Human Centric Lighting

PUTTING PEOPLE FIRST

REGIOLUX
Made in Germany

Light for Living

Importance of daylight for people

The life of most living beings on the planet Earth has been determined by the day-night cycle for millions of years. The biological clock is deeply rooted in our subconscious. Even if humans were already able to create artificial light with fire 300,000 years ago, it did not become possible turning night into day with the distribution of electricity at the end of the 19th century. This period of time is far too short to be reflected in human genes.

Witnessing these Facts, it becomes apparent how straining our way of living must be for us - mainly in enclosed rooms - with only little or even no daylight. It is assumed that at least 20% to 30% of the people working in industrial countries suffer from recurring sleep disorders. The body's inner cock gets out of step.

Topics

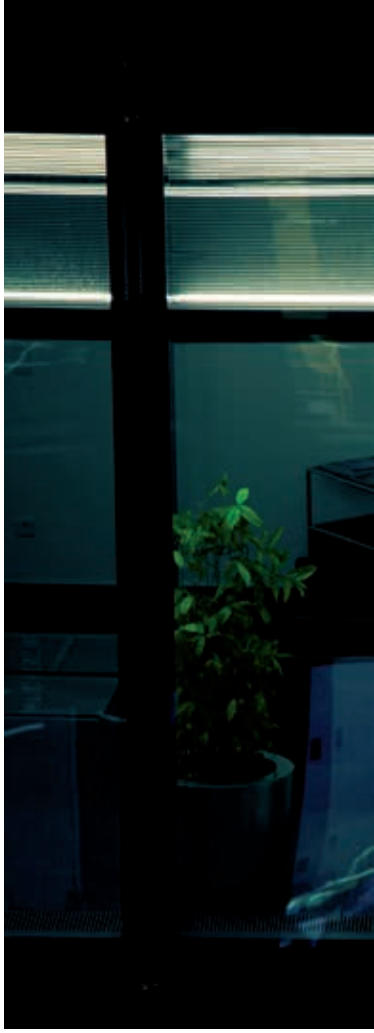
With today's technologies and knowledge it is possible to compensate for this handicap of static light in our surroundings. The lack of natural daylight can be compensated for by convergence of the artificial light to the course of daylight. Thus, the human biological clock will be synchronised again.

Biological Clock

Life on Earth is also determined by the alternation of day and night. Many types of cells from species have developed some type of inner clock in the course of evolution. The brain synchronises this clock with the environment. Light is the pulse generator for this process.

Artificial Light

Consequences of the use of artificial light



The year 1879 is the start of the era of electric lighting. Thomas Alva Edison files a patent for his light bulb. This modern invention has radically changed our lives. Now men were able to extend their day, change their rhythm of time or turn the night into day. Artificial light was introduced in manufacturing plants and it became possible to also work without daylight. Initial approaches for light planning developed, when it became obvious that good light does not only depend on the illumination level.

As well as the illumination level, other criteria are in the focus of today's state-of-the-art light planning, such as harmonic distribution of brightness, limitation of glare effects, light colour, colour rendering, light direction and shade. If all these points, known as quality characteristics of lighting, are met a „good" lighting system will certainly be achieved. So far so good. But why not make something good better?

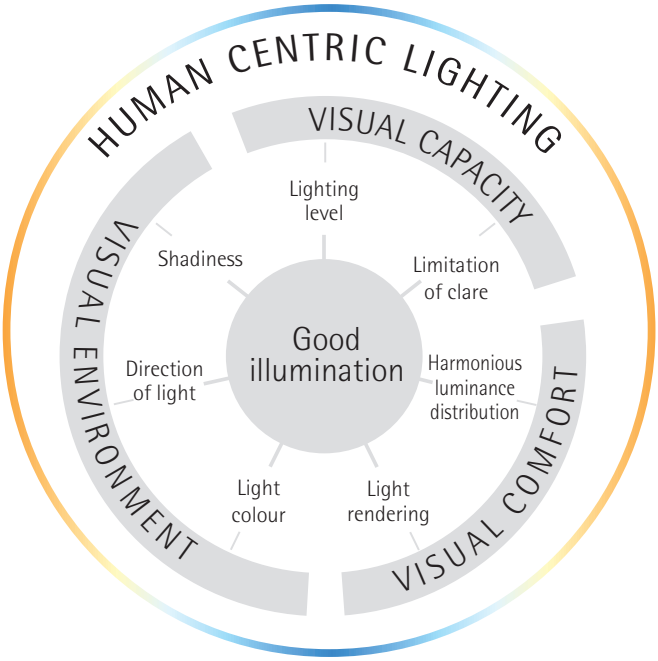
Biologically Effective Light

Light which is characterised by dynamics with regard to luminance, light colour and direction of arrival. This light is able to initiate biological processes for living creatures.

New Approach

The classic quality characteristics are lacking one approach: dynamics. The level of illumination is designed for a specific minimum value according to standard; this so-called target value is kept constant for light control. The light colour is specified in the planning phase and is not subject to any change during operation.

However, people are conditioned differently, people live with and by changes, also in matters of light. During evolution, homo sapiens started around 300,000 years ago to adapt to the cycle of natural sunlight. Daylight is characterised by different levels of light and different light colours. No wonder that people also orient themselves to such parameters of the light and are clocked by them in their rhythm of life.



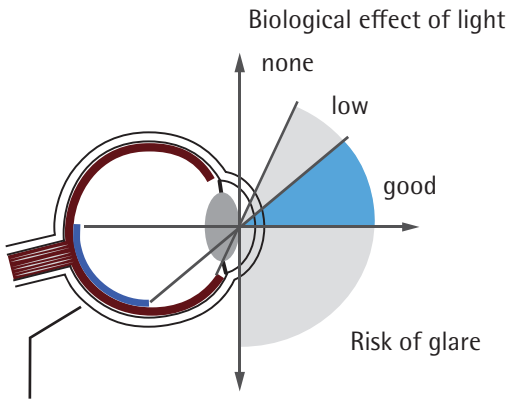
Chemical Messengers

It was not clear for a long time how these light stimuli are exactly processed. It was known that the so-called cones in the eye are responsible for colour vision and the rods for mesopic vision. A third receptor, the ganglion cells, was discovered in the year 2002. However, these light-sensitive cells are not used for vision but regulate biological processes in the body when in contact with light. The retinal ganglion cells are directly connected to a specific area of the brain for this purpose. The body's rhythms are clocked from this central control point - the „Master Clock". It controls the production of hormones and the activation of enzymes. Increasing exposure to light thus ensures, that the production of the sleep hormone melatonin is suppressed. Instead, serotonin is released, which has a mood-enhancing and motivating effect.
The task expands for light planning which is geared to the biological rhythm of men. The objective must be to create a lighting solution beyond the standard quality characteristics for illumination. It is not only a matter of meeting applicable standards. Light, and therefore also good illumination, can do more. Good light does not only illuminate, but has a biological effect.

Retinal Ganglion Cells

Photoreceptors in the retina of the eye. These cells are sensitive to light, however, they are not used for vision. Instead, they assume a role for the synchronisation of the internal clock of the person.

Ganglion cells and direction of light



Area of the retina, where the ganglion cells respond particularly sensitively

Simulation of Daylight

The focus is on the person, also regarding to illumination. A contemporary lighting system must be able to enhance the well-being of the person more than ever before. Knowing that the human organism has been and will be characterised by daylight, the objective must be integrating the

positive aspects of daylight into modern light planning. It was not without reason, that the issue of daylight was included in the revision of the European standard EN 12464-1 „Illumination for workplaces in interior rooms". But what should be done, if sufficient daylight is not available? In this case, artificial light can assume specific daylight functions and provides „the right light at the right time". Based on the natural light, the artificial light is given a dynamic structure in the course of the day. Thereby, the changes in the level of illumination and in the light colour are of particular importance. Such lighting is able to support the circadian rhythm of the person. Our cells and organs and thus the body's functions are linked to this rhythm, with the human body clock being the pulse generator. It cont-

Circadian Rhythm

The term is derived from Latin (circa = around, dies = day) for a cyclic biological process with a period of approx. 24 hours.

Human Centric Lighting

The characteristics of the HCL illumination consider more than just vision. The focus is on the person. Human Centric Lighting stimulates the well-being and supports stable health of the person.

The Solution for Human Centric Lighting

rols sleep and waking phases, but also heart beate, blood pressure and mood. This cyclic process is also characterised by the fact that all biochemical functions have individual high and low points in the course of the day. The circadian rhythm is regularly synchronised with the outside world whereby humans are primarily influenced by the brightness of the day and the darkness of the night.

Biologically Effective Light

For the artificial illumination, a simulation of daylight means starting in the morning with warm-white light. Derived from sunrise, this light has more red content in the spectrum and thus has a relatively low colour temperature of e.g. 3000 Kelvin. A gradual transition to daylight-white light colour (e.g. 6000 Kelvin) is performed in the course of the day. The now increased blue portion in the spectrum results in an activating effect which stimulates the concentration. This change of the light colour at noontime should also involve an increase in the level of illumination to exceed a specific threshold value for the biological effectiveness of the light. As the eye is adapted to the natural environment and thus at noontime to the light of the sky, this should also be taken into consideration for the selection of luminaires and light distribution. The most sensitive ganglion cells are mainly distributed in the rear and lower part of the eye. Large-surface luminaires or luminous ceilings are better suited than point light sources to reach as many of these receptors in the eye as possible.

In the later afternoon and evening, the dynamic process of the morning hours will be reversed, e.g. the level of illumination will be gradually reduced and the colour temperature changes to warm-white light.

Human Centric Lighting

Why Now?

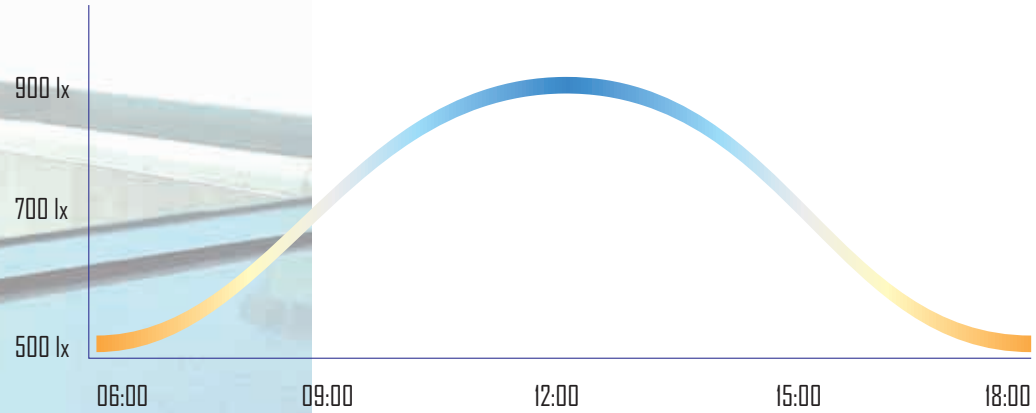
This seemingly trivial question can be answered in various ways:

The time has come

Not only because scientific evidence is now available, giving proof of how our perception of daylight functions, but also because supporting the biological clock promotes health. An optimal light environment can result in significant positive effects in an ageing society, because health will be of more value than ever before.

The technology is available

The new scientific findings can be easily integrated today in a world which is increasingly becoming more digital and



intelligent. The LED technology not only provides efficient and small light sources, but also the control systems which enable such complex dynamic modifications of the light. Thanks to significantly lower consumption values of modern LED technology, even the higher energy consumption of Human Centric Lighting can be compensated for.

Using simulation of daylight, artificial light can assume a biologically effective function. This makes sense as people are spending more and more time in enclosed rooms. Modern dynamic light concepts will replace the static light solutions. The focus is on the person and the increase of his/her well-being.

The economic efficiency is given

Depending on the individual case, economic efficiency can be verified not only for industry, but also in healthcare. The greatest obstacle for wider use of Human Centric Lighting is that investor/operating company and beneficiaries are not directly the same stakeholders. This was determined by a study of ZVEI. If a hospital invests in biologically effective light, it is mainly the health insurance fund that benefits due to shorter treatment periods. However, the hospital itself will benefit indirectly due to a good reputation for better or faster therapeutic outcome.

Smart Control

Like other trades in building services, intelligent control for lighting is catching on. The digitalisation of lighting is in full swing and provides a wide variety of solutions thanks to the LED technology and „smart“ controls.

The terms „smart home“, „smart lighting“ or „smart building“ lift the modern technologies to an appealing level. In addition, they symbolise the trend of the time across building services, which can no longer be ignored.

Tunable White

Tunable White stands for individual, functional light and is special lighting, which therefore also needs special control.

Tunable White

Continuously variable adjustment of different colour temperatures of white light. Option for the implementation of daylight simulations.

For Tunable White, the light is mixed from two light colours. The DALI drivers used for this purpose are designed for optimal control of the creation of colour and performance of the luminaire. Therefore, an appropriate device type 8 (DT8) has been defined in the DALI protocol according to IEC62386 Part 209. It is specifically intended for the control of colour and colour temperature. It must be considered, that the devices are compatible with the DT8 protocol, not only on the part of the drivers, but also on the part of the DALI control. This is because not only dimming, but also colour change is performed via the same address. Ordinary DALI dimmers or DALI broadcast systems usually do not have the required protocol.

As with all control tasks there is an easy solution and a complex solution. The control of Tunable White usually depends on the relevant application. Where the colour-changing light should support daylight cycles you will probably primarily work with fully automated timer controls and only certain light scenes will be temporarily released for manual control.
Manual selection of the light colour is more likely in areas, where the light is to create a mood, which is adapted to the event. Then only a basic scene will run automatically or a preselection, will be offered as needed. Thus it is indispensable to precisely define the function and effect in advance. There is no general applicable solution. For these reasons the controls are not so easy to be tailored. Even if a low priced tailored system basically meets the requirements, e.g. a trivial intervention may discard the entire concept.

The most typical application in Tunable White is the Human Centric Lighting (HCL), the circadian colour cycle in illumination. This cycle is normally triggered by a timer and cannot be influenced by an operator. The cycle can only be interrupted for temporarily available light scenes. Then the illumination will return to the predefined cycle, at the current time.

There is an enormous range in matters of operation and operating comfort, like in other lighting applications. This covers operation via radio, app or PC and integration into the Internet of Things (IoT). However, the customary switch or pushbutton has always been an issue up to now. Like the clarification of the function, the desired operability must also be defined in advance. It can influence the performance of the control. It is recommended to consider consultation in the conception phase, so that optimal function results in the greatest possible outcome.

Regiolux has established a service for your questions and concerns, which can be reached at dali@regiolux.de.

Smart Lighting Technology

Smart – stands primarily for „intelligent" and the term has been retained in many areas of building services.
Smart home:
Intelligent building control by means of interconnection with building services and household appliances. Appliances can be addressed via Internet or smartphone apps. The objective is to increase the quality of living and safety as well as efficient use of energy.
Smart building:
The building becomes part of an intelligent electricity network. Own consumption, own generation and own storage of energy are effectively matched thanks to the interconnection and communication with the energy supplier. Based on energy-efficient building services, this is an important contribution to sustainable construction and protection of the environment.
Smart lighting:
Intelligent lighting systems based on energy-efficient lamps, highly efficient lighting technology and electronic components for operation and control. An intelligent lighting management system takes account of daylight linking and dimming as well as presence detection. Remote control or smartphone can be used for programming and manual interventions. The lighting system may be component of central building control systems.

Application Areas

Optimal use of potentials

The natural daylight changes constantly from morning to evening, both in brightness and colour as well as direction. A professional lighting system can imitate this rhythm. It provides interior rooms with biologically effective artificial daylight or supports the natural light there. Human Centric Lighting can support in particular lighting tasks in the office, care, industry , shop and education sectors.

Office

Optimal office illumination distributes both direct and indirect distribution of light. In this way it creates balanced luminance in the room. The light colour can be adjusted independent of the direction. Direct warm-white light in the morning with a light colour around 3,000 Kelvin provides for a start of the day perceived as comfortable. This can be supported by multiple components, e.g additional wall illumination, which catches the eye by flat distribution. 500 lx at the workstation should be ensured. In the evening the same configuration provides for harmonic Transition, to the end of the working day.

At noon, there will be a transition to cold-white light **of approx. 6,000 Kelvin and a lot of indirect light will be added. Thus, the lighting system is increased to 1,000 lx without glare. This diffuse illumination simulates the blue sky at noon. It helps to overcome the afternoon slump and sustainably increase concentration.**
In this way, Human Centric Lighting can promote creativity and communication of the employees in the office. It alleviates tiredness of the eyes and initiates breaks to replenish energy for the next day.

Education

Also everyday life in school, study and further education is strongly influenced by artificial light, in particular since all-day schools become increasingly popular. Human Centric Lighting can contribute to increase attention and concentration of the students as well as reduce stress in the long term. Similar as in an office the luminaires shall distribute both direct and indirect light in a classroom or lecture hall and map the circadian colour and brightness profile.

Industry

The industrial workstation is typically characterised, by manufacture and assembly in large rooms or halls. Therefore there is often automatically a flat light incidence, also with luminaires with direct distribution. Such an industry lighting is a cost-efficient, but still biologically effective solution.
The circadian rhythm of illumination can have a positive effect to motivation and concentration of the employees. Thus, it primarily increases the safety at the industrial workstation. Studies reveal, that the number of accidents with serious consequences can be reduced with HCL . The circadian lighting rhythm described above is not practical for late shifts or night shifts. Regiolux will be pleased to provide advice on how HCL can be used for such working times.

Care

Experts see the largest potential for Human Centric Lighting in healthcare and most of all in geriatric care. Mobility is often limited for patients and elderly people, which then leads to a strong influence of artificial light to their biorhythm.
Large-surface luminaires can bring biologically effective light into the hospitals and/or nursing homes. An increased amount of light provides for more security of movement and well-being of the residents. The communication with the staff and amongst each other also improves. Preventive treatment with biologically effective light can curtail dementia and depression. In addition, a circadian illumination rhythm supports the sleep and wake cycle. The residents are more active during the day and have a better sleep at night. This can reduce therapy periods and the demand for nursing staff.
Furthermore, because the metabolism is activated, less medication may be sufficient for a successful treatment.

Shop

Long shopping hours and windowless shopping centres - all this can disturb people's biorhythm.
Human Centric Lighting can satisfy the natural need of employees and customers for a dynamic illumination level, depending on the time of day.
This adds to motivation and friendliness of the employees. The customers spend more time in the store.

Planning Practice

Many useful hints for planning and precise application are found in DIN SPEC 67600 : 201304. Often only the classic illumination level on the workstation is crucial for planning, but also the spectral distribution and the illumination level at the eye.

Tunable White as Functional Light

Along with the classic daylight simulation it is also possible to generate targeted illumination scenarios with a special function outside of the circadian rhythm. It needs to be assessed with sensitive care, whether this is a matter of re-setting men's inner clock and therefore a type of manipulation. The variability of the light colour „white" however can be used in many fields of application.

It can be reasonable to illuminate examination and treatment rooms in different shades of white. The consultation session can take place in a warm-white environment to create a harmonic atmosphere. The examination itself will be performed in neutral white which emphasises the factual diagnosis.

In patient rooms, the course of the day can be emphasised with circadian light. A temporally adjustable neutral light colour interrupts the rhythm for ward rounds or patient care. This will increase concentration.

Other design options arise if the illumination of corridors is equipped with a presence control and connected to a night reduction. A corridor illumination, which would be sensed as glaring in the evening, will now create a comfortable warm-white night light. In the course of the day however an appropriate working light designed for safety will be used.

Red fractions in warm-white light change the colour rendering. This effect can be used best for the presentation of goods. Depending on the colour of packages or goods the goods can be optimally presented with correctly „tempered" light. This effect, which is not only used for different food products, is focused on optimal perception of product characteristics. Flexibility is demanded when the choice of goods changes and other requirements result for the light colour. Tunable white allows for easy and quick adjustment to new tasks of presentation.

Depending on the atmosphere to be created, meeting and conference rooms are put in perspective with tunable white. Warm-white creates a casual working atmosphere for an informal meeting. Cooler neutral and daylight white is rather appropriate for negotiations and contract conclusions where keeping cool is a literal requirement.

Mood lighting appropriate to a specific topic can be generated in schools or daycare facilities for children. Increased attention for exercises and tests can be achieved by colder light. The warm light can provide for relaxation during lessons and breaks.

HCL - Project Practice

Technologie- und Gründerzentrum Würzburg (TGZ)

The concepts of modern light planning are aimed at energy efficiency with LED luminaires and light management systems to arrange for functional light appropriate for the needs. Now the concept of Human Centric Lighting can be added for the field of office illumination. It focuses on improved light quality in the interior of a building by imitating the course of natural daylight. A unique light quality for working and living in the office environment is generated with the light solutions which support the dynamics of the biorhythm. In this function it promotes the motivation and satisfaction of the employees.

alvia
tunable white

The suspended LED luminaire alvia is equipped with a microprismatic cover and has direct and indirect light distribution. In the version tunable white, the colour temperature can be set between 3,000 Kelvin and 6,000 Kelvin. When combined with a corresponding control unit, the computer screen compatible luminaire guarantees comfortable office lighting.

Architecture concept

At its new location „am Hubland", the TGZ (Technology and Centre for Startups) in Würzburg offers a platform for non-university institutions and innovative companies as well as for occupational education facilities.
A plinth links the individual parts of the building on ground floor level, thus creating a building complex that forms a landscape on the ground floor upon which a high-technology silver building block seems to hover.

KSG Architekten

Project data

Owner / Investor	Technologie- und Gründerzentrum Würzburg, Würzburg
Projektmanagement:	GUNTAU : KUNZ Projektmanagement, Kitzingen
Architects:	kister scheithauer gross architekten und stadtplaner GmbH, Köln
Responsible partner:	Prof. Johannes Kister
Projectdirector:	Sebastian Schröter
Consultants	Ingenieurgemeinschaft TEN, Aachen
	IDK Kleinjohann, GmbH & Co. KG, Köln

Interior

The design of the interior meshes with the materials on the outside. The bright offices are flooded with light through floor-to-ceiling windows. Along the outer walls, the offices have an exposed concrete surface and ceiling. Acoustic screens are attached on the ceiling to create a pleasant, sound-insulated working atmosphere. The lighting concept relies on the alvia suspended luminaire and the light quality of Human Centric Lighting.

Products for HCL

Products for the realisation of dynamic illumination concepts are designed to allow for temporal variation of illumination levels. Colour temperature and illuminance can be individually controlled and adjusted in the course of time. In this process, the light quality gains importance over the energy efficiency. The planara, visula and alvia families of luminaires are already available. Other products will follow..

planara tunable white

Due to the large light emission surface of the individual luminaire and the option of grouping in a grid ceiling, the planara tunable white activates a particularly large amount of ganglion cells in the eye. Therefore, a high biological effect is achieved, which is ideal for hospital and care sector with IP54 and for the office sector with grid ceilings.

PNEMP 4600 830-860 DALI DT8
PNEG 4500 830-860 DALI DT8
PNEO 4200 830-860 DALI DT8

LED A+ 3000 CE IP 54

Enclosure:
- Steel sheet, traffic white RAL9016
- Dimensions LxWxH (mm): 622x622x81 or 597x597x81
- Suitable for ceiling system: Ceilings with visible rails/24mm

Light technology:
- Light distribution: Always direct distribution
- System performance: Typically 39W, (±5% depending on current light colour)
- PNEMP: 4600 lm, diffuser micro-prismatic, PMMA, suitable for screen workstations, 65° < 3000cd/m^2, UGR < 19
- PNEG: 4500 lm, diffuser satin-finished, PMMA
- PNEO: 4200 lm, diffuser opal, PMMA

Illuminant:
- Incl. LED tunable white, 50000 h L80/B10
- Continuously adjustable from 830/warm-white (3000 K) to 860/daylight white (6000 K)
- Dimmable 10-100%

Circuit:
- Electronic driver DALI device type 8 (1 pc.)

visula tunable white

The visula tunable white is able to map the entire circadian cycle and adapt colour and brightness to the course of daylight. The room is dynamically illuminated with a comfortably even light situation.

VSHIMP/1500 LED 4800 830-860 DALI DT8
VSHIG/1500 LED 4800 830-860 DALI DT8
VSHIMP/1200 LED 3800 830-860 DALI DT8
VSHIG/1200 LED 3800 830-860 DALI DT8

optional:
Surface mounted luminaires
VSAIMP
VSAIG

LED A 3000 CE IP 20

Enclosure:
- Frame made of natural anodised aluminium, visible installation height 30mm;
- Dimensions LxWxH (mm): 1199x330x30 and/or 1480x330x30
- Y-cable suspension with connecting cable and ceiling baldachin

Light technology: (Typical system performance, ± 5% depending on current light colour)
- Light distribution direct(84%)/indirect(16%) distribution
- Homogenous light emittance by lateral LED light introduction
- VSHIMP/1500: 4800 lm, diffuser micro-prismatic; PMMA; 71; suitable for screen workstations, 65° < 3000 cd/m^2, UGR < 19
- VSHIG/1500: 4800 lm diffuser satin-finished; PMMA; 71W
- VSHIMP/1200: 3800 lm, diffuser micro-prismatic; PMMA; 58W, suitable for screen workstations, 65° < 3000 cd/m^2, UGR < 19;
- VSHIG/1200: 3800 lm, diffuser satin-finished, PMMA, 58W

Illuminant:
- Incl. LED tunable white, 50000 h L80/B10
- Continuously adjustable from 830/warm-white (3000 K) to 860/daylight white (6000 K)
- Dimmable 10-100%

Circuit:
- Electronic driver DALI device type 8 (2 pcs.)

Our label for Human Centric Lighting

Regiolux highlights the special characteristics and options of this product group with a dedicated label

alvia tunable white

Direct and indirect portion can be changed independent of each other both in colour and brightness. Thus, alvia tunable white is able to create optimal illumination in the office, providing people with a particularly natural light situation. Ideal for modern offices and health-conscious companies.

ALIMPR/1100 LED 6900lm 830-860 DALI DT8

LED A+ 3000 CE IP 20

Enclosure:
- Frame made of natural anodised aluminium, visible installation height 23mm;
- Dimensions LxWxH (mm): 1120x317x40
- Y cable suspension with translucent connecting cable and ceiling baldachin

Light technology:
- Light distribution: direct (67%)/indirect (33%) distribution with edge brightening
- Independent and continuously adjustable in colour and brightness
- Diffuser micro-prismatic; PMMA
- System performance: Typically 67 W (±5% depending on current light colour)
- Luminous flux of the luminaire: 6900 lm
- Suitable for screen workstations, 65° -< 3000 cd/m^2, UGR < 19

Illuminant:
- Incl. LED tunable white, 50000 h L80/B10
- Continuously adjustable from 830/warm-white (3000 K) to 860/daylight white (6000 K)
- Dimmable 10-100%

Circuit:
- Electronic driver DALI device type 8 (2 pcs.)

9999 2520 216 1.A 1000 02/16 MA/HD Subject to modifications

Regiolux

REGIOLUX
Made in Germany

Regiolux GmbH
Hellinger Straße 3
D 97486 Königsberg
T +49 9525 89 0
F +49 9525 89 7
info@regiolux.de
www.regiolux.de