

# Mirror Head Firmware Manual

For version 10021

This manual is for the new generation of firmware version for the Mirror Head. If you are already familiar with the system please read these instructions to get a picture of what new features this new generation offers.

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## What is new with this firmware generation

- Improved movement algorithm with the ability to smooth the DMX data.
- Tracking and Vector mode for movement - much more flexibility for advanced show programming.
- Extended TILT mode for the standard and the rental Mirror Head edition.
- More projectors are supported for basic RS232 commands.
- Built in effects engine (FX).
- Dynamic Projection Control Center – DPCC / Web Interface for basic show programming including video and geometry control.
- HTTP and MQTT communication stack

## Factory default settings

- IP: 2.0.0.3, Netmask 255.0.0.0, Gateway: 2.0.0.2
- DMX Mode: Art-Net™
- DMX Address: 001, Art-Net™ universe: 01
- Projector is set to Mirror Head default model.
- Power on position is the PAN and TILT center (DMX 128,0,128,0) with all LED channels off.
- MQTT is off.

## Basic operation

The default operation mode of the Mirror Head is through Art-Net™ and HTTP, if the Mirror Head is operated with DMX512 (XLR cable) the mode must be enabled in the menu. The MQTT protocols must be enabled if required.

## Dynamic Projection Control Center – DPCC / Web interface

This is the latest tool developed by Dynamic Projection Institute GmbH that offers a complete solution that enables a simple start for using any Mirror Head and to realize fascinating dynamic projections through a web interface.

The Mirror Head can be accessed using a web browser on the IP address. The web interface offers a control center to move the mirror, make geometry corrections and play media.

As it is already installed on all Mirror Head units, this means that there is no need to be connected to the internet. To get the Dynamic Projection Control Center - DPCC on any Mirror Head, update the firmware to the new generation.

By connecting a network cable from the Mirror Head to a computer and the video output to a projector, it has never been easier to operate a Mirror Head and to test the system for first tryouts and moves. See how content gets projected onto any surface, into any direction, and in any environment.

To start operating all the required information, including a Quick Guide, Shortcut list and a detailed explanation of how to use the Dynamic Projection Control Center – DPCC can be found in the second tab. In this tab, directly configure more of the Mirror Head and Projector settings.

## How to access the Dynamic Projection Control Center – DPCC

The Mirror Head can be accessed using a web browser on the IP address. The web interface offers a control center to move the mirror, make geometry corrections and play media.

### I. Connect Mirror Head to a LAN

To do so, set up the IP, Netmask, and Gateway in the menu and connect the Mirror Head to the LAN. To make this setup easy, you will find some network presets in the “IP Network” sub-menu. see IP Network section Page 6 in this manual.

1. Set up the IP Network of the Mirror Head, IP, Netmask, Gateway
2. Connect with your browser to <http://MirrorHeadIP/>

### II. To use your laptop or PC with a factory default Mirror Head.

1. Disable all other WIFI or cable connections on the laptop or PC.
2. Set the Network interface of your notebook to:
  - Notebook IP: 2.0.0.100
  - Notebook Netmask: 255.0.0.0
  - Notebook Gateway: 2.0.0.1 (or leave empty)
  - Notebook Nameserver: leave empty
3. Connect the Mirror Head to the notebook.
4. Turn on the Mirror Head.
5. Connect with your browser to <http://2.0.0.3/>

Choose any preferred workflow to create projection shows as well as installations. With a small learning curve to set up cues and move them into the sequencer, users can decide on diversified approaches to achieve desired outputs. There are no plugins needed and there is no need to code anything additionally.

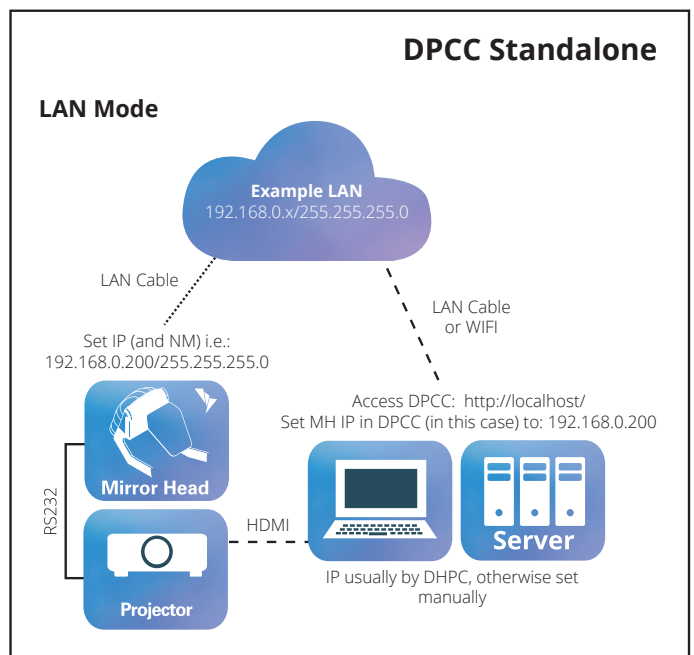
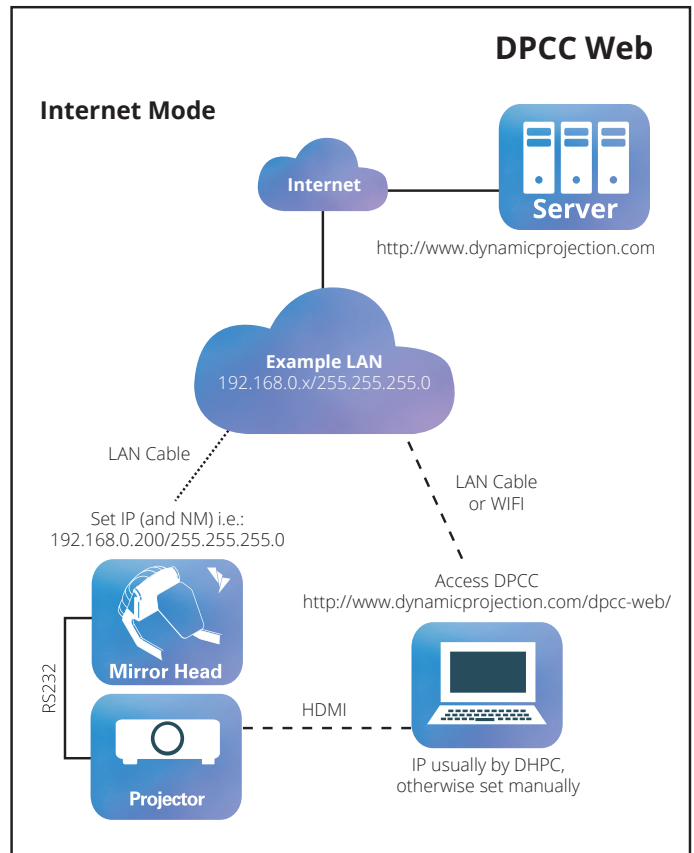
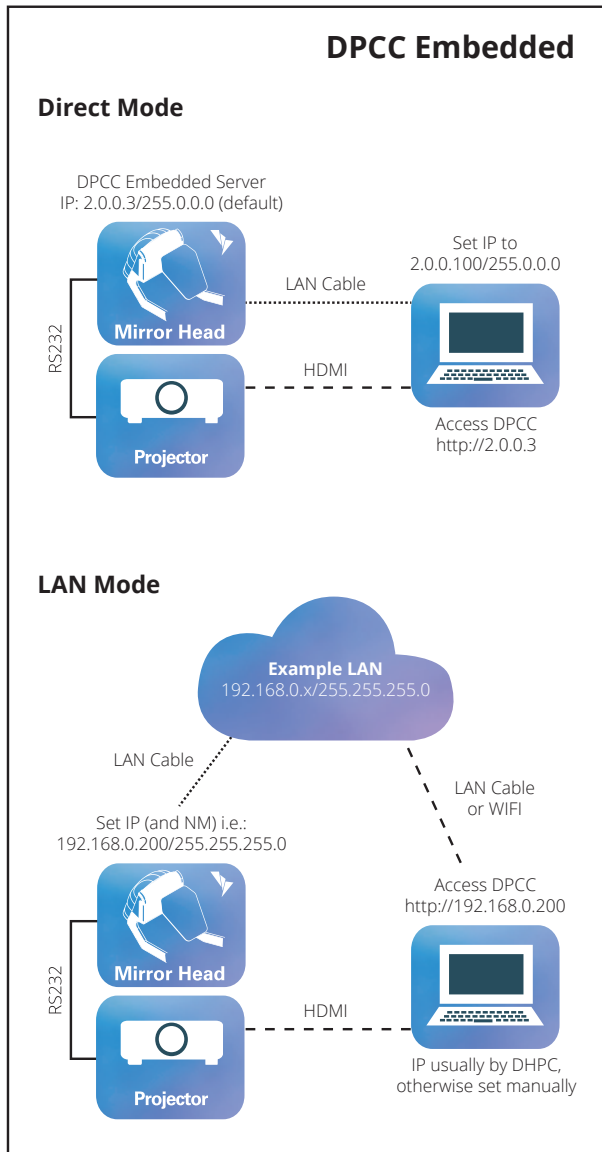
Industry professionals, artists and novices already highly appreciate the creative opportunities and the technical reliability provided by this tool making the Dynamic Projection Control Center – DPCC is really for everybody.

Moving the projection positions of the Mirror Head, aligning output geometry and manipulating the media are the essential elements that can be synchronized with absolute creative freedom for a combined outcome. The user interface of the Dynamic Projection Control Center - DPCC is designed to be intuitive, the needed control panels can be seen on a single-window screen.

The media to be played in the Dynamic Projection Control Center – DPCC can be a file from any storage or an input source from a USB device or NDI® stream. Depending on the performance of your PC, it is possible to playback any desired media resolutions of the media. An important function that can be adjusted, is the easing of the geometrical output, allowing you to create flawless and smooth changes from one projection position to another. Save your adjustments using the “ADD CUE” button in the “Cues” control panel and just move the cues into the sequencer to create shows.

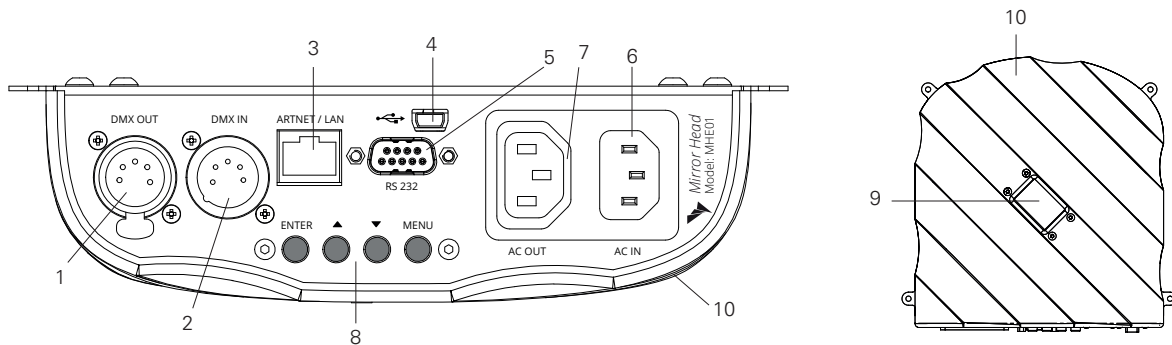


## DPCC Implimentation Scenarios



# Firmware Menu

## Mirror Head Control Unit / MHE01



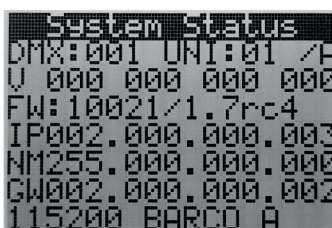
- |  |   |  |
|--|---|--|
| 1. DMX-OUT / Through Socket - 5 Pins XLR   | 5. RS232 connector - male   | 8. Control buttons for menu navigation |
| 2. DMX-IN Socket - 5 Pins XLR              | 6. A/C power input; 80 ~ 260V / 47 ~ 63Hz<br>3-prong C14 male socket      | 9. LCD display                         |
| 3. Art-Net™ /LAN network - 10Mb/s, 100Mb/s | 7. A/C power output; loop trough, 3-prong C13<br>female socket - max. 10A | 10. Control unit                       |
| 4. Mini USB OTG - for firmware update      |   |  |



### DPI Mirror Head

This is the Main Menu. Navigate the Menu with the buttons. To get back to this Main Menu / DPI Mirror Head, press the MENU Button. To change the display orientation, press UP + DOWN, at the same time.

- System Status
- DMX512 Art-Net™
- IP Network
- Projector
- System



### System Status

Show status information of the system. The display is only updated when this screen is entered.

- DMX: Current channel where the fixture starts
- UNI: Current Art-Net™ universe
- DMX Receiver: A = listen to Art-Net™ data; D = listen to DMX512 data.  
C = listen to Art-Net™ and send DMNC512 data
- V / T: V = Vector mode; T = Tracking mode - DMX values Channel 1-4
- FW: Firmware Version / DPCC Version
- IP, NM, DW: Current Network settings
- BAUD / Projector: Current RS232 settings

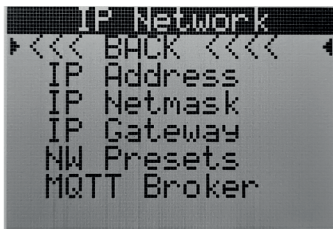


### DMX512/Art-Net™

- DMX Receiver (A) Art-Net™ Only : Receive on Art-Net™  
(D) DMX512 Only : Receive only on DMX512  
(C) Art-Net™-> DMX512: Receive Art-Net™ and send DMX512
- DMX512 Channel: Channel where the fixture starts, default ist #001.
- Art-Net™ universe: Art-Net™ universe number, default is #1 (note: Some Art-Net™ software use Universe 0 as the "first" universe, so you maybe need to adjust the setting here to fit your needs.)
- DMX filter amount: Packet filter amount to average out flickering on DMX values. Default is 1. A value of 40 means that the average of 40 packets is sampled.



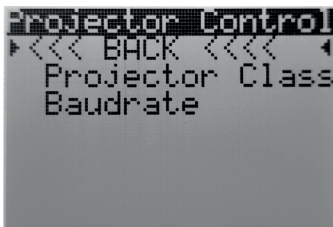
# Menu system



## IP Network

- IP Address: The IP Address of the system. Default is 2.0.0.3
- IP Netmask: The Netmask of the system. Default is 255.0.0.0
- IP Gateway: The Gateway of the system. Default is 2.0.0.2
- NW Presets: Presets for Network setup to make life easier
- MQTT Broker: Telemetry Broker IP

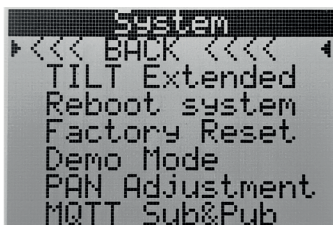
**NOTE:** When making changes in the IP settings please RESTART the firmware in order to make the changes to be set if unsure. For some switching equipment reconnecting the network cable is also required.



## Projector Control

- Projector Class: Select the protocol class of the Projector that is connected using the RS232 interface. Available protocols are: Barco A, Barco B, BenQ, Canon, Christie, DP, Epson, Hitachi, NEC, Optoma, Panasonic, Ricoh, Sanyo, Sony, Vivitek A, Vivitek B.
- Baudrate: Set the Baudrate of the RS232 interface. After changing the projector class one must set the Baudrate to either "DEFAULT" or set the value explicitly. For the correct Baudrate for a projector please see the projectors manual. Available Baudrates: 4800, 9600, 19200, 38400, 57600 and 115200.

For the "power on" Serial command for a specific projector class that is used by the firmware see the table in the appendix.



## System

- TILT Extended: switch the TILT range between 90° and 165°
- Reboot System: Reboot the Mirror Head / Mirror calibration
- Factory Reset: Reset all settings to factory default
- Demo Mode: Start / End the demo mode
- PAN Adjustment: Adjust the PAN center
- MQTT Sub & Pub: Send telemetry data to the MQTT Broker and enable MQTT control

# Control Modes

## DMX / ArtNet™ Control

In order to do a meaningful control of the Mirror Head using DMX a DMX Master with at least 4 channels required. Note that the Mirror Head will always listen to 14 channels.

The Mirror Head control unit allows you to assign the DMX fixture address, which is defined as the first channel from which the Mirror Head unit will respond to the controller. If you set, for example, the address to channel 15, the device will use the channels 15 to 28 for control.

Make sure that you don't have any overlapping channels in order to control each Mirror Head correctly and independently from any other fixture on the DMX Network. If two, three or more Mirror Head units have the same DMX address, they will work simultaneously.

NOTE: Two units cannot have the same Art-Net™ IP-address. Before you start operating you have to decide if you want to control the Mirror Head with DMX-512 (XLR cable) or by Art-Net™ DMX512 (CAT cable, IP layer).

Operations either with DMX-512 or Art-Net™ DMX-512 are equivalent. To get the best movements of the mirror your DMX packet frequency should not be lower than 25Hz.

## HTTP Control

The Mirror Head can also be controlled using HTTP requests. To control it using HTTP you can send a get request to:

`http://YOUR_MIRRORHEAD_IP/empty.shtml?dummy&d0=127&d1=0&d2=127&d3=0&d4=0&d5=0&d6=0&d7=128&d8=0&d9=0&d10=0&d11=0&d12=0&d13=128&rule=0`

The arguments d0-d13 are the DMX channels 1-14 and accept values 0-255. The "rule" argument is for overruling actual ArtNet or DMX data. Please note that you have to set it to 0 manually or reset the Mirror Head after you set it to 1!

## MQTT Sub & Pub Control

- Publish
  - The Mirror Head unit publishes its position information to the Broker with the topic: "DPI/MH/MAC\_ADRESS\_OR\_MIRRORHEAD/status" (example: "DPI/MH/00:80:e1:4f:33:32/status")

For a python example see:

<https://github.com/DynamicProjectionInstitute/MirrorHead-examples/blob/master/mqtt-status-display.py>

- Subscribe
  - The subscription topic is on: "DPI/MH/MAC\_ADDRESS\_OF\_MIRRORHEAD/input" and "DPI/MH/global/input"

To control the Mirror Head over MQTT the message is in the same form as the 14 channel DMX packet with an additional byte at the end to control the override status - this is equivalent to the HTTP Operation!

Example: `mosquitte_pub -t "DPI/MH/global/input" -m "128 0 128 0 0 0 0 0 0 0 0 0 0 0 1"`



## DMX Tracking vs. Vector mode

Let's consider a pan movement of 30 ° from left to right. We position the projection on the left and save this position. Let us assume that the left position corresponds to the DMX value 100. Then we move the projection 30° to the right, e.g. to DMX value 130. The fade time should be 3 seconds. There are now two ways to create this movement:

- If you are using the tracking control, set a fade time of 3 seconds on the DMX controller. The controller now calculates the values that must be sent in order to output the value range from 100 to 130 within 3s; for a standard DMX frame rate of 25 packets per second this gives 75 packets. The projection follows the values that it receives from the control, which is why this type of control is called tracking control. The control tells the Mirror Head where and when to move. So the quality of the data in the constant stream of packets is very important for a good movement.
- When using vector control, give the speed channel a specific value. Let us assume that the value 20 causes the mirror to rotate by 10° in one second. Position the mirror the start position with a DMX value of 100 on the pan channel. The movement is controlled by sending the value 130 on the pan channel and the value 20 on the speed channel (this is a snap). As a result, the mirror rotates by 30 °, namely by 10° per second. There is no need to send a constant stream of packets. The movement is completely controlled by the firmware.

Both methods have advantages and disadvantages. The movement of the mirror can be irregular with some DMX controller and Mirror Head combinations in tracking mode because the mirror stops briefly during movement. Vector control is less convenient during programming, but it can increase the quality of movement, especially at low speeds.

## Adjusting the Tracking Mode

By default the Mirror Head operates in "Tracking" mode which will follow the given DMX data packet by packet. The Mirror Head firmware offers two important tuning methods that can be combined to optimize the quality of the movement when using the tracking mode:

- Damping: When in Tracking mode, the acceleration slider (dmx channel #14) acts as a damping factor selector (1-255). This damping is an arbitrary unit that is used inside of the movement calculations. There is no general rule which value to select - if the movement is not "nice" play with the damping factor between 1-255.
- Packet filtering: This can be controlled in the menu settings. The value is the amount of packets that should be averaged. So a value of 25 means that for a DMX rate of 25 packets/sec the average of 1s is taken for further movement calculations. A too high value will result in a laggy movement and the path will be altered from the unfiltered. Filtering can also be used to filter out jittering in the DMX data that comes from analog DMX controllers. Filtering should only be used as a last resort.

The tracking mode is enabled when the Speed channel #8 is at 000.

## Adjusting the Vector Mode

When working in "Vector" mode the speed and acceleration is determined by a speed value set on a separate DMX channel (8); acceleration is set by channel (14). "Vector" mode is enabled once channel #8 is set to a value greater than 0. Use the "Vector" mode only when the concept of vectoring movement is well understood.

The Vector mode enables the possibility to go to a position within a given time by just snapping to the DMX values of the position (usually using a CUE). A speed value (channel #8) of "1" is the slowest, "255" is the fastest. Note: Start with speed values of about 128 and change the value during the movement to reach the speed you want.

## FX Engine

The Mirror Head offers an effect engine (FX) mode that makes it possible to generate lissajous movements of the mirror. To enable the FX mode channel #7 must be set to 255.

Once the system is in FX mode some DMX channels change their function (see the DMX fixture chart). To control the movement for each axis the following channels can be used:

PAN Axis:

- Position channel #1
- Amplitude channel #2
- Frequency: #8

TILT Axis:

- Position channel #3
- Amplitude channel #4
- Frequency: #14

The FX Engine can easily be tested on the Web Interface. Please note that the FX engine fades in and out when enabled disabled to give smooth transition. At some extreme points it is possible that while fading out the transition is not as smooth as it is while fading in.

## Power on Position - Details

The "Power on Position" feature offers the possibility to set a specific DMX position and LED color when the Mirror Head starts without sending any DMX data to the system. To set the power on position the following methods are available:

- DMX/ArtNet™ control: Use a DMX/ArtNet control device, set the position of the Mirror Head and then save this position by setting channel 5 to a value between 128-245 for 3 seconds - the system will reboot then. Once the system reboots set the channel 5 back to 0.
- DPCC: The easiest way to set the position is using the DPCC Webinterface - position the Mirror Head , then press „ Power On Position SAVE“ on the „Projector& Mirror Head“ tab.
- HTTP / MQTT: Same procedure as with DMX / ArtNet™.

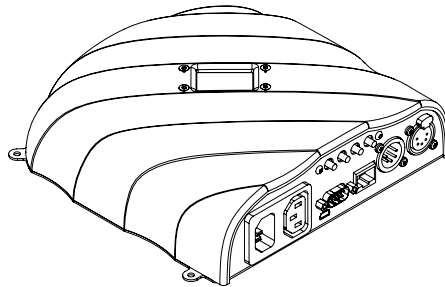
The „Power on Position“ can be loaded to confirm it any time by either setting channel 5 to 10-127 or by using the DPCC and do a „RECALL“.

## PAN Adjustment

The "PAN Adjustment" is for setting the PAN "center" position of the mirror. This is useful if the DMX 128,0 should be in the absolute center of the projection. By default this is the setup in the factory, but in some cases it is needed to be adjusted on site.

Saving the PAN Adjustment resets the "Power on Position" PAN- and TILT-Center (128,0,128,0).

# DMX Fixture



Channel	Function	Value	Notes
#1	PAN Coase (High Byte)	0-255	In FX Mode: PAN Position
#2	PAN Fine (Low Byte)	0-255	In FX Mode: PAN Amplitude
#3	TILT Coase (High Byte)	0-255	In FX Mode: TILT Position
#4	TILT Fine (Low Byte)	0-255	In FX Mode: TILT Amplitude
#5	Mirror Reset	255	Mirror calibration / Reboot system
	Power On Position SAVE	128-245	
	Power On Position LOAD	10-127	
#6	Shutter when move ENABLED	200-250	
	Blank when move ENABLED	128-190	
	Shutter ON	60-70	
	Shutter OFF	40-50	
	Blank ON	20-30	
	Blank OFF	1-10	
#7	FX Engine ENABLED	255	
#8	TRACKING Mode ENABLED	0	
	VECTOR Mode ENABLED	1-255	Value is the speed amount
	In FX Mode PAN Frequency	0-255	In FX Mode: PAN Frequency

## DMX Fixture

Channel	Function	Value	Notes
#9	Projector power OFF	250-255	
	Projector power ON	230-238	
	Mirror Head STANDBY	50-58	
	Mirror Head ON	28-38	
#10	LED Main Intensity	0-255	
#11	LED Red Intensity	0-255	
#12	LED Green Intensity	0-255	
#13	LED Blue Intensity	0-255	
#14	Acceleration default	0	
	Acceleration	1-255	Value is the ACCELERATION amount in VECTOR Mode
	Damping amount	1-255	Value is the DAMPING amount in TRACKING Mode
	In FX Mode TILT Frequency	0-255	In FX Mode TILT Frequency

## Firmware upgrade guide

### Requirements for all operations

- A USB stick which is FAT32 formatted
- OTG USB adapter: Micro USB Type B to USB 2.0 Type A socket (for example DeLock Art.-Nr. 83104)



USB OTG Adapter example

## Upgrading the new Mirror Head Firmware 10021

1. Check if the Mirror Head is running the new Firmware series. The screen looks like this:



Standard Edition



Rental Edition

2. Format the USB stick to FAT32, or remove all files on the stick before you continue.
3. Unzip the Firmware Packages Folder "MHE01-FW-v10021-18rc0-all.zip". In this folder you find two different type of installer packages, one for the Standard Edition and one for the Rental Edition. Unzip the package of the version you need depending on your type of Mirror Head, Standard Edition or Rental Edition, to the USB stick.  
The content of the USB stick must look like this.

- DPI-AXXX.HEX
- DPI-DXX.HEX
- DPI-J-00.HEX
- dpi-mirrorhead-1.3.25rc1.cmf
- DPI-R01.HEX
- DPI-U-00.HEX

4. Remove the power from the Mirror Head and plug in the USB stick using the OTG cable.
5. Plug in the power, press and hold the [MENU] Button while the system starts.



6. Wait until the system screen shows "Verify Data...", then release the button.
7. Once the update is finished the system will reboot. Remove the USB stick when you see the "Starting...." message.

## Upgrading from Legacy Firmware Version 1.3.26

1. Check if the Mirror Head is running the legacy firmware. The screen looks like this:



2. Format the USB stick to FAT32, or remove all files on the stick before you continue.
3. Unzip the Firmware Packages Folder "MHE01-FW-v10021-18rc0-all.zip". In this folder you find two different type of installer packages, one for the Standard Edition and one for the Rental Edition. Unzip the package of the version you need depending on your type of Mirror Head, Standard Edition or Rental Edition, to the USB stick.  
The content of the USB stick must look like this.

- DPI-AXXX.HEX
- DPI-DXX.HEX
- DPI-J-00.HEX
- dpi-mirrorhead-1.3.25rc1.cmf
- DPI-R01.HEX
- DPI-U-00.HEX

4. Remove the power from the Mirror Head and plug in the USB stick using the OTG cable.
5. Plug in the power and wait until you see "USB detected...." on the screen, wait 3sec.



6. Remove the power from the Mirror Head and wait until the display is off. Power it back on.
7. The system will now upgrade the firmware to the latest version and will reboot a few times. Wait until the display shows "Starting...." and the mirror is starting to move. **DO NOT REMOVE THE USB STICK, PRESS ANY KEY OR REMOVE THE POWER WHILE THE UPDATE IS RUNNING!**



**Note: a flickering of the screen during the update is normal.**

After starting the system for the first time with the new firmware the settings will be changed to the factory default. Please set up the system to your needs before using it.

The update to the new firmware series is now completed.



## Serial command lookup table

For the "power on" Serial command for a specific projector class that is used by the firmware see the table below.

<b>Projector Class</b>	<b>Default Baudrate</b>	<b>Power ON command used</b>
Barco A	19200	{ „jsonrpc“: „2.0“, „method“: „system.poweron“, „id“: 7781 }
Barco B	115200	[POWR1]
BenQ	9600	\x0d*pow=on#\x0d
Canon	19200	POWER=ON\x0d
Christie	115200	(PWR 1)
Digital Projection	9600	*power = 1\x0d
Epson	9600	PWR ON\x0d
Hitachi	19200	\xBE\xEF\x03\x06\x00\xba\xd2\x01\x00\x00\x60\x01\x00
NEC	38400	\x02\x00\x00\x00\x00\x02
Optoma	9600	~0000 1\x0d
Panasonic	9600	\x02\x41\x44\x5A\x5A\x3B\x50\x4F\x4E\x03
Ricoh	38400	\x02\x00\x00\x00\x00\x02
Sanyo	19200	C00\x0d
Sony	38400	power \"on\" \x0d\x0a
Vivitek A	9600	V99S0001\x0d
Vivitek B	9600	op power.on\x0d

## Version changes

10020 to 10021:

- Dynamic Projection Control Center – DPCC / Web Interface version 1.8
- Added MQTT Stack
- Added PAN Adjustment
- Minor fixes

10018 to 10020:

- Barco A and Barco B added
- Serial command table
- Added information on HTTP control
- Dynamic Projection Control Center – DPCC / Web Interface