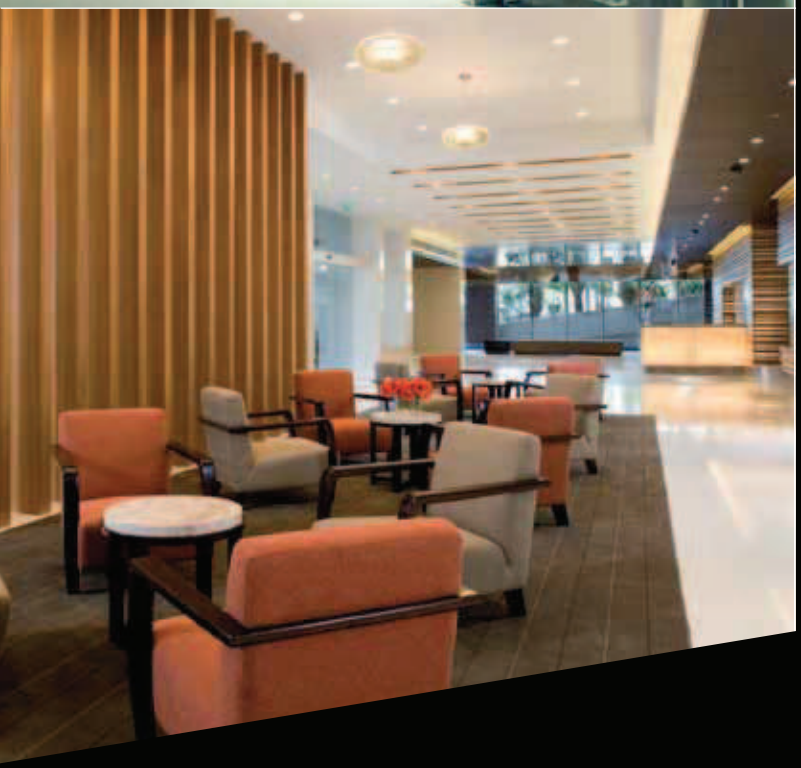
MEGAMAN®

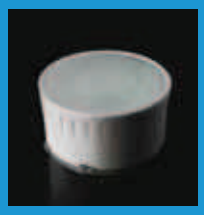
High performance twist-lock LED modules

TECOH® CFx
Fixture Design Guide



2012

CONTENTS



Introduction

1.1 TECOH® CFx concept

MEGAMAN®'s TECOH® CFx range of high performance twist-lock LED modules has an integrated driver for general lighting and is designed in line with proposed Zhaga specifications. With nominal lumen packages of 1200 and 2000 lumen, MEGAMAN®'s TECOH® CFx modules are ideal for use in downlights, replacing conventional light sources such as 50W halogen and 2x13W and 2x18W compact fluorescent lamps.

In line with MEGAMAN®'s policy to develop only eco-lighting solutions, the TECOH® CFx range of socketable modules can be easily serviced and upgraded to the latest LED technology. By using the twist-lock solution the existing luminaire can be retained, minimising the environmental impact of replacing the whole fixture.

MEGAMAN®'s TECOH® CFx modules are based on a unique design using a multiple-chip white LED array at the bottom of the module and a reflector to direct the light through a slightly opaque cover with beam shaping center part, resulting in a lambertian* output. This unique approach ensures that TECOH® CFx modules offer good colour characteristics and superb lumen maintenance over life, emit negligible UV, have excellent dimming capabilities and result in low maintenance costs. Furthermore, compared to remote phosphor solutions, it has the advantage of minimizing the use of scarce and increasingly expensive phosphor.

TECOH® CFx is to be MEGAMAN®'s first Zhaga certified product.

* Lambertian: this means the module viewed from any angle has the same luminance (lm/m²/sr) so is a near perfectly diffused source of light. This results in a output from the module being a smooth polar curve with a 120 degree beam angle.

Introduction

1.2 Thermal control

The TECOH® CFx LED Module base must be used with a PHJ65d-2 lamp holder and mounted on a heat sink or directly to the body of a fixture. Design requirements of the heat-sink are described in chapter 3.6 thermal management on page 20.
When the thermal control is designed in accordance to instructions in this manual, MEGAMAN® TECOH® CFx products have a rated life of L70 = 35.000h, meaning at the rated L70 life, 70% of the initial lumen output is still available.

1.3 Specific applications for the MEGAMAN® TECOH® CFx

The TECOH® CFx modules are intended to be used in downlights for general lighting such as:

- Hospitality
  - Lobbies
  - Restaurants
  - Corridors
- Retail
  - Supermarkets
  - Non-food shops
  - Corridors
  - Fitting rooms
- Office
  - Corridors
  - Reception area's

1.4 Features of TECOH® CFx

- Twist-lock design with integrated driver allowing easy installation directly on mains input.
- Beam shaping disc, for smooth Lambertian output, reduced glare and improved control
- Offers different lumen packages in the same compact size allowing for multifunctional fixture design when thermal limits are respected
- Future-proof design, enabling easy upgrading of the TECOH® CFx as technology advances.
- High colour uniformity, with colour consistency < 3 SDCM.
- Stable colour temperature with a negligible shift over the entire rated life.
- Offering linear dimming from 10% – 100%, with compatible dimming switch, without colour shift.
- Long lamp life with good lumen maintenance (L70) of up to 35,000 hours.
- Negligible UV and IR radiation, allowing objects to be lit from very short distances.
- Instant start – TECOH® CFx reaches the declared light output and colour temperature at the time of switching on.
- Instant start even at low temperatures, therefore very suitable for outdoor application in cold regions
- Contains no mercury for enviromentally friendly lighting solution.
- Wide range of operating temperatures (-30°C to +40°C).
- Low maintenance cost due to the long life and extremely stable operation, both in output and colour performance.
- Wipe to clean glass front cover for easy maintenance.
- Robust design resulting in high reliability.

MEGAMAN® TECOH® CFx modules

2.1 Nomenclature

CF 01 12 d / PHJ65d-2 - 828 - 230V

Category Name
CF = LED Module TECOH® CFx
MH = LED Module TECOH® MHx

Version
Two Digits for indication
From 01 to 99

Luminous Flux Indication*
Two digits for indication
12 = Nominal 1200lm
20 = Nominal 2000lm

Technology
d = Dimmable

Lamp Base

Colour Indication
First digit = Ra
8 = Ra 80 – 89
9 = Ra 90 – 99
Last two digits = Colour Temperature
28 = 2800K
40 = 4000K

Input Voltage or Current
For modules operated on line voltage
230V = AC 220 – 240V
For modules driven by halogen transformers/ constant voltage converters
12V = AC/DC 12V
24V = AC/DC 24V
For modules driven by constant current converters
500 mA = constant input current of 500 mA
700 mA = constant input current of 700 mA

* The luminous flux indication refers to the higher nominal value within the flux category. Different colour temperatures or technologies used share the same flux category indication

2.2 Construction

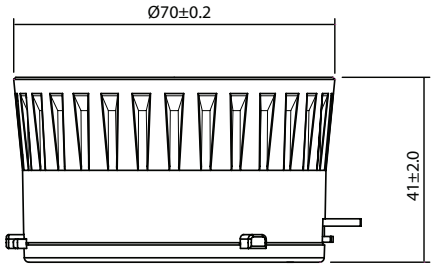
MEGAMAN® uses a unique concept for the TECOH® CFx modules. In these modules a multiple chip white LED array is positioned at the bottom of the module. A reflector is used to control the light and to direct through a slightly opaque cover with beam shaping center part.
This results in a Lambertian beam shape. The MEGAMAN® TECOH® CFx modules are designed in line with the proposed Zhaga specifications and can be used with a PHJ65d-2 holder.

The key to maximising light output and lumen maintenance lies in sound thermal management. While using the Zhaga format TECOH® CFx has a unique combination of ceramics and aluminum for excellent heat dissipation allowing the LED's to expel heat efficiently via the bottom of the module and prevents deterioration of the LED multi-chip array and other components. This technology gives the modules longer life with high lumen maintenance.
The thermal conductivity between module and the fixture is optimized by the use of a Thermal Interface Material (TIM).

MEGAMAN® TECOH® CFx modules

2.3 Physical specifications

	TECOH® CFx
Module height	41 ± 2.0 mm
Max. Module diameter	70 ± 0.2 mm
Diameter base	65 ± 0.3 mm
Module weight	20W: 108g; 30W: 122g
Base	PHJ65d-2
Flammability	Complies to glow wire test 650°C
RoHS	Compliant



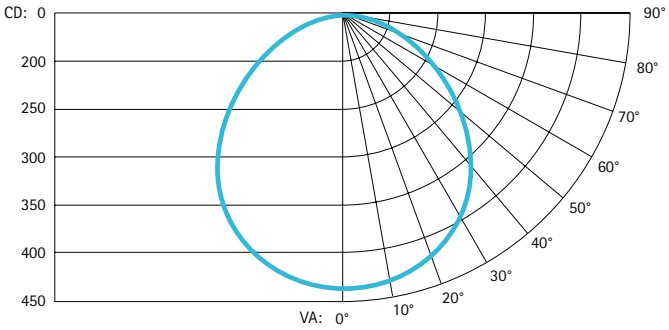
2.4 Electrical and Photometrical Characteristics

The electrical and photometrical data for TECOH® CFx operated on mains voltage are listed below.

Module type	CF0112d/PHJ65d-2 -828-230V	CF0112d/PHJ65d-2 -840-230V	CF0120d/PHJ65d-2 -828-230V	CF0120d/PHJ65d-2 -840-230V
Lumen output	1100 lm	1200 lm	1800lm	2000 lm
System Efficacy	55 lm/W	60 lm/W	60 lm/W	67 lm/W
Colour Temperature	2800K	4000K	2800K	4000K
Colour consistency Initial Over life	 < 3 SDCM < 5 SDCM	 < 3 SDCM < 5 SDCM	 < 3 SDCM < 5 SDCM	 < 3 SDCM < 5 SDCM
CRI	80	80	80	80
Rated voltage	220-240V	220-240V	220-240V	220-240V
Wattage	20W	20W	30W	30W
Power Factor	> 0.9	> 0.9	> 0.9	> 0.9
Total Harmonic distortion	30%	30%	30%	30%
Life (L70) at 65 °C case temperature	35,000 hours 70% lumen maintenance	35,000 hours 70% lumen maintenance	35,000 hours 70% lumen maintenance	35,000 hours 70% lumen maintenance
Operating Temperature	-30°C to +40°C	-30°C to +40°C	-30°C to +40°C	-30°C to +40°C

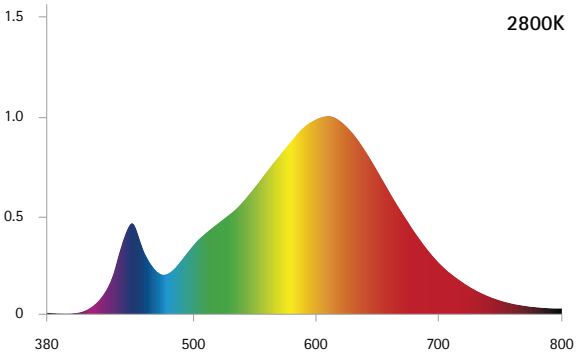
2.4.1 Photometrics

TECOH® CFx products have a Lambertian light distribution as shown in the polar intensity diagram.

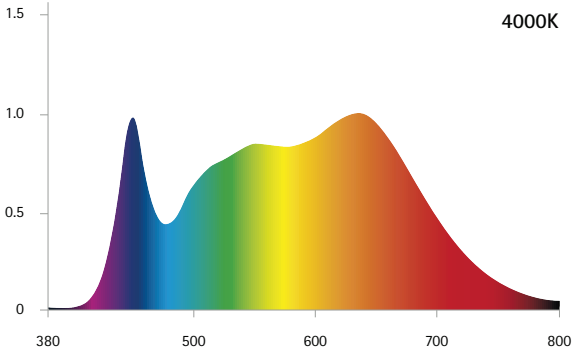


Photometric files for TECOH® CFx, including ray trace files can be downloaded from the MEGAMAN® website: www.megamanlighting.com/OEM.

TECOH® CFx solutions come in two colour temperatures 2800k and 4000K, the spectral power distribution of both options is illustrated in below graphs.



2800K Spectrum (for reference only)



4000K Spectrum (for reference only)

MEGAMAN® TECOH® CFx modules

2.4.2 Start-up characteristics

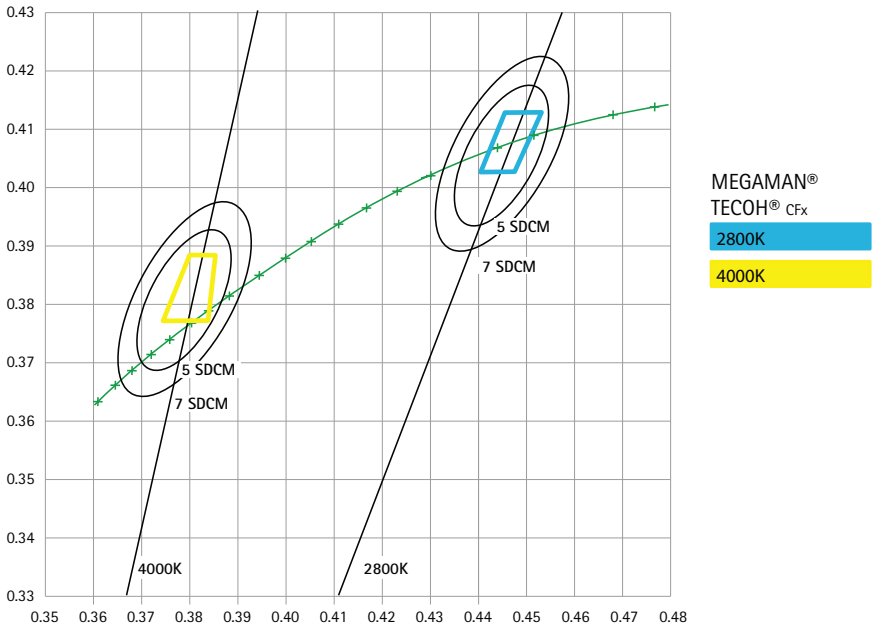
TECOH® CFx modules reach the declared light output and colour temperature at the time of switching on. Unlike some conventional light sources, TECOH® CFx can be switched on at dimmed level and restart instantaneously. TECOH® CFx even starts instantly at temperatures of -30°C.

2.4.3 Colour consistency

The key to creating a LED lighting scheme, that looks good for years to come is in ensuring that, over their lifespan, all of the lamps are performing within an acceptable tolerance in terms of colour deviation. To define 'acceptable tolerance' from lamp to lamp, LED manufacturers have adopted the MacAdam ellipse and SDCM (Standard Deviation of Colour Matching) measurement of colour consistency.

The MacAdam ellipse is a system of colour measurement. It measures how much colour variation is possible before the human eye detects a colour change. A series of ellipses can then be drawn around any target colour, and the closer any given lamp is to the target, the less colour deviation will be experienced when these lamps are placed side by side in an installation.

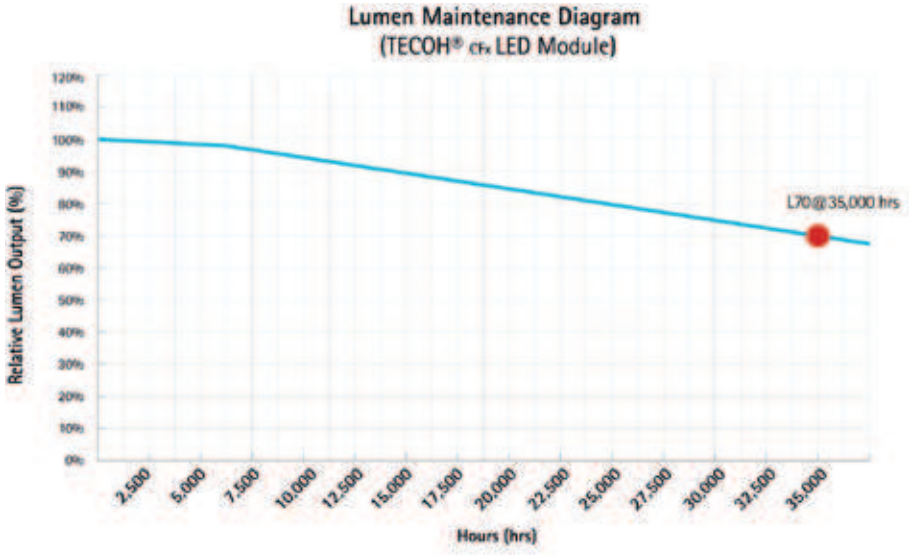
The distance from the target point in each ellipse is measured in SDCM. An SDCM of 1 step means that there is no colour difference between LED chips, 2-3 SDCM means that there is hardly any visible colour difference. Colour consistency of 7 SDCM is in line with Energy Star requirements. The MacAdam ellipse system is not directly related to a colour temperature range since similar Kelvin differences at higher colour temperatures are less visible to the human eye.



Thanks to MEGAMAN®'s control of the phosphor/LED blend and the optimised control, MEGAMAN® TECOH® CFx products have an excellent colour consistency of < 3 SDCM initially and < 5 SDCM throughout the rated life.

2.4.3 Lumen maintenance

Lumen maintenance is specified as the lumen output after a given time relative to the initially measured lumen output. The TECOH® CFx products, when operated within the specified temperature limits, have a good lumen maintenance of above 70% through the rated product life.



2.4.4 Life

Unlike conventional light sources, LED's are not subject to sudden failure or burnout. Instead, the performance of an LED shows slow, gradual degradation over time.
When used according to specification, MEGAMAN® TECOH® CFx modules will lose light output gradually and reach 70% of their initial intensity at their rated L70 life of 35,000 hours.
For TECOH® CFx products, and other LED products, lumen maintenance is the better measure to define the life of the product. With its extremely good lumen maintenance and colour stability over life, TECOH® CFx products allow individual product replacements in case, due to external factors, premature failures should occur.
The rated life for TECOH® CFx 'L70 = 35.000 hours' is defined as the operation hours after which the lumen output has dropped 30% below its initial reading.

2.4.5 UV and IR radiation

MEGAMAN® TECOH® CFx modules, as with all MEGAMAN® LED products, have negligible UV. Next to having virtually no UV radiation the TECOH® CFx modules do not generate any appreciable heat (IR) in the beam.

MEGAMAN® TECOH® CFx modules

2.4.6 Photobiological safety aspects

In IEC 62471 you will find acceptable exposure limits, reference measurement techniques and classification scheme for the evaluation and control of photobiological hazards from e.g. LEDs, but excluding lasers in the wavelengths from 200 to 3,000 nm. IEC 62471 contains four Risk Groups:

- Exempt Group, which covers lamps that do not pose any photobiological hazards for the end points of the standard.
- Risk Group 1, Low Risk, which covers lamps that do not pose a hazard due to normal behavioral limitations on exposure.
- Risk Group 2, Moderate Risk, which covers lamps that do not pose a hazard due to aversion response to very bright light sources or due to thermal discomfort. This group can be accepted with adequately marking.
- Risk Group 3, High Risk, which covers lamps that may pose a hazard even for momentary or brief exposure.

The multiple-chip white LED arrays in TECOH® CFx have been tested by an independent laboratory 'TUV' and are classified as 'Exempt Group' when tested against IEC 62471.

2.5 Dimming

Dimmable from 10% to 100% with a leading edge dimmer. Please visit www.megamanlighting.com/LEDdimmers for the list of compatible dimmers.

MEGAMAN® TECOH® CFx modules

2.6 Standards

All of MEGAMAN®'s CFL and LED solutions, including TECOH® CFx, are designed, tested and produced in its own factories in Xiamen, China. Standards have been implemented factory-wide to ensure MEGAMAN®'s manufacturing processes deliver innovative, reliable and safe products now and in the future.
To ensure that MEGAMAN® products, including TECOH® CFx, comply with the highest quality standards, the company's manufacturing plants are equipped with state of the art assembly lines. The in-house laboratory is ISO 17025 certified by CNAS and NVLAP, and is also eligible to perform on-site testing for UL, SEMKO and TUV marks.

MEGAMAN®'s business is run under the most stringent management and quality systems, so that the green elements of the production process are maximised, that employee welfare is prioritised and that the company is socially responsible to the local community. To continually develop these areas, MEGAMAN® has undertaken a range of international accreditations. These include:

Quality Management System
MEGAMAN® lamps are manufactured in ISO 9001:2000, ISO 14001:2004, ISO 14064-1:2006, OHSAS 18001:1999, SA 8000:2001 and QC 080000:2005 certified manufacturing plants.

Corporate Social Responsibility
MEGAMAN® has received OHSAS 18001:1999 and SA 8000:2001, confirming the highest level of care for employees and reinforcing the company's pledge to being socially responsible.

Control of hazardous substances
MEGAMAN® plants are QC 080000 certified. Underlining the fact that the company's manufacturing processes are closely monitored to ensure ultimate control of hazardous substances.

MEGAMAN® modules are made using premium quality materials and innovative technologies within stringent control measures, to deliver maximum performance and energy efficiencies.

MEGAMAN® TECOH® CFx products are specifically designed and produced to comply with the following standards:

Safety Requirement	according to IEC / EN62031
Performance Requirement	according to IEC / EN60969
Photobiological Safety	according to IEC / EN62471
EMC	according to IEC / EN55015 according to IEC / EN61547 according to IEC / EN61000-3-2 according to IEC / EN61000-3-3
EMF	according to IEC / EN62493

When integrated into a fixture a re-test is required to check compliance with some of the listed standards.

TECOH® CFx modules are built in compliance with the proposed Zhaga specifications.

Fixture design

To optimize the integration of the TECOH® CFx module in existing fixtures or new developments please follow the guidelines below.

3.1 IEC recommendations

The general recommendations for fixture designs given by the IEC (IEC60598) have to be taken in to account.
Additional luminaire performance standards should be taken into account:

IEC 62722-1 :Luminaire performance – Part 1: General Requirements

IEC 62711-2-1 :Luminaire performance – Part 2-1: Particular requirements for LED luminaires

3.2 Module holder

The TECOH® CFx is designed to be used in combination with a PHJ65d-2 module holder. The holder must be mounted on a heatsink (or heat dissipating luminaire body) to allow proper heat dissipation of the module to the heatsink. The holders are designed to assure proper pressure between the Thermal Interface Material (TIM) of the TECOH® CFx module and the heatsink.
Make sure that the surface of the heat sink is clear of coatings and oils and also ensure that the surface is flat and clean.
Follow the instructions of your module holder supplier.

3.3 Reflectors

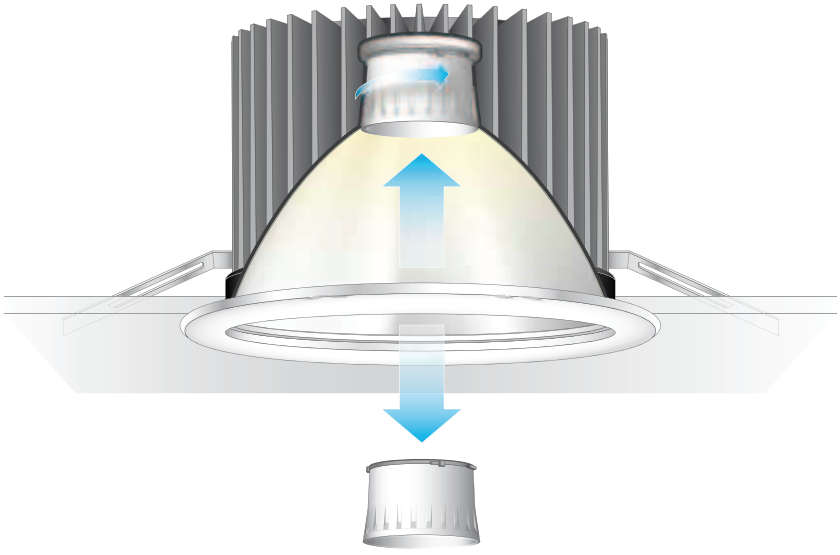
TECOH® CFx products have a Lambertian light distribution. This allows you to design reflectors for even and a wide light distribution, mainly intended for general lighting.
To facilitate the design of reflectors, ray trace files can be downloaded from www.megamanlighting.com/OEM
For accent lighting applications we recommend MEGAMAN® TECOH® MHx LED Modules.

3.4 IP (Ingress Protection) rating

TECOH® CFx modules are build-in solutions and therefore have no IP rating.

3.5 Burning position

The TECOH® CFx modules are rated universal burning as long as the maximum specified temperatures in the application are respected.



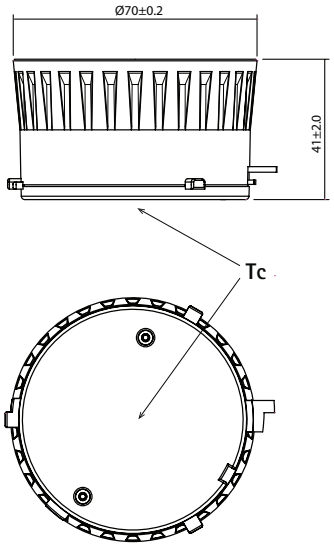
Fixture design

3.6 Thermal Management

LED's are sensitive to temperatures.
To optimise the reliability and performance proper thermal management is required. Below describes the basics of the heat transfer principle and basics for heat sink design.

The indicated temperature limits should be respected to ensure specified performance and reliability. Exceeding the indicated temperature limits will reduce the lumen output, running the unit cooler than the indicated limits will improve the product performance.
Validation of the temperatures must be carried out by means of temperature measurements.
Temperature measurements should only be performed when the luminaire is thermally stable, meaning after a minimum of 2 hours of operation. Measurements must be performed by means of thermocouples that are properly connected to the surface at the positions indicated below.

The maximum thermal resistance allowed for the luminaire must be observed. This can be checked by measuring the module's Tc point and making sure the rated temperature is not exceeded. The limits are listed on the module data sheet.



Max temperature of the Tc point is 65°C.

3.6.1 What is thermal management

The critical temperature on a LED is the junction temperature (Tj). In order to achieve the specified performance of a LED, the temperature must be controlled.
Thermal management is the method used for transferring the heat from LED's to satisfy the functional integrity (performance drop/ malfunction) and operational reliability (lifetime expectancy) while also satisfying the relevant safety regulations e.g. IEC60950 of all components including the LED itself.
Conduction, convection and radiation are the three means of heat transfer.

3.6.2 Why do you have to control temperatures

The key to maximising light output and lumen maintenance lies in good thermal management and keeping the Tj under the specified temperature. When temperatures are above the rated values permanent damage to the LED and/ or even early failures may occur.

3.6.3 Heat generation

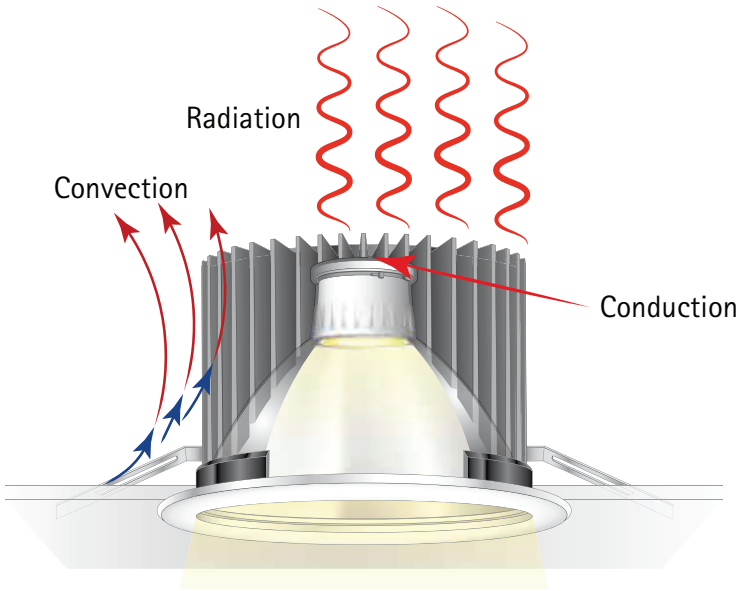
LED arrays do not convert all input power to light, although much more efficient than incandescent lamps still 85% of the energy is converted into heat and this heat must be efficiently transferred away from the LED.

3.6.4 Modes of heat transfer

The three models of heat transfer are

- conduction
- convection
- radiation

Heat flow is driven by temperature gradients. Each of these modes play a role in transferring the heat from hot (the junction) to cold (the ambient or surrounding atmosphere) area.



Fixture design

Conduction
The first of the three modes is conduction. This is the transfer of heat between adjacent molecules of a material. Parameters that influences the conduction are:

- the thermal conductivity of the material
- the cross section surface area
- the distance heat is travelling through

Convection
Convection is the heat transfer from the heat sink to air and is directly dependent upon the amount of flow of the air.

Radiation
Radiation is energy transfer by electromagnetic waves.
Plays an important role for heat sinks cooled by natural convection only.

3.6.5 Considerations for heat-sink

Conduction optimization:

- select a material that has a high thermal conductivity. See examples below. In practice aluminum is mostly used because of the freedom in production processes, costs and weight. The conductivity of extruded aluminum is better than cast aluminum.

If cast aluminum is used make sure that there are no air inclusions in the product as this negatively influences the conductivity. This can be done by radii on the edges and proper processing.

As air is a very bad conductor, air gaps between the LED array and the surface of the heatsink must be avoided. First of all the contact surface of the heat-sink must be flat and free from imperfections.

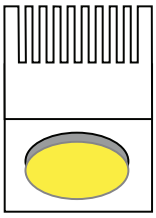
- The contact area of the heat-sink must also be free from coatings, as these are poor conductors depending upon the coating, its thickness. Smooth anodization is generally not a problem.
- The cross section area is the area where the heat flows through. TECOH® CFx uses a thermal interface material (TIM) to improve the thermal contact of the heat-sink. A big surface area improves the conductivity. The size of the source with respect to the heat-sink base size is important. Is the source smaller than the base you have to be aware of spreading resistance.
- The distance heat must travel must be minimised. Long distances have a negative effect on the effectiveness.

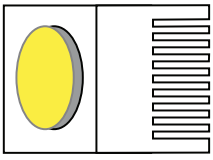
Convection optimization:

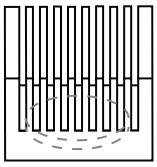
- Maximise the surface area of the heat-sink. In order to limit the total size of the heat-sink and reduce the length of the thermal path, fins are recommended.
- Create as much as possible airflow. Vertically oriented fins, which are not constricted, allow best airflow.

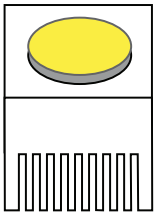
Other orientations reduce the effectiveness of the heat-sink.

FIN Orientation


Vertical 100%


Horizontal 85%


Horizontal Up 85%


Horizontal Down 60%

Material	Thermal Conductivity (W/mK)
Iron	79.5
Aluminium (extruded)	140-200
Aluminium die cast	60-120
Copper	385
Air (at 0°C)	0.024

Table: Thermal conductivity of common heat-sink materials and air.

Radiation optimization:

- Also here the surface area determines the effectiveness of the heat-sink
- A coated heat-sink radiates the heat much better compared to an unfinished surface.

3.7 Handling

Installation

Make sure that the mounting surface between the LED module and heatsink is flat and clean.

1. Remove the sticker from the TIM on the base plate of the module.
2. Fit the MEGAMAN® TECOH® CFx module into the PHJ65d-2 holder, match with the relevant solts. Press down and twist to the right.
3. You will hear a 'click' sound when the module is locked.

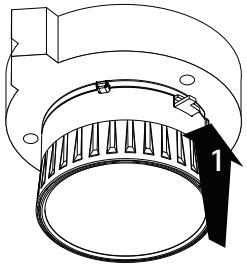
Electrostatic device measures

The TECOH® CFx module does not require special measures regarding electrostatic devices (ESD) during production.

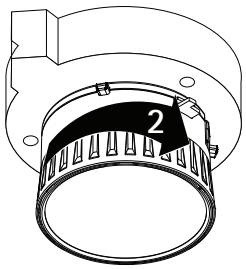
Storage

The TECOH® CFx modules must be stored in a dry and, if unpacked, in a clean environment.

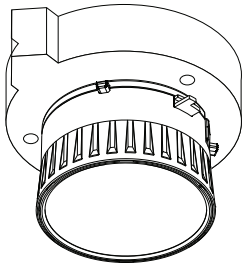
1



2



3



CLICK

3.8 Cross reference table

Family	New codes	Previous codes
TECOH® CFx	CF0112d/PHJ65d-2-828-230V	LM0120d-26F-2800K
	CF0112d/PHJ65d-2-840-230V	LM0120d-26F-4000K
	CF0120d/PHJ65d-2-828-230V	LM0130d-36F-2800K
	CF0120d/PHJ65d-2-840-230V	LM0130d-36F-4000K
TECOH® MHx	MH0133/830-700mA	EM0136-35M-3000K
	MH0133/840-700mA	EM0136-35M-4000K
	MH0133R9/930-700mA	EM0136R9-35M-3000K
	MH0133R9/940-700mA	EM0136R9-35M-4000K
	MH0220/830-700mA	-
	MH0220/840-700mA	-