Technology Demonstrator High Bay

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July 31st, 2014

High-bay lighting

Lighting where the roof trusses or ceiling height is greater than approximately 7.6 m above the floor.

Maximum productivity is top of the agenda in production halls. Lighting makes an important contribution.

The right light distribution and light color prevent glare and signs of fatigue among employees. They also reduce the risk of accidents, make visual tasks easier and improve manufacturing efficiency.

High bay lighting usually difficult to change the light sources. Long lifetime LED high bay lamp helps to reduce maintenance cost.

160W High Bay from ELS

Benefits of LED in high-bay applications

An LED high-bay luminaire has multiple advantages over traditional metal-halide lamps.

1. No warm-up time
2. No cool down needed before restart
3. No humming or flickering
4. No mercury
5. Longer lifetime
6. No re-lamping cost, which can be a significant expense in high-bay applications
7. No risk of lamp breaking, sending glass fragments over a large area
8. Dimmable, enabling the use of occupancy sensors for power savings

High-bay lighting

Traditional solution with HID lamp

Solution	HID with aluminium reflector	HID with prismatic reflector
Light source efficacy	80~100 lm/w	80~100 lm/w
Luminaire power (W)	436 W	436 W
Lamp Luminous flux (lm)	29000 lm	29000 lm
Fixture lumens (lm)	20900	26800
System efficacy (lm/w)	48 lm/w	61.5 lm/w
Usable lumens within 60 deg (lm)	15770	17600
Application efficacy (lm/w)	36.2	40.4

The data here is only for reference.

HID
metal halide lamp

aluminium reflector

prismatic reflector

Possible Solutions - 1

- A cluster of Mid-Power-Leds (100 pieces / 5000 Lumen)
- Advantages:
- Good spread of heat, smaller heat sink
- High Efficency (190 Lumen+ are available)
- Less Glare
- Formfactor does not matter. Linear and round Types

- Disadvantages
- Needs a PCB with a huge Number of parts.
- Big LES, not so easy to direct the light where needed
- Binning could be a problem

- EBV-Offer: Osram, Samsung, Everlight, Luminus

Possible Solutions - 2

- A cluster of High – Power Leds (10-15 pieces for 5000 Lumen)

- Advantages
- Still a good spread of heat
- good Efficency (170 Lumen+ are available)
- Formfactor does not matter. Linear and round Types
- Good possiblities to direct the light

- Disadvantages
- Still needs a PCB-Layout.
- Binning could be a problem (Forwardvoltage)

EBV Offer: Osram, Samsung, Ledil

Possible Solutions - 3

- Singel-COB-Solution (1 for 15.000 Lumen)

- Advantages:
- Easy to control the light through small LES
- NO PCB needed
- Easy to mount
- No Binning Problem

- Disadvantages:
- High density of heat, good thermal design neccessary
- Good efficiency 150+ Lumen
- Optimized for round solutions

- EBV Offer: Bridgelux, Luminus, Ledil, Power Supplies, Heatsinks

EBV High-bay reference design

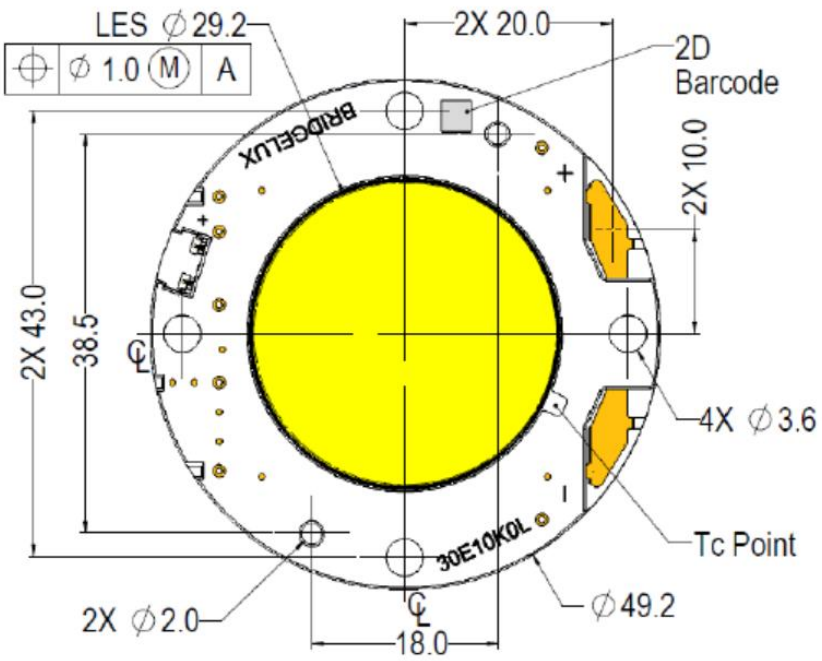
- Based on:
  - Bridgelux Vero29 COB
  - Ledil Stella-HB silicone lens
  - FrigoDynamics 2-phase coolers
  - Meanwell 160W Power Supply

- Thermal and optical verified in

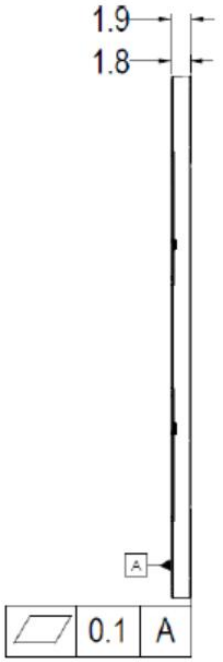
EBV LIGHTLAB

Bridgelux Vero29

- One BXRC-40E10K0 (VERO29) is used in this demonstrator and is driven with 3300mA.



TOP VIEW



SIDE VIEW

Vero29 (4000K)

The range of drive conditions used for the VERO29:
BXRC-40E10K0-L-xx

Current (mA)	Typ Voltage (V)	Electrical Power (W)	Thermal Power (W) *	Typical Flux@ Tj = 25ºC (lm)
2100	38.8	81.5	65.2	10270
2800	39.9	111.7	89.4	13270
3150	40.4	127.3	101.8	14740
4200	41.3	173.5	138.8	19070

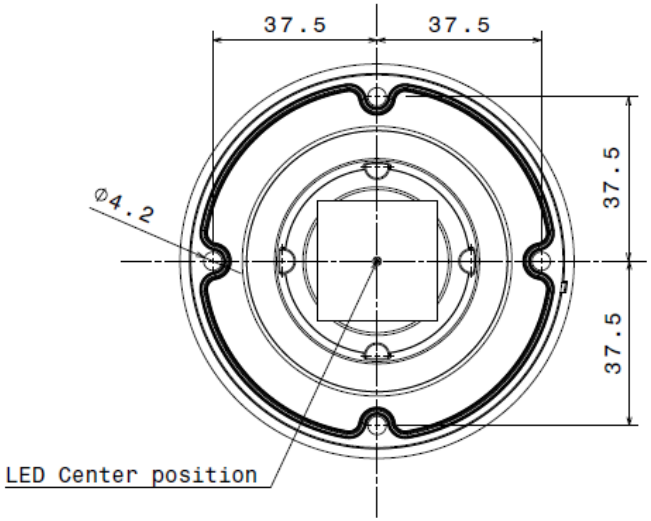
*** Estimates 80% thermal conversion**

NOTE For VERO29, 50k Hours of Life:
@ 2100mA (nom 1x) max Tc < 85C
@ 3150mA (1.5x) max Tc < 80C

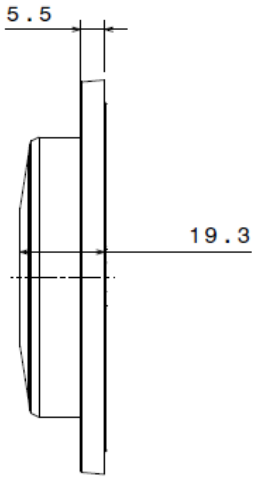
Ledil Stella-HB

- Silicone High bay lens
- Designed for Vero29
- Diameter 90mm, h=19.5mm
- 60° radial pattern
- Typ. efficiency 93%
- Excellent thermal properties
- Very good UV-withstanding
- IP-65 rating

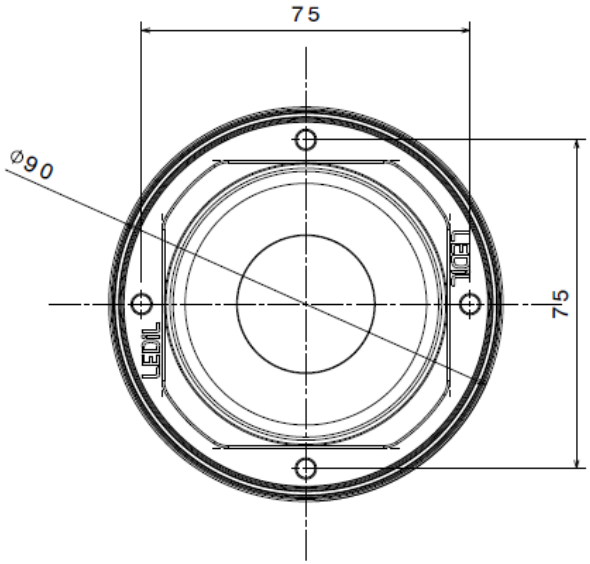
Ledil Stella-HB



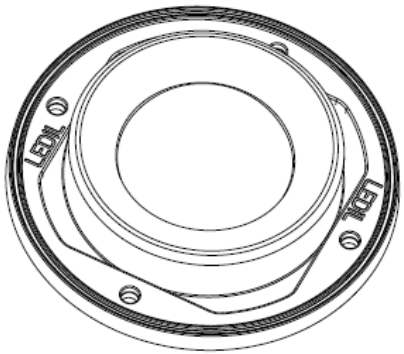
Bottom view



Right view



Front view



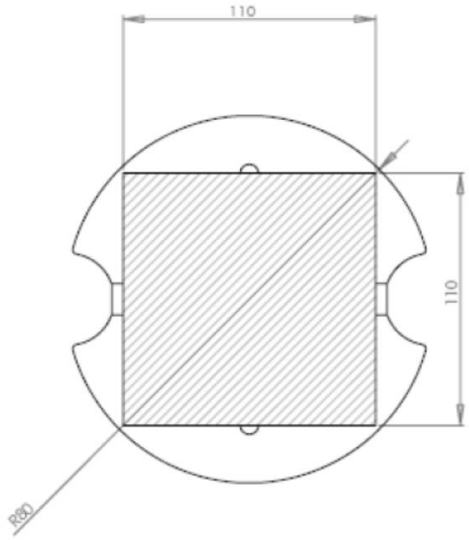
Isometric view

Lens Material: Optical grade LS
Frame material: PC black

Tolerances if not otherwise shown According to DIN ISO 2768-1 Linear measures: Up to 30mm class F, otherwise class M. According to DIN ISO 2768-2 Form and position: class K	LEDiL	Ledil Oy Salorankatu 10 FIN 24240 SALO Finland
THIRD ANGLE PROJECTION:	DRAWING TITLE	STELLA-HB datasheet
This drawing is the property of LEDiL Oy. It may not be reproduced, copied or communicated without a written agreement with LEDiL Oy.*	SIZE: A3	PART NUMBER: FN14074
	SCALE 1:1	WEIGHT (g) / Rechteck / SHEET 1

FrigoDynamics HB HPK 270/360

- FrigoDynamics® **HPK-Fin™ 360 Cooler** (available with Bridgelux holes)
- Highest performing passive coolers utilizing 2-phase heat pipe technology.



EBV Elektronik
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FrigoDynamics HPK360

2-phase Hybrid Heat Exchanger for CoB LEDs ≤ 220W

- Passive, no CO_2 emissions
- Light weight
- Compact
- Zero noise levels
- No lifetime issues
- No operating cost
- Works in any orientation
- Easy installation

HB HPK-Fin 360	Value	Conditions
Thermal Resistance (Tc)	0.28 K/W	Measured between LED Tc - ambient
Thermal Resistance (Hs)	0.20 K/W	Measured between LED mounting base and ambient
Design Power	220W (Tc-Ta < 50°C)	Electrical load
Surface finish	Black	Anodized
Weight	1.410g	Complete unit

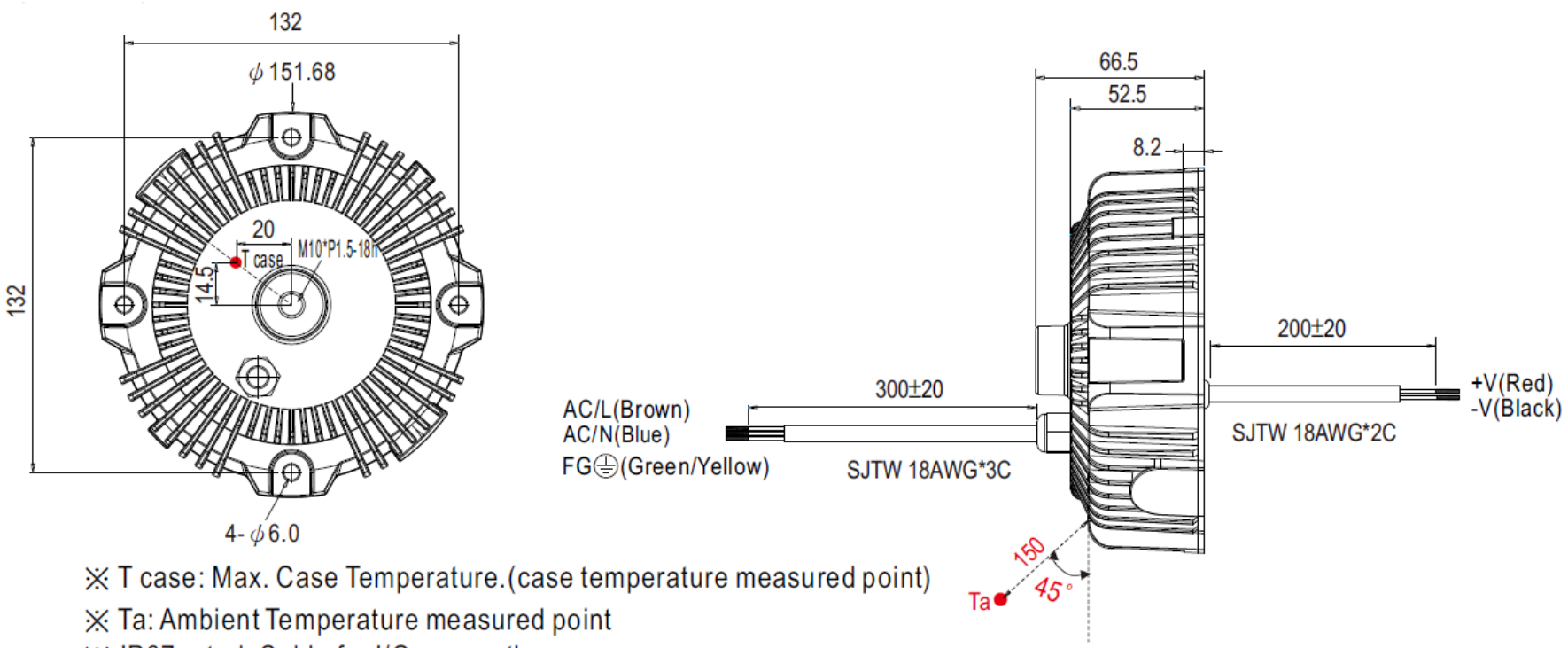
PSU Meanwell HPG-160-48

160W Single Output Switching PSU

- Universal AC input (up to 305VAC)
- Constant Current 3.3A, U_{max} = 48V
- Built-in active PFC function (93%)
- Protections: Short circuit /Over current /Over voltage /Over temperature
- IP67 / IP65 design for indoor or outdoor installations
- Suitable for dry / damp / wet locations
- 5 years warranty, T_c 70°C 40000hrs

Mechanical Specification

PSU Meanwell HPG-160-48



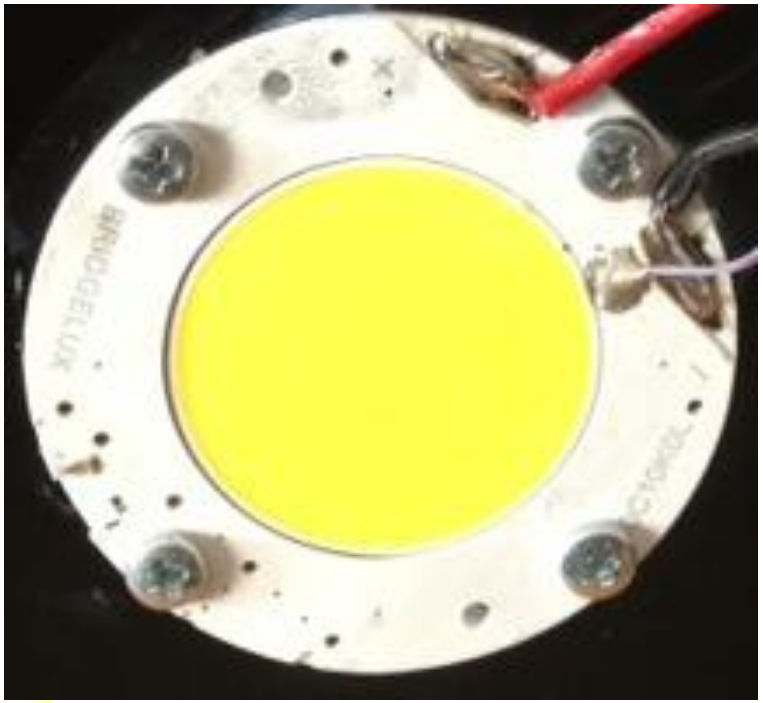
※ T case: Max. Case Temperature.(case temperature measured point)

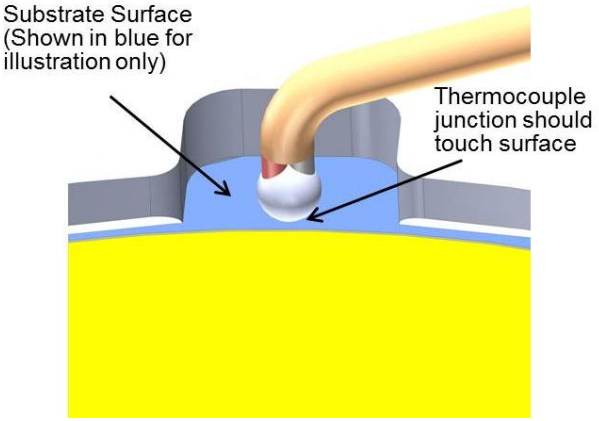
※ Ta: Ambient Temperature measured point

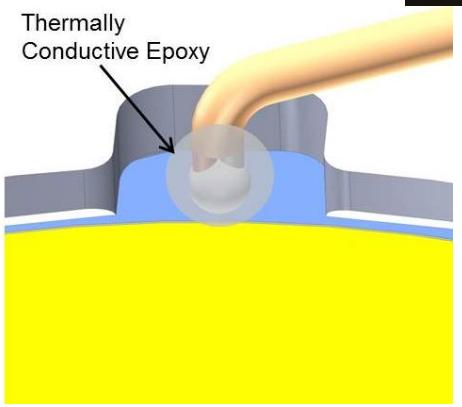
※ IP67 rated. Cable for I/O connection.

Thermocouple Tc Placement

- A thermocouple was positioned on the Tc point of the VERO29 and fixed using thermal epoxy

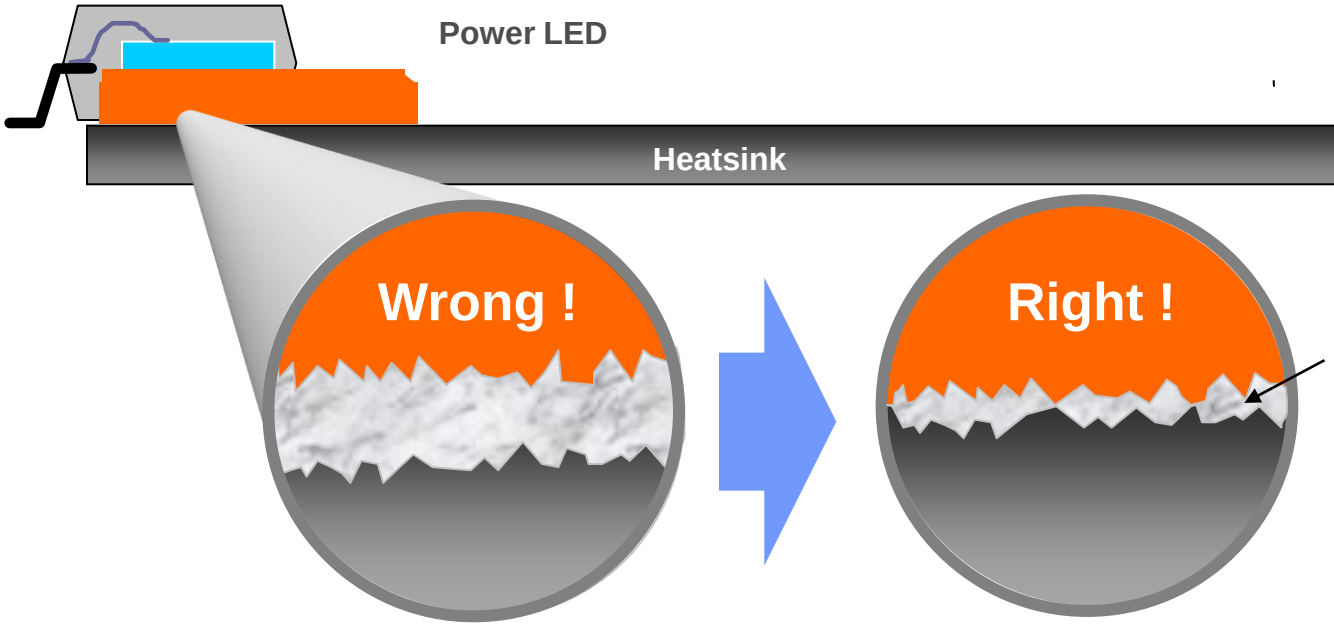






Contact Resistance

Thermal Grease as an Interface Material



Thermal Grease
apply it thriftily and with well defined thickness!

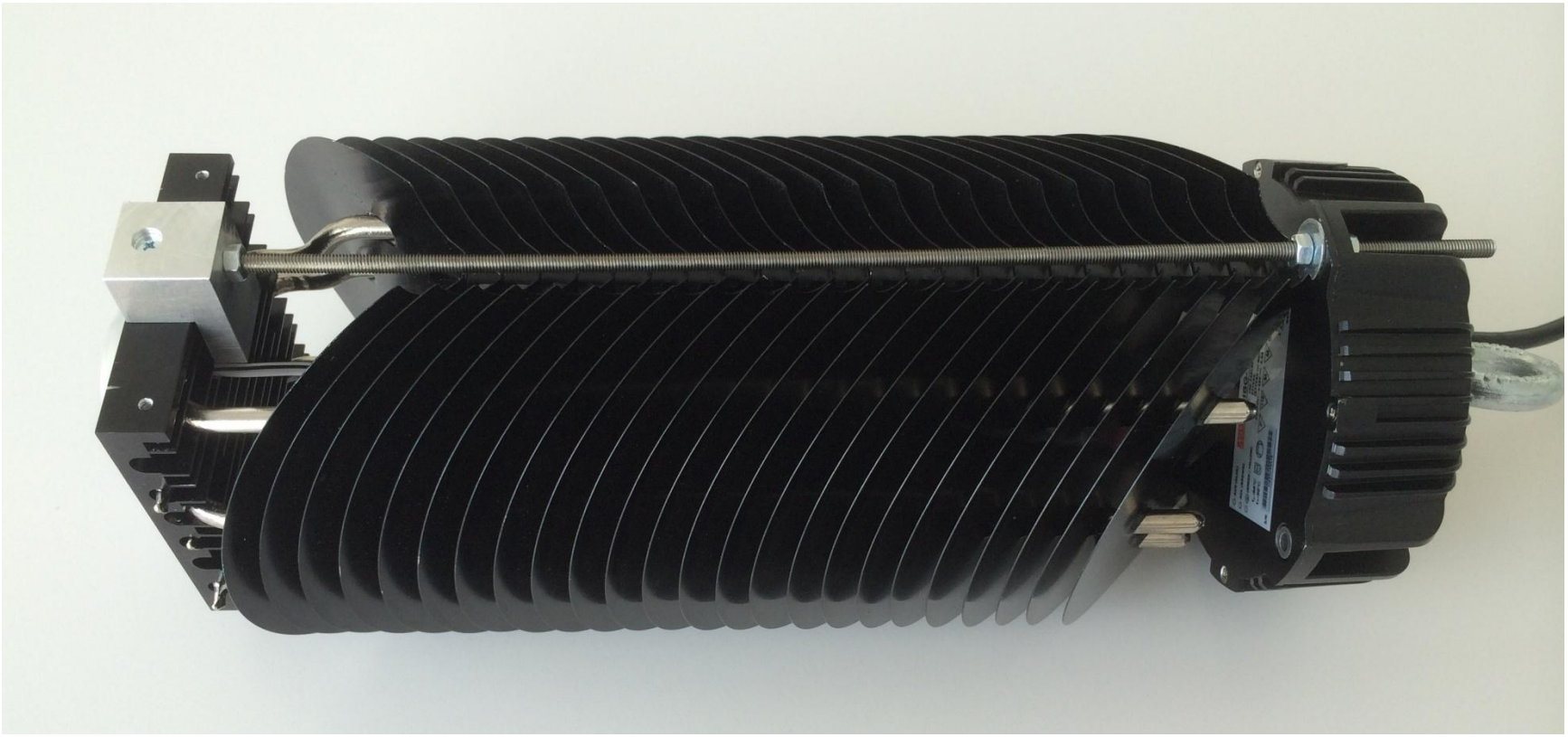
It´s only for filling the surface roughness !

Thermal resistance at an area of 1cm²

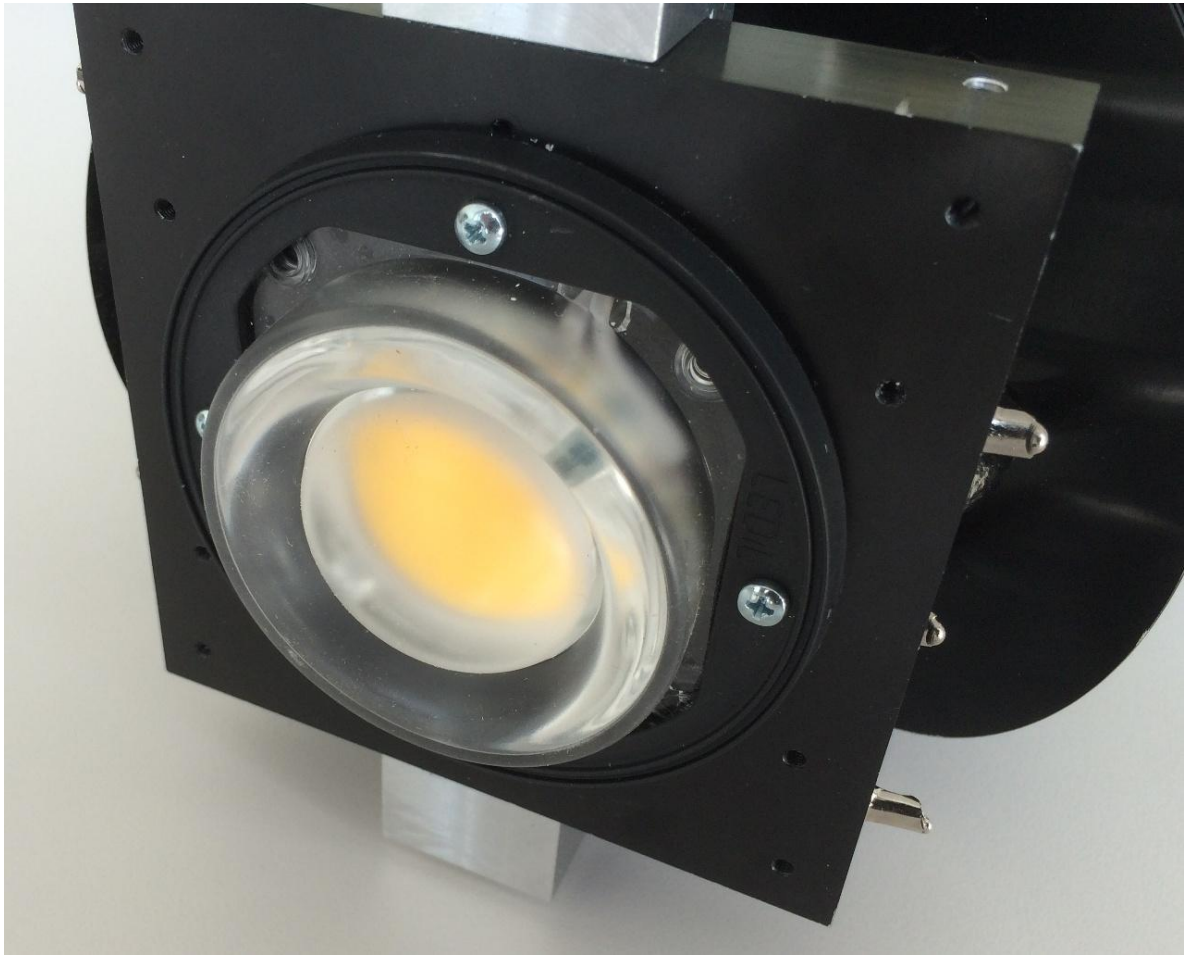
≈ 2 K/W	≈ 0,4 K/W	≈ 16 K/W
(@ 200µm grease)	(@ 40µm grease)	(@ 40µm air)

Source: Fraunhofer Institut

High-bay HPK360 version

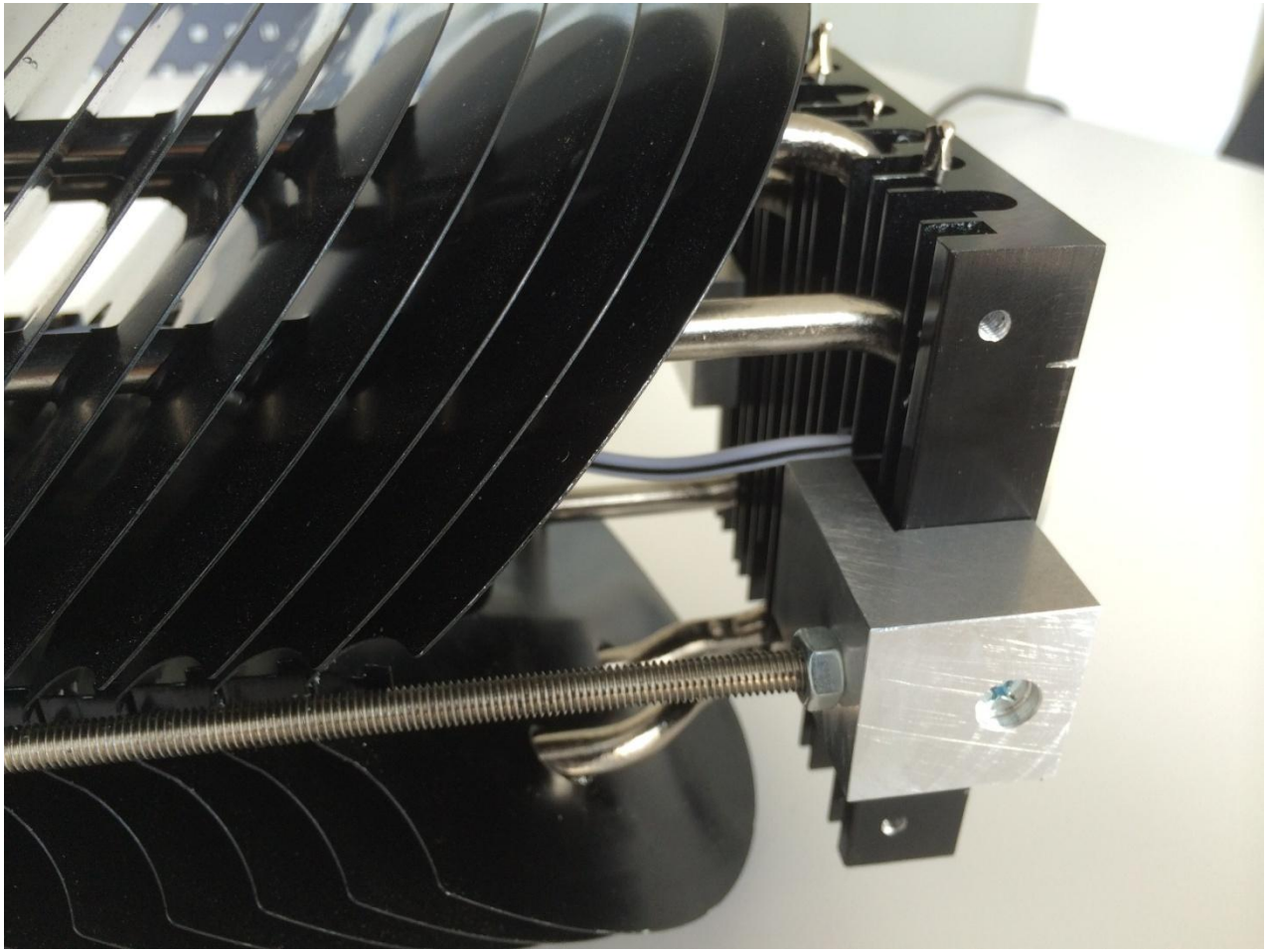


COB and Stella HB lens



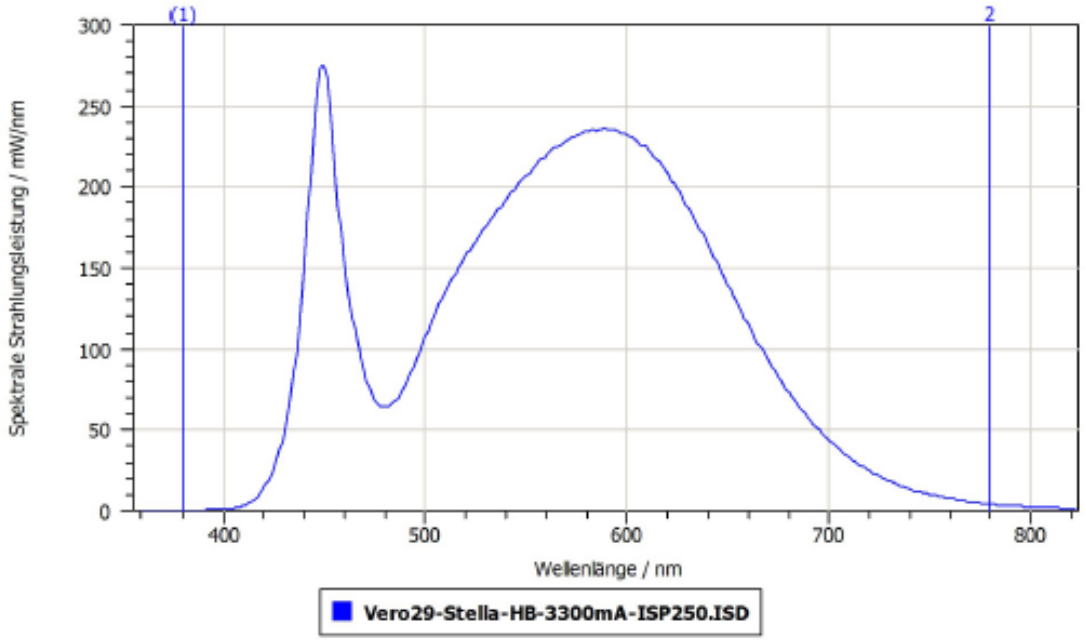
Power Supply mounting

Mounting details



Measuring results (1)

Spectrum



Results

Photometric:	14,16 klm
Radiometric:	44,33 W
Centroid WL:	567,37 nm
Peak WL:	449,15 nm
Dominant WL:	579,00 nm
Purity:	0,265
width50:	22,33 nm
CCT:	4032 K
Planck distance:	-9,7E-005

Color Coordinates:

x:	0,3790
y:	0,3756
u:	0,2246
v:	0,3339
u':	0,2246
v':	0,5009

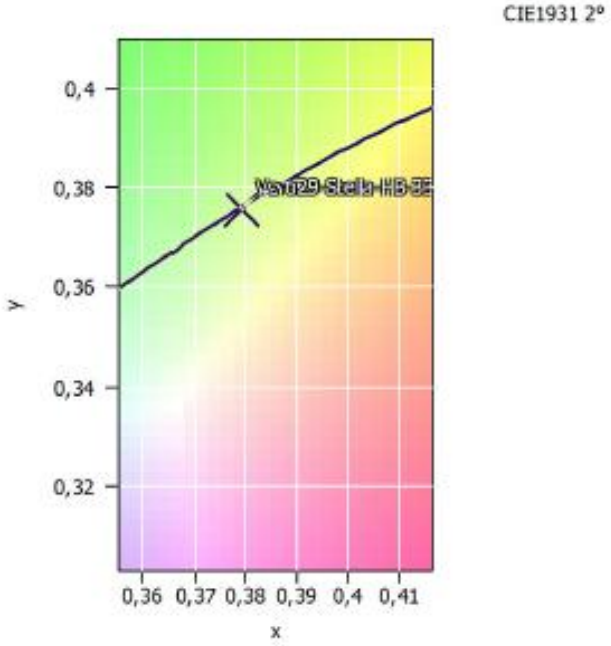
Measuring results (2)

CRI

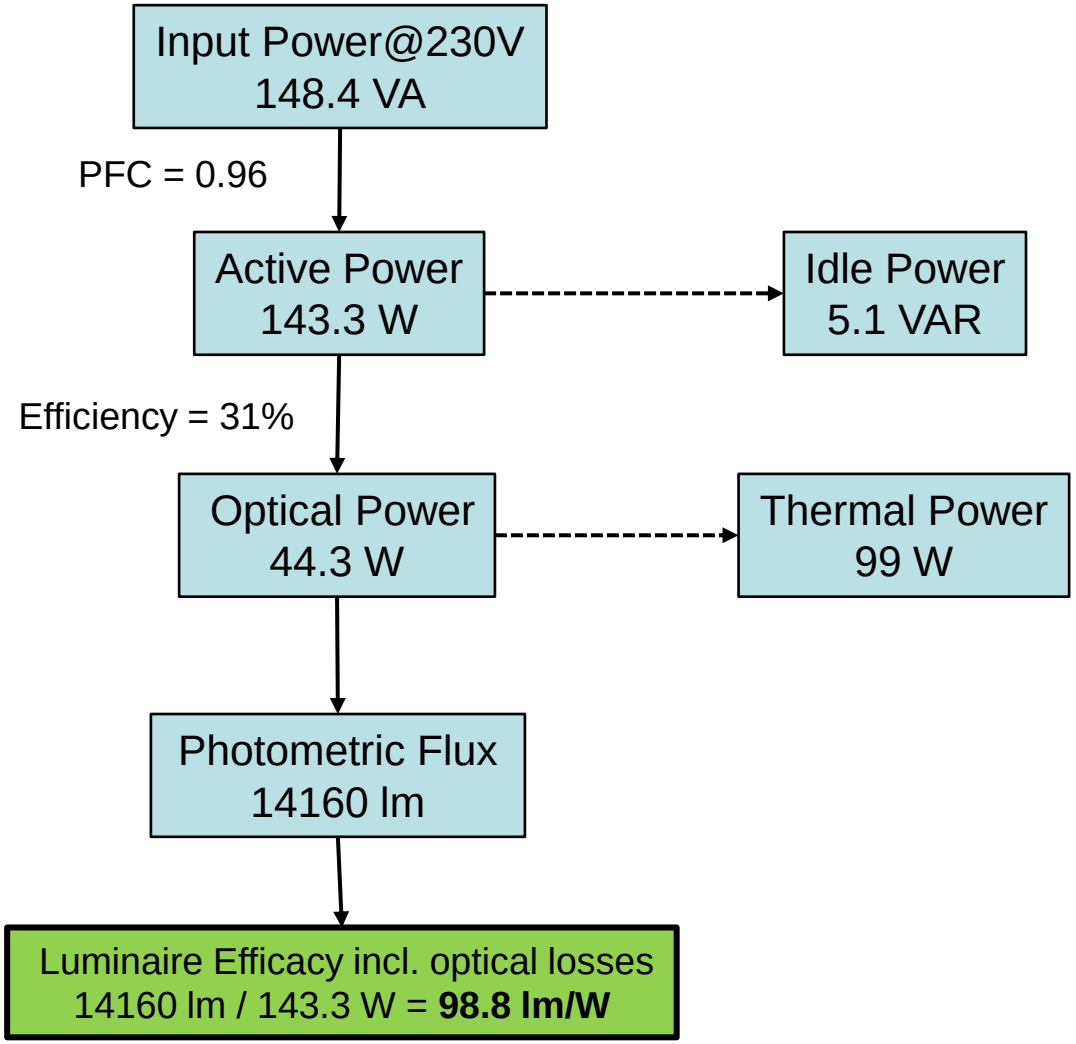
CRIa:	81,8

CRI1:	80,1	CRI9:	14,7
CRI2:	87,0	CRI10:	68,5
CRI3:	91,5	CRI11:	78,1
CRI4:	80,6	CRI12:	59,0
CRI5:	80,1	CRI13:	81,4
CRI6:	87,0	CRI14:	95,2
CRI7:	91,5	CRI15:	75,5
CRI8:	80,6	CRI16:	75,2

Gamut chart

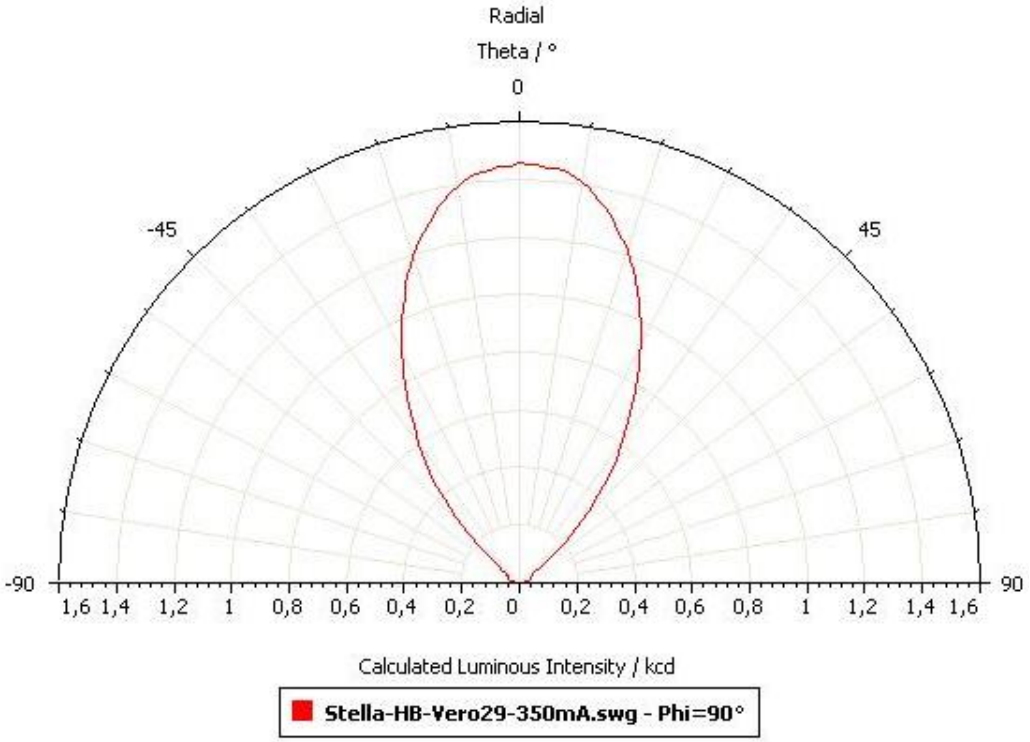


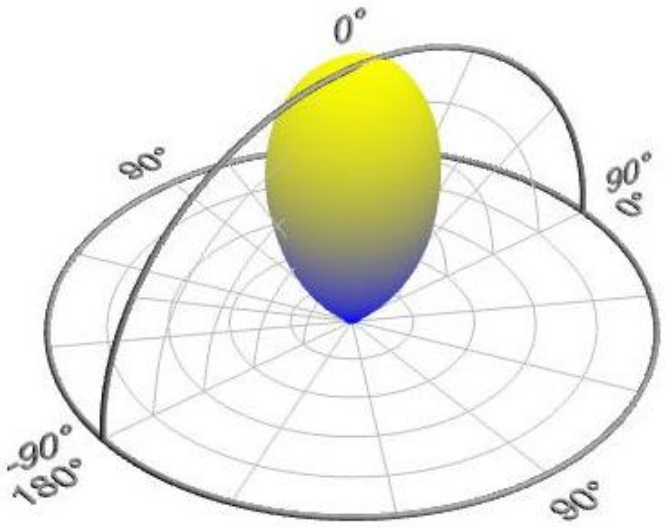
Efficiency Verification



Optical Verification

Vero29 and Ledil Stella-HB





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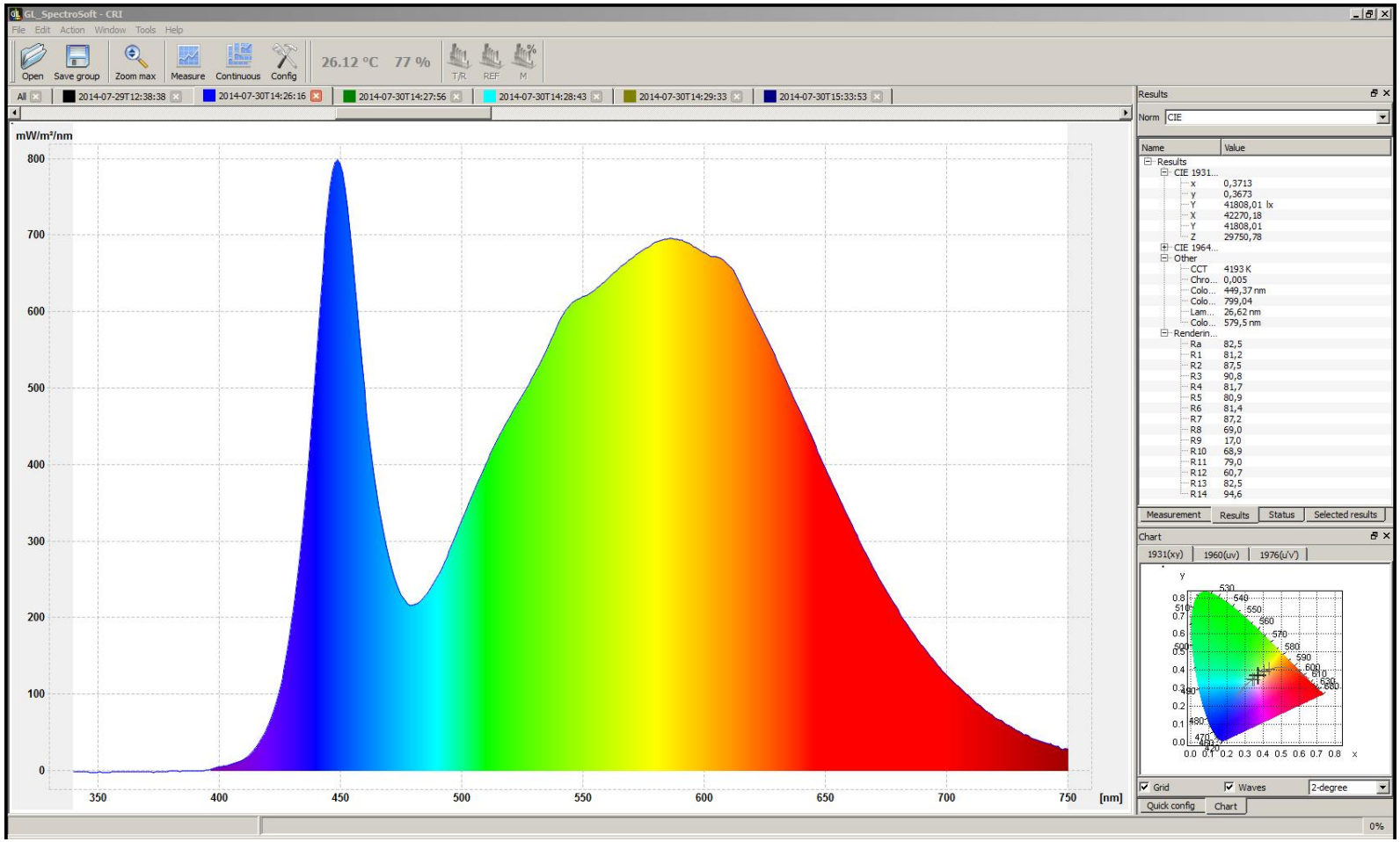
Color Spectrum BXRC-40E10K0-L

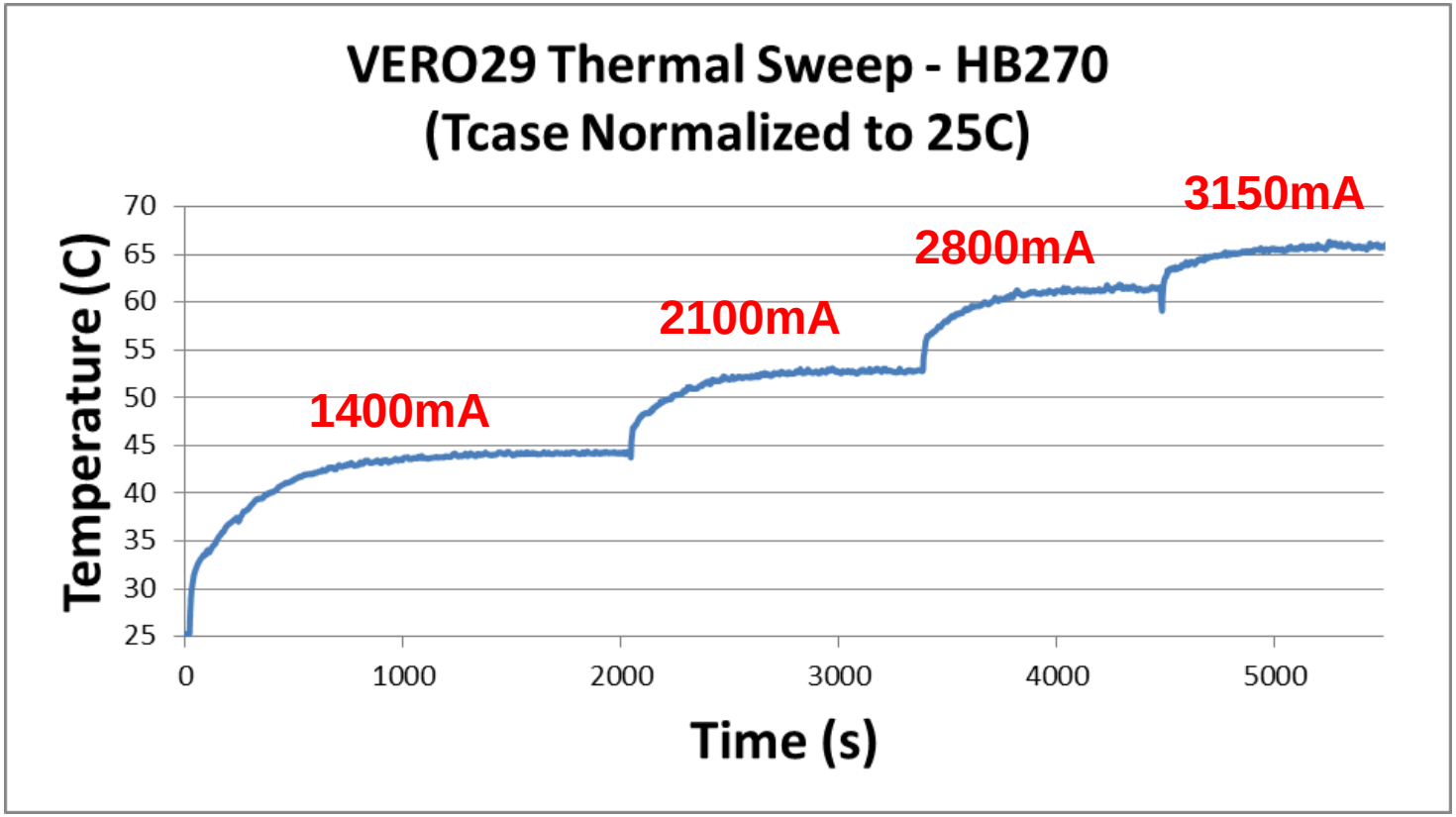


Thermal verification

- Tests were conducted on:
  - FrigoDynamics HB270 and HB360 cooler
- Thermo coupler used
  - Type T thermocouples: 36 Gauge
- All coolers were shown to cool the VERO29 at nominal (3150mA) current at 25 C ambient

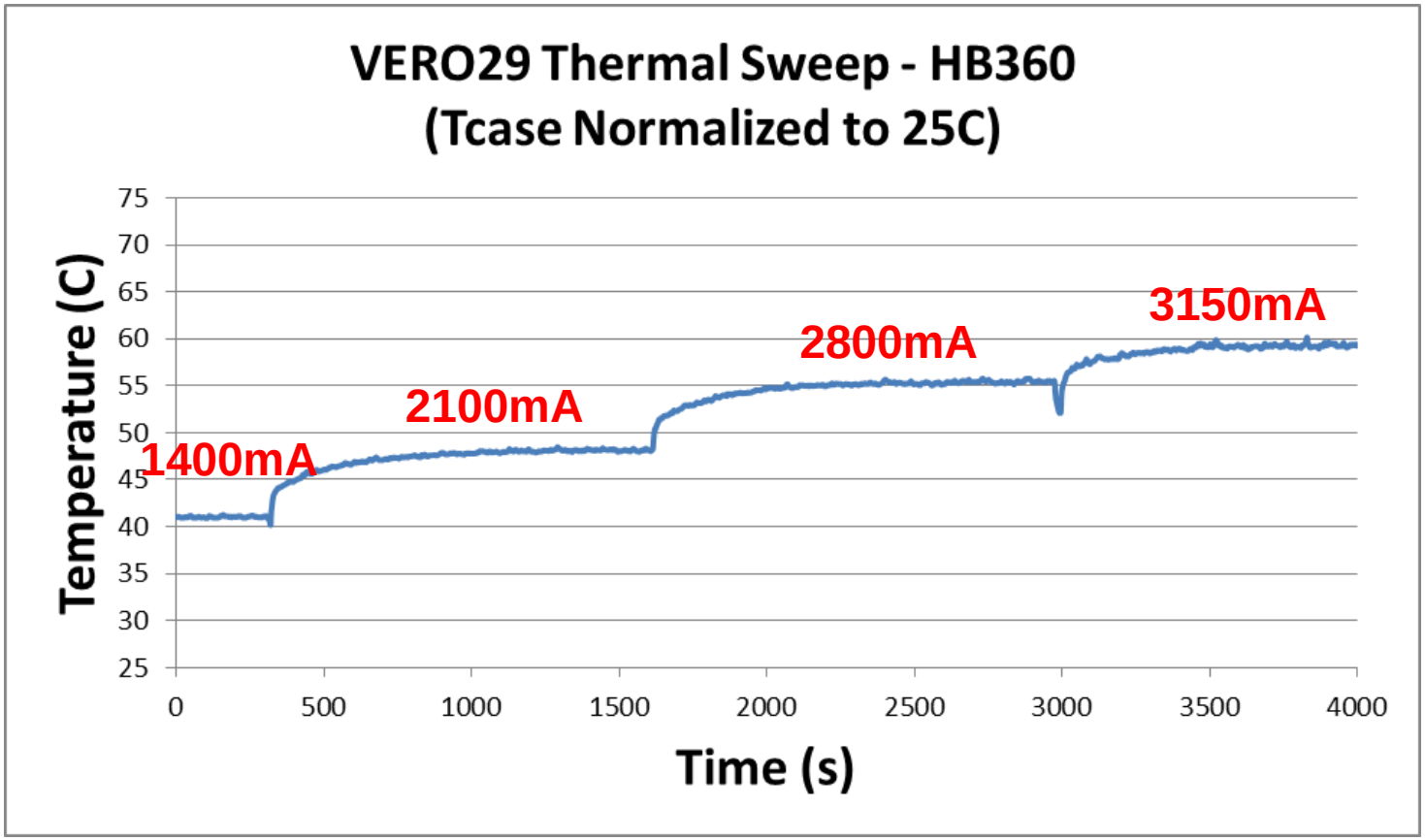
Thermal Measurements

Tc temperatures using the FrigoDynamics HB270 are shown in the thermal sweep graph



Thermal Measurements

Tc temperatures using the FrigoDynamics HB360 are shown in the thermal sweep graph



Conclusion

- At 3150mA and 25°C ambient, the FrigoDynamics HB270 can operate with a comfortable margin. The HB360 can operate up to 35°C ambient.

- At 4200mA (new spec:176W!) HB360 is mandatory.


Distribution is today.
Tomorrow is EBV.