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products for  
excellent lighting.



# HUMAN CENTRIC LIGHTING

System overview



## Human Centric Lighting

– healthy light for the whole day

Light affects our well-being, frames our day and night rhythm, and improves our ability to concentrate. "Human Centric Lighting" is the overarching term for one of the most promising and fastest-growing market segments in the area of professional illumination. At the centre of this is the impact artificial light has on our health and wellbeing. The spectral composition of the artificial light as well as the illumination level are modelled after the course of natural daylight and replicate it perfectly. This way, the light has an activating or relaxing impact on the human organism. The light of the future is healthy.

## Human Centric Lighting

Inspired by the sun, we bring daylight into the building.



Human Centric Lighting makes the day light.

The fitting solution for any application



### Light for modern office and work environments

Work environments are undergoing an enormous change: The increasing digitalisation of business processes puts increased pressures on the employees. However, those who spend a large part of the day in closed buildings can no longer listen to their internal clock. An intelligent lighting control based on circadian rhythms counters this. Large-format luminaires and brightened ceilings: a biologically effective illumination strengthens the well-being of humans at the workplace, makes them more alert and more focussed, and prevents phases of exhaustion and tiring. This function is particularly important during the winter months which feature less light.



### Light for industry and technology

In industry and manufacturing, multi-shift operations are a matter of course. The effects that changing work hours have on people's ability to perform and on their health is quite often being underestimated. More than few employees complain about bad sleep and tiredness during the day. Dynamic illumination scenarios for the general illumination can counter this effect in manufacturing. The result: employees are once again more focused and work more carefully. Especially in order to maintain focus during long night shifts, Human Centric Lighting can make an important contribution. Not only does this make production more efficient, but it does make it – more importantly – safer and more secure: Improved concentration does at the same time mean a lower risk for work accidents. Thus, the illumination can contribute to improved work safety.



### Light for healthy learning

In sleep mode to school: especially in the early lessons, a lot of students still lack concentration. An activating lighting prevents this effect. As a result, the young people are more awake and capable of higher performance in the morning; at the same time, the error rate drops significantly.

These positive effects were proven in a Hamburg study in 2007/2008 and once more confirmed in 2012 by a study at two high schools in Ulm, Germany. The result: in rooms with a Human Centric Lighting illumination concept, students were significantly more focussed, they worked faster and showed better performance.



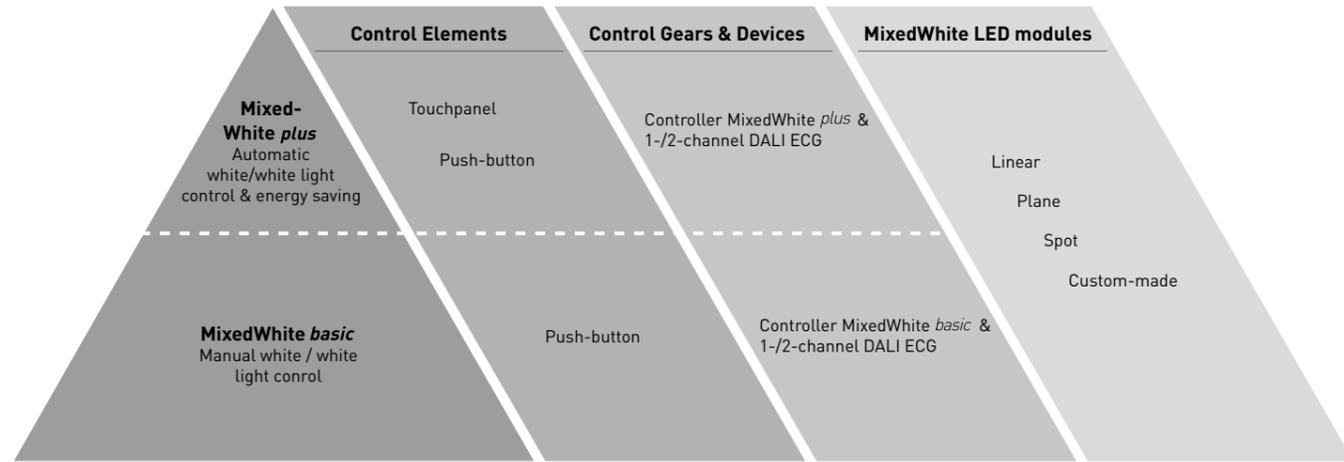
### Light for health and well-being

For sick people, light can be like medicine. To Date, only the surface has been scratched, at best, of which opportunities and perspectives applications of Human Centric Lighting are opening up in the healthcare and care sector. One example regarding this: during their hospital stay, patients only rarely get outside, or not at all. An illumination based on the circadian rhythm can counter this – both in regular hospital operation as well as in intensive care units where healthy light can additionally promote recovery. In care-giving, too, the impact of illumination is gaining importance in the support of natural sleep/ wake rythms of dementia patients in nursing homes.

# Most straight-forward entry into Human Centric Lighting

## Realising light applications cost-efficient and goal-oriented

Human Centric Lighting is the light of the future. And this future has already started today: BAG electronics is offering an complete system for a straight-forward and efficient entry into MixedWhite applications – from ECG via LED modules all the way to the Touchpanel for easy-to-use control.



### MixedWhite basic

#### Manual system for circadian applications

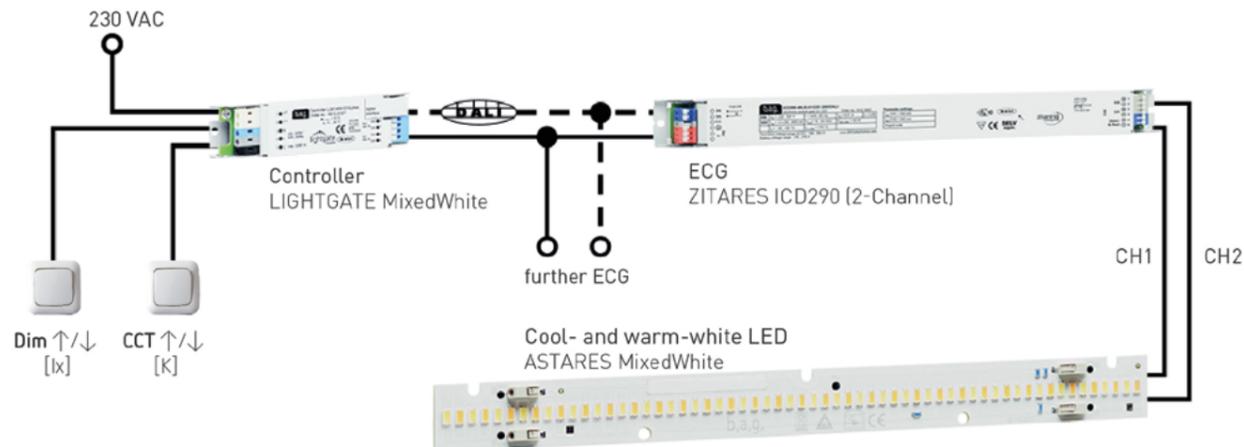
The MixedWhite *basic* system includes the ECG, controller and LED modules with highly efficient warm-white and cool-white LEDs. The overall solution enables the realisation of white/white light controls for a manual operation via commercial push-buttons. The core element of this system is the MixedWhite *basic* controller. It provides the option to adjust the brightness and colour temperature of the lighting system individually via wall push-buttons.

The two DALI interfaces of the controller enable the connection of dimmable electronic control gear units for the operation of LED modules with cool-white and warm-white LEDs. A particular advantage is provided by the combination of the ZITARES intelligent ECG with two independently controllable output channels.

**Functions**

- Manual control via Push-button
- ON/OFF
- Dimming
- Colour temperature

#### System design of MixedWhite basic (example)



### MixedWhite plus

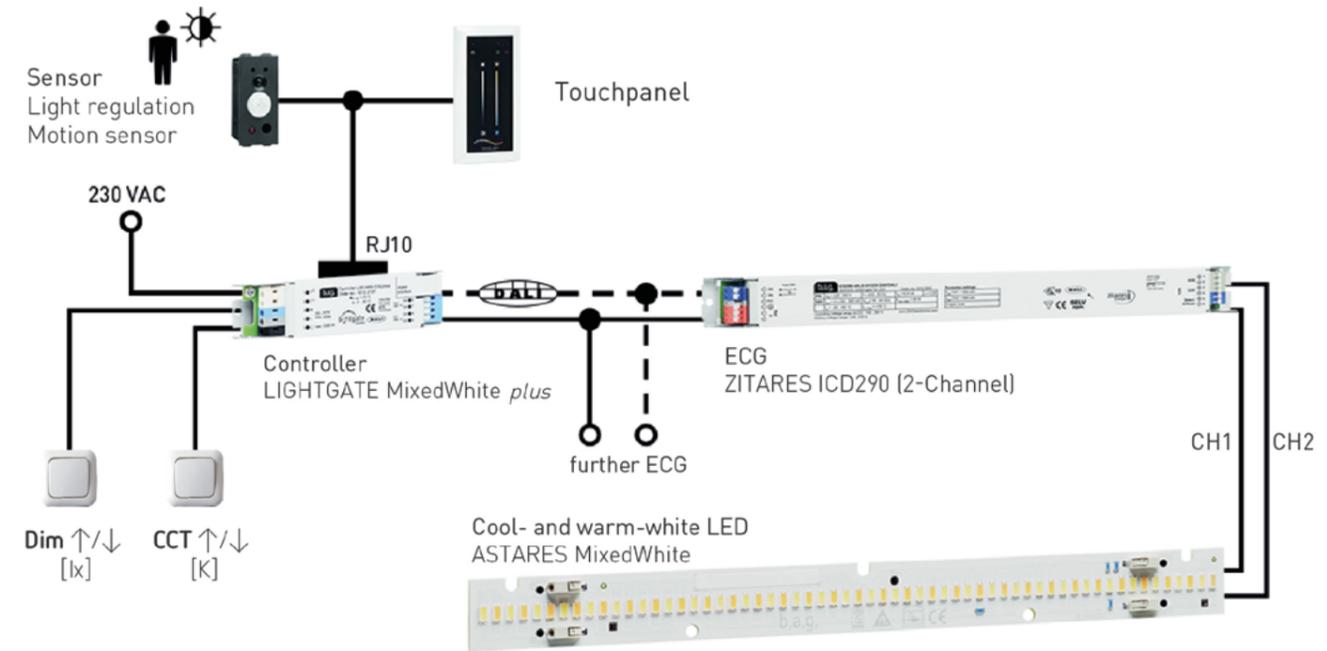
#### Automatic system with real-time clock for circadian light applications

MixedWhite *plus* is building upon the convincing properties of MixedWhite *basic*. This solution additionally includes a real-time clock which allows for the automatic progression of daylight-dependent characteristics with a change of the colour temperature – corresponding to the circadian rhythm. In combination with a sensor, additional energy savings can be achieved thanks to the daylight-dependent regulation and presence detection. Controlling this system is conveniently possible via push-button or Touchpanel.

**Functions**

- Automatic time-dependent control of the colour temperature
- Daylight-dependent regulation and presence-dependent switching
- Manual control via Touchpanel
- ON/OFF
- Dimming
- Colour temperature

#### System design of MixedWhite plus (example)



#### Programming daylight progressions via smartphone App

The handling of the system is just as easy as the system itself is convincing: The programming of circadian daylight progressions is possible comfortably and intuitively via smartphone App, thanks to the intelligent overall solution. The LIGHTGATE App by BAG (for iOS 8 and Android) makes the configuration of MixedWhite *plus* systems particularly easy.

The App includes options for the setting of colour temperature and brightness curves for the four seasons of the year, or a universal curve for the whole year, each dependent on the time of day or the position of the sun.

## The impact of light on humans

Replicating the natural rhythm for more quality of life.

### Promising perspectives for Human Centric Lighting

In modern societies, the human being has quite often withdrawn itself from the natural flows: We are spending more and more time in closed rooms under artificial light, many turn "night into day" in their work-life, without taking into consideration the rhythm of the circadian system.

Human Centric Lighting helps to reduce these deficits. High quality lighting systems that utilise LED technologies are nowadays capable of replicating circadian rhythms and thereby support our "inner clock". The results include increased well-being, the ability to concentrate and perform better – and, above all: a higher quality of life.

As such, it is already possible today to support the natural biorhythm at the workplace via the colour temperature progression over the course of the day: From a stimulating effect before noon via a relaxing lunchtime all the way to phases of concentration in the afternoon.

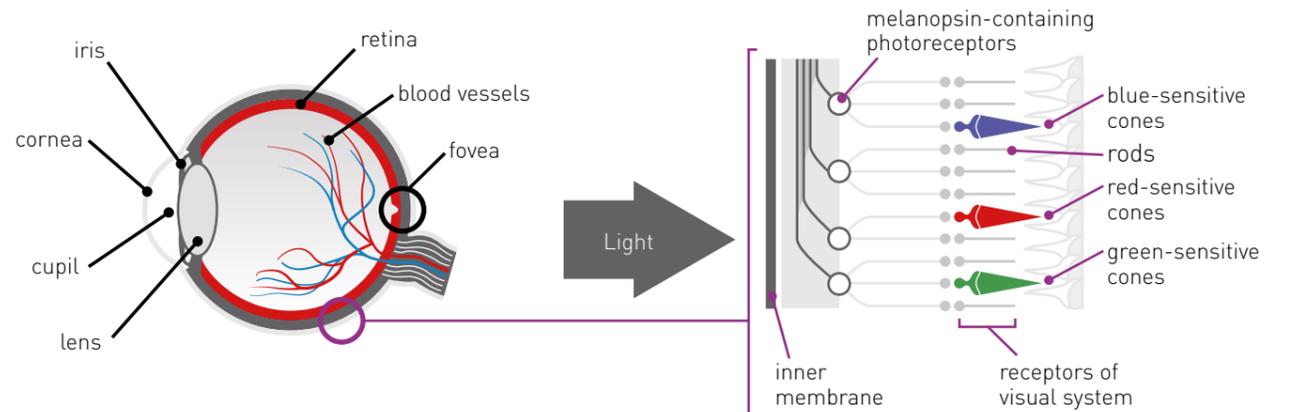
### In the natural rhythm – how circadian systems shape the flow of our day and our well-being

In the course of evolution, the circadian system developed under the influence of the natural sequence of day and night.

Daylight has a decisive impact on physiological and psychological parameters. For instance, in the human eye there are, in addition to the rods and cones that are responsible for seeing bright/



dark and colour, also so-called non-visual photo receptors that are responsible for influencing the human circadian rhythm. The receptors have their highest sensitivity in a wavelength range around approx. 480 nm.



Photoreceptors for daytime vision are particularly concentrated in the fovea (the small depression at the centre of the retina responsible for sharpness of vision, Ø~1.5 mm). The area contains around 60,000 cones but no rods.

Melanopsin-containing ganglion cells are distributed over the entire retina; the most sensitive are in the lower and nasal areas.

#### Melanopsin

Photosensitive pigment contained in retinal ganglion cells involved in the signal transduction of the non-visual effects of light. Its maximum sensitivity lies at around 480 nanometres – i.e. in the blue spectral region.

#### Ganglion cells

Nerve cells in a ganglion (a mass of nerve cell bodies) that transmit visual information from retina to brain via the optic nerve. Two to three percent of ganglion cells are themselves photosensitive. They contain the pigment melanopsin and trigger biological responses in the body.

Source and additional information available at <http://www.licht.de> (licht.wissen, issue 19)

## In sync with inner clock

How the circadian rhythm is affecting our well-being.

### Circadian rhythm at a glance

- Time of day and time of year shape our rhythm. Be it breathing and heartbeat, being awake or being asleep: All biochemically controlled functions have their individual high and low points over the course of a day.
- Shortly before waking up, body temperature, blood pressure and pulse frequency rise. Approximately one hour later, the body produces stimulating hormones. Therefore, complex mental tasks are easiest to handle between 10 am and 12 noon. The short-term memory is also in high gear; as such, ideal conditions for tests and job interviews.
- Between 12 noon and 2 pm, the stomach produces the most acid. This way, it is not difficult to digest lunch. In the process, the stomach is spending so much energy that the rest of the body gets tired.
- But even without eating anything, we experience a performance low during the middle of the day. In the early afternoon, things improve again for both body and spirit. In turn, the susceptibility to pain is at a low point.
- The performance of those who perform sports between 4 pm and 5 pm is particularly high. This period is ideal for building muscle and for fitness training. The body is best at metabolising the after-sports beer between 6 pm and 8 pm. At this point in time, the liver is performing a particularly high amount of work so that alcohol is handled well.
- When it gets dark, we get tired. At 3 am, our body reaches its absolute low.

It is exactly this natural flow that Human Centric Lighting hooks into – with the objective to support the circadian rhythm of the human being. The human hormonal balance is responsible for the circadian rhythm, particularly the melatonin, responsible for the wake and sleep patterns. To control its release, intelligent lighting systems provide different light spectra with different intensities, dependent on the time of the day.

For this, the following applies: light sources with warmer light colour, and therefore with a lower colour temperature, have a lower circadian activation factor. The higher the share of blue in the spectrum of the light source, the higher the circadian factor and the stimulation of the „blue receptors“ which are responsible for controlling the biological functions. When the artificial light adapts to the natural human biorhythm via the control of the colour temperature and intensity, positive effects can be achieved.

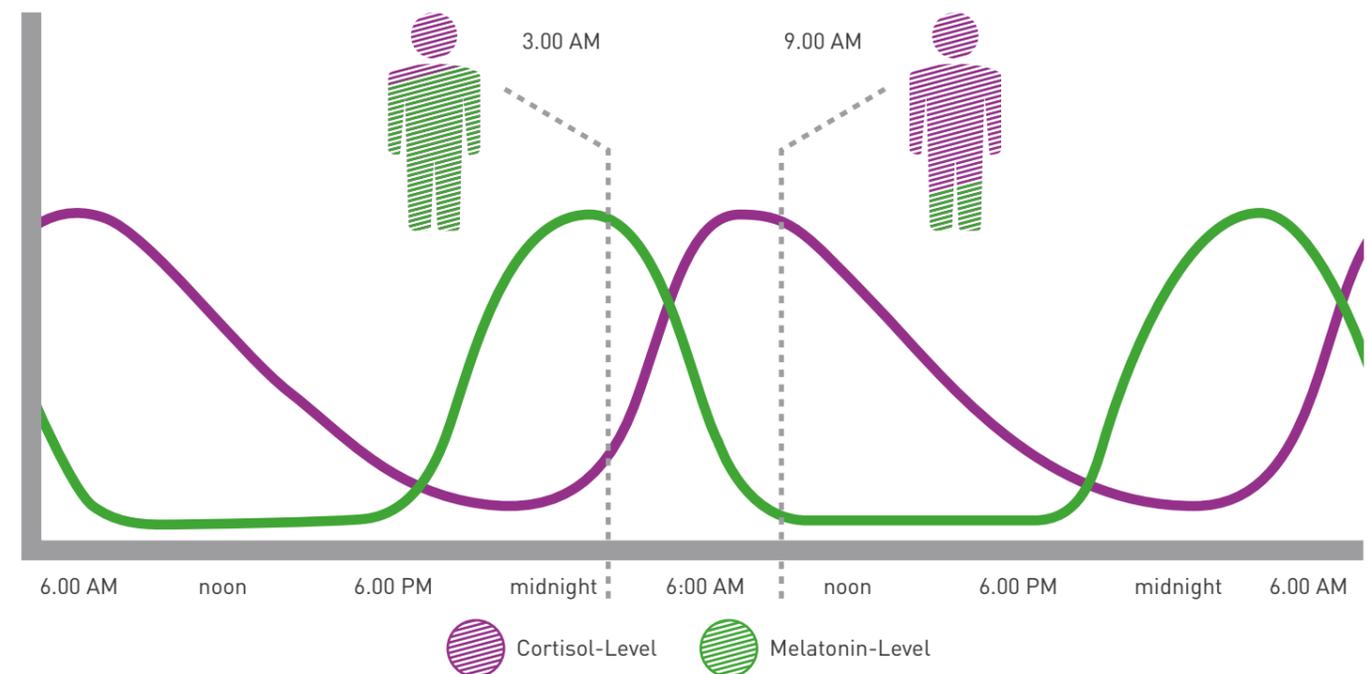
#### Cortisol (hydrocortisone)

Hormone with stimulating effect on various bodily functions („stress hormone“).

#### Melatonin

Hormone that signals „night rest“ to the human body and makes us feel tired. Also referred to a „sleep hormone“.

Source and additional information available at <http://www.licht.de> (licht.wissen, issue 19)



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