WHITE **PAPER**

Set It and Forget It™ (SiFi)

Auto Color Balancing

Planar has introduced a broad category of innovative features in Clarity rear-projection display products under the name Set It and Forget It,™ or “SiFi.” As the name implies, these features are designed to automate the continuous operation of Clarity displays at peak performance. SiFi Auto Color Balance (ACB) reduces the time and complexity involved in maintaining an optimally balanced wall. It is also designed to work in concert with the SiFi Auto Lamp Changer.

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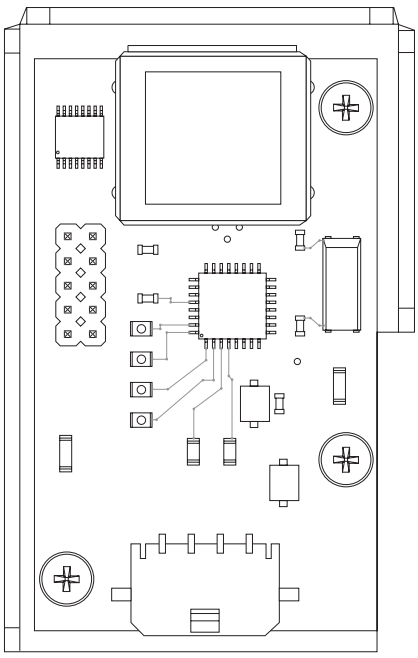
Background

Color and brightness balancing is a constant process
In tiled video wall displays, such as the new Clarity SP Series from Planar Systems. It is critical to maintain color and brightness matching between the individual cubes that make up the entire wall. This process is called “color balancing”, and generally requires a skilled operator with a trained eye to make adjustments to each cube so that the entire array matches.

The effectiveness of this matching depends on the level of control provided by the cube design, and the skill of the operator in using this control. A reasonable analogy would be the process of tuning up instruments in an orchestra to make sure each instrument’s pitch matches the other instruments in the whole.

With adequate control and proper skill, a video wall can be color and brightness balanced to match across the array to a convincing degree. Unfortunately, with today’s lamp technology, this matching is only sustained until the lamps start to degrade. Because of the physics of today’s lamps, they tend to degrade over time and at different rates.

The differential degradation results in uneven color balancing after some time, which often requires a service call to re-balance the wall. As this can be a time consuming and expensive operation, it tends to be put off for as long as possible until the wall is significantly out of balance. Going back to the orchestra analogy, this is like waiting until the music is unbearable before tuning up the instruments.



SiFi color sensing electronics use a sophisticated digital signal processing algorithm to tune both color and brightness.

Lamp failure is inevitable
While a poorly color-balanced wall can still be functional, a wall with a failed lamp is not. Once a lamp fails, generally speaking the cube associated with it turns black, and all the display information is rendered un-viewable. Lamps are consumables, and we know they will eventually fail.

Mitigating lamp failures centers around two solutions: First, choosing the longest life lamp system possible to minimize the frequency of failures; and second, providing a redundant lamp system that is available if the primary lamp fails.

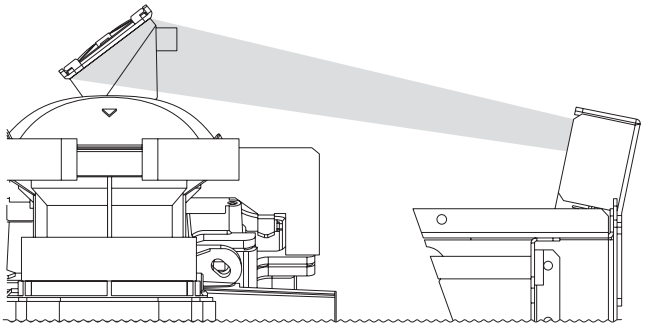
SiFi Technology

Planar has developed a number of features which address both color balancing and lamp failures in a way that minimizes service calls and screen blackouts while maintaining the optimum wall performance at all times. These features include a proprietary Auto Color Balance (ACB) system, and a Dual-Lamp System (DLS).

Auto color balance compensates for variations
There are two main requirements to achieve good color balance in a wall: First, the red, green, and blue primary colors must match in color. Second, each of these must match in brightness. This matching must be maintained throughout the dynamic range of each primary (that is, from full dark to full bright).

Different components within typical video wall optical systems have variations in their optical characteristics that affect both the brightness and the color of the system. Examples of these are the color wheel (in the case of DLP®), color filters (in the case of LCD), and lamps (in all cases). Some of these variations are fixed, that is, they don’t drift with time, whereas others do. These variations are the root cause of color mismatch in a video wall array, and it is these variations that the operator, via controls, must tune out.

The controls used to tune out variations are most often electronic controls acting upon the display data. This is similar to the “tint” and “saturation” controls one might find on a TV set. In the case of video walls, these controls are precisely set up to allow the best matching of each primary color and brightness. This is done through a digital signal processing algorithm called a color space converter (CSC) and an adjustment called the color coordinate adjustment (CCA). The CSC is a matrix operation



During the ACB procedure, a mirror moves into place in order to direct light coming out of the lamp onto the color and brightness sensor. Measuring the actual color that hits the screen ensures the highest accuracy.

that allows subtle blending of color components to precisely tune each primary color. This is like a painter mixing small amounts of other colors on his or her palette to attain exactly the color he or she desires.

With the same CSC algorithm, both the primary colors and the brightness of each color can be precisely tuned. In a wall configuration, each cube has its own CSC which allows each cube to be tuned to a common match point resulting in a balanced wall.

The CSC works well to compensate for the fixed variations from cube to cube and, for a time, to compensate for the lamp to lamp variations. However, once the lamps start to drift apart from each other as they age, the CSC must be readjusted to maintain proper balance.

Our SiFi ACB technology completely automates this process. Built-in precision color sensors determine the entire wall characteristics, track any variations due to any of the major optical components, and calculate an optimum setting for the CSC in each cube to give the brightest and best color balance performance. SiFi ACB measures the fixed variations and tracks the drifting variations over time, compensating in a way that is best for the the wall. If any component that could affect color or brightness (such as a lamp or color wheel) is changed, SiFi ACB tracks this and readjusts the wall accordingly.

How SiFi ACB works

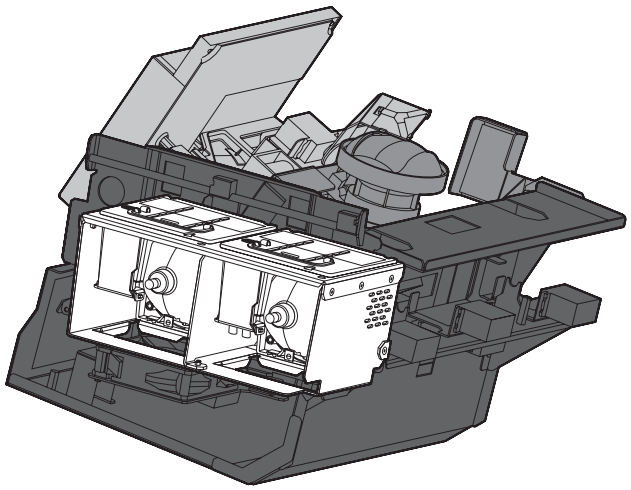
In action, an ACB sequence proceeds in the following way. The sequence is first initiated either manually or automatically (as determined by the setting in the SiFi controller). Once initiated, the CSC is set to a default setting so that each cube displays its natural native color. A sensor mirror is actuated into position in front of the projection lens of each cube's optical engine, reflecting the light to the sensor which measures the color and brightness of the light.

The cubes in the wall display first red, then green, then blue for about five seconds each while the sensor measures these primaries. Once the measurements are taken, the SiFi ACB controller collects all the data from the wall, determines the settings for each CSC in each cube based on all the collected data, and then downloads these settings. Then the sensor mirror retracts and the image is restored, fully balanced. Depending upon the size of the wall, the entire process can take about 30 seconds from start to finish.

With the SiFi ACB system, the wall is automatically kept in the optimal color balance – that is, once you set it, you can forget it.

A totally unique approach

Our SiFi ACB approach is unique in several aspects: how and where color and brightness are measured, and what is done with these measurements once they are taken. To insure the most accurate measurement, our custom designed color sensors are built-in to each cube. SiFi ACB measures directly at the output of the projection lens to ensure the most relevant measurement. Other approaches attempt to short cut this measurement by using calculated predictions or by



Coupled with the automated dual-lamp system SiFi ACB can be configured to automatically start upon lamp switchovers and scheduled rotations.

measuring the output of the lamp, or the light reflections off other components – all of which are not a true measure of the light hitting the screen. Only the SiFi ACB approach guarantees that what's measured is the actual light hitting the screen. A consequence of this approach is that we must briefly interrupt the displayed image in order to take accurate readings. However, the benefit in accuracy is worth the brief interruption. Planar has developed a unique algorithm that takes the measured data from the entire Clarity cube wall and develops the best CSC settings for each cube to result in the brightest, best color balance the wall can achieve.

In Clarity Open System displays, the SiFi ACB system is controlled via a network adapter similar to our WallNet® controller. In Clarity Integrated System displays our Com.Base Software is used to control the SiFi. These controllers allow the wall to manually initiate an ACB sequence at any time, or to schedule an ACB sequence on a periodic basis at a certain time (e.g. at 12 a.m. every Sunday). In both cases, ACB can be initiated via IR remote as well. The ACB can also be linked with the dual-lamp system to initiate anytime a lamp is switched from primary to secondary position.

Dual-lamp system maintains optimal wall performance

While the SiFi ACB system can compensate for significant lamp variation and degradation, it can't compensate for a failed lamp. For this, we have developed an automatic dual-lamp system which detects a lamp failure and automatically switches to a completely redundant lamp. This dual-lamp system is fully motorized, with a linear slide mechanism that precisely locates either of two lamps into position. Each lamp has its own ballast, thus the dual-lamp system guards against ballast failures as well as lamp failures.

Our system is unique in that it is coupled with the SiFi ACB system. With this, an ACB sequence can be set to be performed in the event of a lamp failure and subsequent lamp switchover. So, even when a lamp failure causes a new lamp to be switched in, the wall continues to be optimally color balanced.

In addition to a switchover indicated by a lamp failure, the dual-lamp system can also be used for scheduled lamp rotations. Through the SiFi controller, a scheduled lamp rotation can be executed automatically on a periodic basis, and it can be coupled with the SiFi ACB sequence. The advantage of this approach is that both the primary and secondary lamps are aged evenly, effectively doubling the time between lamp failures and ensuring continuous color and brightness balance across the wall.

There are several other support features associated with the dual-lamp system. First, the cubes may be set up to flash the high bright diagnostic LEDs to indicate a lamp failure to system operators. This is important because a lamp may fail and be automatically swapped without an operator noticing – and because of the ACB, an operator may not notice that anything has happened on the wall even though a lamp has failed. Thus, the high bright diagnostic LED will flash a code that will alert the operator that the failed lamp should be replaced sometime conveniently in the near future. Alternatively, the SiFi controller can be set to send an email to a specified address in the event of this failure.

With the SiFi dual lamp system, especially combined with the ACB system, operators can concentrate on the important business of monitoring their network and less time worrying about lamp failures or color balancing.

For more information

To learn more about the use of SiFi ACB technology in the Clarity display product line, contact us at 503-570-0700 or visit us on the web at www.planarcontrolroom.com

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