control that was just created, and rename it "tY Position." Change the new control's address to 3, and set the control type to "Texture Y Pos".

Tip 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.

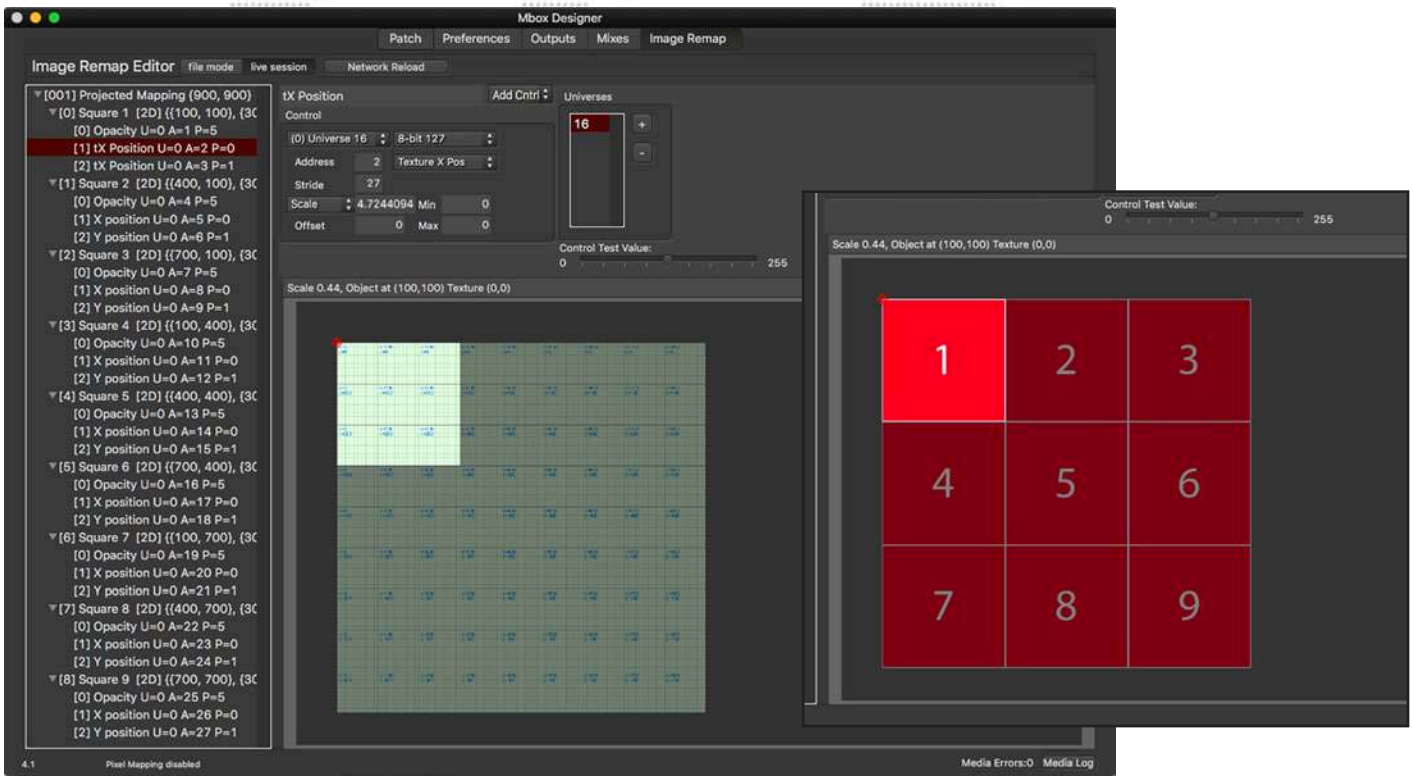
Step 17. Leave the texture X position's scale as positive, but make the texture Y position's scale negative. To do this, put the cursor before the value, and type a [-] on the keyboard, then hit [tab] to accept the change.

Tip 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.

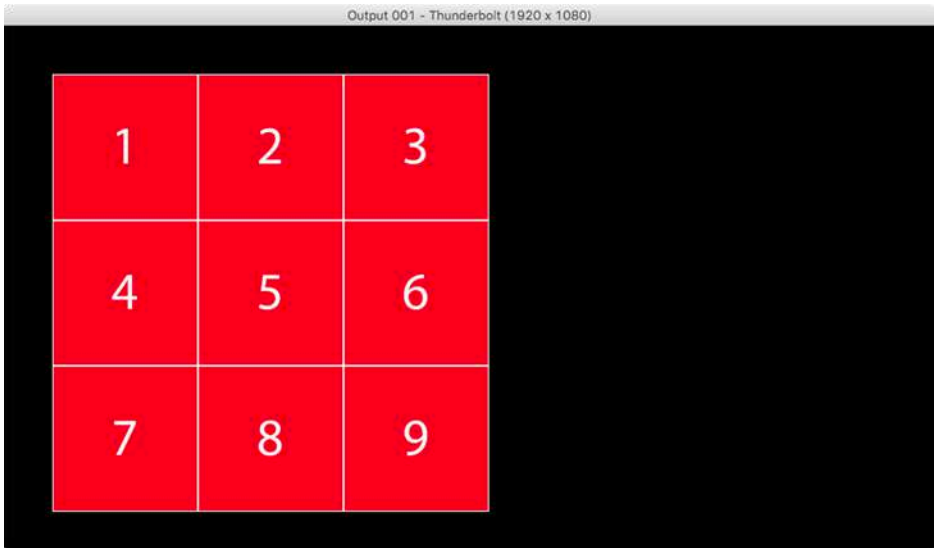




Step 18. With the first screen object setup correctly, go ahead and add eight more screen objects by copying and pasting the first screen object. Make sure to use the correct active and texture origins and width and height values from the chart on page 155, and also to substitute the correct address for each control. The result should be what is shown below:



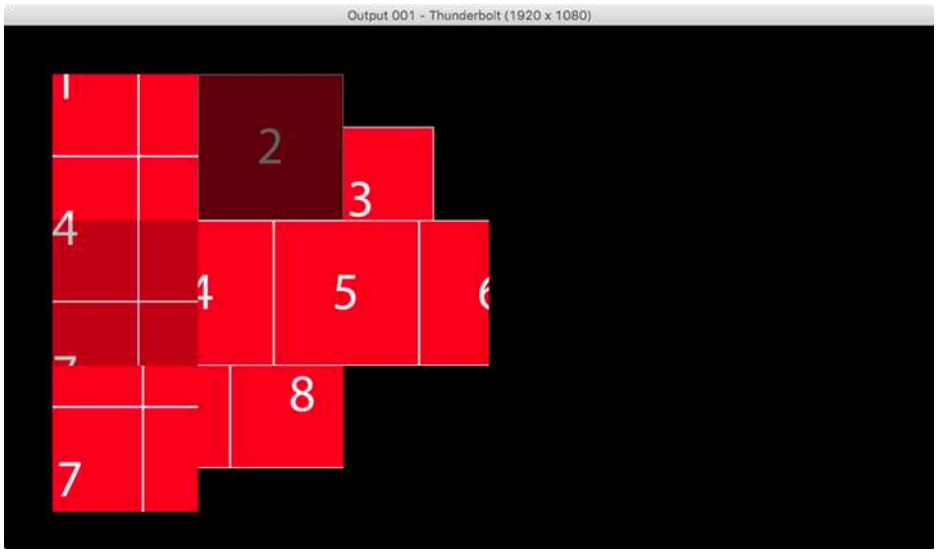
Step 19. With the configuration done, it's time to test it in Mbox. On Layer 1 - bring up the opacity, select the sample PNG as the texture on the layer, set the Image Remap parameter to a value of 001, and also supply the correct default external control data (for the opacity and texture X & Y position 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.

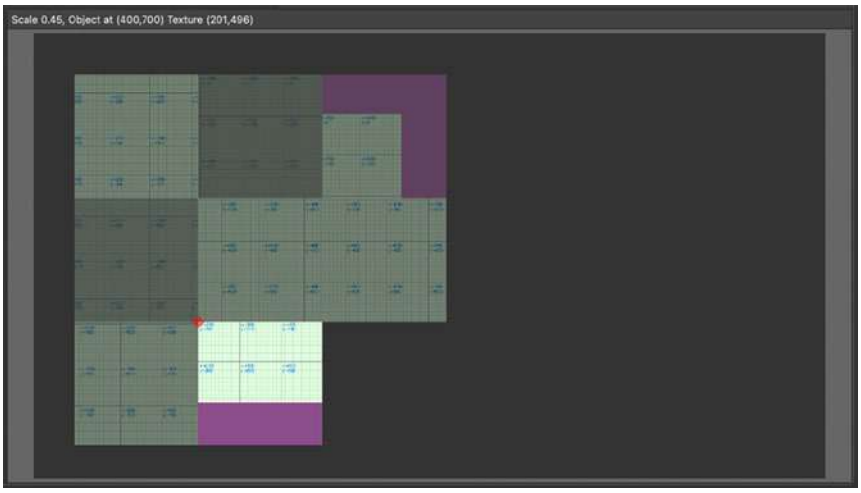
Note: The Mbox output's size is set to 1920 x 1080 to match the image remapping configuration's Display Width and Height values.

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 purple 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.

Tip 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 162 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 151) 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.

SCREEN OBJECT CONTROL GLOSSARY

Screen Object Control Types (Units, Typical Scale Value)

Control Parameter (CSV import/export string value)	Description	Units	Typical 8-bit Scale/ Counts Value
Texture X Position (Texture_X)	Left/Right position of the texture on screen object (affects Texture Position)	Pixels	Varies
Texture Y Position (Texture_Y)	Up/Down position of the texture on screen object (affects Texture Position)	Pixels	Varies
X Position (Position_X)	Left/Right position of the screen object on the Global Surface (affects Active Position)	Pixels	Varies
Y Position (Position_Y)	Up/Down position of the screen object on the Global Surface (affects Active Position)	Pixels	Varies
Dimmer (Dimmer)	Brightness (fade to black, not transparent) of texture on screen object	0 - 1.0	Scale: 0.0039215686 Counts: 255
Opacity (Opacity)	Transparency (fade to transparent) of texture on screen object	0 - 1.0	Scale: 0.0039215686 Counts: 255
Tex Rot 90 (Rotate_90)	Texture rotation in 90° increments	90° Steps	Scale: 1 Counts: 1
Tex Flip (Flip)	Texture flips in 4 steps - normal, reversed, upside-down, reversed and upside-down	Steps	Scale: 1 Counts: 1
Enable (Enable)	Enable/Disable rendering of screen object - make it visible/ invisible. A value of 0 disables the rendering	Enable/Disable	Scale: 1 Counts: 1
Abort (Abort)	Enable/Disable rendering of all screen objects including the current object and all objects after it. A value greater than 0 causes an Abort. This is a sticky control[1]	Enable/Disable	Scale: 1 Counts: 1
Texture Gain (TexGain)	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 (ActGain)	Multiplier for position of screen object. Allows position controls to be scaled on-demand for either greater accuracy or increased range	%	Varies
Tex Rotate (TexRotate)	Texture rotation in an arbitrary fashion. A value of 0 is no rotation, a value of 1 is 360° of rotation	0 - ∞	Scale: 0.0039215686 Counts: 255
X Rotate (X_Rotate)	Rotates Triangle Strip or Fan screens about their X axis, with the screen's origin being the origin of rotation[2] A value of 0 is no rotation, a value of 1 is 360° of rotation	0 - ∞	Scale: 0.0039215686 Counts: 255
Y Rotate (Y_Rotate)	Rotates Triangle Strip or Fan screens about their Y axis, with the screen's origin being the origin of rotation[2] A value of 0 is no rotation, a value of 1 is 360° of rotation	0 - ∞	Scale: 0.0039215686 Counts: 255
Z Rotate (Z_Rotate)	Rotates Triangle Strip or Fan screens about their Z axis, with the screen's origin being the origin of rotation[2] A value of 0 is no rotation, a value of 1 is 360° of rotation	0 - ∞	Scale: 0.0039215686 Counts: 255
Repeat Count (RptCount)	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 (Repeat_X)	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 (Repeat_Y)	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

Screen Object Control Types continued...

Control Parameter (CSV import/export string value)	Description	Units	Typical 8-bit Scale/ Counts Value
Repeat tX Dist (Repeat_tX)	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 (Repeat_tY)	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 (Repeat_XtX)	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
Repeat Y/tY (Repeat_YtY)	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
Red (Red)	Controls Red subtractive color mixing on the screen object. A value of 0 is no red, a value of 1 is full red	0 - 1.0	Scale: 0.0039215686 Counts: 255
Green (Green)	Controls Green subtractive color mixing on the screen object. A value of 0 is no green, a value of 1 is full green	0 - 1.0	Scale: 0.0039215686 Counts: 255
Blue (Blue)	Controls Blue subtractive color mixing on the screen object. A value of 0 is no blue, a value of 1 is full blue	0 - 1.0	Scale: 0.0039215686 Counts: 255
RGB (RGB)	Controls RGB subtractive color mixing (combination of Red, Green, and Blue as above) using three consecutive addresses. This provides the same functionality as patch three individual controls - Red, Green, and Blue to consecutive addresses	0 - 1.0	Scale: 0.0039215686 Counts: 255
RGBW (RGBW)	Controls RGBW color mixing (combined) using four consecutive addresses in a manner similar to RGBW lighting fixtures. Adding white level makes the RGB color paler.	0 - 1.0	Scale: 0.0039215686 Counts: 255
Global Opacity (GlblOpacity)	Transparency (fade to transparent) of texture on all screen objects	0 - 1.0	Scale: 0.0039215686 Counts: 255
Origin X (OriginX)	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 (OriginY)	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 (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

Additional Guidelines:

+ Control Parameters for opacity, dimmer, and color with absolute unit ranges from 0 to 1.0 will only work as intended with the 8-bit unsigned or 16-bit unsigned data formats.
+ Parameters for rotation or gain, and those using pixels for units can use any data format.
+ The Tex Rot 90 and Tex Flip controls do not work with triangle-based screen objects

Note 1: Sticky controls affect the current screen object and all following screen objects until another sticky control of the same 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.

Screen Object Control Formats

Control Format (CSV import/export string value)	Description	Typical Units	Typical Parameters
8-bit Unsigned (8_u)	Unsigned 8-bit value with a range of 0 - 255 and a typical default value of 0.	0 - 1.0	Opacity, Dimmer, RGB
8-bit Offset 127 (8_127)	Unsigned 8-bit value with a range of 0 - 255 and a typical default value of 127.	0 - 1.0, steps	Rotation, Flip
8-bit Offset 128 (8_128)	Unsigned 8-bit value with a range of 0 - 255 and a typical default value of 128.	0 - 1.0, steps	Rotation, Flip
16-bit Unsigned (16_u)	Unsigned 16-bit value with a range of 0 - 65535 and a typical default value of 0.	0 - 1.0, Pixels	Opacity, Dimmer, RGB, Position
16-bit Offset (16_o)	Unsigned 16-bit value with a range of 0 - 65535 and a typical default value of 32767.	0 - 1.0, Pixels	Opacity, Dimmer, RGB, Position
32-bit Signed (32_s)	Signed 32-bit value with a range of –2,147,483,648 through 2,147,483,647 and a typical default value of 0.	Pixels	Position

Additional Guidelines:

+ The 8 and 16-bit unsigned formats are intended primarily for use with control parameters like opacity, dimmer, and color that have absolute unit ranges from 0 to 1.0 .
+ Any format can be used with any parameter, but it makes little sense to control some parameters with precision higher than 8-bit. Likewise, the offset formats are generally used for parameters that have a “center 0” and can move/rotate in a positive manner.
+ The 32-bit signed format should only ever be used for Texture Position or Position parameters. The 32-bit format is custom and in may only be compatible with some sources - e.g. the Mbox Automation Interface application.

6.

EXTERNAL VIDEO INPUT AND OUTPUT

This chapter provides instructions for external video input and output.

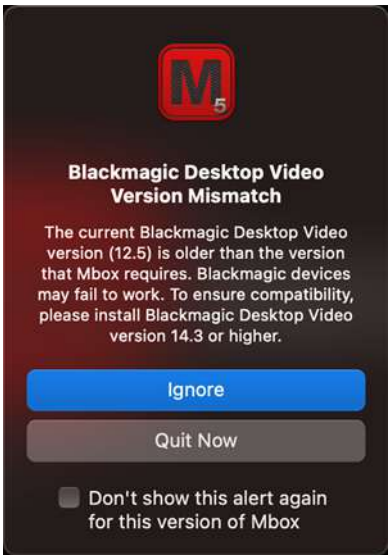
+ EXTERNAL VIDEO SIGNAL INPUT
+ SYPHON INPUT
+ SYPHON OUTPUT
+ NDI® INPUT
+ NDI® OUTPUT

EXTERNAL VIDEO SIGNAL INPUT

Overview

Mbox supports three types of external video inputs: Blackmagic Decklink PCIe cards, Blackmagic UltraStudio Thunderbolt devices, and other AVFoundation-compatible video capture devices - typically USB devices. For best performance (i.e. lowest latency and best image quality), Mbox has native support for Blackmagic (Decklink and UltraStudio) video capture devices. Other PCIe cards that support video capture using AVfoundation should work, but may not work as well as Blackmagic devices. USB devices must output an AVFoundation compatible format and will usually have greater latency and lower quality than PCIe or Thunderbolt devices.

IMPORTANT COMPATIBILITY WARNING! **Beginning with the release of Mbox 5.3, the Mbox application requires a minimum version of the Blackmagic Desktop Video suite (applications and drivers) to be installed on the Mbox computer. For Mbox 5.3, the minimum version of Blackmagic Desktop Video is version 14.3. If the version of Blackmagic Desktop Video installed on the computer is older than the minimum required version, then Blackmagic devices cannot be used for either input or output! If the installed Blackmagic Desktop Video version is incompatible, when the Mbox application launches it will display an alert. This alert provides options to ignore the issue - and allow Mbox to launch - or to immediately quit the Mbox application - to install a compatible Blackmagic Desktop Video version. Because the alert appears even if Blackmagic devices are not being used, the alert also includes a checkbox that will suppress the alert, but only for that version of the Mbox application. Launching a different version of Mbox, which has the same restriction, will cause the alert to appear again - and require suppression as desired.**



The Mbox Designer license allows up to eight external video inputs, the Studio/Studio+ license allows up to four inputs, and the Mini license allows up to two inputs. The actual number of inputs will depend on the video input device(s) used. Each of the inputs must be set up in advance to work properly with Mbox; setting the input type, input number, and video format.

CAUTION! Before using Mbox with any external video input/capture device, make sure the correct macOS-compatible version of that device's drivers have been installed and are working. Refer to the important compatibility warning on this page regarding drivers for Blackmagic devices.

Note: If a layer is attempting to display a video input while that input is being configured, it may be necessary to change the folder.file index of the layer and then return to the input's index to see the results of the change.

Note: If a video input is reconfigured outside the Mbox application or from Mbox Remote while Mbox is running, it may be necessary to click on some other preference item and then back on the input's preference item to cause the input's preference values to update.

Blackmagic Design UltraStudio devices and Decklink PCIe Capture Cards

The Mbox software has been optimized to provide the best possible video input (high quality, smooth framerate, low latency) with Blackmagic Design's UltraStudio devices and Decklink PCIe cards.

Note: Some older Blackmagic Design devices do not work with Apple Silicon Macs.

Install Blackmagic Desktop Video

Before the Mbox application is able to use Blackmagic devices for capture, the Blackmagic Desktop Video software must be installed. **Refer to the important warning on the previous page for compatibility requirements.** This software can be downloaded from the Blackmagic Design website: https://www.blackmagicdesign.com When the Blackmagic Desktop Video software is installed, make sure that this software is allowed to run in the background - this should happen automatically on install, but permission can be denied. If this permission was denied on install, it can be granted afterwards in System Settings > General > Login Items > Allow in the Background (on macOS Ventura and newer).

To set up Blackmagic devices:

Before use with Mbox, many Blackmagic devices may need to be configured to receive the correct video signal type (SDI, HDMI, etc.) using the Blackmagic Desktop Video Setup application.

Step 1. Quit the Mbox application, if running.

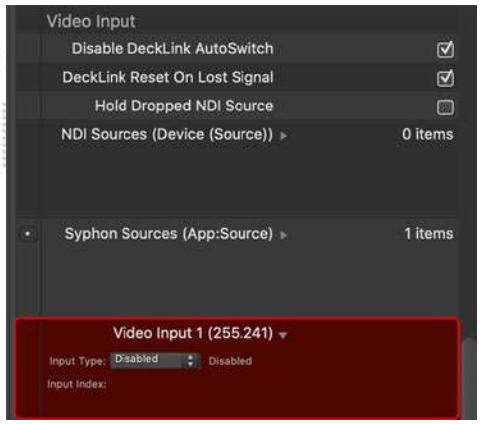
Step 2. Locate the Desktop Video Setup application in the /Applications/Blackmagic Desktop Video folder and double-click to launch the Blackmagic Desktop Video Setup application.

Step 3. On the Blackmagic Desktop Video Setup window, select the device to be configured then click on the configuration button to open the pane where the input type can be selected and other settings can be adjusted.

Step 4. After making changes, press the save button on the configuration pane and then close the Blackmagic Desktop Video Setup window and launch the Mbox application.

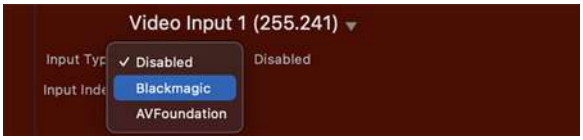
Note: The audio inputs on Blackmagic devices only receive/capture audio when the unit is actively capturing video (i.e. only when Mbox is displaying that video input on a layer) and therefore the audio inputs cannot be used as a timecode audio input to the Mbox application.

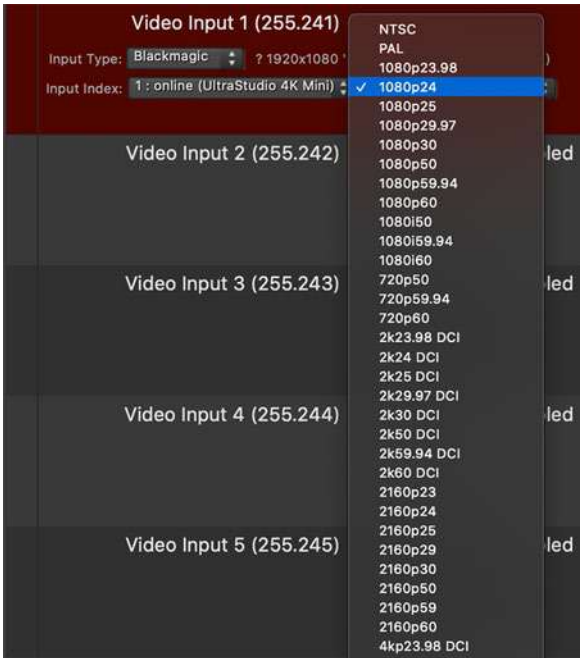
To configure Mbox video inputs for Blackmagic devices:



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". Click on the input index pop-up to assign a physical input on a device to the input that is being configured. Note: 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 format pop-up and select 8 bit YUV or 10 bit RGB as required.





CAUTION! The choices on the input format pop-up may include formats that do not work with the connected video input device. Check the documentation for the input device to determine what formats it can receive. Do not select a format that the hardware does not support!

Step 3. Once everything is set up correctly, the input status 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 unknown input respectively. "Unknown" in this case meaning no input, incorrect format, or unsupported format.

  - The status text may be colored yellow to indicate a warning or error condition.

+ Manual selection of the correct input format 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 "Mode not supported!" In such cases, a supported format should be manually selected.

+ Some Decklink cards (Duo 2, Quad 2, 8K Pro) allow reconfiguration of their I/O connectors, which can result in some connectors being disabled. Disabled connectors show "disabled" on the input index pop-up and their input format pop-up will have no formats to select from.

+ Once an input format has been manually selected it will be remembered whenever the Mbox application is quit and relaunched.

+ Mbox always remembers the last eight Blackmagic inputs (devices or their connectors) that are active when the Mbox application runs. This is so that input indices are not altered (and therefore their folder.file) if the Mbox application is launched without a device being present. This can mean that devices that were previously connected can be selected but cannot be configured or used. Whenever a ninth Blackmagic input is connected, the Blackmagic History is reset to include only the first eight currently-connected devices. Starting with Mbox v5.2.2 the "Reset Blackmagic Device History" item in the Commands menu can be used to immediately remove all remembered devices from the Blackmagic History and delete/reset all currently-configured Blackmagic inputs.

+ The color format pop-up is only applicable to Blackmagic inputs. Most Blackmagic inputs use the "8 bit YUV" option, which is the default. But some HDMI inputs may require the "10 bit RGB" option for the input to work.

+ 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.

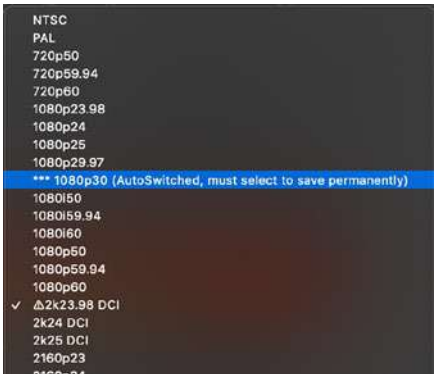
  - Mbox has a "Disable Decklink AutoSwitch" preference that is enabled by default. This serves to disable the autoswitching.

  - It is recommended to leave 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.

+ It is recommended that the "DeckLink Reset On Lost Signal" preference always remain checked.

Pre-set Cropping for Video Inputs

If there is a need to consistently crop out portions of a video input, then there is a method of cropping that can be set in advance and which will be applied every time the input is used.

The MediaInfo.plist file (Refer to "MediaInfo plist" on page 47) 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 can also be 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 always crop out part of the input. However, if 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) then applying a single crop to this 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 an .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 actual text content.

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. This suffix 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 - which represents 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 or USB)

Mbox also supports other capture devices, but only those that provide a video capture format that is compatible with AVFoundation. Such devices may include USB cameras or capture devices, and some PCIe capture cards. The configuration for these devices is similar to that for Blackmagic devices, except:

+ The input type must be set to "AVFoundation" rather than Blackmagic.
+ The input will be selected by name (e.g. "FaceTime HD Camera") rather than by number.
+ No configuration of the input format is required as this is set automatically when the device is selected.

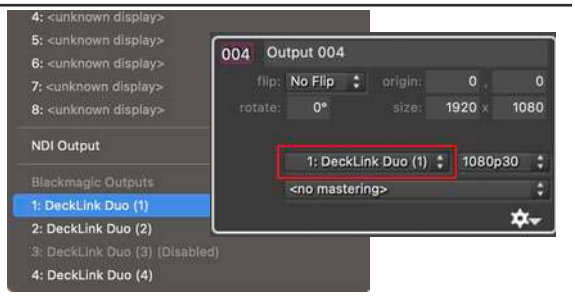
EXTERNAL VIDEO SIGNAL OUTPUT

Blackmagic Design UltraStudio devices and Decklink PCIe Capture Cards

In addition to direct video output via compatible video connectors (HDMI, USB-C, etc.) on the computer, Mbox also supports external video output using Blackmagic Decklink PCIe cards and UltraStudio Thunderbolt devices. The allowed number of Blackmagic outputs is not limited by the license level, but the license level does restrict the overall number of output pixels. Blackmagic output devices must be set up in advance to work properly with Mbox; setting the output format and/or connector configuration - using the Blackmagic Desktop Video preference pane in System Preferences or the Desktop Video Setup application in the /Applications/Blackmagic Desktop Video folder.

CAUTION! Before using Mbox with any Blackmagic output device, make sure to install the correct version of Blackmagic Desktop Video and update firmware in all Blackmagic devices. Make sure to connect UltraStudio devices and apply power to them before launching the Mbox application.

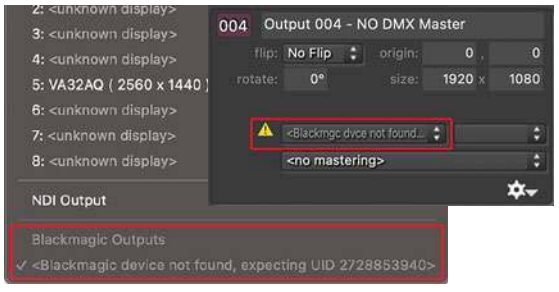
Blackmagic outputs are configured on the Outputs tab of the Mbox application, in a similar manner to normal video outputs. (Refer to "Outputs Tab: Output Configuration " on page 63) When clicking on the pop-up to assign a display to an output, rather than selecting a normal connected display device, select a Blackmagic output device. Possible Blackmagic output devices can be found at the bottom of the pop-up, under the "Blackmagic Outputs" heading.



Note: It is important to define the concept of a Blackmagic "output" to explain what that word can refer to and how this impacts what is shown in Mbox's user interface. Output may refer to the single input/output on an UltraStudio device or a Decklink card that only supports a single input and/or output. Alternately, output may refer to one of several input/output connections on a Decklink card like the Duo 2, Quad 2, and 8K Pro that supports multiple inputs and/or outputs at the same time. Most Blackmagic devices function as one single device and therefore only one possible output. In the case of the three Decklink cards mentioned above, the card can have multiple outputs, and reconfiguration of the connectors on the card can cause one or more of those outputs to be disabled. Please refer to Blackmagic Design's product documentation for more information on the configuration of these devices.

The Blackmagic outputs shown on the pop-up includes all possible outputs connections for all currently-connected Blackmagic devices. Outputs on disconnected devices may be shown on the pop-up under certain circumstances:

+ If a device was previously connected and configured with an output, but the device is no longer connected, the output will be shown on the pop-up, but will be disabled and labeled "Blackmagic device not found".
+ Outputs on disconnected devices will remain on the pop-up in a disabled state until such time as the Mbox output is assigned to another Blackmagic device's output or configured as an NDI or normal video output.



When a connected output is selected on the popup, Mbox shows a list of available formats (resolutions and frequencies) for the output on the format pop-up. Selecting a format from the pop-up will automatically set the output's width and height (in the size text fields above) to match the width and height of the selected format. The output's width and height cannot be manually set to other values, they must match those for the selected format.

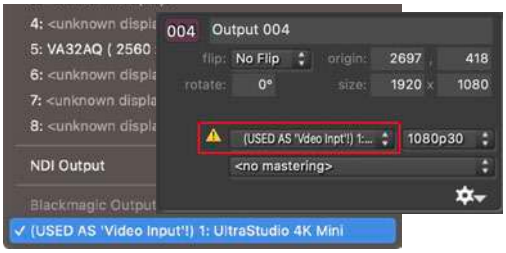
Because many Blackmagic devices can be both inputs and outputs, care must be taken to coordinate the use of a Blackmagic device as an output when trying to use the same device (or connector on a device) as an input. Whether each connection on a device can be an output and/or an input depends on the hardware: some devices only have input or output connections but not both, some devices have both input and output connections, and some devices have one set of connections that can be inputs or outputs but not both at the same time.

Any device that has only input or output connections can only be an input or output device, not both. Devices that can't have output connections will not be available for selection as outputs in Mbox. Likewise, devices that can't have input connections will not be available for selection as input in Mbox.

Most Blackmagic devices that are compatible with newer Apple Silicon computers are capable of supporting both input or output connections. These devices typically allow both inputs and outputs at the same time but on separate connectors - a connector cannot be both an input and an output at the same time. Each connector on a Decklink card (or a group of connectors) can be configured to be a connection/device that can be either an input or output. UltraStudio devices typically feature separate sets input and output connectors, thus allowing separate input and output connections at the same time.

Most newer Blackmagic devices are capable of having both input and output connections (both receiving and outputting video) at the same time and are therefore "duplex" devices. But as noted above, some older devices cannot do this. While Decklink cards can be duplex devices, each connector can only be one or the other at any given time. Depending on each device and how its connectors are configured, Mbox will show different information on the Outputs tab when the same device is used for both input and output.

With duplex devices, Mbox will display an alert ("USED AS Video Input!)") on the Outputs tab if the selected output device is also being used as an input device (configured as a video input on the Preferences tab). This warning does not mean that the device cannot be used simultaneously as both an input and an output, but indicates that care may need to be taken:



- In the case of Decklink cards, where each connector (or group of connectors) can only be used as an input or output, that connection can only work in Mbox with the function (input or output) that was configured first. If the connection is first configured as an input on the Preferences tab and then configured as an output on the Outputs tab, then only the input functionality will work. When a Decklink device's connector has been configured as an output first and then configured an input, the input setup will fail and the status message "Error (see log)" will be shown on the input's configuration tile on the Preferences tab of the Mbox application.
- If a Decklink connection that doesn't allow input and output at the same time has been configured as both input and output in Mbox, and the Mbox application is quit and relaunched, the connection will always function as an input, no matter what function it provided prior to the relaunch. This is because when the Mbox application launches the configuration of inputs happens prior to output configuration and a connection that can't support both functions will only have the functionality that was first applied.
- Most UltraStudio devices have separate connectors that allow both input and output at the same time. These devices will still show the "USED AS..." alert on the Outputs tab. While this is not considered an error, it should be taken as a caution - using the same device for both input and output may limit the bandwidth for one or the other and therefore affect performance.

SYPHON 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 Unity or other Syphon-aware applications running on the same computer 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 application has automatic discovery of active Syphon sources to aid in the assignment of sources to index numbers.

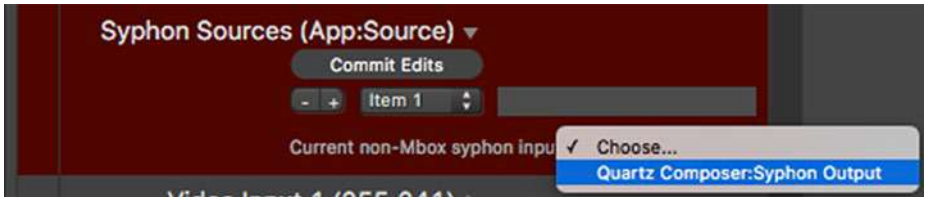
To assign Syphon sources:

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 from non-Mbox sources.

Guidelines:

+ The Mbox Designer license has a limit of 12 Syphon inputs, the Studio/Studio+ license has 4, and the Mini license has 2.
+ When the Mbox application launches, it will assign any Syphon inputs that are not pre-configured 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 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.

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 with a Designer or Mbox Studio+ license creates Syphon sources for the Global Surface, each output, and each layer. Mbox with a Studio or Mini license only create Syphon sources for the Global Surface and each output.

Note: Syphon outputs that use Mbox outputs as their source are rendered with the corresponding output master's effects, RGB+B/C, and camera/geometry/keystone/warp/shutter. Syphon outputs that use Mbox layers as their source are rendered with only the layer's 2D texture (no 3D object), effects, RGB+B/C, and without other parameter adjustments like position, rotation, and blend mode.

NDI® INPUT

The Mbox application includes NDI®, a product of Vizrt Group, allowing Mbox to receive real-time, full-framerate video streams over an Ethernet network. This can be a quick and easy alternative to video input through a capture device.

Note: For more information on NDI®, refer to Vizrt Group's NewTek website: https://www.newtek.com

Configuring NDI Inputs

Unlike Syphon inputs, without any configuration Mbox will not automatically give NDI inputs an index number. This means that NDI sources must 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.

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.

Note: The NDI source list includes an entry "-", which can be used instead of an actual NDI source to reserve any index for later assignment.

Guidelines:

- The Mbox Designer license has a limit of 12 NDI inputs, the Studio/Studio+ license has 8, and the Mini license 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 matching input source is configured, nothing will be visible on the layer.
- NDI inputs are displayed at the same resolution as they are sent from the source device.
- Mbox can accept either of the NDI standard's YUV or BGRA input pixel formats and will switch automatically between the two formats. When an NDI signal switches formats, there may be a brief pause in the display of frames, therefore switching formats mid-stream should be avoided whenever possible.
- Mbox cannot send or receive NDI using multicast and works best with standard Single TCP.
- Mbox can work with an NDI Discovery Server. The Discovery Server's IP address can be viewed or edited using the NDI Access Manager application or via the NDI Discovery Server IP preference in Mbox. Using the preference in Mbox is simplest - enter an IP address to use a Discovery Server, or delete the IP address to disable Discovery Server functionality. The Discovery Server should always run on a separate computer.
- 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 stream is intentionally turned off by the source, any layer using that stream will immediately show no imagery. But if the stream between the source and the Mbox computer fails, the default action is for the last-received frame from the NDI source to remain visible for two seconds, after which the layer will display nothing. The Hold Dropped NDI Source preference may be used to cause the last-received frame to be displayed continuously, until the layer's Folder.File index is changed.

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

The Mbox application supports NDI video outputs, using NDI®, a product of Vizrt Group. 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.

CAUTION! NDI Output requires both highly capable computer hardware and a robust and fast network that is dedicated to NDI transmission. Most issues with NDI transmission result from incorrect configuration or the limitations of the network used.

Configuring NDI Outputs

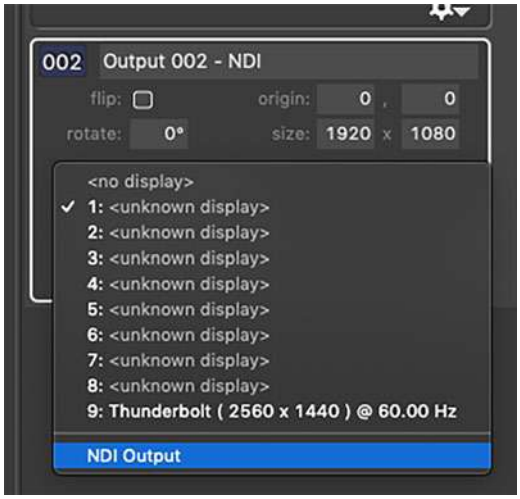
Note: Previous versions of the Mbox application required at least one "normal" video output configured on the Outputs tab be able to successfully create an NDI output stream, even if there was no actual video output required. Mbox v5 does not have this limitation and will output NDI at the same refresh rate as the computer's primary output.

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 Outputs tab UI 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.

Mbox will show a separate output window for NDI outputs. NDI outputs will work both when the Mbox application is in window mode or when it is in fullscreen mode.

Guidelines:

+ As with any output from Mbox, the imagery for the NDI output 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 the correct width and height if the receiving device requires a specific resolution for its NDI input.
+ By default, all NDI streams will have an output frequency matching that of the first normal video output/display of the computer. If no display is connected, Mbox will use a default output frequency of 60fps.
  - 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' frequency may be affected by the Mbox application's "Rendering FPS" preference. When the Mbox computer has a connected display and the NDI output rate is set to default, if this preference is set to "divide by 2" the NDI output frequency will be 1/2 that of the computer's first output's refresh frequency. If the "Rendering FPS" preference is changed, either the Mbox application must be quit and relaunched, or the NDI outputs deleted and then recreated for changes to the NDI output rate to take effect.
- Starting with Mbox v5.2, a maximum output frequency can be set for all NDI output streams. The NDI Output Rate preference allows either the default rate or other standard rates to be selected. Changes are immediately applied.

+ NDI output streams are given a name based on the OS share name of the Mbox computer with the mix number of the output in square brackets: e.g. "Mbox Primary MacBook Pro [002]"
  - Extremely long computer names may result in the name getting truncated, try to keep the computer's share name to 12 characters or less if possible.
+ Each instance of Mbox software will ignore NDI output from itself, but can receive NDI from other instances 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.
+ By default, Mbox v5 outputs NDI streams using YUV encoding, without an alpha channel. Starting with Mbox v5.2, NDI output streams can be either YUV or RGBA. RGBA output includes an alpha channel, YUV output has no alpha channel. The NDI Output Format preference allows the format to be selected.
+ Mbox can send (and receive) NDI on any of the active network interfaces on the computer upon which there is a route between sending and receiving devices. This means that it is possible to use more than one interface for NDI, and that any single NDI stream can be sent using more than one interface as well. While using more than one interface for NDI may seem to be desirable, in practice this can lead to issues. The recommendation is that all NDI signals should always be kept on a single, separate network interface from all other Ethernet protocols - e.g. Art-Net, sACN, and Mbox content syncing.
+ Mbox outputs standard Single TCP NDI. It cannot send multicast NDI.
+ Mbox can work with an NDI Discovery Server. The Discovery Server's IP address can be viewed or edited using the NDI Access Manager application or via the NDI Discovery Server IP preference in Mbox. Using the preference in Mbox is simplest - enter an IP address to use a Discovery Server, or delete the IP address to disable Discovery Server functionality. The Discovery Server should always run on a separate computer.

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 incompatible or incorrectly formatted may not play at all or may not play as well as compatible 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 as the basis for its playback engine. 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. Therefore, 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 without conversion. However, this does not mean that Mbox can successfully play any movie that QuickTime Player can open and play, since that application works in a different manner to Mbox in many cases.

Note: Mbox can play movies files that use the HAP codec, but QuickTime Player cannot. The ProRes and HAP codecs do not need to be installed to allow Mbox to play movie encoded using ProRes or HAP.

File Extension

QuickTime movies can have many different 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 that 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.

Codec

A movie's codec (**co**der/**dec**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 Apple ProRes, Photo-JPEG, H.264, HAP, or DV codecs will actually play. And within that list of codecs, only ProRes, HAP, and Photo-JPEG 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 (H.264 and DV) are handed off to a playback engine based on AVFoundation that has less functionality than the enhanced engine.

One of the supported ProRes codec's formats should be the first choice when creating content for Mbox. The Photo-JPEG codec and the supported HAP codecs will work well, although there are some additional considerations that must be taken into account when using them. Movies created using any other codec may not play at all or as well as those using a preferred codec:

+ Apple ProRes is a family of high-quality, spatially compressed, scalable codecs that were designed to compress HD content sufficiently to keep bitrates at SD levels. Decoding of ProRes can be multi-threaded, providing better performance on computers with multiple CPU cores. Newer Mac computers may include dedicated hardware to aid in decoding ProRes. 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. Mbox supports ProRes: 422 Proxy, 422 Lite, 422 Normal, 422 High Quality, and 4444 (which includes alpha channel support).

WARNING!: When using ProRes422 formats (but not ProRes4444) with Mbox v5, for best results all movies must have a width that is a multiple of two - i.e. an even number!

+ 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 CPU-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 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. The result of this is that adjustments to playspeed and in/out frames can cause jerky playback with H.264 content and movie load times can be longer than with other codecs. Therefore, using H.264 is not recommended in many 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 format typically used by older video cameras. For best results, DV-encoded movies must conform to either NTSC or PAL resolutions, rather than some other resolution. The quality of DV is not as high as that of Photo-JPEG, though it may be less processor-intensive. DV movies may be interlaced and therefore can look quite poor, especially if there is fast motion in the movie.

CAUTION! Mbox does not support playback of content using the DVCPro codec, only the DV codec.

+ HAP is decompressed using the GPU rather than the CPU. Mbox uses APIs that enable the GPU-decoding for HAP movie content. This can allow computers with fewer/slower CPU cores to have better performance using HAP than with other codecs, provided they have a powerful GPU. HAP content can have a high bitrate and therefore require a fast disk with good bandwidth. Mbox supports HAP, HAP Alpha, HAP Q, HAP Q Alpha, and HAP Alpha Only.

Compression (Bitrate)

Movie compression can have a large impact on playback performance. With higher compression, a movie file will be smaller (on disk) and its bitrate will be lower. Under normal circumstances, when deciding between higher or lower compression, there will be a point where either quality or playback becomes unacceptable. Higher compression (lower quality) might play very well, but look unacceptable. Lower compression (higher quality) may look better but performance may suffer.

Therefore, 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 created. Exclusive of other performance bottlenecks like decompression and rendering, lower bitrates can help lead to better playback if the Mbox computer's storage device is 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 storage device.

Another factor to consider when thinking about compression is the computer's ability to rapidly decompress the movie. Some codecs require the CPU to perform all decompression tasks. A computer with a larger number of fast CPU cores can make a difference, as can codecs like ProRes that can be decompressed on more than one CPU core at a time. HAP makes use of the computer's GPU to perform the decompression task, thereby reducing the load on the CPU. Newer Apple Silicon computers include hardware decoding for ProRes, and make a significant different in performance.

As a rule of thumb, movie bitrates for Mbox should be kept below 300Mbits/sec in order to play content on multiple layers at the same time. Mbox can handle bitrates up to approximately 1600Mbits/sec.

Frame Rate

Movie frame rate must be considered when creating content for Mbox. For the best results, content should be rendered at a frame rate that is exactly one-half of the intended refresh frequency of Mbox's video output. e.g. If the connected display has a 60Hz refresh, movies should be created at a frame rate of 30fps.

Content with frame rates that are not one-half of the output frequency can be used, but there may be noticeable effects depending on the difference in rate. In the above example, if the movie has fewer than 30fps, then Mbox must repeat some frames and the movie could 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 typically looks better with a 60Hz output than 24fps content does. If the Mbox output frequency is 50Hz, then content should be rendered at 25fps. If output frequency is 59.94Hz, then content should be rendered at 29.97fps, and so on. Mbox's frame blending can 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 78 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 no point to attempting to play a movie made with 120fps if the computer's output refreshes at on 60Hz as one-half of the frames will not be displayed.

Note: In most situations, based on the connected display device(s), the refresh frequency for the Mbox computer will be 60Hz at most. Therefore, the maximum frame rate for movie content should be 60fps.

For best results, all content for a specific event should be created using the same framerate; e.g. all movies or image sequences for one show might be 30fps, rather than some being 30fps and others being 24fps. It is also 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 is only rendered in sync with the first output's refresh. Therefore content displayed on 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. Typically, the larger a movie's pixel dimensions, the harder it is to play. For best performance, always 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, etc. - but for the most part, there is often little point in playing content that has a higher resolution than the display it will be viewed on. But admittedly, the smallest possible movie is not always the one that looks the best with every setup, so make sure to test in advance if possible.

WARNING!: See warning on page 180 regarding the width of ProRes422 content.

Mbox v5 does have a limit to the resolution of visual content, imposed by the computer's graphics system and OS. This limit is 16,384 x 16,384. As long as content is smaller than this limit and the Mbox computer's hardware can support reading the movie from the hard drive, decoding it, and rendering it without dropping frames then that content is fine to use. Newer Apple Silicon processor computers will generally provide better performance than older Intel computers. In all cases, the power and speed of the computer will factor into the results.

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 compatible 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. Depending on the computer hardware, unless the movie is fairly small and/or has a reasonable bit-rate (< 600mbits/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 HAP codecs 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 a 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 600Mbits/sec if at all possible.

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.
+ 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 47 for more information on locking image sequences.

Color Space/Profile

When creating visual content for use with Mbox, the color space or color profile of the content should be considered. For best results with Mbox, it is recommended that content be created using the standard sRGB IEC61966-2.1 profile. This may also be referred to as just "sRGB" depending on the application used for content creation.

Other color profiles like Rec.ITU-R BT.709-5 (Rec709), Rec.ITU-R BT.2020-1 (Rec2020), and Display P3 may also work well, as long as the profile's chromaticity is the same as or similar to that of sRGB. Avoid using color profiles with a gamma value outside the range of 2.0 to 2.4, and those with PQ, HLG, or HDR in their name.

CAUTION: The QuickTime Player application is a poor tool for color comparison, as it uses a different gamma value for displaying movies.

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 102 for more information)

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. 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 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 can play directly from the file - the embedded audio must use AAC audio encoding, otherwise the audio will not play properly.

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 "Audio Output" on page 102 for more information.

Note: Mbox v3 required uncompressed LPCM encoding for embedded audio, therefore movies with embedded audio that were made for Mbox v3 may be converted before being used in Mbox v5. 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 "Audio Output Volume Control" on page 103 for details.

Applications for Content Creation

There are many applications that can be used to create or edit content for Mbox. 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.

+ 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.
+ To create and/or play content outside of Mbox using some codecs (e.g. HAP), the corresponding codec component may need to be installed on the computer, and the application must support exports using that codec. Newer versions of the Adobe suite and most applications on the PC may not support ProRes or HAP without 3rd-party plugins. Alternatives like FFMPEG can be used, but can be more complicated.

MEDIA UTILITY APPLICATIONS

Mbox Media Lock

Note: The Mbox Media Lock utility was only installed and used on older versions of PRG's 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 provided a way to lock (copy protect) custom content on PRG's standard rental Mbox server. Mbox Media Lock will not work on computers running newer versions of macOS and is therefore no longer included as part of the Mbox software installation.

When an attempting to play locked content on an Mbox computer that does not have the correct username and password entered, Mbox will display nothing on the layer unless the "Show Diagnostics" preference is enabled, in which case the "locked content image will be displayed. Otherwise, there is no other notification that a file is locked.

Mbox Media ID

The Mbox Media ID application is included with the installation of the Mbox software and is placed in the /Applications/Mbox Utilities folder. Mbox Media ID can be used to perform simple batch renaming or numbering of files. Folders with content that needs to be batch-renamed can be dragged and dropped onto the application's UI, and then the files from that folder can have their file extension and/or numerical prefix removed or added, and can also have specific text removed or appended to the file name.

AVF Batch Converter

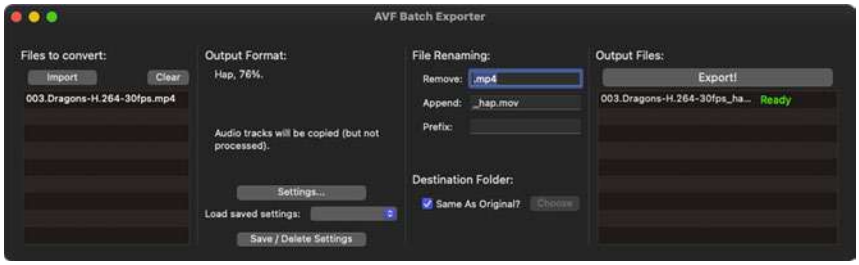
In some cases, Mbox may not be able to play custom movie content at all, or playback may not be smooth. This can happen for many reasons, but the most common reasons are the use of incompatible codecs or improperly-formed movies. If this happens and the "Show Diagnostics" preference is enabled on the Preferences tab, (Refer to "Preferences Table - Categories and Preferences" on page 56) Mbox may display the broken movie image (shown at right). This diagnostic image indicates that there is a problem with the movie file and that Mbox cannot play it at all. However, this image will not appear if a movie uses a compatible codec but does not play smoothly.

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 39) If the movie is not using one of these codecs, it can be converted to a preferred codec using the AVF Batch Converter application. If the movie is already using the one of the preferred codecs, then the AVF Batch Converter application can be used in an attempt to eliminate the problem.

IMPORTANT! The AVF Batch Converter application was created by VidVox LLC (https://vidvox.net) and is included in the Mbox installers with their permission - big thank you to David Lublin! The PRG team has made minor changes to the original code of this application, to expand the available ProRes versions for export, and resolve some issues in the UI. Therefore, the version that is installed with Mbox is not identical to the version available directly from VidVox. But the functionality is much the same.

About File Conversion

The AVF Batch Converter application accepts file imports or drops of more than one movie file at a time. Files are processed one at a time with additional files being queued. All converted files are created as new copies of the original file and can be placed in the same location as the original file or a new folder. The converted files can be renamed using tools that allow the files' names to be modified according to pre-set file-renaming specifications. 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

Press the "Settings..." button to open a pane that allows the conversion settings for both video and audio to be configured. All files dropped in the "Files to convert" list will be converted using the same settings. There are quite a few settings that can be modified: Output Codec, Quality, Resizing, plus Audio Transcoding.

+ **Output Codec:** This setting applies to the video codec used to transcode the video track in the file. The codec pop-up has eleven possible values: PJPEG, H264, six versions of ProRes, and four versions of HAP.
  - Depending on the codec selected, the options available will vary. PJPEG provides only a quality setting, H264 provides settings for profile, key frames, data rate, and multi-pass encoding, and HAP provides settings for quality and chunked en/decoding.
+ **Quality:** This setting only applies for conversions to Photo-JPEG, HAP, and HAP Alpha. With PJPEG, there is little point in using a quality greater than 80%.
+ **Chunked En/Decoding:** This setting only applies to HAP codecs. Chunking can provide better performance with higher-resolution content on computers with multiple CPU cores. This value should never be set to a value higher than the number of CPU cores on the intended playback computer.
+ **Profile:** This setting only applies to H264. Typically the Main Profile Auto Level or High Profile Auto Level is appropriate for use with Mbox.
+ **Key Frames:** This setting only applies to H264. This sets how often key frames are inserted into the track. Generally this should be once per second. Adding more keyframes may help to provide better results with playback in Mbox in some cases, but comes at the expense of a higher overall bitrate.
+ **Data Rate:** This setting only applies to H264. Typically this should be set to automatic as setting a value manually my result in poor quality.

+ **Multi-pass encoding:** This setting only applies to H264. Multi-pass encoding will be slower and is not necessary for files used by Mbox.
+ **Don't Recompress Video:** If this button is pressed, the video track in each processed file can either be copied (not transcoded) or stripped (removed) from the resulting output file.
  - If the intention is to use this output file with Mbox, the video track should never be removed from the output file!
  - If a video track is copied, it will not be converted, but the audio track in the movie can be converted or removed.
+ **Resize the Video:** If this button is pressed, the video track can be resized. It is not recommended that this functionality be used with movies intended for use with Mbox, as the resulting quality may be undesirable.
+ **Audio Codec:** This setting applied to the audio codec used to transcode the audio in the file. The audio codec pop-up has three possible values: Linear PCM, AAC, and Apple Lossless.
  - Depending on the codec selected, the options available will vary. Linear PCM provides settings for sample size, little endian, and floating point. AAC provides settings for bitrate strategy and target bitrate. Apple Lossless provides a setting for bitrate hint.
  - For use with Mbox, only the Linear PCM or AAC codecs should be used and not the Apple Lossless option!
  - The Linear PCM codec is appropriate for both stereo and multichannel output, but will require the use of a sidecar audio file (Refer to "External Audio Files" on page 103) for proper playback by Mbox. For best results, Linear PCM audio for use with Mbox should be little endian and have a sample size of 16 or 24 bits.
  - The AAC codec is appropriate only for stereo output and does not require the use of sidecar audio. For best results, AAC audio for use with Mbox should have a bitrate of at most 192 kbps.
+ **Don't Recompress Audio:** If this button is pressed, the audio track in each processed file can either be copied (not transcoded) or stripped (removed) from the resulting output file.

File Conversion Procedure

Step 1. Locate the AVF Batch Converter application in the /Applications/Mbox Utilities folder. Double-click its icon to launch the application. Drag and drop movie files onto the "Files to convert" list or press the "Import" button to select files in a Finder dialog window.

Step 2. Adjust settings for video and audio as desired

Step 3. Adjust file renaming values as desired and select new destination folder if desired.

Step 4. Press the "Export!" button to convert all files.

Step 5. If converted files were placed in the same folder as the original files, manually (re)move the original files from the folder, so there are not two files with the same index value.

Note: Movie file conversion with the AVF Batch Converter application does not require that any additional codec .component files be installed on the computer.

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 must 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.

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B.

NOTABLE CHANGES FROM MBOX v4

This chapter briefly outlines notable changes between Mbox v4 and v5.

+ MBOX DAEMON
+ LAYER X/Y POSITION PARAMETERS
+ DRAW MODES
+ OBJECT (3D) EFFECTS
+ TEXTURE EFFECTS
+ 3D CAMERA
+ COLOR CONTROLS
+ IMAGE REMAPPING
+ PIXEL MAPPING PREVISUALIZATION
+ OUTPUT MASTERS AND PIXEL MAPPING
+ NDI OUTPUT
+ CITP/MSEX
+ PROFILE EMULATION
+ LICENSES

NOTABLE CHANGES FROM MBOX V4

This section reviews features that have been added, changed, or removed in Mbox v5 as compared to Mbox v4

There have been some substantial changes in the Mbox software between Mbox v4.4.x and Mbox v5. Most of these changes are to make the Mbox application a universal binary and to switch from OpenGL to Metal. But some other changes have resulted in adding or removing features, or changing how features work in some cases.

When switching between versions it may be necessary to change the way that certain results are achieved.

Mbox Daemon

The version of Daemon used with Mbox is critical for correct function. i.e. Do not use Daemon v4.x with Mbox v5.x and vice versa. The formatting of the database that Mbox and Daemon use for content management and synchronization is different between v3 and v4/v5. If switching between major 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 X/Y Position Parameters

In Mbox v4, the layer X and Y Position parameters converted the incoming DMX value to onscreen pixels using different scales - the X:Y ratio was 4:3. An X Position value change caused a larger onscreen position change (1.33x larger) vs. that for an equal Y Position value change. In Mbox v5 the ratio is 1:1, which results in equal onscreen position changes for equal incoming DMX value changes.

Draw Modes

Due to changes in the methods for rendering between Mbox v4 and v5, the concept of Draw Modes, which was found in Mbox v4, is not yet implemented in Mbox v5. If possible, this functionality will be restored in a future version of Mbox.

Object (3D) Effects (AKA Matrix-based Effects)

Most but not all of the “object” effects found in Mbox v4 remain in Mbox v5. The Spin w/ Stop @ 127 matrix-based effect (#231) now only spins textures on the Z axis, but can spin 3D objects on all three axes.

Texture Effects

Mbox v5 keeps almost all the same texture (2D) effects as Mbox v4 and many new effects have been added. The Decay effect (#153) has been removed and the Histogram effect (#188) has been replaced by Thermal. New effects like Gain Clamp (#028), Color Temp and Tint (#029), Dither (#149), Bayer Dither (#150), CRT (#198), Metaballs (#199), Z Spin (#200), and Line Overlay (#201) have been added.

CAUTION! Some effects may take a while to load the first time they are used. This is 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.

3D Camera

Mbox Designer v5’s 3D camera works in the exact same manner as the 3D camera in Mbox v4. However, the position and FOV of the default Global Surface camera has been changed to use the same values as the defaults for the configurable/controllable 3D camera. These changes affect how large 3D objects appear to be when the default camera is used. In Mbox v5, objects will appear to be smaller in such cases.

Color Controls

Color controls on Mbox's layers and output masters are now 16-bit, and now have a default of 32767.

Image Remapping (Multiscreen gobo)

In Mbox v4, Image Remapping had an Active and Texture size (width and height) limit of 8192 x 8192. In Mbox v5, this limit has been increased to 16384 x 16384.

Pixel Mapping Previsualization

Mbox v4 included functionality that allowed an onscreen previsualized version of portions of the pixel mapping output to be viewed on the outputs of the Mbox application. At present time, this functionality is not available in the Mbox v5 application.

Output Masters and Pixel Mapping

When using an output as the source for a pixel mapping context, in Mbox v4 the majority of the output master parameters did not affect the pixel mapping output. This was because the pixel mapping sample happened earlier in the rendering pipeline than these parameter changes were applies. In Mbox v5, all of the output master parameters affect the pixel mapping output. For this reason it may be advisable to create additional outputs strictly for pixel mapping mastering when mixing pixel mapping and normal video output.

NDI Output

Mbox v4 output NDI streams using RGB encoding, with an alpha channel. This meant that blank/empty areas of the Global Surface were output with full transparency. Mbox v5 adds a preference to select either RGB encoding, with an alpha channel, or YUV encoding, without an alpha channel. Mbox v5 also adds a preference to set the rate of the NDI output.

CITP/MSEX

Mbox v5 continues to use CITP/MSEX (v1.1) for the transfer of thumbnails to consoles and the streaming of imagery to consoles and visualizers. However, for the purposes of sharing video imagery with a visualizer, NDI is a much better option than CITP/MSEX.

Profile Emulation

Mbox v5 provides emulation modes for the modes used for Mbox v4 - Mini, Studio, and Designer. These modes are intended to provide the ability to use a previously programmed show file to control the new Mbox software in most cases. Emulation for versions prior to Mbox v4 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 the previous version of the Mbox software. While every attempt has been made to ensure compatibility, some features (e.g. Draw Modes) may not work in emulation modes. Testing the functionality in advance is strongly recommend, and no guarantee of full compatibility is given.

Licenses

Mbox v5 uses a different license than Mbox v4. Therefore a soft license or USB license key for Mbox v4 will not license the Mbox v5 software. A license upgrade is required, contact Mboxsupport@prg.com or a PRG rep for more details.

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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 can be combined into groups. In keeping with generic lighting control terminology, each of these groups may be 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 v5. 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 v5.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 license levels of Mbox use 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 14 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.

3D Lighting Fixtures

For the Mbox Designer and Studio license levels, the five virtual 3D lighting fixtures provide adjustable lighting for 3D objects displayed within Mbox's 3D environment. Each virtual 3D 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 an output. Additional functionality provides output effect selection and adjustment, 3D Camera configuration (Mbox Designer license level only), output geometry, keystone, and shuttering.

Mbox v5 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 usually 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. Each effect in Mbox v5 allows 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: With the Mbox Designer license level, multiple outputs can each have a separate 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 provides 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, effects to modify imagery, volume control for audio on the layer, and 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 shader-based effects (1 - 220) and matrix-based 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 up to 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.

Starting with Mbox v5.2, the Layer DMX Timecode parameters can be used as an alternate to set the layer's in frame and out frame. This functionality allows the layer's in/out frame to be set in minutes, seconds, and frames rather than with a 16-bit number or frame number - as with the standard in/out frame parameters. This functionality cannot be combined with the standard live timecode sync functionality for the layer in question.

Guidelines for setting In/Out Frame using the Layer DMX Timecode parameters:

+ When the hours parameter value is less than 254, the standard functionality of the timecode parameters is retained. If the hours value has been set to a value greater than 253 - in order to set the in or out frame value - and is then returned to a value less than 254, the standard in/out frame parameter values will be immediately reapplied.
+ Setting the hours parameter to a value of 254 causes the standard in frame parameter to be overridden by a value created from the timecode minutes, seconds, and frames values.
+ Setting the hours parameter to a value of 255 causes the standard out frame parameter to be overridden by a value created from the timecode minutes, seconds, and frames values.
+ When used for this purpose: the frames parameter allows a maximum value of 59 (for 60fps content), the seconds parameter allows a maximum value of 59, and the minutes parameter allows a maximum value of 255 (i.e. 4 hours, 15 minutes).
    - The values for minutes, seconds, and frames are added together to get the actual in/out frame value. Therefore the maximum time is approximately 4 hours, 16 minutes, and 2 seconds. Therefore, if any movie is longer than that, this method may not be useful to set the in/out frame values.
+ Only the in frame or the out frame can be set at one time. Additionally, as soon as the hours value is set to 254 or 255, the corresponding in/out frame value will immediately be applied! Therefore this functionality may be best reserved for deliberate setup actions rather than live adjustment. A typical method of usage would be in a sequence of preset cues:
    - Cue 1: With opacity and playspeed at 0, select content, set hours parameter to 254 and select minutes, seconds, and frames values to set in frame.
    - Cue 2: Set hours parameter to 255 and select minutes, seconds, and frames values to set out frame.
    - Cue 3: Leaving the hours parameter at 255, restore playspeed to the desired rate and raise opacity above 0.
+ This method of setting in/out frames achieves the best accuracy when movies are rendered at exactly 30fps. When movies use a different frame rate, the accuracy may not be perfect, but will be within 1 or 2 frames.

PATCHING NOTES

Note: This manual describes only the new patch layouts for Mbox v5. For information on patch layouts for the Mbox v4 control modes, please refer to the Mbox v4 user manual.

Output Master Guidelines

CAUTION! When patching multiple Output Masters, care must be taken to get the patch ordering correct.

The Mbox Designer license allows up to 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 98 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 virtual 3D 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). If even more Output Masters are added, the playback layers will always be moved up by one universe when Output Masters are added beyond the limit of the last existing universe that contains them.
+ 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.

The Mbox Studio/Studio+ license allows up to 8 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 68 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 virtual 3D Lighting fixtures - at address 51.
+ Six Output Masters will fit into the first universe. The seventh and eighth Output Master must be placed on the next consecutive universe.
+ Universe Offset 0 = Output Masters 1 – 6
+ Universe Offset +1 = Output Master 7 & 8
+ When seven or 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.

The Mbox Mini license allows up to 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 45 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 four playback layers. If more than three Output Masters are used, the sixth Layer must be placed on the next consecutive universe. If more than four Output Masters are used, the fifth and sixth Layers must be placed on the next consecutive universe.
+ Universe Offset 0 = Output Masters 1 – 6 and Layers 1 – 4 (Layers 1 – 5 if four Output Masters are used or Layers 1 - 6 if fewer than four Output Masters are used)
+ Universe Offset +1 = Layer 6 if more than three Output Masters are used and Layer 5 and 6 if more than four Output Masters are used.
+ The controls for playback layers always start on the first control universe (universe offset 0), and Layer 6 will be moved up one universe (to offset +1) if more than three Output Masters are used. Layers 5 and 6 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.

CAUTION: The Mbox v5 application's Patch tab UI shows the allowed number of Output Masters and Layers based on the current license level. The patch layout can only be configured with the maximum allowed number. However, when using a higher-level license than the selected control mode (e.g. a Studio license with Mini control mode) additional Output Masters and Layers can be patched and used - beyond the limit implied by the control mode, but only up to the limit imposed by the active license.

Note: Without a license (in demo mode), the Mbox application is limited to 2 Output Masters, 6 playback layers, and an output pixel resolution of 3840 x 2160.

PATCH ORDER SUMMARIES

Summary: Mbox Designer

Start	Size	Type	Sub-Type	Universe
1	5	Global Master		1st 148 Total Channels (1 Master)
6	9	3D Light 1		
15	9	3D Light 2		
24	9	3D Light 3		
33	9	3D Light 4		
42	9	3D Light 5		
51	11	Output Master 1	Base	
62	6		FX 1	
68	6		FX 2	
74	16		Camera	
90	12		Geometry	
102	26		Keystone	
128	21		Shutter	
Up to 31 additional Output Masters may be added, 98 channels each, using consecutive universes as necessary.				
1	55	Layer 1	Base	Next Universe after Masters 504 Total Channels (6 Layers)
56	6		FX 1	
62	6		FX 2	
68	6		FX 3	
74	6		FX 4	
80	1		Audio Volume	
81	4		DMX Timecode	
85	84	Layer 2		
169	84	Layer 3		
253	84	Layer 4		
337	84	Layer 5		
421	84	Layer 6		
Up to 18 additional Layers may be added, 84 channels each, using consecutive universes as necessary.				

Summary: Mbox Studio

Start	Size	Type	Sub-Type	Universe
1	5	Global Master		1st 118 Total Channels (1 Master)
6	9	3D Light 1		
15	9	3D Light 2		
24	9	3D Light 3		
33	9	3D Light 4		
42	9	3D Light 5		
51	11	Output Master 1	Base	
62	6		FX	
68	12		Geometry	
80	26		Keystone	
106	13		Shutter	
Up to 7 additional Output Masters may be added, 68 channels each, using consecutive universes as necessary.				
1	46	Layer 1	Base	Next Universe after Masters 504 Total Channels (8 Layers)
47	6		FX 1	
53	6		FX 2	
59	1		Audio Volume	
60	4		DMX Timecode	
64	63	Layer 2		
127	63	Layer 3		
190	63	Layer 4		
253	63	Layer 5		
316	63	Layer 6		
379	63	Layer 7		
442	63	Layer 8		
Up to 4 additional Layers may be added, 63 channels each, using the next consecutive universe.				

Summary: Mbox Mini

Start	Size	Type	Sub-Type	Universe
1	5	Global Master		1st 50 Total Channels (1 Master)
6	11	Output Master 1	Base	
17	6		FX	
23	16		Keystone	
39	12		Shutter	
Up to 5 additional Output Masters may be added, 45 channels each, using consecutive addresses. Patch before any layers!!				
51	46	Layer 1	Base	Same Universe after Masters 342 Total Channels (6 Layers)
97	6		FX	
103	1		Audio Volume	
104	4		DMX Timecode	
108	57	Layer 2		
165	57	Layer 3		
222	57	Layer 4		
279	57	Layer 5		
336	57	Layer 6		
If more than 3 Output Masters are used, Layers may need to be moved to the next consecutive universe.				

Pixel Mapping Group Control Fixture

Start	Size	Type	Sub-Type	Universe
1	6	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 using 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 most 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 control modes. The applicable mode 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**			

3D 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	2	Red	32767	N	Subtractive 0-32766, Additive 32768-65535
3	2	Green	32767	N	Subtractive 0-32766, Additive 32768-65535
4	2	Blue	32767	N	Subtractive 0-32766, Additive 32768-65535
5	2	Brightness	32767	N	
6	2	Contrast	32767	N	
	11	**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	Top-left corner X axis
9	2	Keystone 1y	32767	N	Top-left corner Y axis
11	2	Keystone 2x	32767	N	Top-right corner X axis
13	2	Keystone 2y	32767	N	Top-right corner Y axis
15	2	Keystone 3x	32767	N	Bottom-right corner X axis
17	2	Keystone 3y	32767	N	Bottom-right corner Y axis
19	2	Keystone 4x	32767	N	Bottom-left corner X axis
21	2	Keystone 4y	32767	N	Bottom-left corner Y axis
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	Top-left corner X axis
3	2	Keystone 1y	32767	N	Top-left corner Y axis
5	2	Keystone 2x	32767	N	Top-right corner X axis
7	2	Keystone 2y	32767	N	Top-right corner Y axis
9	2	Keystone 3x	32767	N	Bottom-right corner X axis
11	2	Keystone 3y	32767	N	Bottom-right corner Y axis
13	2	Keystone 4x	32767	N	Bottom-left corner X axis
15	2	Keystone 4y	32767	N	Bottom-left corner Y axis
	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	Left edge control A
7	1	Shutter 1b	0	N	Left edge control B
8	1	Shutter 2a	0	N	Top edge control A
9	1	Shutter 2b	0	N	Top edge control B
10	1	Shutter 3a	0	N	Right edge control A
11	1	Shutter 3b	0	N	Right edge control B
12	1	Shutter 4a	0	N	Bottom edge control A
13	1	Shutter 4b	0	N	Bottom edge control B
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	Left edge control A
7	1	Shutter 1b	0	N	Left edge control B
8	1	Shutter 2a	0	N	Top edge control A
9	1	Shutter 2b	0	N	Top edge control B
10	1	Shutter 3a	0	N	Right edge control A
11	1	Shutter 3b	0	N	Right edge control B
12	1	Shutter 4a	0	N	Bottom edge control A
13	1	Shutter 4b	0	N	Bottom edge control B
	13	**Total Channels**			

Output Master Shutter [Mini]

Chan	Size	Function	Default	Snap	Notes
1	1	Red	0	N	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	Left edge control A
6	1	Shutter 1b	0	N	Left edge control B
7	1	Shutter 2a	0	N	Top edge control A
8	1	Shutter 2b	0	N	Top edge control B
9	1	Shutter 3a	0	N	Right edge control A
10	1	Shutter 3b	0	N	Right edge control B
11	1	Shutter 4a	0	N	Bottom edge control A
12	1	Shutter 4b	0	N	Bottom edge control B
	12	**Total Channels**			

Layer Base [Designer]

Chan	Size	Function	Default	Snap	Notes
1	1	Opacity	0	N	
2	2	Red	32767	N	Subtractive 0-32766, Additive 32768-65535
4	2	Green	32767	N	Subtractive 0-32766, Additive 32768-65535
6	2	Blue	32767	N	Subtractive 0-32766, Additive 32768-65535
8	2	Brightness	32767	N	
10	2	Contrast	32767	N	
12	1	Texture Folder	0	Y	Folder 255: see Video and Utility Inputs
13	1	Texture File	0	Y	
14	1	Play Mode	0	Y	See Play Modes
15	1	Play Speed	127	N	See Play Speed
16	2	In Frame	0	N	
18	2	Out Frame	65535	N	
20	1	Sync Stream	0	Y	See Sync Streams
21	1	Sync Offset	127	N	
22	1	Aspect Ratio	0	N	See Aspect Control
23	1	Frame Blending	255	N	See Frame Blending Control
24	1	Texture Xfade Type	0	Y	See Texture Transitions
25	1	Texture Xfade Time	0	Y	See Texture Transition Timing
26	1	Object Folder	0	Y	
27	1	Object File	0	Y	
28	2	X Position	32767	N	
30	2	Y Position	32767	N	
32	2	Z Position	32767	N	
34	2	Scale	32767	N	
36	2	X Scale	32767	N	
38	2	Y Scale	32767	N	
40	2	Z Scale	32767	N	
42	2	Z Rotation	32767	N	
44	2	X Rotation	32767	N	
46	2	Y Rotation	32767	N	
48	1	Z Spin	127	N	
49	1	X Spin	127	N	
50	1	Y Spin	127	N	
51	1	Mix Select	0	Y	
52	1	Mix Mode	0	Y	See Layer Mix Modes
53	1	Blend Mode	0	Y	See Blend Modes
54	1	TBD	0	Y	TBD
55	1	Image Remap	0	Y	
	55	**Total Channels**			

Layer Base [Studio or Studio+/Mini]

Chan	Size	Function	Default	Snap	Notes
1	1	Opacity	0	N	
2	2	Red	32767	N	Subtractive 0-32766, Additive 32768-65535
4	2	Green	32767	N	Subtractive 0-32766, Additive 32768-65535
6	2	Blue	32767	N	Subtractive 0-32766, Additive 32768-65535
8	2	Brightness	32767	N	
10	2	Contrast	32767	N	
12	1	Texture Folder	0	Y	Folder 255: see Video and Utility Inputs
13	1	Texture File	0	Y	
14	1	Play Mode	0	Y	See Play Modes
15	1	Play Speed	127	N	See Play Speed
16	2	In Frame	0	N	
18	2	Out Frame	65535	N	
20	1	Sync Stream	0	Y	See Sync Streams
21	1	Sync Offset	127	N	
22	1	Frame Blending	255	N	See Frame Blending Control
23	1	Texture Xfade Type	0	Y	See Texture Transitions
24	1	Texture Xfade Time	0	Y	See Texture Transition Timing
25	1	Object File	0	Y	
26	2	X Position	32767	N	
28	2	Y Position	32767	N	
30	2	Scale	32767	N	
32	2	X Scale	32767	N	
34	2	Y Scale	32767	N	
36	2	Z Rotation	32767	N	
38	2	X Rotation	32767	N	
40	2	Y Rotation	32767	N	
42	1	Mix Select	0	Y	
43	1	Mix Mode	0	Y	See Layer Mix Modes
44	1	Blend Mode	0	Y	See Blend Modes
45	1	TBD	0	Y	TBD
46	1	Image Remap	0	Y	
	46	**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	
6	1	White/Amber/Lime	255	N	
	6	**Total Channels**			

FIXTURE PARAMETER DESCRIPTIONS

The data in these charts is organized by product control mode. 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
3D 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
		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
		TBD	TBD
		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
3D 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
		TBD	TBD
		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

Parameter Descriptions: Mbox Mini 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 8 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
		TBD	TBD
		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
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
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
206	Select ArtTimeCode Stream		N/A	0-255 for stream number
207	Rebuild Daemon Database		Value then 0	N/A
208	Rebuild Daemon Webpages		Value then 0	N/A
214	Show Single Mix with X	Show outline + diagonals of one mix	N/A	Mix index number
215	Show All Mixes with X	Show outline + diagonals of all mixes	N/A	N/A
216	Show Output Mixes with X	Show outline + diagonals of output mixes	N/A	N/A
217	Show Single Mix Filled	Show filled rectangle of one mix	N/A	Mix index number
218	Show All Mixes Filled	Show filled rectangles of all mixes	N/A	N/A
219	Show Output Mixes Filled	Show filled rectangles of output mixes	N/A	N/A
220	Cancel Keyboard HUD		Value then 0	N/A
221	Show Topo Grid	Shows grid overlay on topo objects	N/A	0 = all layers, 1-24 = individual layers
222	Show Edge-blend guides	Shows guides for blend areas	N/A	N/A
224	Show Single Mix	Show outline of one mix	N/A	Mix index number

Global Master Control Channel continued...

Value	Command	Notes	Macro Trigger Action	Master Control Selector
225	Show All Mixes	Show outline of all mixes	N/A	N/A
226	Show Output Mixes	Show outline of output mixes	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
248	Enable White Square	"No Media at index" white square shown	Value then 0	N/A
249	Disable White Square	"No Media at index" white square not shown	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	N/A
253	Restart Mbox Application		Hold 3-sec then 0	N/A
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	Size Limit
0	NONE	No effect						
1	Hue	Simple hue adjustment	Hue angle					
2	Hue Saturation Value	Combined hue saturation & value adjustment	Hue angle (127=def)	Saturation (127=def.)	Value (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.)			
26	RGB Contrast	Adjusts contrast by color	Overall (127=def.)	Red (127=def.)	Green (127=def.)	Blue (127=def.)		

Combined Effects continued...

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5	Size Limit
27	RGB Gamma	Adjusts gamma by color	Overall (80=def.)	Red (80=def.)	Green (80=def.)	Blue (80=def.)		
28	Gain Clamp	Limits min and max brightness level	Mode[3]	Amount (Mode 0)	Top Limit	Bottom Limit		
29	Color Temp and Tint[4]	Adjusts color temp and tint based on base and target levels	Mixer	Base Temp (127=def.)	Base Tint (127=def.)	Target Temp (127=def.)	Target Tint (127=def.)	
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		
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		6500 x 3656
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					

Combined Effects continued...

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5	Size Limit
64	Crop - Circular	Circular image crop with soft edge	Mixer	Size	Edge	Mode		
65	Crop - Rectangular	Rectangular image crop with soft edge	Mixer	Size	Edge	Mode		
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	Aspect	Size	Edge	X position (127=def.)	Y position (127=def.)	
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	Crop - Circular XY Reverse	Circular image crop from inside out with soft edge & xy position adjust	Mixer	Size	Edge	X position (127=def.)	Y position (127=def.)	
80	Crop - Rectangular XY Reverse	Rectangular image crop from inside out with soft edge & xy position adjust	Mixer	Size	Edge	X position (127=def.)	Y position (127=def.)	
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	Size Limit
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	Crop - Rectangular XY Aspect	Rectangular image crop with soft edge, xy position, and aspect adjust	Aspect	Size	Edge	X position (127=def.)	Y position (127=def.)	
88	Crop - Rectangular XY Aspect Reverse	Rectangular image crop from inside out with soft edge, xy position, and aspect adjust	Aspect	Size	Edge	X position (127=def.)	Y position (127=def.)	
89	Crop - Oval XY Reverse	Oval image crop from inside out with soft edge & xy position adjust	Aspect	Size	Edge	X position (127=def.)	Y position (127=def.)	
90	Mask from File	Creates mask using plugin image[5] with alpha	Mixer	File index number	Flip mode 0-7			6500 x 3656
91	Matte from Layer	Applies alpha matte to layer using imagery from selected layer and mode	Mixer	1-24 = layer w/o FX, 101-124 = layer w/ FX	Mode[6]			5760 x 3240
92	UV Map from Layer	Uses UV Map imagery from selected layer to generate texture map	Mode[7]	1-24 = layer	Scale/ Distortion amount[8]	X position	Y position	6500 x 3656
93	Fixed Alpha Mask from Layer	Applies imagery from selected layer to alpha mask on layer	1-24 = Layer	Scale	X Position	Y Position	Rotation	5760 x 3240
94	Matte from Layer XY	Applies alpha matte to layer using imagery from selected layer and mode, w/ scale and position	1-24 = layer w/o FX, 101-124 = layer w/ FX	Mode[6]	Scale	X Position	Y position	5760 x 3240
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		

Combined Effects continued...

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5	Size Limit
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		
113	Smear - Horizontal	Spread single column over horizontal space	Mixer	Column				7000 x 3937
114	Smear - Vertical	Spread single row over vertical space	Mixer	Row				
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			
127	Tile - 1	Image tiling no gaps	Mixer	Divisions				6500 x 3656
128	Tile - 2	Image tiling with gaps	Mixer	Horizontal divisions	Horizontal spacing	Vertical divisions	Vertical spacing	6500 x 3656
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	Tile - Repeats	Image Tiling with variable direction, number of repeats, and XY offset	Mode (Direction)	Size	Number of repeats	X offset	Y offset	5760 x 3240
144	Screen - Line	Line patterned halftone screen	Width	Angle	Sharpness			
145	Screen - Circular	Circle patterned halftone screen	Width	Sharpness	X position	Y position		
146	Screen - Dot	Dot patterned halftone screen	Width	Angle	Sharpness			
147	Screen - Hatched	Hatch patterned halftone screen	Width	Angle	Sharpness			

Combined Effects continued...

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5	Size Limit
148	Screen - CMYK Halftone	Color, halftone rendition	Width	Angle	Sharpness	GCR	UCR	
149	Dither	Simple dither	Amount					
150	Bayer Dither	Dither with selectable pattern	File[9]	Scale	Brightness			6500 x 3656
153	Reverb	Reverb/Decay/Trails[10]	Amount	Skips/Mode	Scale	X position	Y Position	
154	Black & White	Converts image to transparent/color	Mixer	Threshold	Red	Green	Blue	
155	Mirrors	Various mirror modes	Mixer	Mode				16000 x 9000
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			6500 x 3656
159	Rippling	Simple ripple effect	Mixer	Size	Granularity			5760 x 3240
160	Flicker	Dynamic flickering effect	Mixer	Size				6500 x 3656
161	Shake 2D	Dynamic shaking effect	Mixer	Size	Speed			5760 x 3240
162	Wobble	Dynamic wobbling effect	Mixer	Size	Speed			5760 x 3240
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			
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			5760 x 3240

Combined Effects continued...

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5	Size Limit
176	Meta-Image	Uses plugin image[11] to replaced sampled areas in source	Mixer	File index number	Scale	Saturation		5760 x 3240
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			5760 x 3240
180	Roll - Up	Vertical roll up	Mixer	Speed	Pause			5760 x 3240
181	Roll - Right	Horizontal roll right	Mixer	Speed	Pause			5760 x 3240
182	Roll - Left	Horizontal roll left	Mixer	Speed	Pause			5760 x 3240
183	Freeze	Freezes image	<128 idle, >127 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	Thermal	Simulated output of thermal camera						
189	Roll - XY	Horizontal & vertical roll		X amount (127=def.)	Y amount (27=def.)			5760 x 3240
190	Pillow Blocks	Egg-crate mask effect	Mixer	Multiplier	Size	Brightness	Mode[12]	
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			5760 x 3240
194	Cartoon2	Revised cartoon effect	Mixer	Line width	Color reduction	Brightness reduction		
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		
197	Traffic Sign	Break up image similar to road alert sign pattern	Mixer	Size	Brightness			
198	CRT	Simulated CRT shape and pixelation with rolling static	Size	Warp	Stripe Height	Stripe Spacing	Stripe Speed & Direction (127=def)	
199	Metaballs	Resampled conversion to blobs with color and transparent	Blur	Threshold	Red	Green	Blue	
200	Z Spin	Z spin with stop at 127 and reset at 0	Speed & Direction (127=def)					10000 x 5625

Combined Effects continued...

Value	Effect	Description	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5	Size Limit
201	Line Overlay	Converts imagery into black outline with transparency	Noise Reduction Level	Noise reduction sharpness	Edge intensity	Threshold	Contrast	
202	Waves	Creates undulations or wavelike distortion	Mixer	Mode/ Direction	Wave speed	Frequency	Intensity	5760 x 3240
211	Scrolling Gradient	White/rainbow lines or concentrics with animated motion	Mode[13]	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[14]	Speed	Scale	X scroll (127=def) or density	Y scroll (127=def) or n/a	
214	Cloud Generator	Generative cloud effect on blue sky background	Scale	Speed	Cover	Alpha	Brightness	3840 x 2160
221	LRBT Shutter	Shuttering from sides of the screen	Left	Right	Bottom	Top		
222	Move Center	Offsets rotational center of texture (not object)	X (127=def.)	Y (127=def.)				
223	Shake and Wiggle	X/Y Shake with rotational wiggle	Texture & Object X offset	Texture & Object Y offset	Texture & Object Z wiggle	Object (only) X wiggle	Object (only) Y wiggle	
224	Strobe	Strobe	Off time	On time				
225	Strobe2	Strobe effect with variable timing	Mixer	Mode[15]	Frequency	Speed	Range	6500 x 3656
228	X/Y Position & Scale Damping	Damps movement of parameters in 1/30sec increments	XY position damping	Scale damping				
229	Z Rotation & Scale Damping	Damps movement of parameters in 1/30sec increments	Z rotation damping	Scale damping				
230	Texture Flip	Flips texture drawing on objects	mode[16]					
231	Spin w/ Stop @ 127	Spin effect, allowing the spin to stop at a non-zero angle	Texture & Object Z spin: 0=home, 1-126=rev, 127=stop, 128-255=fwd	Object (only) X spin: 0=home, 1-126=rev, 127=stop, 128-255=fwd	Object (only) Y spin: 0=home, 1-126=rev, 127=stop, 128-255=fwd			
232	Timecode Burnin	Show incoming timecode value overlaid on output/ layer	Mixer	Scale	X position (127 - def.)	Y position (127 - def.)		

Notes for Combined Effects

Note 1: The Gradient effect only works if the layer has an active image. 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. 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.

Note 3: Modes for Effect 28 - Gain Clamp

Value	Description
0	Gain Threshold - gain is mastered by Amount when darker than Bottom Limit and brighter than Top Limit
1	Gain Clamp - gain is clamped between Bottom Limit and Top Limit, both using RGB luma calculation
2	Hybrid Gain Clamp - as with Mode 1, but using HSV calculation for the Top Limit

Note 4: The Color Temp and Tint effect uses two color temperature/tint reference points: “Base” being what the media uses, and “Target” being the desired conversion from baseline. It is possible to set either the baseline or target values to specific levels and then adjust the other pair of values to get the desired result. The color temperature default of 127 represents 6500K, with a minimum of ~2500K and a max of ~10500K.

Note 5: 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 6: Modes for Effects 91 and 94 - Matte from Layer and Matte from Layer XY

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 7: 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 8: 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 9: Plugin image for Effect 150 - Bayer Dither. File must be located in Mbox/plugins/images/masks using an 8-bit index number, and must use the PNG format. Image should use a Bayer Dither pattern and is limited to 1024 x 1024px.

Note 10: The Skip/Mode parameter for Effect 153 - Reverb is used to both set the frame count (value modulo 60) between repeated frames and to select a blend mode. Values 1-60 use Max blending, 61-120 Darken, 121-180 Divide, 181-240 Hard Light, 241-255 Pin Light.

Note 11: Plugin image 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 12: 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.

Note 13: Modes for Effect 211 - Scrolling Gradient

Value	Description
0	White lines, horiz. scroll, soft-edge both sides
1	White lines, horiz. scroll, soft-edge one side
2	White lines, vert. scroll, soft-edge both sides
3	White lines, vert. scroll, soft-edge both sides
4	RGBCMY lines, horiz. scroll
5	RGBCMY lines, vert. scroll
6	White lines, concentric circle scroll, soft-edge both sides

Value	Description
7	White lines, concentric circle scroll, soft-edge inside
8	White lines, concentric circle scroll, soft-edge outside
9	White lines, concentric circle shrink/grow, soft-edge inside
10	RGBCMY lines, concentric circle scroll
11	White lines, concentric square scroll, soft-edge both sides
12	RGBCMY lines, concentric square scroll

Note 14: Modes for Effect 213 - Noise Generator

Value	Description
0	Perlin Noise
1	Flow Noise
2	Caustic Noise
3	Voronoi Noise

Note 15: Modes for Effect 225 - Strobe2

Value	Description
1	Square Wave, equal on and off
2	Square Wave, hold on longer
3	Square Wave, hold off longer
4	Sine Wave, equal on and off
6	Sine Wave, adjustable on/off

Value	Description
6	Pos. Sine Wave, adjustable hold
7	Neg. Sine Wave, adjustable hold
8	Snap off, fade on
9	Snap on, fade off

Note 16: Modes for Effect 230 - Texture Flip

Value	Description
0-31	Flip X
32-63	No Flip
64-95	Flip XY
96-127	Flip Y

Value	Description
128-159	Flip XZ
160-191	Flip Z
192-223	Flip XYZ
224-255	Flip YZ

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
239	CG Amber Rectangle
240	CG Lime 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 license level (Designer/Studio/Studio+/Mini/none) 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 the Mbox Designer license. The Studio/Studio+ license allows 12 layers, and the Mini license allows 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
23	Forward Once with Ease Out
24	Forward Once, Fade Layer to Null Image at end, using Layer transition time
30	Reverse Once
31	Reverse Once, Pause when Layer Opacity = 0
32	Reverse Once, Pause and Reset to In-Point when Layer Opacity = 0
33	Reverse Once with Ease Out
34	Reverse Once, Fade to Null Image at beginning, using Layer transition time
40	Forward Bounce
43	Forward Bounce with Ease In/Out
50	Reverse Bounce
53	Reverse Bounce with Ease In/Out
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
133	Timecode sync - strict lock, Layer Opacity fades to 0 if timecode stops/drops and fades to nominal level if timecode returns, opacity fades if timecode is before in frame or after out frame
135	Timecode sync - sync then freewheel
136	Timecode sync - jam sync
137	Timecode sync - jam sync with Layer Opacity fading same as Mode 133
140	Layer Sync Receiver - Forward Loop
145	Layer Sync Receiver - Forward Once
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 output 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
62	Circle Center Reverse	Circle in from edge
63	Circle Center + Blend Reverse	Circle in from edge, blended edge
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
250	Object Dissolve - Alternate 5	“Dipless” fade out on current object, fade in on new object
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 (black areas appear transparent)
2	Screen	Similar to Additive, with less of underlying color (black areas appear transparent)
3	Multiply	Multiplies layer's color with underlying color (black areas appear opaque)
4	Subtractive	Layer's colors are subtracted from underlying colors (black areas appear transparent)
5	Exclusion	Underlying colors are inverted where layer color is lighter; layer's colors are then added to underlying colors (black areas appear transparent)
6	Subtractive Invert	Underlying colors are subtracted from layer's colors (black areas appear opaque)
7	Additive Invert	Layer's colors are inverted and are added to inverse of underlying colors (black areas appear transparent)
8	Darken	Underlying dark areas darken layer's colors (light area areas appear transparent)
9	Lighten	Underlying light areas lighten layer's colors (black areas appear transparent)
10	Subtractive 2	Alternate subtractive blend
11	Subtractive Invert 2	Alternate subtractive invert blend
12	Hard Light	Combination of Screen and Multiply
13	Alpha Matte	Makes opaque areas of the layer black
14	Alpha Matte Invert	Makes transparent areas of the layer black
15	Alpha Channel Off	Turns off alpha channel transparency on the layer

Pixel Map Group Control Modes

Value	Mode	Description
0	Off	No effect
1	IRGBW Master	RGBW controls act as inhibitive submasters for Mbox's RGBW data on all fixtures in the group and Intensity control masters the final output
2	IRGBW Replace	RGBW controls generate a color that replaces Mbox's RGBW data for all fixtures in the group and the Intensity control masters the final output
3	IRGBW Master, Merge Replace	Merge data replaces Mbox's output and is then mastered by the group IRGBW controls
4	IRGBW Master, Merge Multiply	RGBW 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	RGBW Master, Merge XFade	RGBW controls act as inhibitive submasters for Mbox's RGBW data on all fixtures in the group, and the intensity control is used to crossfade between that result and the merge data
6	RGBW Replace, XFade	RGBW controls generate a color for all fixtures in the group, and the intensity control is used to crossfade between that generated color and the Mbox color data
7	IRGBW Master, Merge HTP	Merge data and Mbox data are merged using HTP, the result is then mastered by the group IRGBW controls
8	RGBW Replace, HTP	RGBW 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 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 246 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 parameter 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 one of the Object Dissolve transitions. 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. Therefore, to get a very fast transition - as close to a snap as possible - but including the actual transition type, use a parameter value of 255.