APPLICATION NOTE
MO-SYS STARTRACKER INTEGRATION

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APPLICATION NOTE – MO-SYS STARTRACKER INTEGRATION

Processor Firmware Version:	3.3.x and above
Fixture Firmware Version:	3.3.x and above
Mo-sys Firmware Version:	3.4.3.2 and above
Date:	14/10/2022
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OVERVIEW

Mo-Sys StarTracker now supports integration with LED stars powered by Brompton Tessera SX40 and S8 LED processors. This means LED stars can be generated from within Tessera and displayed on the LED. Using our Frame Remapping technology, the stars can be hidden on a separate frame, so they are unseen by camera sightlines and reflections.

PRE-REQUISITES

- Mo-Sys tracking system running 3.4.3.2 or higher firmware
- Blue filter or no filter for Mo-Sys sensor
- Brompton processor running 3.3.x or higher firmware
- Panels running 3.3.x or higher firmware

THE PROCESS

Setting up the Brompton processor

The StarTracker Markers can be found in the Hidden Markers section within the Camera Tile or the Network tile if running processor firmware below 3.4.1. For StarTracker Markers to appear you can either use them with Frame Rate Multiplication or from 3.5 they can be used with ShutterSync.

For Frame Rate Multiplication you need it enabled with a multiplier of at least 2. As you are adding in a new frame, this will increase the processor load which will reduce port capacity. However, there is no additional capacity reduction with StarTracker compared to Frame Remapping alone. When Hidden Markers are used with ShutterSync the markers are displayed when the camera shutter is closed without affecting processor load or port capacity.

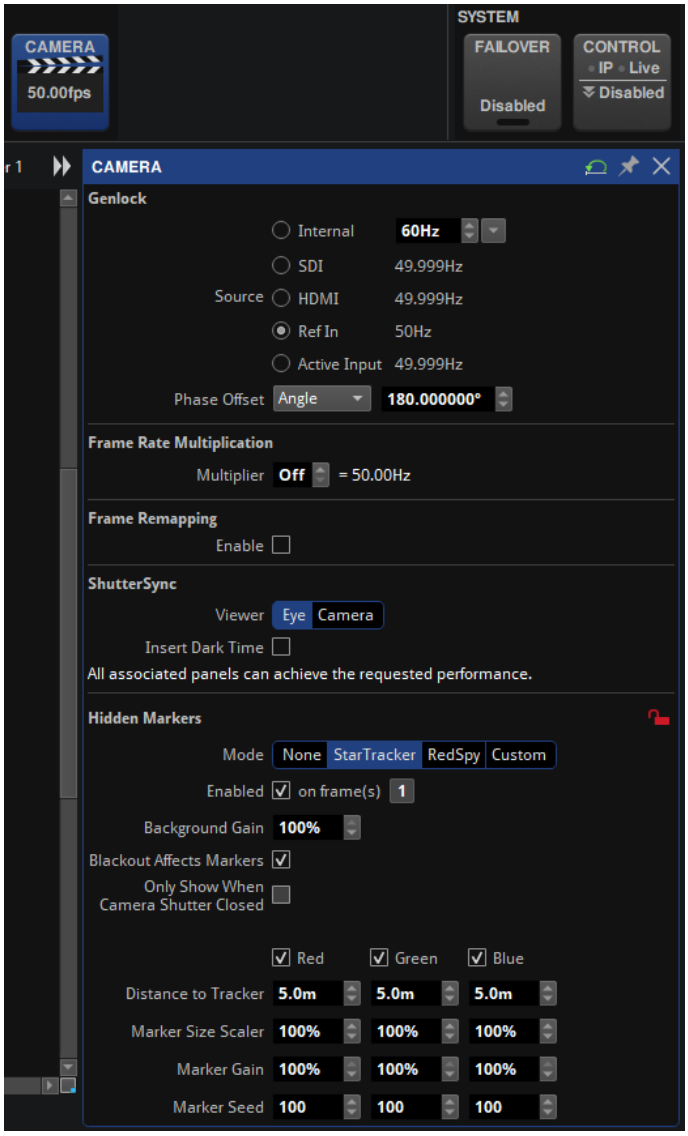


Figure 1 Enable StarTracker Markers

Genlock

To ensure your stars, and their reflections, are not seen by cameras, Genlock needs to be utilised. This requires your cameras and processors to be genlocked to the same reference signal. In this instance we have a separate sync source which is attached via Ref In at 50Hz.

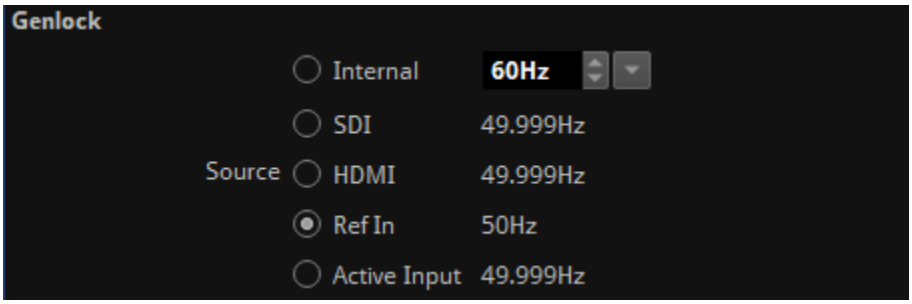


Figure 2 Genlock Settings

Phase Offset

To ensure the camera is picking up only the desired frame, adjust the Phase Offset angle on the processor. For ease of fine adjustments, it can be simpler to do this with using Frame Remapping with two different colour frames; one black and one green. Then, adjusting the processer Phase Offset until the camera can only see black will ensure the phases are perfectly aligned. Alternatively, you can adjust phase offset within a genlock source that supports phase offset per output.

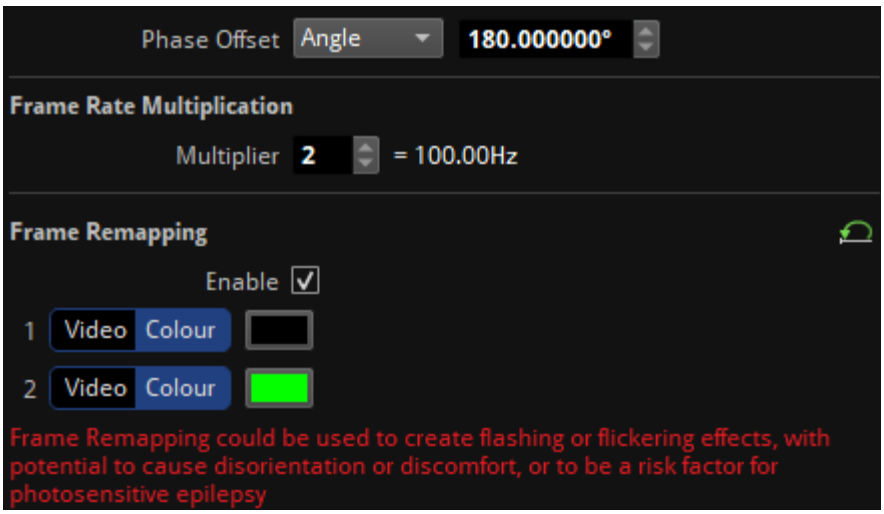


Figure 3 Adjusting Phase Offset and Frame Rate Multiplication

To enable the camera to see the opposing frame simply add the required angle to the phase offset. The phase offset needs to be fine-tuned depending on if a rolling shutter or global shutter camera is being used.

Global Shutter

As an example, if Frame Rate Multiplication Multiplier = 2

Angle between frames *= 360° / Multiplier*

= 360 / 2

= 180°

If Frame 1 is aligned at 0° then Frame 2 would be aligned at

Frame 2 Phase Offset Angle *= Frame 1 Phase Offset Angle + 180*

= 0 + 180

= 180°

Rolling Shutter

Rolling shutter cameras require a low camera readout time to be compatible with Frame Remapping. This is to ensure that the whole screen can be read within the correct frames, and to prevent frame bleed where artefacts from other frames become visible on camera. To prevent frame bleed it can be useful to have multiple frames of the same content.

For example, running at 4 times Frame Remapping: Frame 1= Content, Frame 2 = Content, Frame 3 = Content, Frame 4 = Stars

This would cause content to be on the screen for a long-enough time to contain both the camera exposure and readout times and prevent frame bleeding.

$$Camera\ Exposure\ Time = \frac{1}{Camera\ Frame\ Rate} x \frac{Camera\ Shutter\ Angle}{360}$$

For example, with Camera Frame Rate = 24fps

Camera Shutter Angle = 180°

Camera Readout Time = 10ms (this can vary greatly between cameras)

$$Camera\ Exposure\ Time = \frac{1}{24} x \frac{180}{360} = 0.02083s = 20.83ms$$

$$Total\ Camera\ Frame\ Time = Camera\ Exposure\ Time + Sensor\ Readout\ Time$$

$$Total\ Camera\ Frame\ Time = 20.83+10=30.83ms$$

If your content is also running at 24fps, at 4 times Frame Rate Multiplication each frame is visible for:

$$LED\ Frame\ Time = \frac{1}{24} x \frac{1}{4} = 0.0104s = 10.4ms$$

By displaying the content on 3 frames your total content LED time is:

$$LED\ Content\ Time = LED\ Frame\ Time\ x\ Number\ of\ Content\ Frames$$

$$LED\ Content\ Time = 10.4ms\ x\ 3 = 31.25ms$$

If the LED content time is longer than the Total Camera Frame Time, there will be no bleed between frames.

Frame Rate Multiplication

Within the Tessera UI you can adjust which frames the stars are shown on.

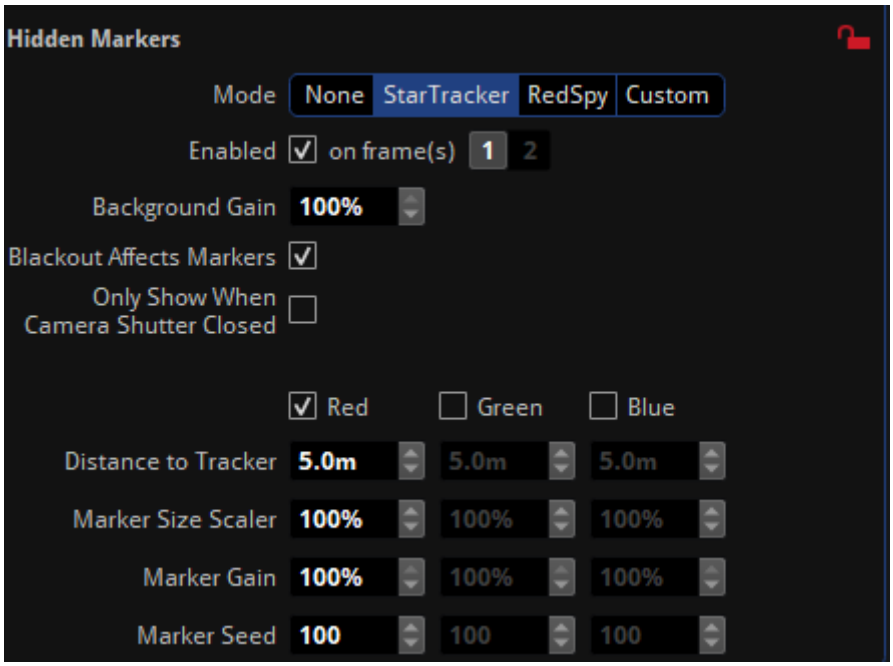


Figure 4 Adjusting StarTracker Marker settings

Figure 5 Frame 1

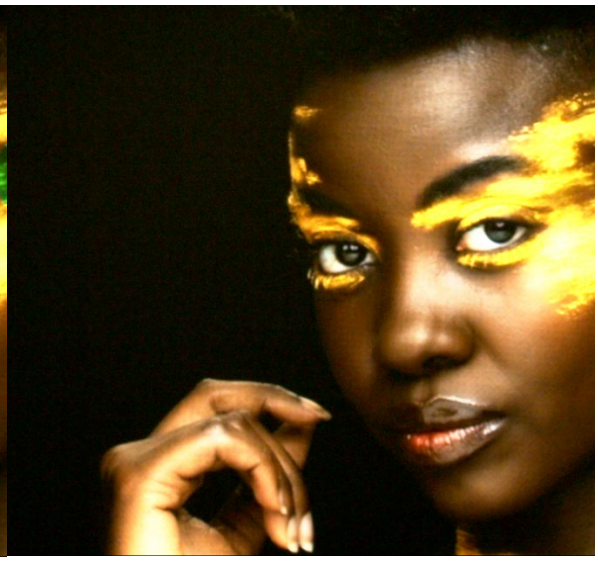
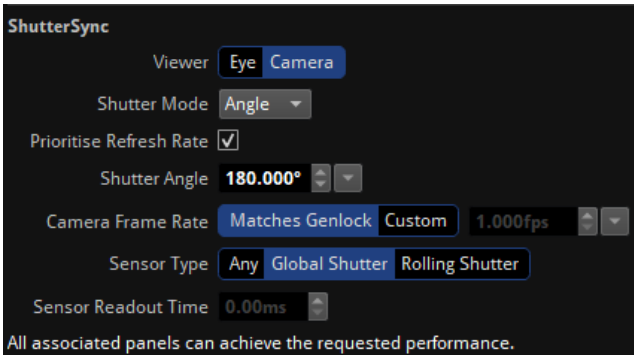
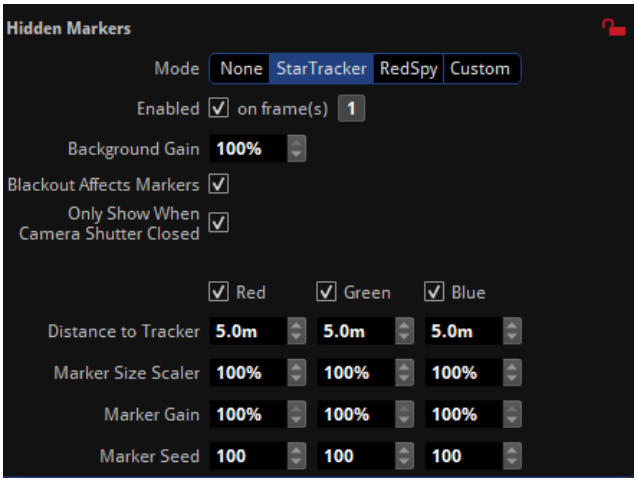


Figure 6 Frame 2

ShutterSync

Using ShutterSync the markers can be chosen to show only while the camera shutter is closed. It requires the camera settings to be inputted on Brompton, including Shutter Angle and Sensor Type.





Setting up the Mo-Sys system

The Mo-Sys system should operate the same with stars as it does for stickers once the sensor and initial parameters are adjusted.

Sensor Light

When using conventional stickers, the LED ring on the sensor must be turned on to create reflections. When using LED stars, the LED ring on the sensor is not required so should be turned off with the switch on the sensor box.

Filter

When conventional stickers are being used, the sensor has an IR filter to allow only IR light reflected by the stickers to be registered. To convert the sensor so that it can be used with LED stars the StarTracker unit needs to be changed for a StarTracker with no filter inside. To acquire this, you will need to get in touch with Mo-Sys support and they will provide you with a solution. Please note, the sensor system will not function if you have an IR sensor in it but will have limited functionality if you have a blue light filter. The blue light filter will only work if you have blue stars on the LED, so it is a very specific use-case in which this is a function that will work alongside other filming requirements. To get the widest array of use-cases it is advised to use a sensor system with no filter attached which will enable it to see LED stars of all colours.

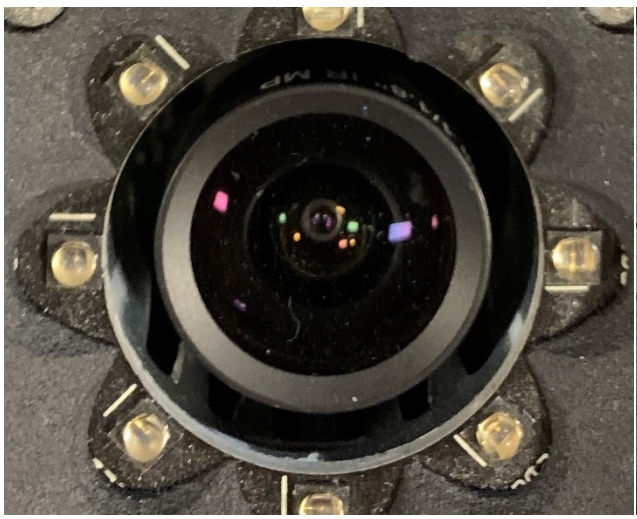


Figure 7 No Filter

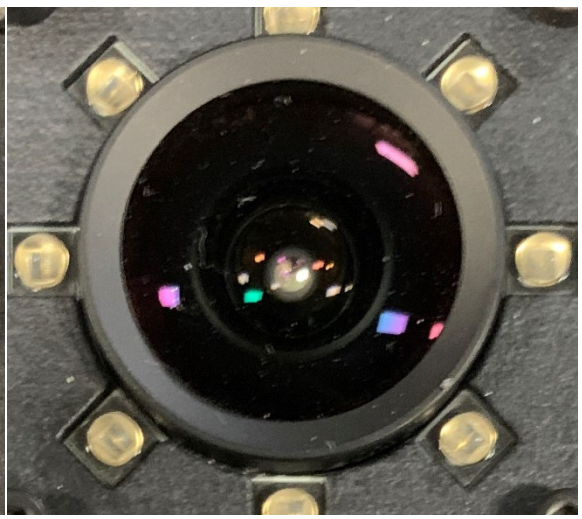


Figure 8 IR Filter

Distance

Usually within set-ups you will have larger stickers if there is a higher ceiling, which leads to the stickers being further away from the sensor. However, within the Tessera UI you can enter the distance between the sensor and the stars. This will adjust the size of the stars to ensure they are compatible with what the sensor can recognise.

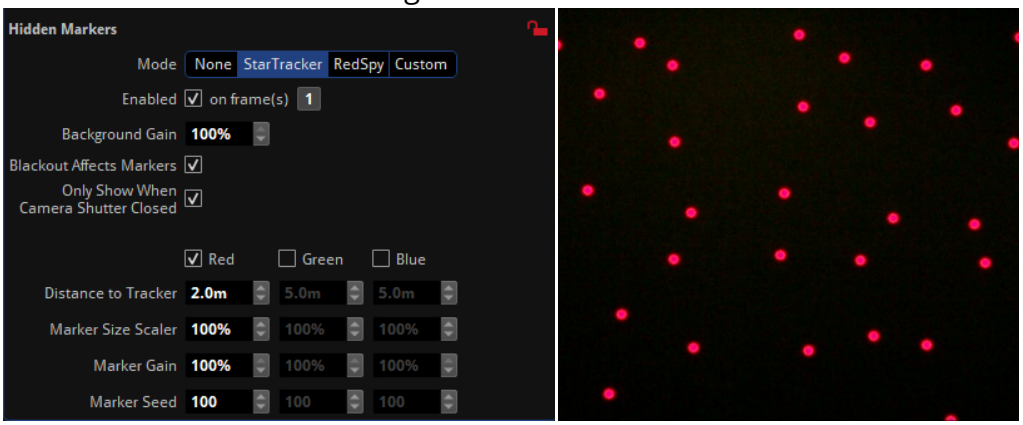


Figure 9 Adjusting Distance to Tracker

Intensity and Colours

The Marker Gain can be reduced to reduce the brightness of the LED stars. A dimmer star will reduce the visual impact on those working within the physical space. This will need fine tuning with the Mo-Sys system to ensure it is at a brightness where the sensor is still seeing a minimum of 11 stars at any one time.

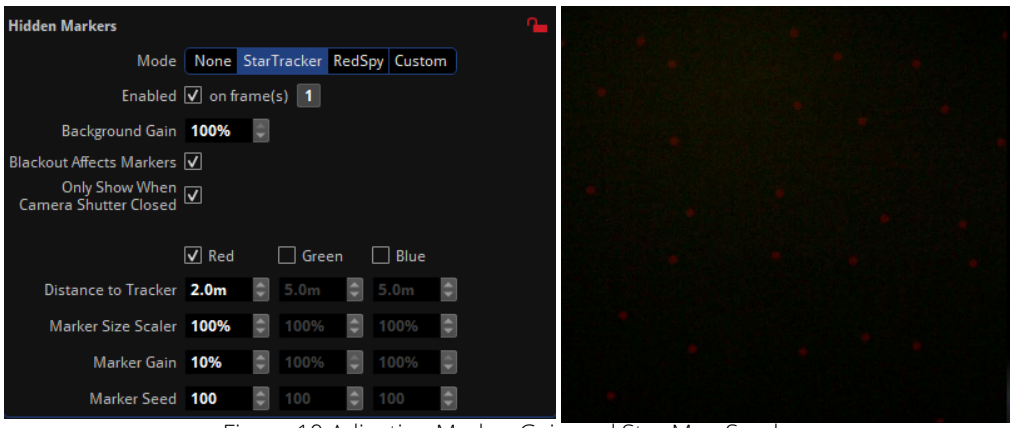


Figure 10 Adjusting Marker Gain and Star Map Seeds

Within the Tessera UI (which you can see in the picture above), there are three columns: Red, Green, and Blue. When you enable all three colours you will initially see three sets of dots in those respective colours appear on your LED. If you want to make white dots you simply change the Star Map Seed of the RGB stars respectively to the same value. You can then adjust the marker gains to make the stars brighter or dimmer. You can then use this method to make dots of any colour composition that you require.

It is also good to note that the colour of the dots should contrast the colours of the content behind them. For example, red stars on a red/orange background may not always work with StarTracker as it may not be able to see the contrast between the background and the stars, but you could combine the green and blue trackers to make cyan markers which would contrast the red/orange background.

Mapping and using the system

The system will then be mapped and operated within the Mo-Sys system in the same manner as with conventional stickers.

Within the Mo-Sys interface the StarTracker sensor exposure can be tuned in the “Stars > Exposure” button and is usually in the range 0.1-1ms. Additionally setting “Stars > Type” to “LED wall dots” instead of “stickers” can improve their detection when there is content on the wall around the virtual stars.

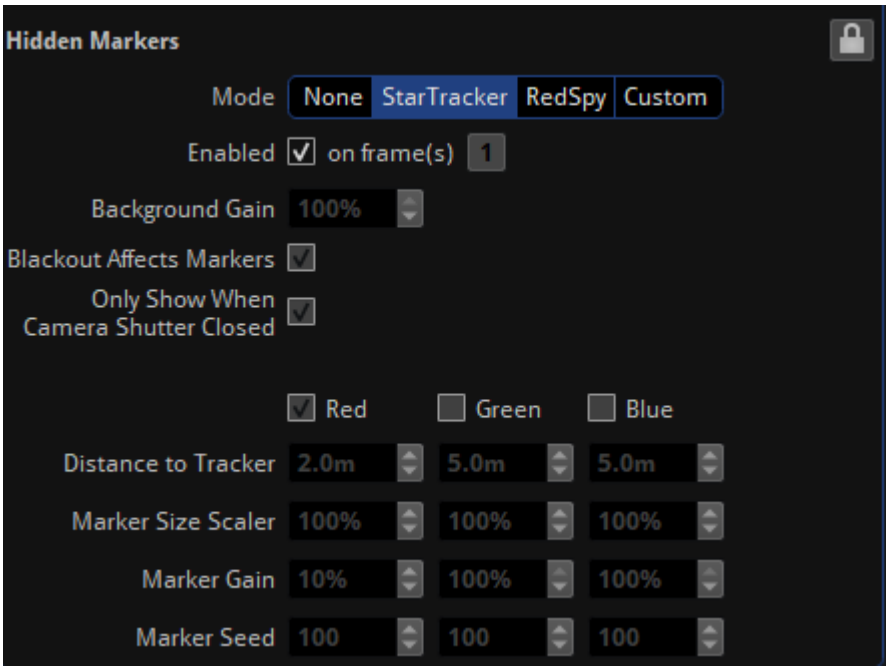


Figure 11 Locking StarTracker Markers

Once you want to start mapping it is recommended to lock the StarTracker Markers within the Tessera UI to ensure the map will not change which would then require remapping.

NOTE: *Once you have mapped the system you should not change the star map, therefore after it has been generated do not change Distance to Tracker or Star Map Seed. If any of these are changed the star map will be regenerated and will need to be remapped.*

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DOCUMENT REVISION HISTORY

Date	Version	Author	Changes
2022.10.14	1.0	EL & PM	Initial version
2024.03.13	1.1	EL	Formatting and 3.5 Updates