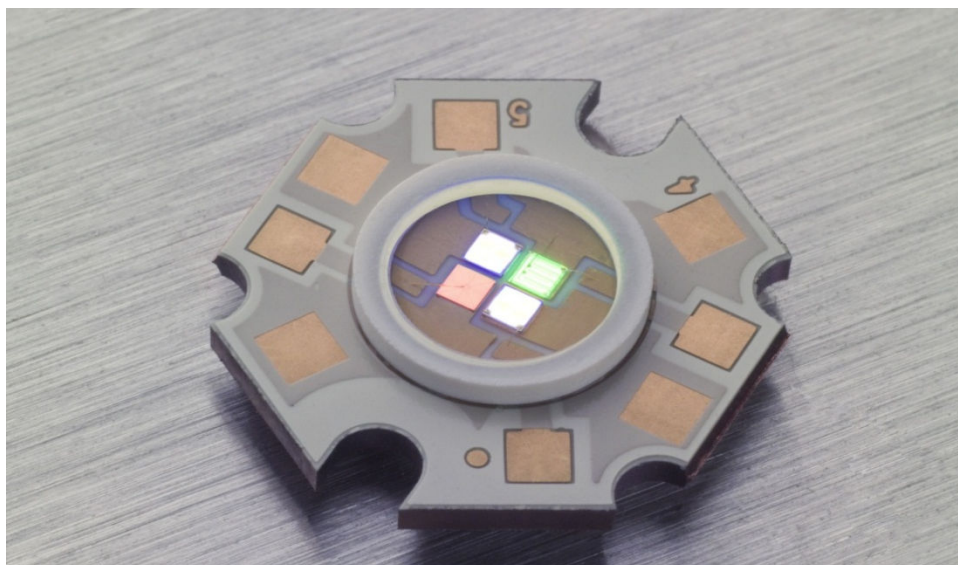




## **White ACULED® – Model R3C6** **For High CRI, High R9** **Medical OEM Medical OEM Applications**



*Excelitas' White ACULED® - Model R3C6 - delivers High CRI, High R9, and the Light Output required for Surgical and Dental Operating Room Lights.*

### **Overview**

Excelitas' newest ACULED® Model consists of 4 separately-addressable LED chips to provide widely tunable color temperatures (CCT) from 3500 to 5500 °K, while maintaining the high CRI, high R9 value, and light output required for medical applications such as surgical lighting and dental operatory lighting.

Excelitas' ACULED Model R3C6 is a standard COB package that comes with four different LED dice: a Warm-white, Cool-white, Cyan, and Red. The LED dice are mounted on a copper circuit board with dielectric film (Cu-IMS-PCB). To protect the LEDs, a ring is mounted on the PCB and filled with a silicone resin encapsulant.

Benefits of the ACULED platform include excellent heat transfer from the chips to the substrate and heat sink, and its compact design with the chips extremely closely-spaced, allowing for superior color mixing and compact optics.

In addition to the standard White ACULED, Model R3C6, a variety of design-your-own (DYO) chip combinations are available from Excelitas Technologies so as to achieve just the right combination of CRI, R9, luminous flux, and CCT range for specific surgical lighting requirements.

### **Key Features**

- High Color Rendering Index (CRI) light source
- High R9 value, an indication of how well the light shows deep, saturated shades of red
- Widely tunable CCT - from 3500 to 5500 °K
- 4-chip design with independent control of the drive current of each chip, allowing movement along Planckian black body line
- Close to Planckian locus
- Good color mixing
- Excellent thermal properties, advantageous for high-performance applications
- Near-Lambertian emission
- RoHS-compliant

### **Applications**

- Surgical operating room lighting
- Dental operatory lighting
- Examination lights

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**Performance Specifications**

**Table 1. Absolute Maximum Ratings of Individual Dice**

| Parameter            | Symbol | Unit | Red | Cyan | Warm-white | Cool-white |
|----------------------|--------|------|-----|------|------------|------------|
| Junction temperature | $T_J$  | °C   | 125 | 125  | 125        | 125        |
| DC forward current   | $I_F$  | mA   | 700 | 500  | 700        | 700        |
| Reverse voltage      | $V_R$  | V    | 10  | 5    | 10         | 10         |
| Reverse current      | $I_R$  | µA   | 10  | 2    | 10         | 10         |

**Table 2. Absolute Maximum Ratings of Complete ACULED**

| Parameter             | Symbol   | Unit | Maximum rating |
|-----------------------|----------|------|----------------|
| Operating temperature | $T_{OP}$ | °C   | - 40 to +85    |
| Storage temperature   | $T_S$    | °C   | - 40 to +100   |
| ESD sensitivity       |          | kV   | 2              |

**Table 3. Electrical and Optical Properties for Individual Dice, Red and Cyan**

| Parameter                 | Symbol           | Unit | Red |       |     | Cyan |       |     |
|---------------------------|------------------|------|-----|-------|-----|------|-------|-----|
|                           |                  |      | Min | Typ   | Max | Min  | Typ   | Max |
| Peak wavelength           | $\lambda_{peak}$ | nm   | 620 | 635   | 645 | 500  | 502   | 505 |
| Dominant wavelength       | $\lambda_{dom}$  | nm   | 615 | 625   | 630 | -    | 503   | -   |
| Chromaticity coordinate x |                  |      | -   | 0,700 | -   | -    | 0,103 | -   |
| Chromaticity coordinate y |                  |      | -   | 0,300 | -   | -    | 0,529 | -   |
| Radiant flux              | $\Phi_e$         | mW   | -   | 155   | -   | -    | 93    | -   |
| Forward voltage           | $V_F$            | V    | 1.8 | 2.1   | 2.6 |      | 3.3   | 3.6 |

*Characteristics for Red and Cyan die at  $I_F=350$  mA and 25°C ambient temperature*

**Table 4. Electrical and Optical Properties for Individual Dice, Warm-white and Cool-white**

| Parameter                    | Symbol   | Unit | Warm-white |       |       | Cool-white |       |       |
|------------------------------|----------|------|------------|-------|-------|------------|-------|-------|
|                              |          |      | Min        | Typ   | Max   | Min        | Typ   | Max   |
| Correlated color temperature | CCT      | K    | 3200       | 3560  | 3900  | 3900       | 5730  | 7600  |
| Chromaticity coordinate x    |          |      | 0,381      | 0,401 | 0,422 | 0,306      | 0,328 | 0,351 |
| Chromaticity coordinate y    |          |      | 0,362      | 0,388 | 0,413 | 0,287      | 0,321 | 0,355 |
| Luminous flux                | $\Phi_v$ | lm   | 72         | 80    | -     | 78         | 88    | -     |
| Forward voltage              | $V_F$    | V    | -          | 3.4   | -     | -          | 3.4   | -     |

*Characteristics for Warm-white and Cool-white die at  $I_F=700$  mA and 25°C ambient temperature*

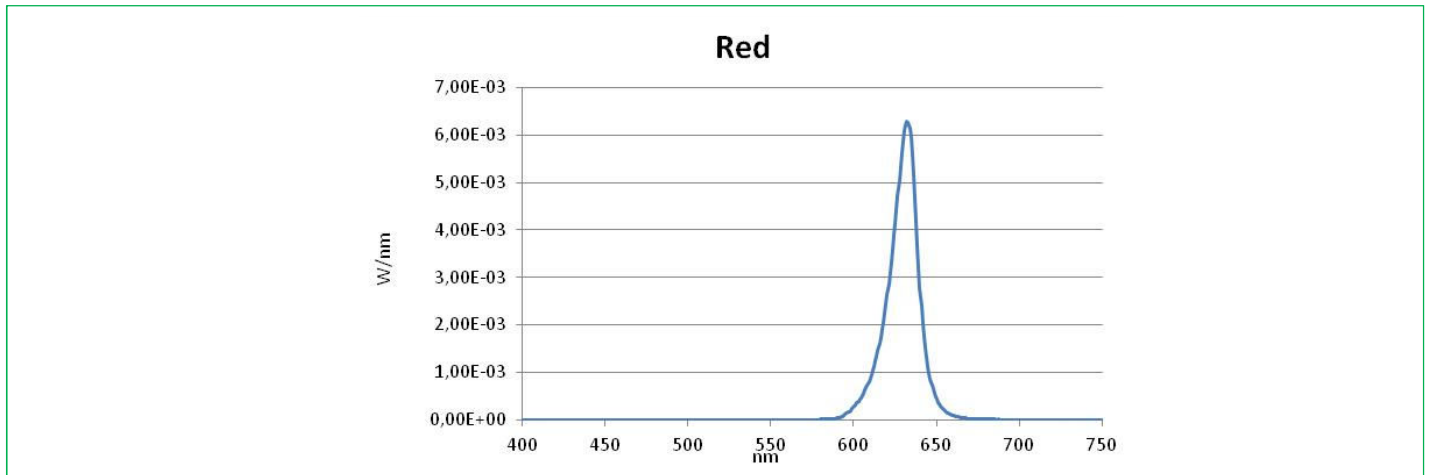
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**Table 5. Optical Characteristics with All Dice On**

Typical characteristics at 25°C, with each die driven at optimal current to achieve CCT and CRI.

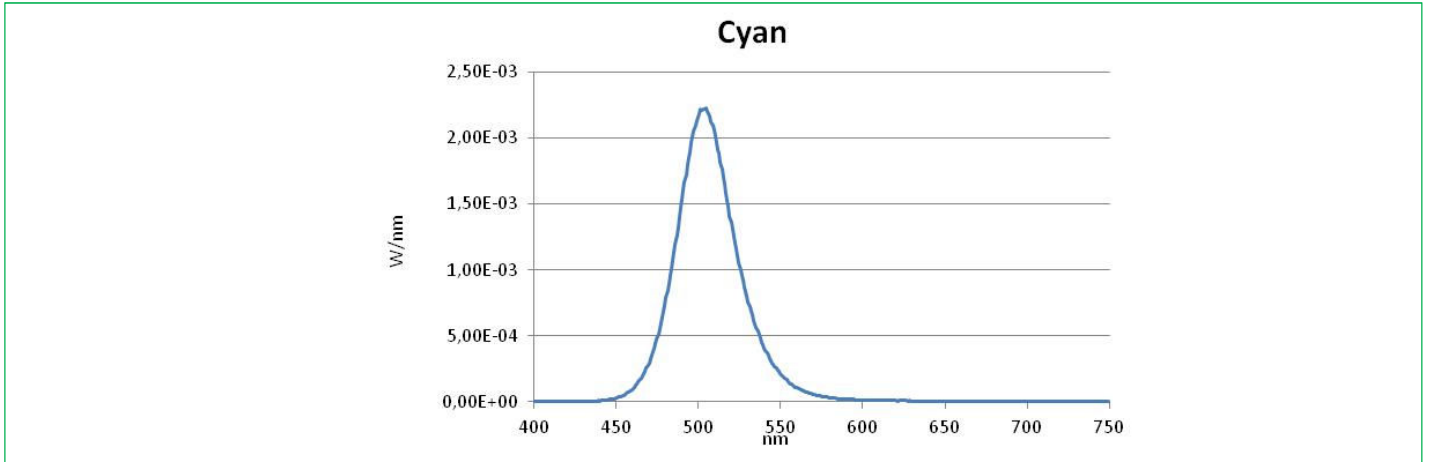
| Parameter   | Symbol   | Unit | 3800 ° K | 4500 ° K | 5500 ° K |
|---|----------|------|----------|----------|----------|
| Luminous flux   | $\Phi_v$ | lm   | 120      | 145      | 140      |
| Color Rendering Index (CRI)   | $R_a$    | -    | 95       | 96       | 93       |
| R9  | -        | -    | 98       | 98       | 96       |
| Distance to Planckian Locus ( $\Delta(u,v)$ – according to CIE1960) | -        | -    | 0,00006  | 0,0006   | 0,0011   |

**Spectral Characteristics of Individual LED Die**

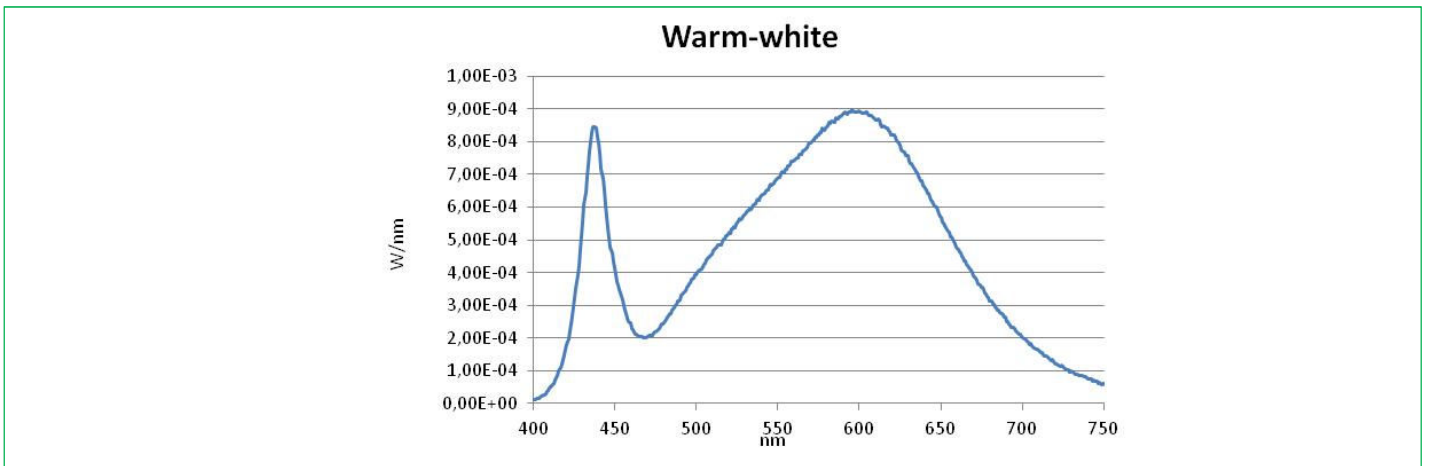


**Figure 1. Spectral Output of Red Die.**

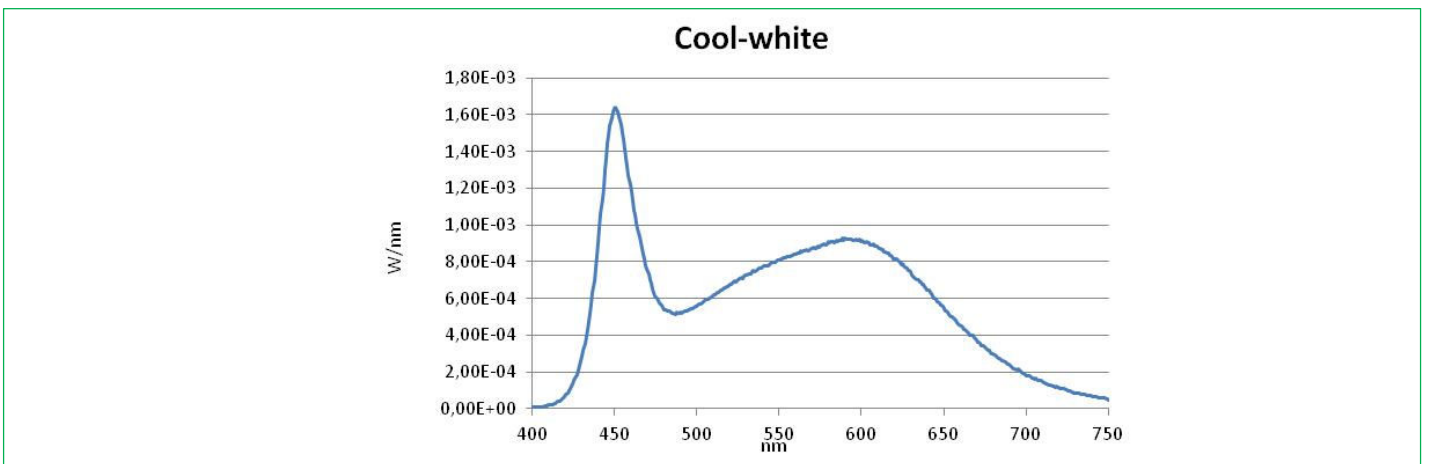
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**Figure 2. Spectral Output of Cyan LED Die**



**Figure 3. Spectral Output of Warm-white LED Die.**



**Figure 4. Spectral Output of Cool-white LED Die.**

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Spectral Output of ACULED - with All Four LED Dice On

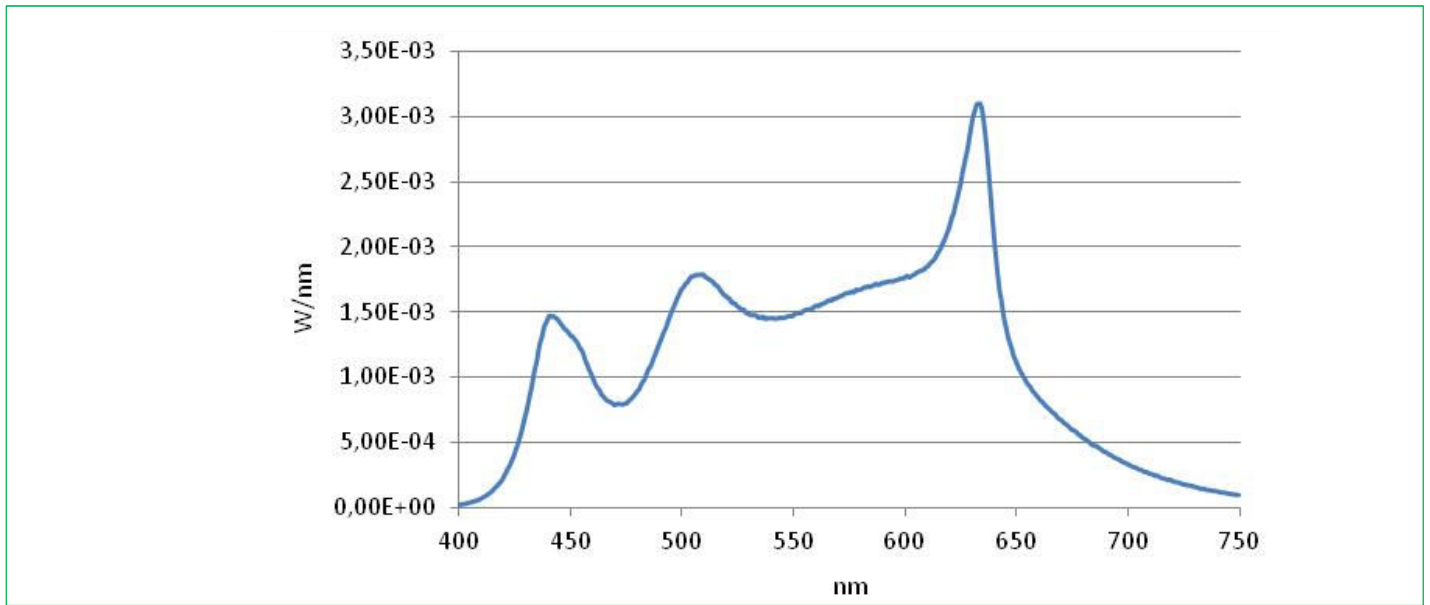


Figure 5. Typical spectral output at 3800 K, with the Warm-white, Cool-white, Red and Cyan LED dice running at 700 mA, 100 mA, 100 mA and 130 mA, respectively.

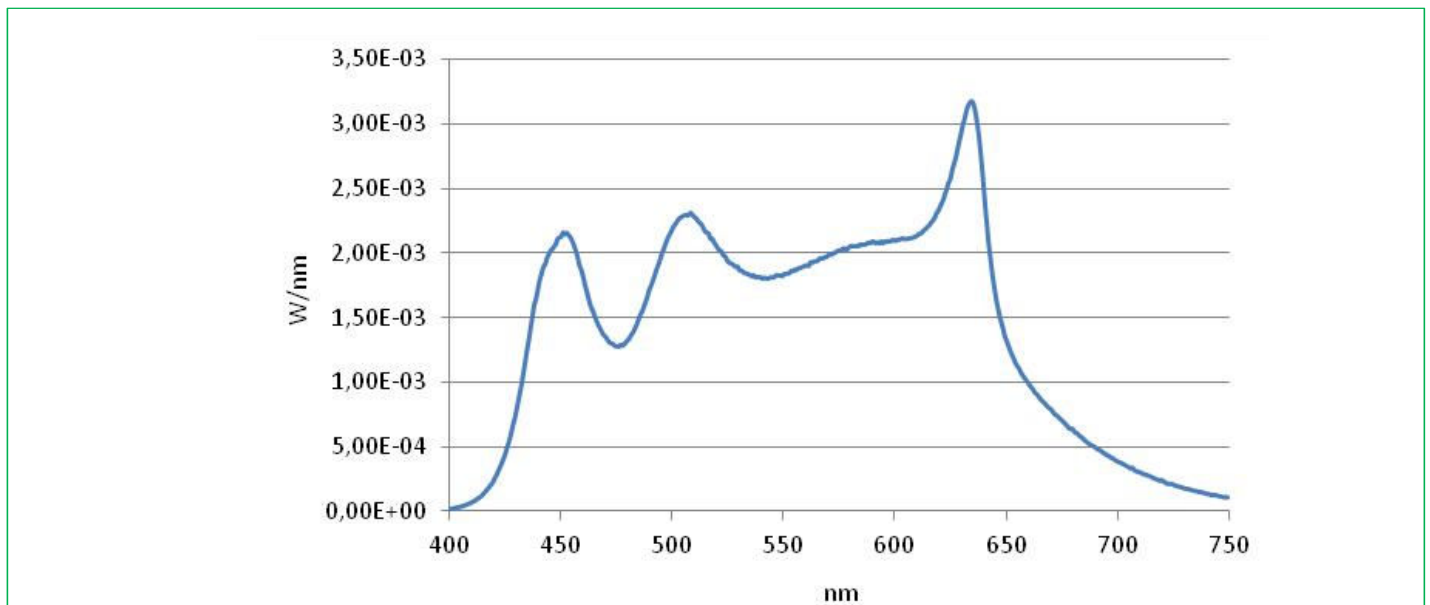
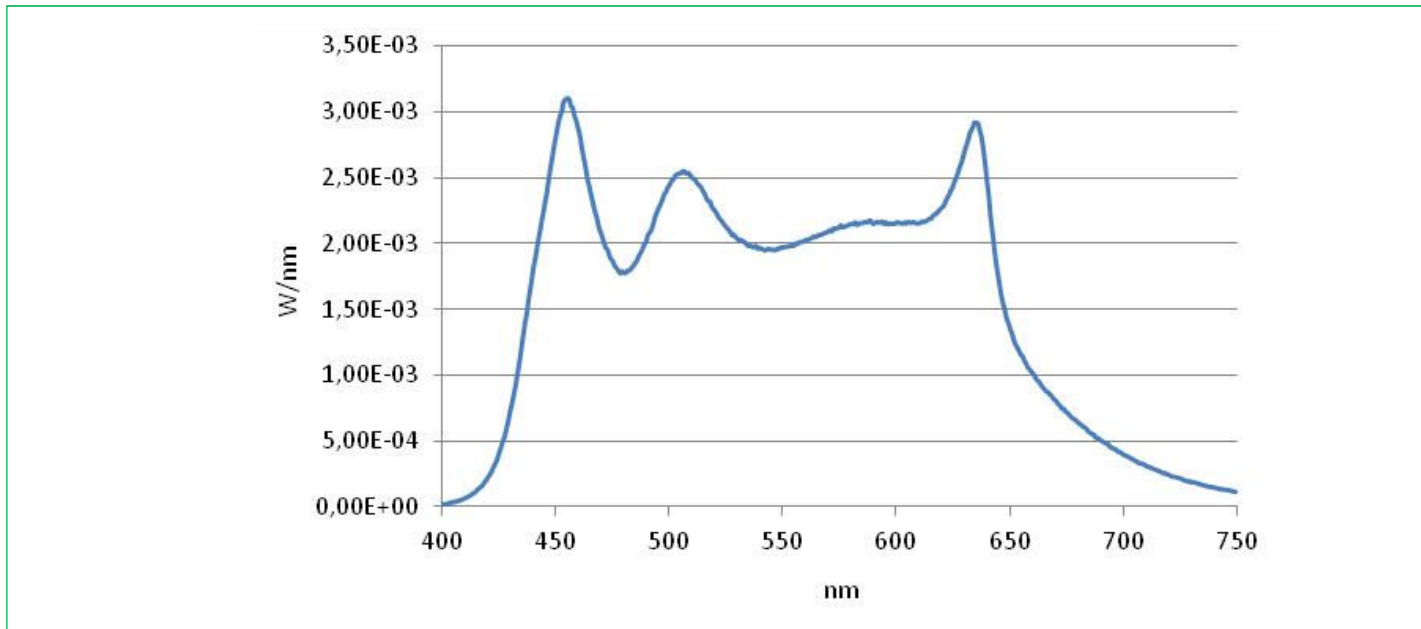


Figure 6. Typical spectral output at 4500° K, with the Warm-white, Cool-white, Red and Cyan LED dice running at 700 mA, 300 mA, 110 mA and 180 mA, respectively.

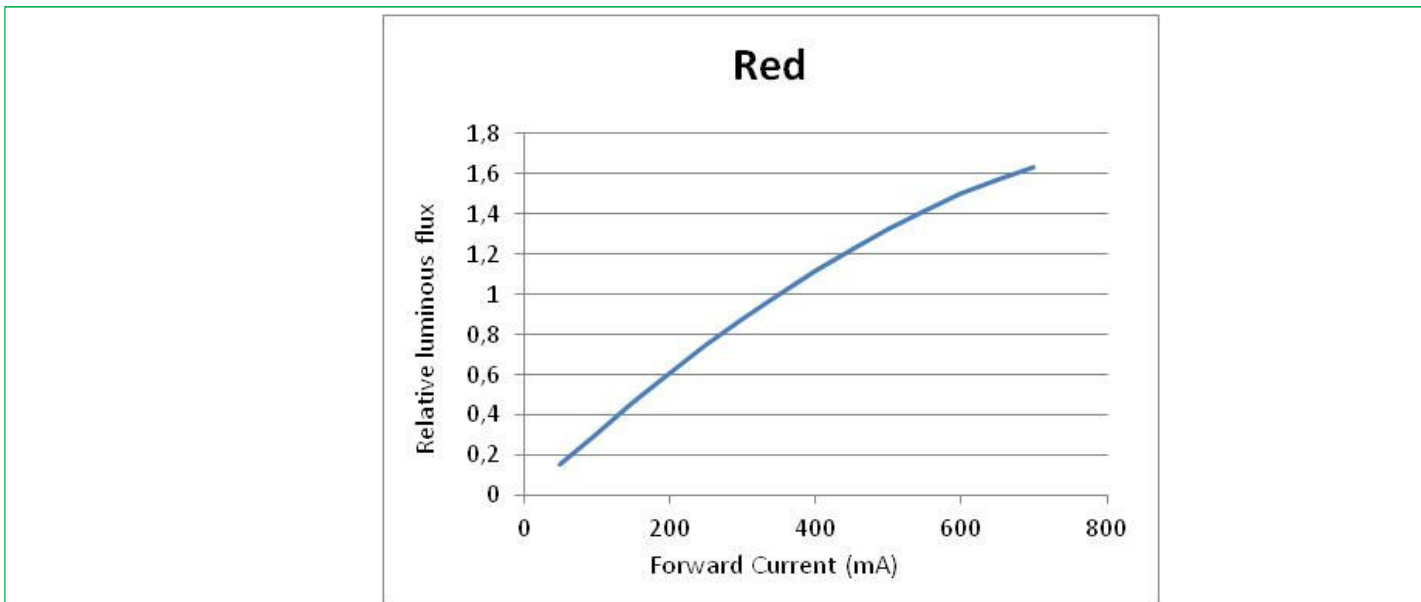
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**Figure 7. Typical spectral output at 5500 °K, with the Warm-white, Cool-white, Red and Cyan LED dice running at 400 mA, 700 mA, 100 mA and 200 mA, respectively.**

**Output of Each Die as a Function of Current**

The following charts show typical relative output of each LED die as a function of drive current, all at the nominal temperature of 25°C.



**Figure 8. Relative luminous flux of Red LED die vs Current**

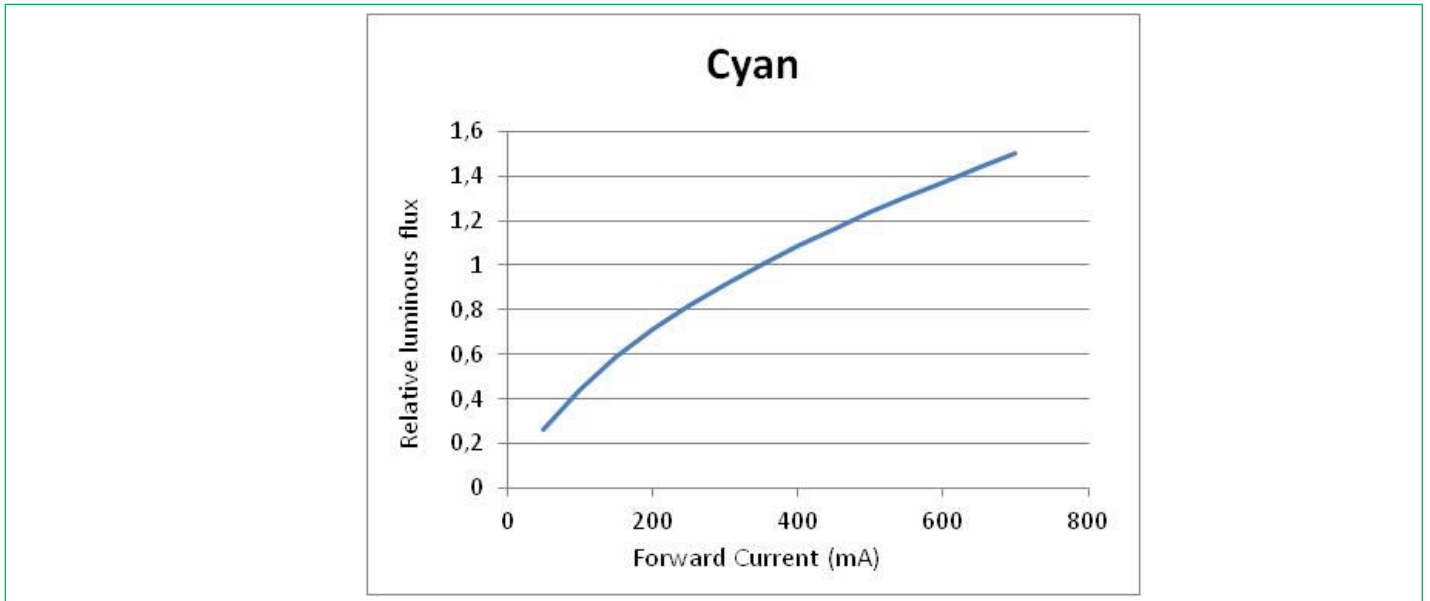


Figure 9. Relative luminous flux of Cyan LED die vs Current

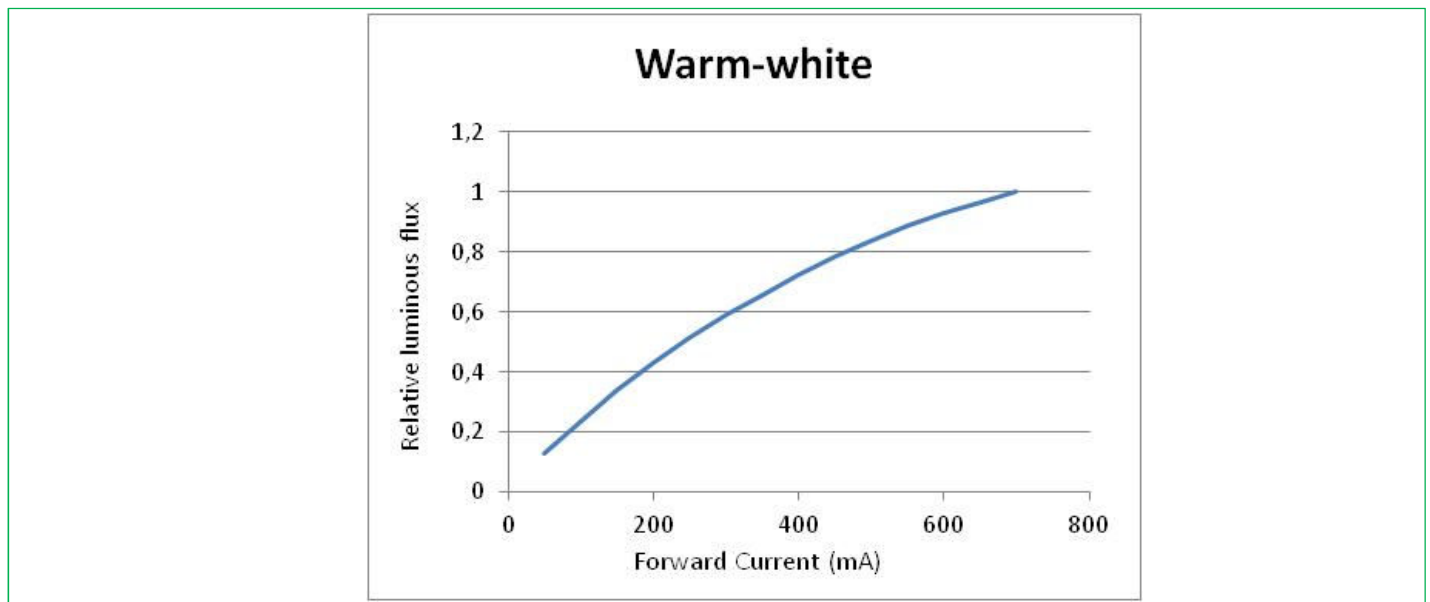


Figure 10. Relative luminous flux of Warm-white LED die vs current

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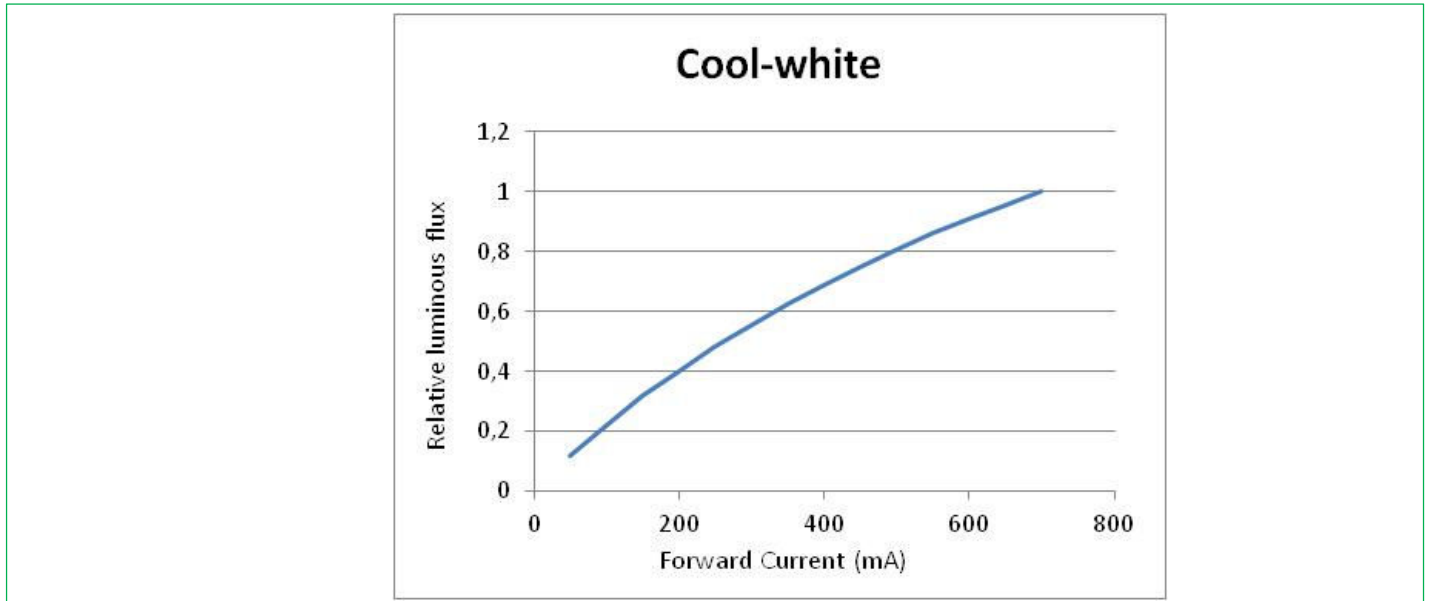


Figure 11. Relative luminous flux of Cool-white LED die vs Current

**Electrical Schematic – ACULED – Model R3C6**

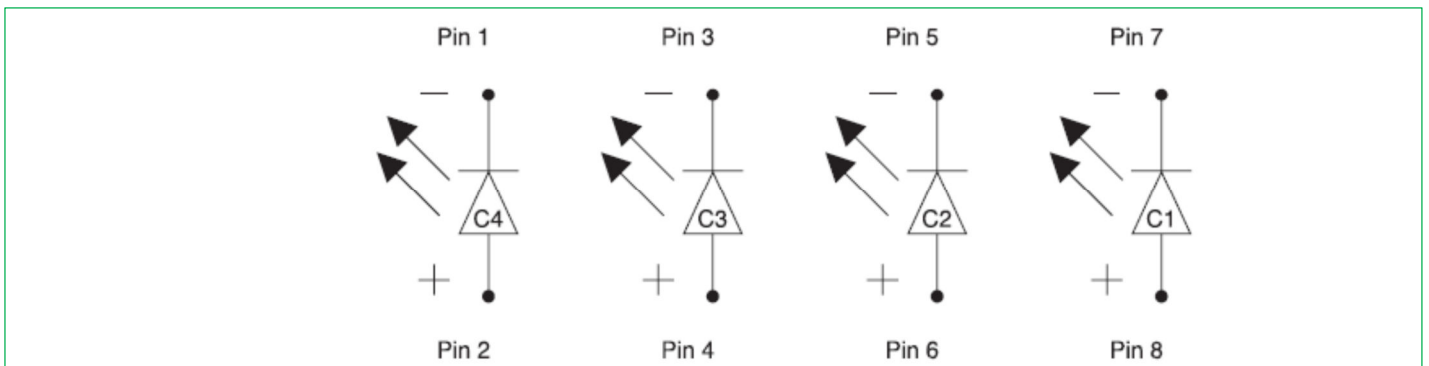


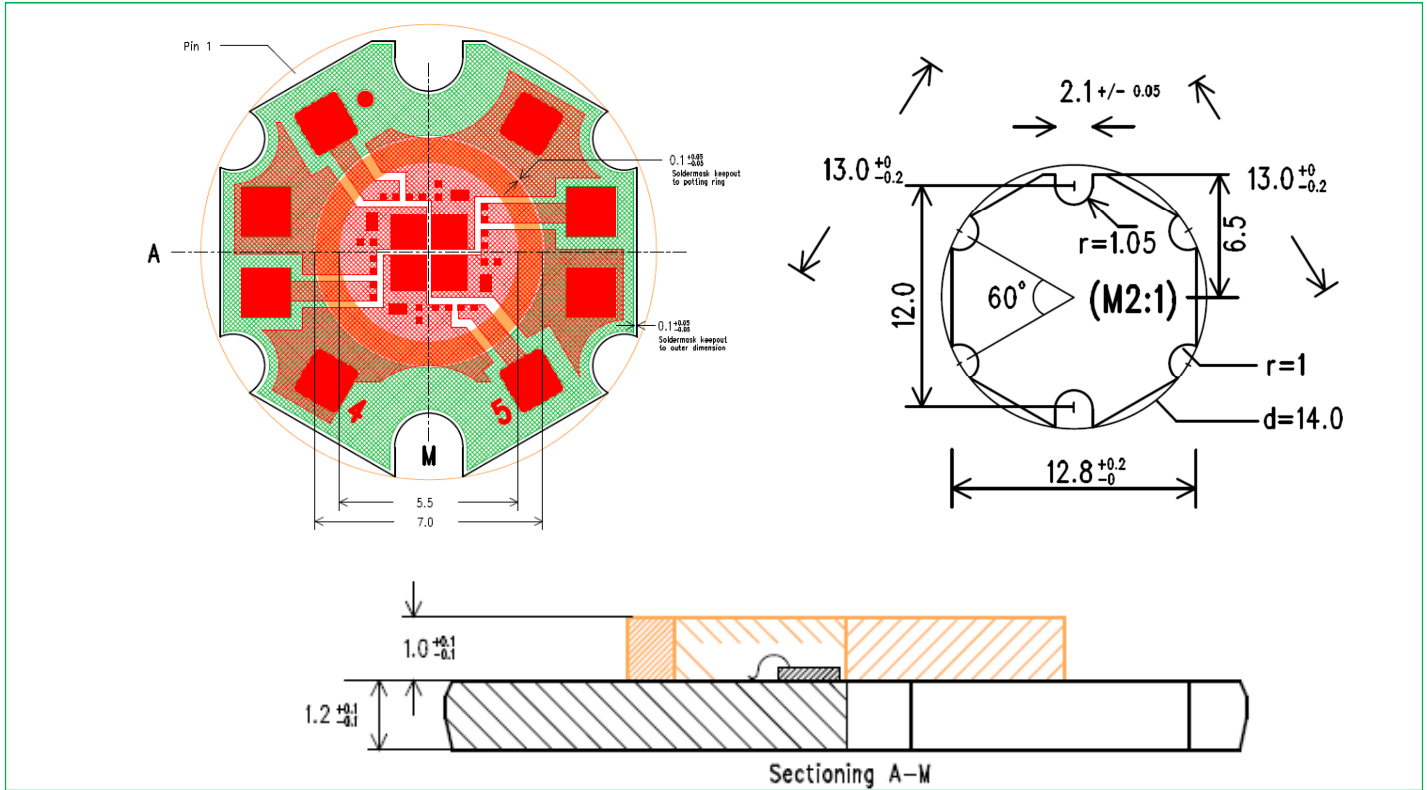
Figure 12. Electrical schematic, ACULED – Model R3C6

| Pin          | Connection                |
|--------------|---------------------------|
| <b>Pin 1</b> | <b>Cathode Cool-white</b> |
| Pin 2        | Anode Cool-white          |
| Pin 3        | Cathode Cyan              |
| Pin 4        | Anode Cyan                |
| Pin 5        | Cathode Warm-white        |
| Pin 6        | Anode Warm-white          |
| Pin 7        | Cathode Red               |
| Pin 8        | Anode Red                 |



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**Mechanical Dimensions**



**Figure 13. Mechanical arrangement and dimensions.**

**Thermal Properties:**

Nominal thermal resistance ( $R_{th}$ ) of the package is 5 °K/W from the LED junction to the backside of the package.

Approximate temperature of the LED junction may be calculated by the following formula:

$$T_j = T_s + P \cdot R_{th}$$

$T_s$  = temperature on the back side of the package

$P$  = power dissipated in the package ( $V_f \times I_f$ )

$T_j$  = resulting junction temperature

### Solder Pad Geometry

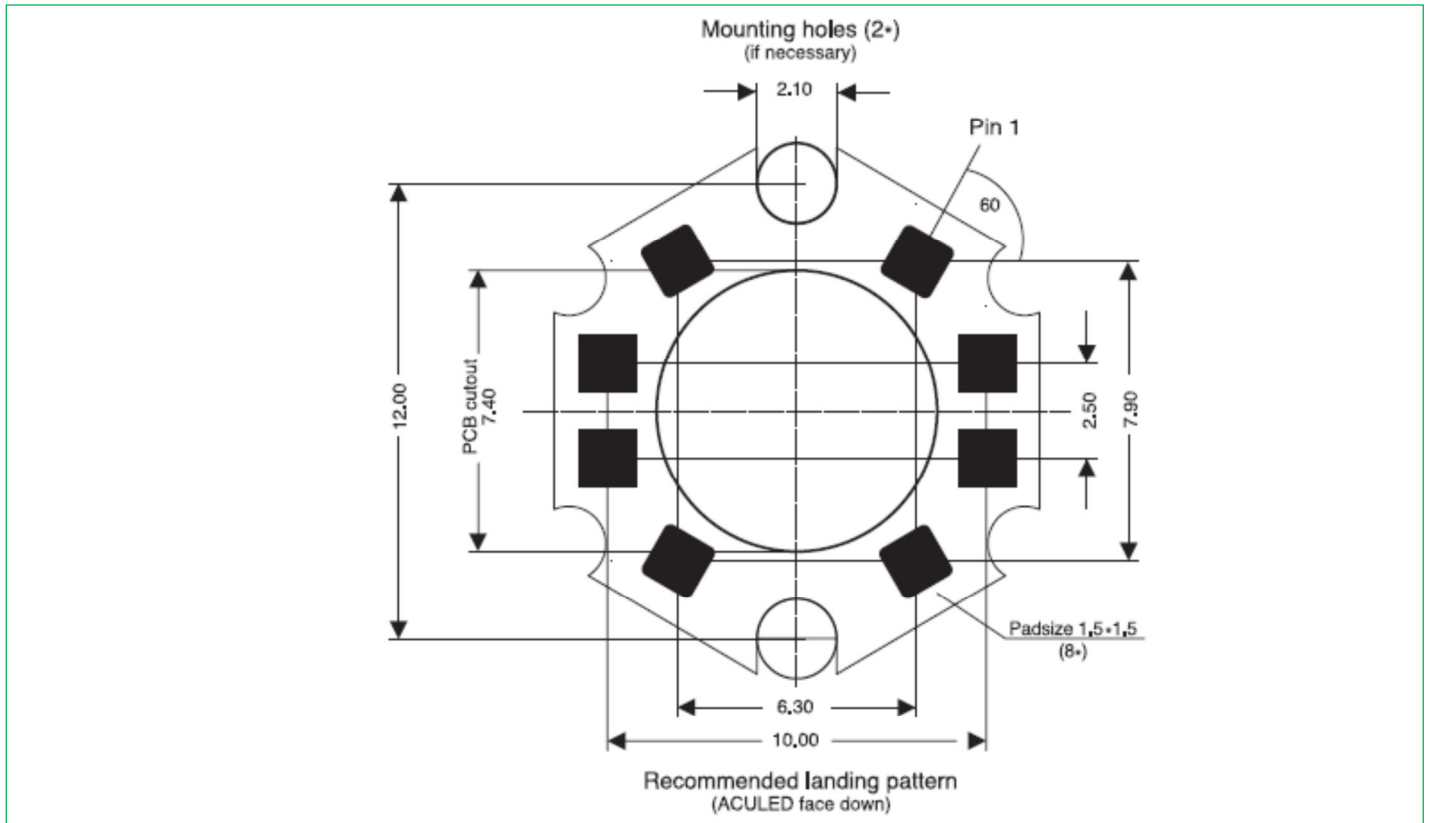


Figure 14. Solder Pad Geometry

### Soldering Profile

This product is not suited for hand soldering. Only reflow soldering is allowed. In the case of reflow soldering, the following Reflow Soldering Profile is recommended.

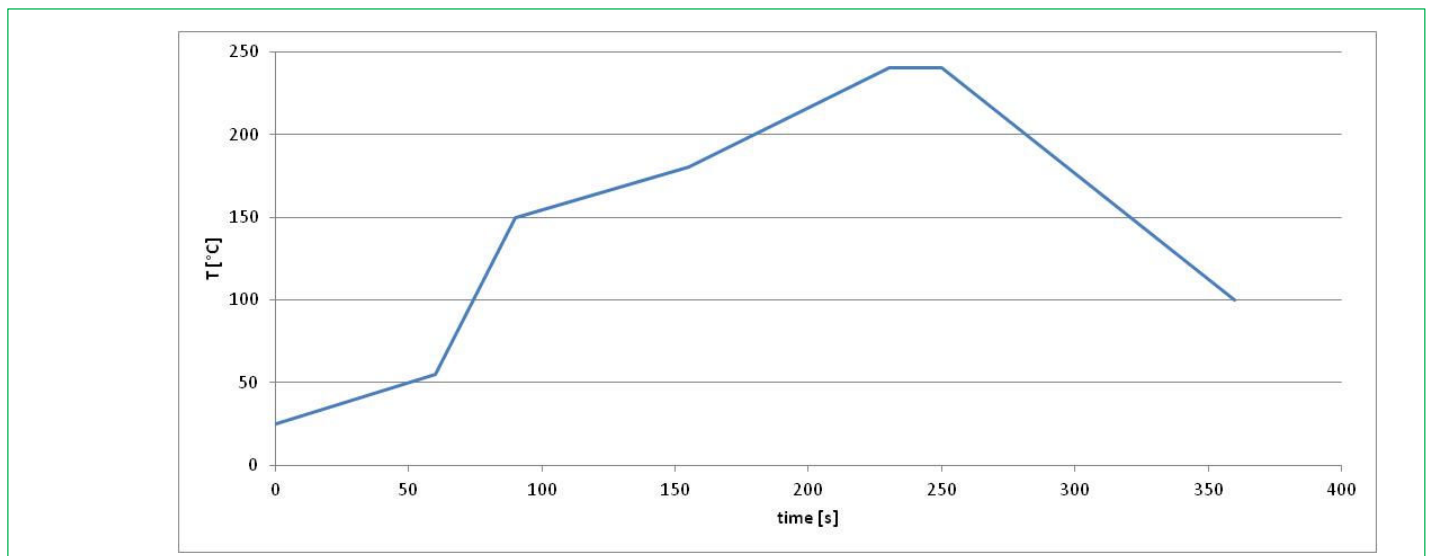


Figure 15. Reflow Soldering Profile

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| Temperature zone | Zone temperature (°C) | Heating speed (°C/s) |
|------------------|-----------------------|----------------------|
| Region 1         | 25 to 55              | 0.5                  |
| Region 2         | 55 to 150             | 3.17                 |
| Region 3         | 150 to 180            | 0.46                 |
| Region 4         | 180 to 240            | 0.80                 |
| Region 5         | 240                   | 0                    |
| Region 6         | 240 to 100            | -1.27                |

Note: Do not exceed peak temperature of 250°C. Do not expose LED to peak temperature for more than 20s.

### RoHS Compliance

The ACULED – Model R3C6 is designed to be fully compliant with the European Union Directive 2002/95/EEC – Restriction of the use of certain hazardous substances in electrical and electronic equipment.

### Caution

#### Storage

In the packaging material, product should be kept at temperature below 30°C and 90 %RH or less.

The product should be used within a year and moisture-proof packaging is recommended.

After opening the package, store the product below 30°C and 70 %RH or less.

Soldering should be done within 7 days of opening the package.

If unsure about the humidity conditions, bake the product for 24 hrs at 65°C.

The contacts of the package are gold-plated and may corrode in aggressive environments.

Avoid conditions which may lead to such corrosion. Corrosion may cause difficulty during soldering.

It is recommended that the customer use the product as soon as possible.

Avoid rapid transitions in ambient temperature, especially in high-humidity environments where condensation can occur.

#### Static Electricity

Static electricity or surge voltage will damage the LEDs. It is recommended that a wrist band or anti-electrostatic gloves be used when handling the ACULED product.

All devices, equipment and machinery must be properly grounded. It is recommended that precautions be implemented against surge voltage on all equipment that handles the product.

#### Application and System Design Considerations

It is not recommended that several LEDs in parallel be used, as this may lead to uneven distribution of the drive current, due to variations in forward voltage  $V_f$ . In extreme cases, over current in one or more packages can lead to damage or severely shorten life time. Ideally, please use in serial strings, with each string having a single current source.

Pulse width modulation is the preferred method for dimming LEDs. Always drive the LED as close as possible to its nominal drive current. Operating the LED at very low currents (<10% of nominal value) may lead to unpredictable results.

# White ACULED® – Model R3C6

## For High CRI, High R9

### Medical OEM Applications

Thermal design of the final product using the ACULED is of paramount importance. Always operate the LEDs well below  $T_j$  (maximum junction temperature). It is strongly recommended that the temperature be measured local to the LED package and the actual junction temperature be calculated based on the formula in the Thermal Properties section.

Take care during mechanical mounting not to overstress the product. It is recommended to set a torque limit on the mounting screws or to design a stress-free mounting.

#### Handling Precautions

**Bare Hands.** When handling the product touching the encapsulant with bare hands, the surface may become contaminated, which will affect the optical characteristics.

**Tweezers.** When using tweezers to handle the package, always hold the product on the circuit board.

**Soldering.** This product is not suitable for hand soldering. For reflow soldering the temperature should not exceed 240°C. During soldering, the peak temperature of 240°C should be kept for a maximum of 20 sec.

**Cleaning.** Use isopropyl alcohol to clean the product. When using other cleaning methods, always verify that no damage occurs and observe local regulations.

**Safety guidelines for human eyes.** Please apply appropriate safe handling when working with these LEDs. Great care should be taken especially when viewing the LED which is driven directly at high drive currents. This may increase the hazard to your eyes. Never stare into the LED without adequate protection.

*part number. E002329*

*order number. ACL01-MC-000-R3C6-E10-C01-L-0000*

#### About Excelitas Technologies

Excelitas Technologies is a global technology leader focused on delivering innovative, customized solutions to meet the lighting, detection, and other high-performance technology needs of OEM customers.

From medical lighting to analytical instrumentation, clinical diagnostics, industrial, safety and security, and aerospace and defense applications, Excelitas Technologies is committed to enabling our customers' success in their specialty end-markets.

Excelitas Technologies has approximately 3,000 employees in North America, Europe and Asia, serving customers across the world.

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The logo for Excelitas Technologies, featuring the word "EXCELITAS" in a bold, sans-serif font with a stylized green and blue graphic element above the "E", and the word "TECHNOLOGIES" in a smaller, green, sans-serif font below it.

For a complete listing of our global offices, visit [www.excelitas.com/Locations](http://www.excelitas.com/Locations)

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