

BIOS Dynamic Engine

Bio-Dimming™ Lighting Control Protocol

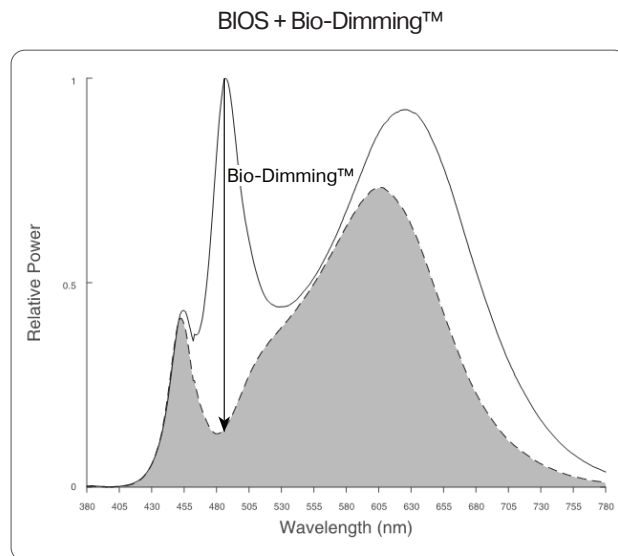
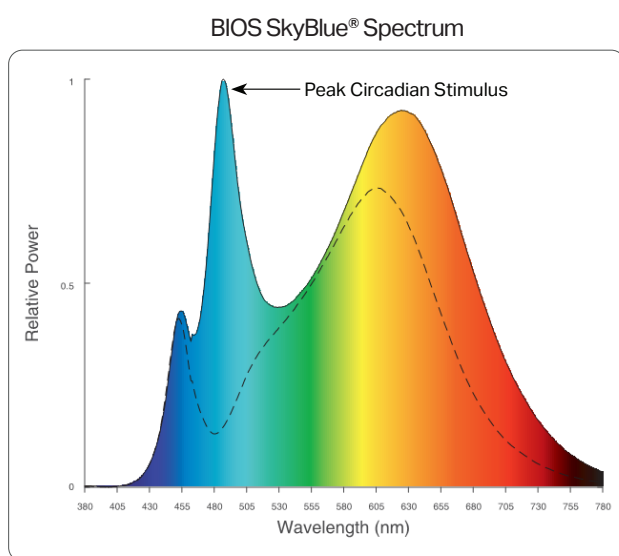
DW DAY WORKING ENVIRONMENTS

BIOS Dynamic Engine + Bio-Dimming™

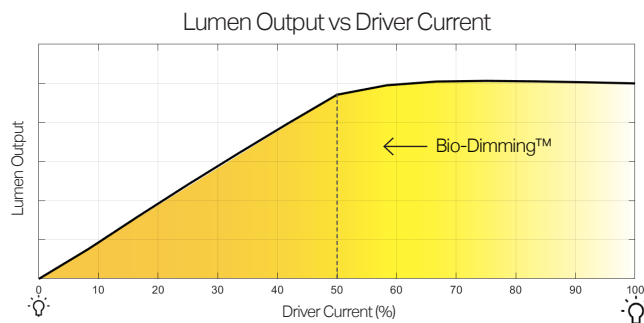
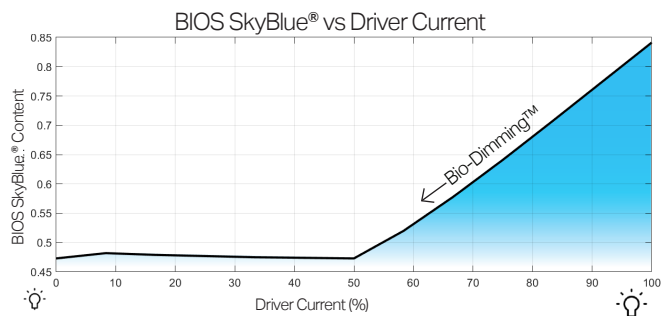
BIOS SkyBlue® Dynamic Light Engine provides a brilliant white light that is optimized for vision and circadian needs. BIOS is pleased to offer SkyBlue® Dynamic Light Engines in 3000K, 3500K, and 4000K with Bio-Dimming™.

BIOS SkyBlue® Dynamic Light Engine is dimmable and features a simple approach to circadian lighting controls. When paired with the BIOS Bio-Dimming™ module, it operates using any single channel constant current (CC) LED driver and can be used with any standard dimming interface/protocol (0-10V, ELV, DMX, Wireless) and could work with existing two-channel control systems as well.

Spectral Power Distribution



Bio-Dimming™ - SkyBlue® Content and Lumen Output



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Dimmer Settings with Bio-Dimming™

| | DIMMER SETTING* | BIOS SKYBLUE® | LIGHT OUTPUT | |
|--|--------------------|---------------|----------------|-------------------|
| | 100%* (Full On) | 100% | 100% | Bio-Dimming™ |
| | 99%-51% | 100%-0% | 100%-90% | |
| | 50% | NO BIOS | ~90% | Intensity Dimming |
| | 49%-0% | NO BIOS | LINEAR DIMMING | |

BIOS SkyBlue® maintained for maximum circadian impact.

Light output remains relatively constant.

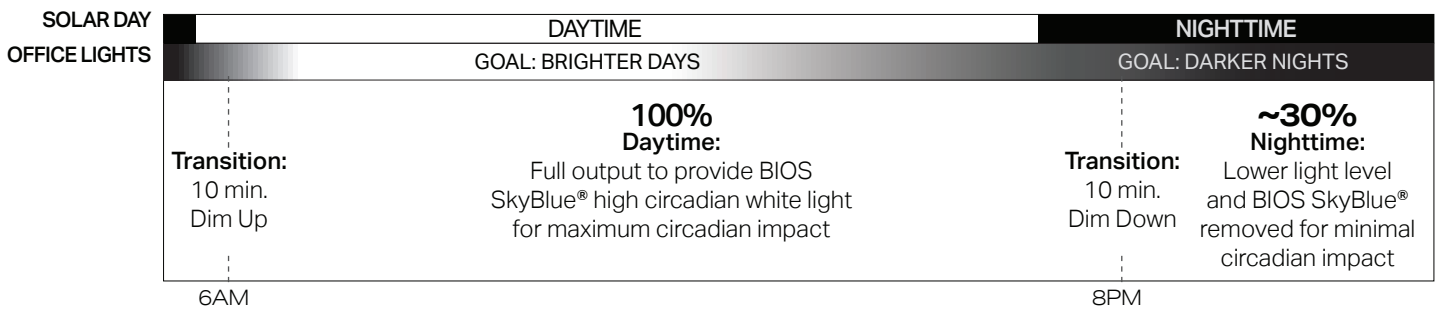
BIOS SkyBlue® removed to provide minimal circadian impact.

Light output dims down linearly.

*Note: Bio-dimming learns individual brightness preferences and maximizes BIOS SkyBlue accordingly. Dimmer setting percentages as shown are relative to this learned maximum brightness set point. For more information, please see "What to Expect from the BIOS Bio-Dimmer Machine Learning System" or go to www.bioslighting.com

BIOS Optimal Circadian Lighting Protocol

For day-working people, circadian lighting control strategies should focus on creating brighter biological daytime signals. BIOS recommends setting the lighting system to dim up in the morning over the course of 10 minutes to full on around 6am. During the day the lights should remain at their full output until 8pm in the evening where they should dim down below the 50% threshold to remove the BIOS SkyBlue® spectrum and provide a circadian depleted light source and lower light levels.



Note: BIOS recommends lengthening the solar day, but not shortening it. This means, in the winter BIOS lighting should be used to provide circadian daytime signals beyond the hours that the sun is up (for most latitudes) to correspond with daily activity; and in the summer, BIOS lighting should provide circadian daytime signals for the hours that the sun is up.

BIOS Dynamic Engine

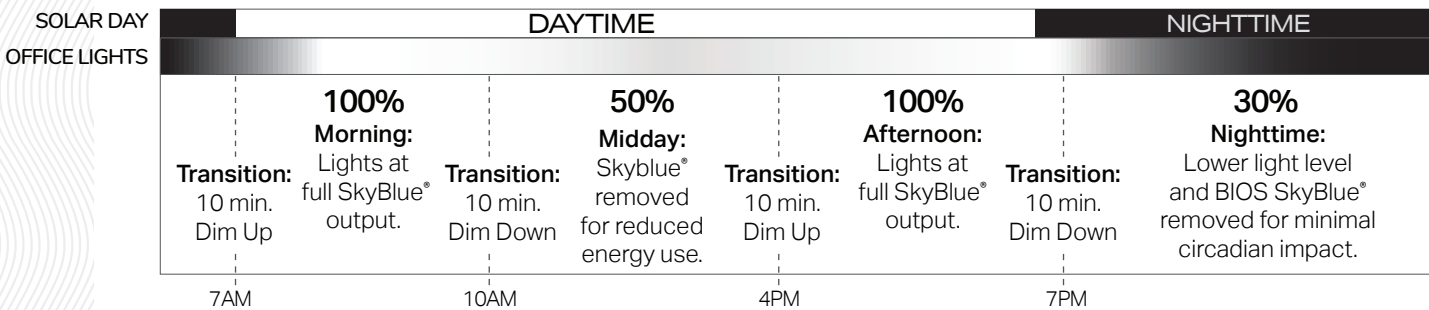
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BIOS Recommended Protocol - Energy Saver

The following schedule illustrates a lighting control strategy for providing daytime circadian stimulus while also reducing energy use over the course of the day. This strategy focuses on providing BIOS SkyBlue® signals at the beginning and end of each day. Energy Saver Protocol does not provide sustained circadian stimulus and therefore . This is a good strategy if energy use must be further reduced during daytime hours of operation.

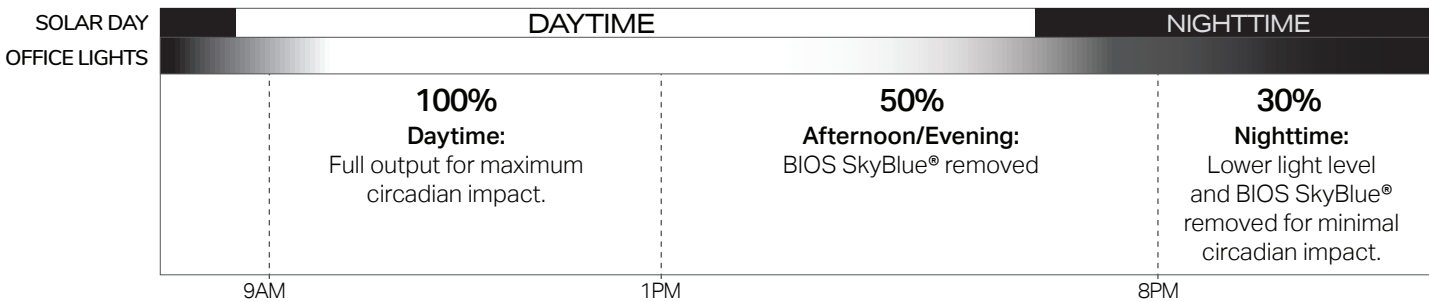
BIOS recommends all dimming transitions to be set to at least 10 minutes. The Energy Saver Protocol should allow the lighting system to dim up to full output around 7am and remain at that level until 10am. At 10am the lights should dim down to 50% light output and remain at that level until 4pm. At 4pm the lights should dim up to full output until 7pm where they should then dim down to 30% output until 7am.



BIOS Recommended Protocol - WELL Building Standard™

The following schedule illustrates a basic lighting control schedule that helps satisfy the requirements for the WELL Building Standard Circadian Lighting Feature. Almost all program types for both WELL v1™ and WELL v2™ require Circadian Lighting to be implemented for at least 4 hours a day from the hours of 9am to 1pm.

Note: The following does not outline the lighting schedule to comply with WELL v1™ Feature 54 Part 1b for Work Areas or Parts 3a or 4a for Breakrooms and Living Environments. Parts 1b, 3a, and 4a require "maintained" light exposure.



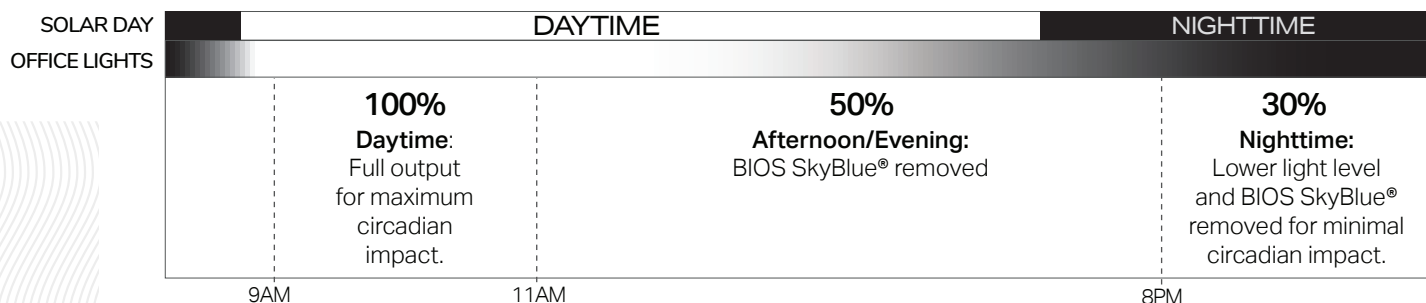
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Lighting Research Center + Circadian Stimulus Model

The following illustrates a basic lighting control schedule which meets the recommendations of the Lighting Research Center (LRC) and the Circadian Stimulus (CS) Model. To meet the requirements of the CS Model, the LRC recommends implementing circadian lighting for at least 2 hours a day (in the morning) from the hours of 9am to 11am.



Frequently Asked Questions

Does protocol change with the seasons?

No. The main culprit of negative health consequences are due largely to social jet lag. Social jet lag occurs when our activity patterns no longer align with the solar day. Social jet lag is common in modern society and is especially prevalent during winter months when daylight hours are very short, and we still need to be active during hours of darkness. BIOS does not recommend lighting protocols/scenes that mimic the seasons.

Should I use an astronomical timeclock?

Yes, you can use an astronomical clock for solar synchronization. However, you should be careful to ensure that short days during the winter won't encroach normal working hours. When this happens, we recommend a set hour schedule rather than astronomical clocks and solar synchronization.