Design Guide

Electroluminscent Lamps

All information contained herein are typical values
only and should not be considered specifications.

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Section 1
GENERAL INFORMATION

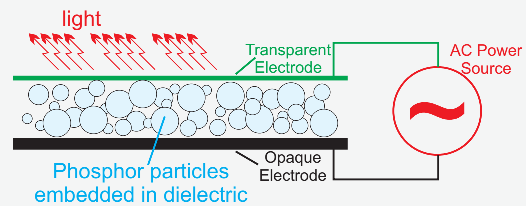
Electroluminescence is a solid state phenomenon in which semiconductor crystals, known as phosphors, convert electrical energy directly into light energy.

Quantaflex 1700™ electroluminescent lamps provide our customers with an unmatched combination of quality, long life, environmental stability and economy.

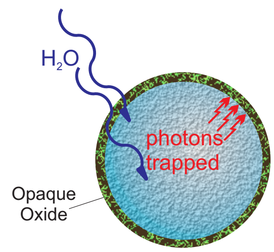
Electroluminescence is the most efficient method known for converting electrical energy into light energy.

The high efficiency of this conversion minimizes power consumption and losses due to heat or IR emissions. Electroluminescent (EL) devices consequently consume relatively little power, and remain within two degrees of ambient temperature under normal operation.

Electrically, an electroluminescent lamp is a “Lossy Capacitor”. Electroluminescent phosphors embedded in the dielectric medium of a capacitor will emit photons when an AC power source is applied.



An electroluminescent lamp is a very specialized capacitor in which one of the conductive plates of the capacitor is comprised of a transparent or translucent conductor, allowing the photons to escape.

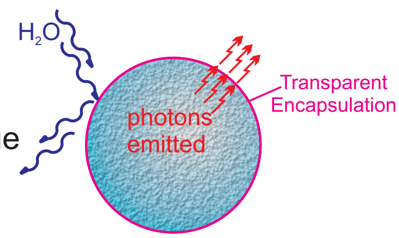


STANDARD PHOSPHOR

Standard phosphors react with environmental moisture. The resulting oxide layer on the surface of the particle is opaque and does not allow photons to escape, greatly diminishing light output.

The Quantaflex 1700^{tm} Electroluminescent Lamp is thin, flexible, durable and can withstand the environmental strains that cause many other types of EL Lamps to fail.

Quantaflex 1700^{tm} is not dependent upon the package integrity of expensive Aclar encapsulation systems that many other products rely upon. Instead, we make use of a new Microencapsulation technology. Each individual phosphor particle is encapsulated with a thin layer of a glassy material. This encapsulation layer provides an efficient moisture vapor barrier, effectively protecting the moisture sensitive phosphor.



MICROENCAPSULATED PHOSPHOR

Micro-encapsulated phosphors are protected from environmental moisture, resulting in a greatly extended life.

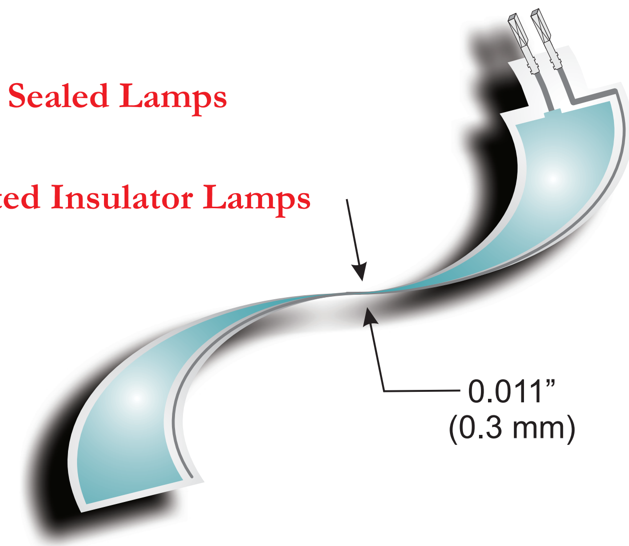
Quantaflex 1700^{tm} also utilizes our unique polymer binder system, which imparts durability and flexibility to the product. We have eliminated the use of extremely hygroscopic materials commonly used as binders in "foil" lamps.

By eliminating the dependence upon packaging, we also have eliminated much of the intensive manual labor in production, resulting in significant economies. Quantaflex 1700^{tm} lamps are manufactured via a screen printing process, allowing multiple lamps to be manufactured simultaneously.

2.1 Thickness

0.0115" +/- 0.001" for Heat Sealed Lamps
(0.3 mm +/- 0.03 mm)

0.0085" +/- 0.001" for Printed Insulator Lamps
(0.22 mm +/- 0.03 mm)



The extremely thin profile of Quantaflex 1700tm E.L. Lamps makes them ideal for a wide variety of applications. When used in membrane switches, tactile feel and actuation pressure are relatively unhindered, allowing the lamp to be placed in front of the membrane switch, directly behind the graphics. This gives you, as a design engineer, the freedom to put light where you need it, without the need for extensive redesign of your other components.

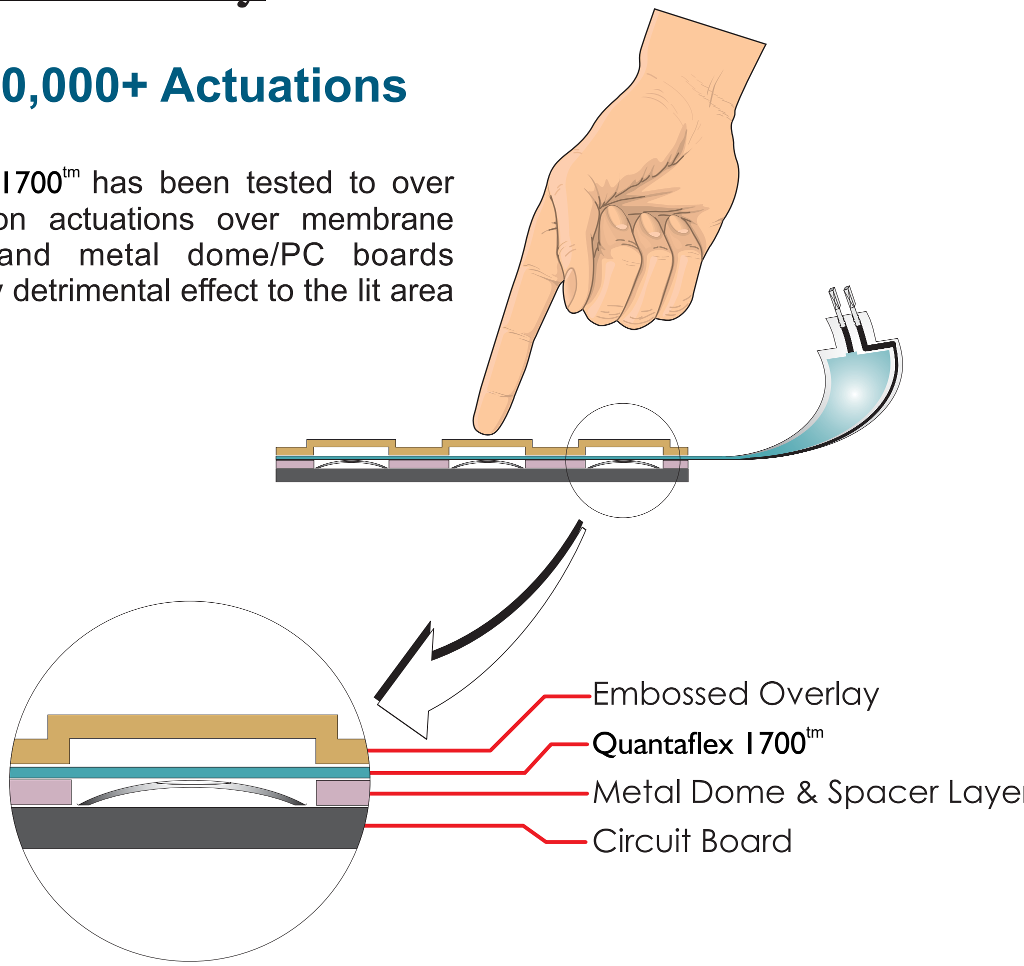
In lit nameplates, decals and appliqués, the Quantaflex 1700tm lamp allows you to light your graphics, without significant increase in the package size of your component. The even light output over the surface of the lamp eliminates the need for expensive light piping, or increased packaging size to diffuse the light of "point light sources" such as incandescent or LED's.

Quantaflex 1700tm E.L. Lamps are ideal for backlighting transflective L.C.D. displays, when it is necessary to view these displays in low ambient lighting conditions.

2.2 Flexibility

3,000,000+ Actuations

Quantaflex 1700tm has been tested to over three million actuations over membrane switches and metal dome/PC boards without any detrimental effect to the lit area



Radius bends

Quantaflex 1700tm EL Lamps can be flexed to a radius of 0.150” (4 mm) in either direction. Quantaflex 1700tm conforms to the radius of your fixture and puts the light where you want it.

Flex Tail Termination

Quantaflex 1700tm EL Lamps make use of time tested screen printing techniques used for years in the manufacture of membrane switches and flex circuits. Polyester flex tails and printed conductive tracks compatible with standard FFC connectors assure a reliable connection.

2.3 Dimensional Tolerances

Standard Tolerance for all dimensions is **+/-0.010” (+/- 0.25 mm)**.
If tighter specifications are required, please contact the factory.

2.4 Dimensional Stability

Quantaflex 1700tm EL Lamps are manufactured on a substrate of heat stabilized polyethylene-terephthalate (polyester) and are dimensionally stable within the range of **-40˚C to +90˚C**.

2.5 Minimum Borders Required

A) Bus Bars

On those edges where a Bus Bar is required there is a minimum border from the edge of the part to the beginning of lit area of **0.090" (2.2 mm)**.

B) Edges/Cutouts

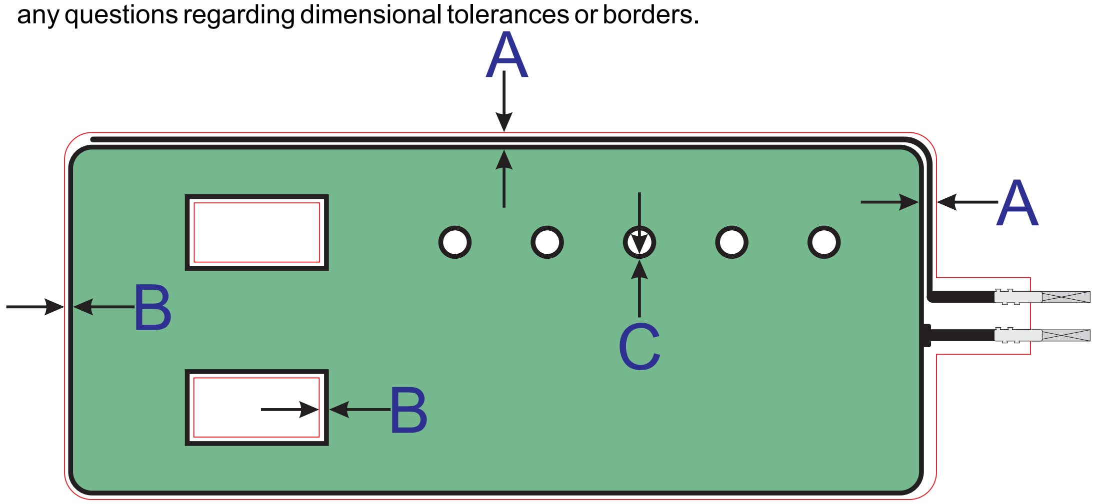
On those edges where no bus bar is required and on all internal cutouts, there is a minimum border from the edge of the part to the beginning of lit area of **0.045" (1.1 mm)**.

C) Clear Areas

When it is required that an area internal to the lit area be clear, there is a minimum border from the edge of the clear area to the beginning of lit area of: **0.025" (0.6 mm)**. This type of design is used most commonly when an E.L./LED combination is used. The required clear areas must be specified on all prints.

D) Exceptions

Quantaflex Printed Electronics makes every effort to meet the needs and requirements of your particular design. Please consult with our technical representatives if there are any questions regarding dimensional tolerances or borders.

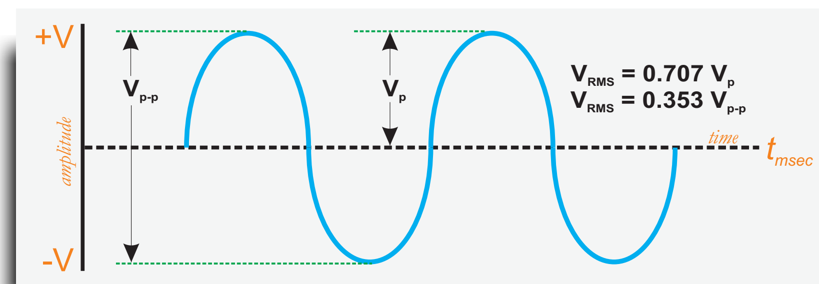


3.1 Operating Voltage

60 - 120 $V_{AC\ RMS}$ Recommended for most applications
40 - 200 $V_{AC\ RMS}$ (Min. - max.)
Sine Wave is preferred

If you have a design requirement which is outside of the recommended range, please contact one of our representatives for additional information.

Within the normal operating range of an EL lamp, the brightness is approximately proportional to the square of the RMS Voltage. Therefore, a doubling of RMS voltage will increase the brightness of the lamp by approximately four times.

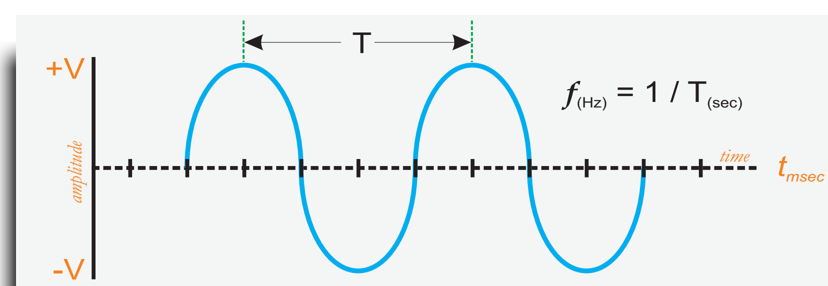


3.2 Operating Frequency

400 - 800 Hz. Recommended for most applications
50 - 5000 Hz. (Min. - max.)

If you have a design requirement which is outside of the recommended range, please contact one of our representatives for additional information. In some applications, Quantaflex 1700™ lamps can be designed to operate at frequencies as high as 30,000 Hz.

Within the normal operating range of an EL lamp, the brightness is approximately directly proportional to frequency.. Therefore, a doubling of the frequency will approximately double the brightness of the lamp.

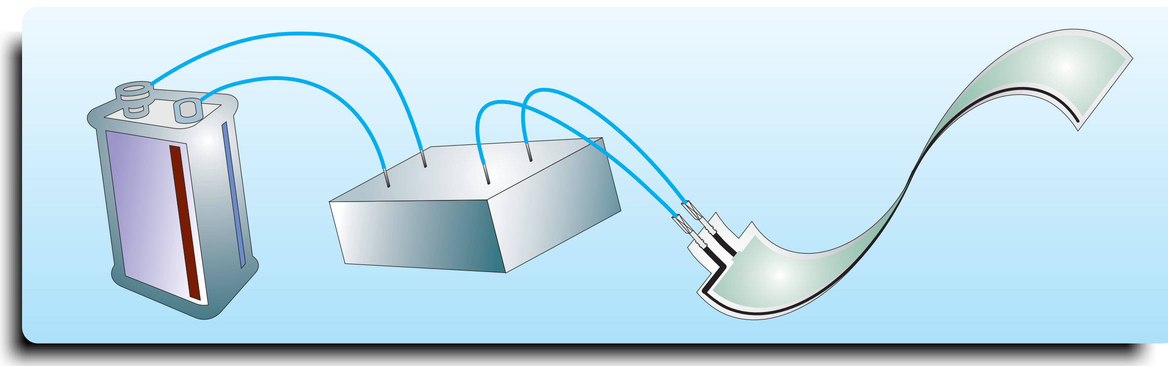


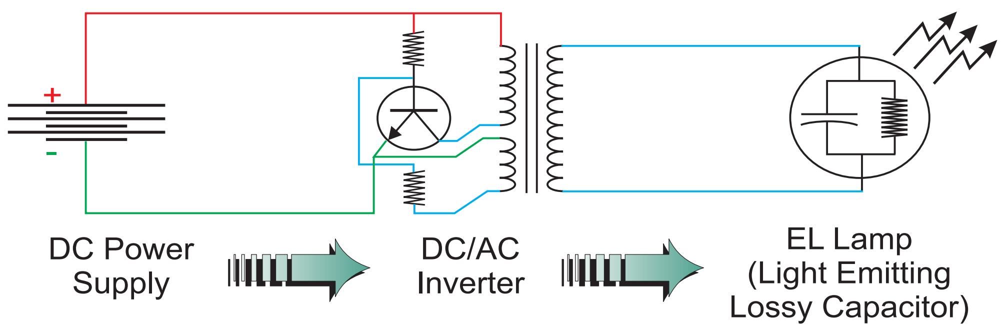
3.3 Power Consumption

0.01 - 0.06 Watt/in² (typical range for most applications)

Total Power Consumption is primarily dependant upon:

- the size of the lamp
- the voltage and frequency at which the lamp is driven
- the color of the lamp





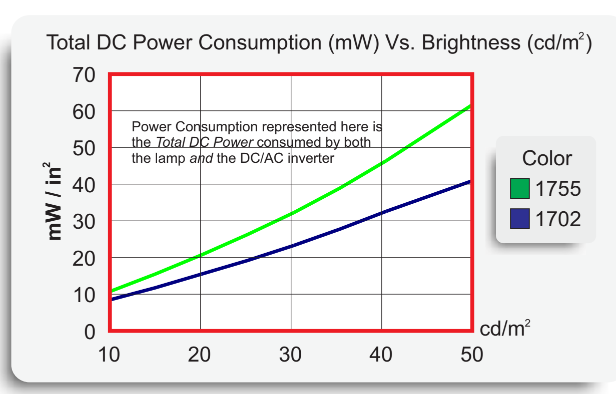
Some of the total power consumed in the operation of an EL Lamp is used by the DC/AC Inverter. The balance is used by the Electroluminescent Lamp.

Because of the efficiency of electroluminescence, most of the power used by the lamp is converted to light. If properly designed and driven, only a *negligible portion* of the power used in the EL Lamp is converted to heat (infra-red). A well designed lamp, properly matched to an inverter, will remain cool to the touch.

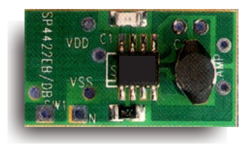
Because of the wide variety of lamp and inverter configurations, accurate total power consumption can only be calculated using the actual components used in the application.

Different EL colors have different efficiencies. Different types of inverters also have different efficiencies.

The graph at right is meant as a general guide only. Please contact one of our representatives if you need additional assitance.



3.4 Inverters



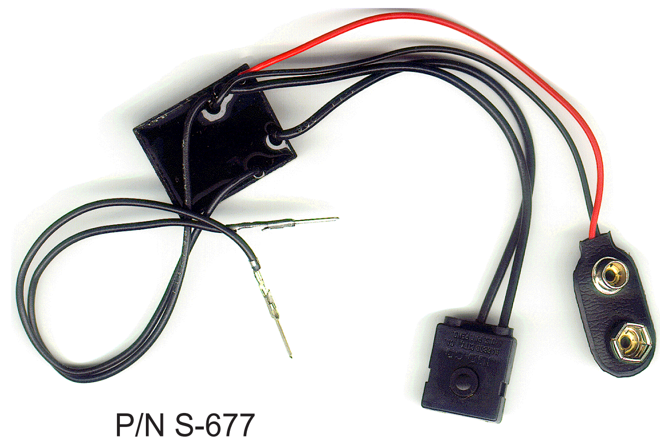
Surface Mount
Chip Inverter
Demo Circuit

Quantaflex Printed Electronics can provide a wide variety of DC/AC inverters. The choice of the correct inverter is critical to the success of every EL project.

From tiny chip inverters suitable for use in watches and small handheld devices.... to large transformer based inverters suitable to drive hundreds of square inches of lit area.

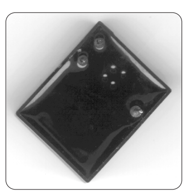
We have the right inverter

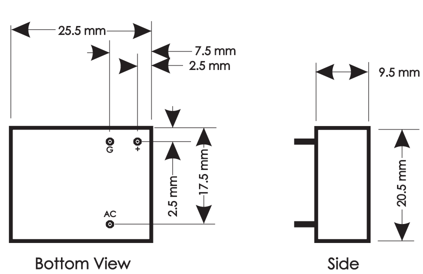
- Chip Inverters
- PC Mount Inverters
- Wire Mount Inverters
- Options
  - Switches
  - Flashers
  - Connectors



P/N S-677

"N" PACKAGE
Low Profile
Inverter





The wide range of possible input voltages, output voltages, output frequencies, lamp sizes, inverter package sizes, mounting styles and options, results in many applications requiring a custom designed inverter.

Quantaflex Printed Electronics does maintain inventory of some inverters. Lead time for custom designed inverters can range from 2 - 7 weeks.

Please contact one of our representatives to see how we can

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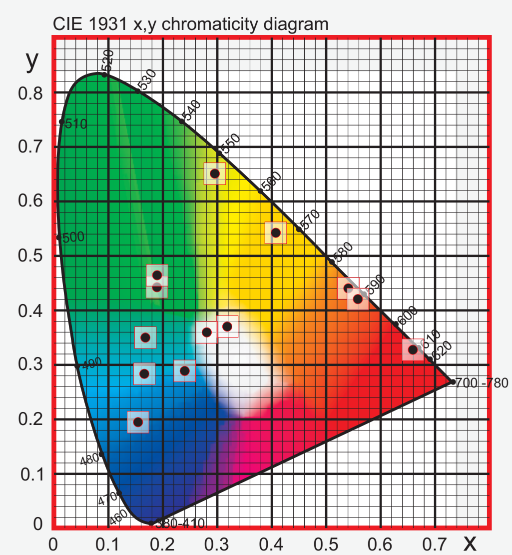
4.1 Available Colors

- 13 Standard Colors
- Custom Colors Available

See charts in Appendix A for more detailed spectral and photometric data on specific colors.



Overview of Standard Colors

x, y values are CIE 1931 coordinates measured at 100 V_{AC} / 600 Hz.

Values are typical, not for specification. Std. color tolerance for x,y = +/- 0.02

Color ID	Description	x	y
1701	Aviation Blue	0.172	0.349
1702	Green	0.187	0.442
1704	Blue	0.166	0.283
1705	Aviation Green	0.189	0.465
1706	Lime Green	0.297	0.655
1720	Amber	0.544	0.445
1725	Yellow	0.409	0.546

Color ID	Description	x	y
1741	Phosphor White	0.307	0.359
1755	Dye Conv. White	0.280	0.360
1757	Blue White	0.241	0.291
1760	Deep Blue	0.157	0.198
1785	Orange	0.559	0.425
1790	Red	0.650	0.328

4.2 What determines the color of an EL lamp?

- **The type of Phosphor used.**

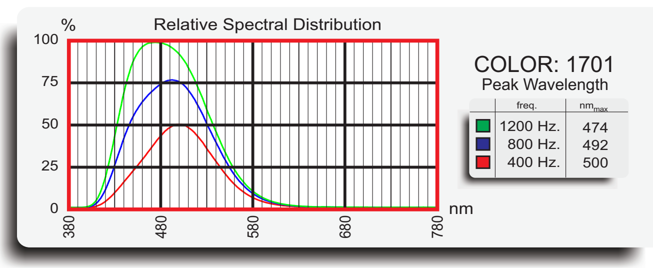
Each phosphor particle is a semi-conductor comprised of a "doped" Zinc Sulfide crystal.

The type and concentration of dopant in the crystal determined the wavelength of the emitted photons.

There are numerous different phosphors utilized to manufacture

- **The frequency of the AC signal applied.**

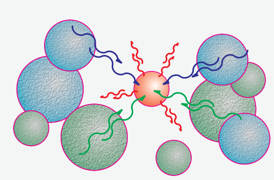
As the frequency of the applied power is increased, the frequency of The light emitted is also slightly increased (blue shift).



The extent to which the spectral output is effected by the input is dependent upon the type of phosphor used. Some phosphors are dramatically effected, others only minimally.

- **The addition of Fluorescent Conversion Dyes and Pigments to the Phosphor Layer or the addition of Conversion Dyes or Filters to the front of the lamp.**

This method is used to produce "Dye Conversion White" and other Dye Conversion colors. There are no commercially available phosphors which efficiently produce light in the red-orange-yellow spectrum. Therefore, fluorescent conversion dyes are often used to produce the red and yellow components necessary to produce various shades of white light. These red and yellow fluorescent dyes and pigments can *absorb* some of the green and blue light produced by phosphors which are efficient in this range and *re-emit* the light in the Red-Yellow spectrum. The choice of dye and its concentration will determine the shade of white produced. Because some of the energy is lost in this color conversion, the efficiency of dye conversion colors is generally less than those in the Aviation Green/Aviation Blue



Blue and Green light is emitted by efficient phosphors. That light is absorbed by a red fluorescent dye particle and re-emitted as red light.

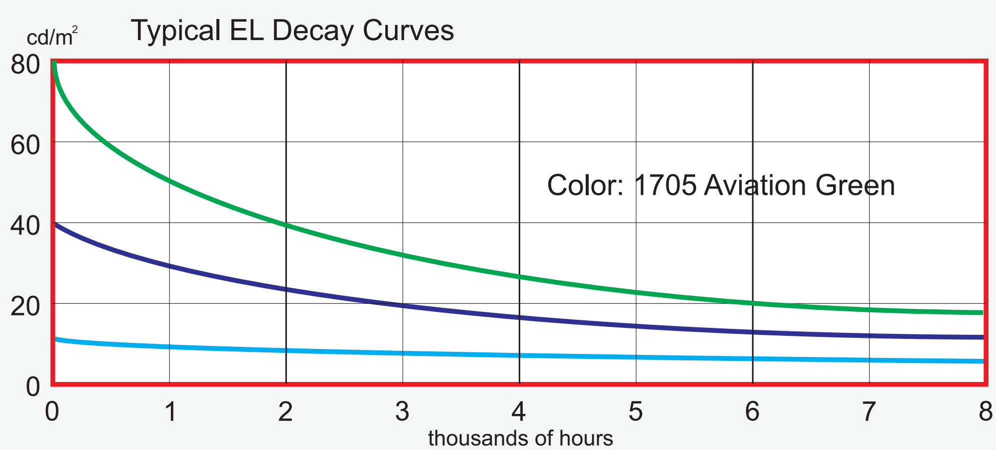
5.1 Useful Life

The phosphors which produce the light in an EL lamp are comprised of a special class of doped Zinc Sulfide crystals. As with all Zinc Sulfide phosphors, those in an EL lamp gradually lose their efficiency over time. This loss of efficiency (decay) occurs only during the time the lamp is used. In a properly constructed lamp, using microencapsulated phosphors, there is no decay during normal storage conditions.

The Useful Life of an EL lamp is somewhat subjective and must be determined by taking into consideration the ambient lighting conditions, the end use of the product, the minimum acceptable brightness for the intended use, available power and other factors specific to the application.

> The Useful Life of an EL lamp should not be confused with the "Half Life" of the lamp. The Half Life is a period of time of continuous operation which must elapse in order for the brightness to have declined to one half of the initial brightness.
> In contrast, the Useful Life of the lamp is that period of time of continuous operation which must elapse before the brightness of the lamp has declined to the point where it is no longer functional in its specific application.
> In most EL applications, Useful Life is typically far greater than Half Life. The Useful Life of the lamp can range from a few thousand to as high as 50,000 operational hours.
> Correct matching of the lamp, inverter, and the graphics or display are essential to a successful project.

Different colors have different decay characteristics. In all cases, a higher initial brightness results in a steeper decay curve, whereas a lower initial brightness results in a more level decay curve.



The use of "load responsive" inverters can greatly increase the useful life of the EL lamp. As an EL lamp ages, its electrical characteristics change. These changes cause the inverter's output voltage and frequency to rise, increasing the brightness of the lamp.

Turning an EL lamp on and off has no detrimental effect on its life. Therefore, a duty cycle of 10% "on" time would increase the life of the lamp tenfold.

Contact one of our Representatives for additional information. We will be glad to help specify an inverter for your application. Choosing the right inverter is a critical part of every EL project.

5.2 Storage and Operational Temperatures

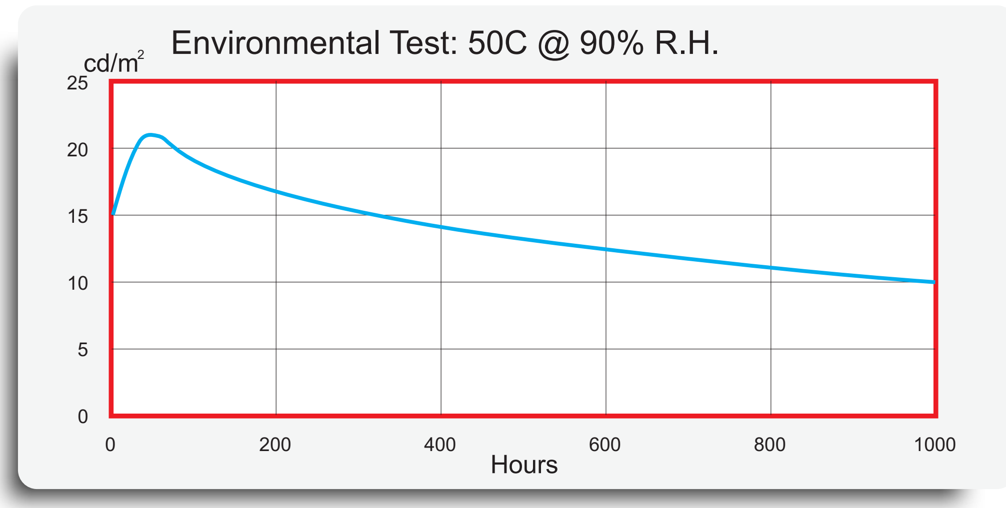
Storage: **-50°C to + 90°C**
Operational : **-40°C to + 80°C**

Storage at temperatures within the above range will have no detrimental effect on the lamp.

Operation at low temperatures will result in reduced brightness, and an extended life curve.
Operation at high temperatures will result in increased brightness, and a reduced life curve.
In most applications, it is recommended that operational temperatures be kept below 60C.

5.3 High Temperature / Humidity Testing

The Quantaflex EL lamp has been designed to withstand the severe stresses of automotive interior environments. Microencapsulation of the phosphors protects them from environmental humidity, even at high temperatures.



5.4 Thermal Shock

Quantaflex 1700™ lamps are manufactured on a single substrate. Quantaflex 1700™ inks closely match the coefficient of expansion of the substrate and the laminates. Consequently, during thermal shock, such as often occurs in an automotive environment, stresses do not occur. Package integrity and functionality are maintained.

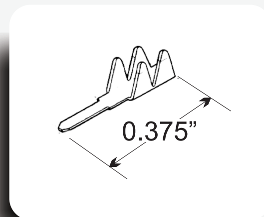
Thermal shock has been a frequent and common failure mode for some other types of EL lamps. In these other types of lamps, the practice of using materials with widely varying coefficients of expansion causes unreconcilable stresses in the package and termination areas which lead to lamp failure.

Quantaflex 1700™ lamps have been designed to pass severe thermal shock tests including multiple cycles moving directly from -40C to +80C and back again.

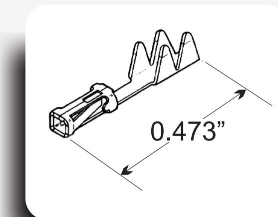
5.5 Vibration

The Quantaflex 1700™ EL lamp is a solid state lighting device and contains no filaments or other fragile components. It can withstand vibrational stresses that would cause many other types of lamps to fail.

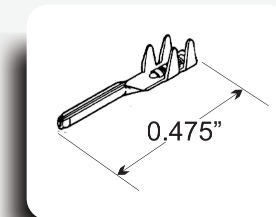
6.1 AMP Contacts



Solder Tab
P/N 88997-2

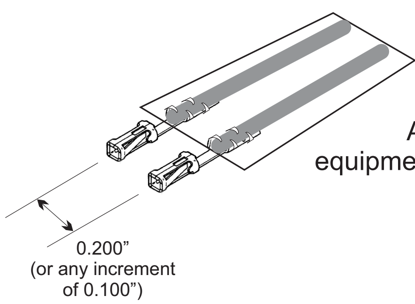


Receptacle
P/N 487406-4
(accepts 0.025”Square Pin)



0.025” Square Pin
P/N 88976-2

Amp Solder Tabs and Female Receptacles are the contacts most commonly used to terminate Quantaflex 1700tm EL Lamps. These contacts are economical and highly reliable.



Tin/Lead is Standard. Gold plating is available. Plain or locking housing are also available.

Amp contacts are typically installed by semi-automatic equipment onto polyester flex tail extending from the body of the lamp. Standard pitch is 0.100” or 0.200”.

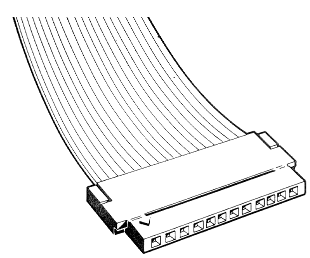
Any increment of 0.100” can be accommodated. Additional contacts can be installed when multiple selectively addressed areas are required.

6.2 BERG Clincher

Berg Clinchers are available in both female (65801-XXX) and male (66226-XXX).

Tin/Lead is standard. Gold plating is available.

This connector is highly reliable but is also more expensive than the equivalent Amp connection.



6.3 Conductive Pads

Quantaflex 1700tm lamps can be provided with two conductive pads on the rear surface of the lamp, or on the rear surface of an extended flex tail.

Connection is generally accomplished by one of various types of pressure connection.

When the conductive pads are on the end of a flex tail, this type of connection is suitable for use with low insertion force (LIF) or zero insertion force (ZIF) connectors.

Alternatively, connection is accomplished by pressing against spring load tangs or other projections (such as those used in flashlights to connect to batteries).

In some applications, a small amount of z-axis adhesive is used to make contact between the conductive pads on the EL lamp and mating conductive pads on a circuit board.

6.4 Optional Connectors

Virtually any connector designed for membrane switches or flat flex circuitry can be used with Quantaflex 1700tm EL lamps.

The use of a termination type not standard to Quantaflex 1700tm usually results in extended lead times, but can be made available.

If your application requires a specific plug or terminal, please contact one of our technical sales representatives for additional assistance.

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APPENDIX A

PHOTOMETRIC DATA

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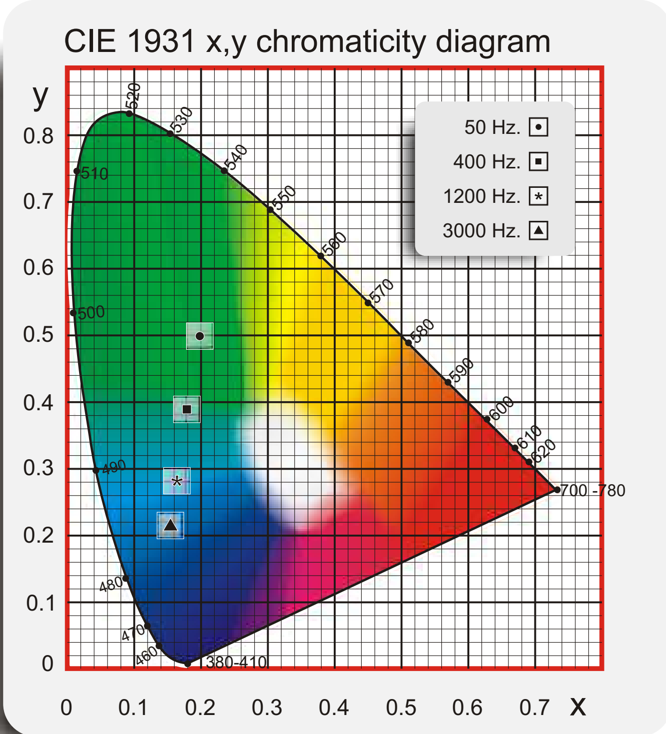

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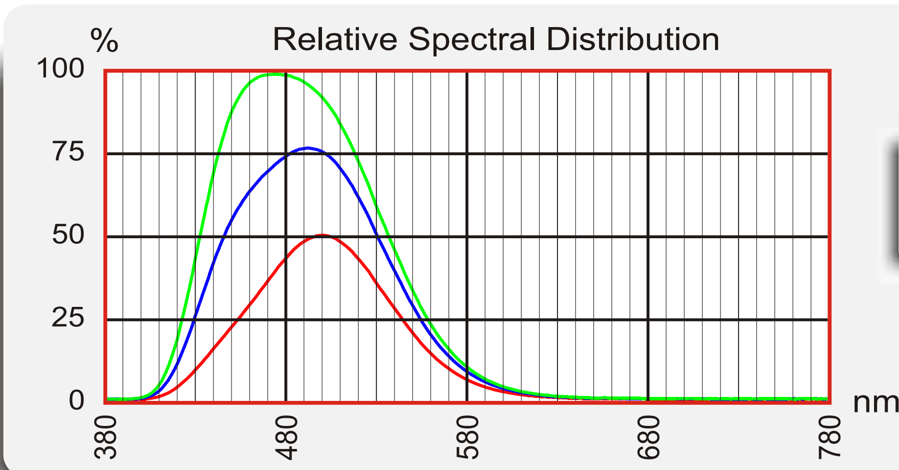
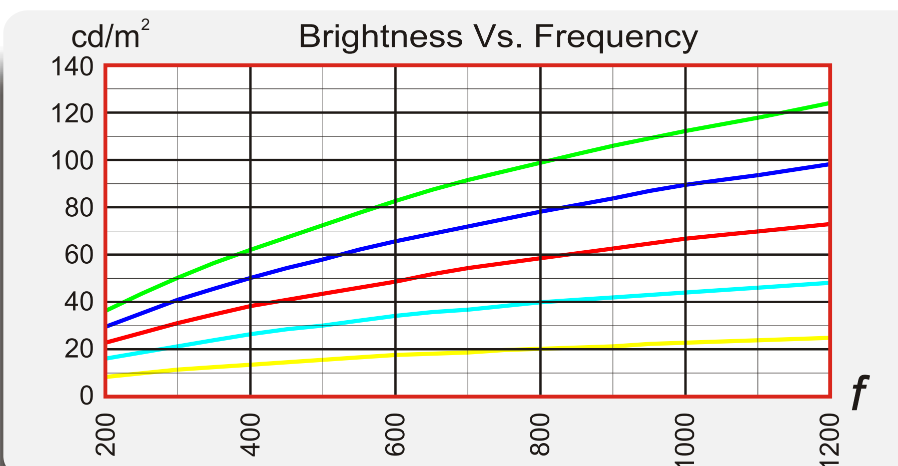
PHOTOMETRIC DATA
COLOR: 1701
Aviation Blue



Peak Wavelength

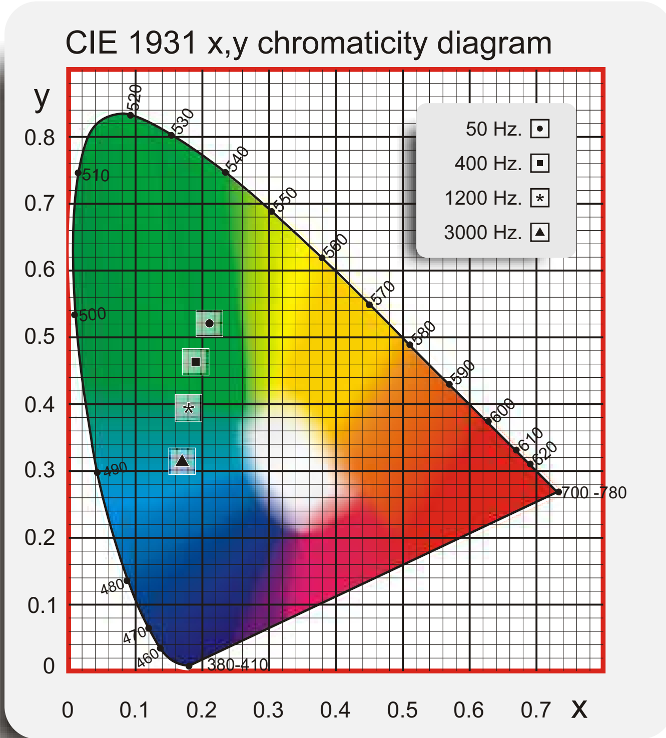
	freq.	nm_{max}
green	1200 Hz.	474
blue	800 Hz.	492
red	400 Hz.	500

measured at 100 VAC



Applied
RMS Voltage

- 140 VAC
- 120 VAC
- 100 VAC
- 80 VAC
- 60 VAC



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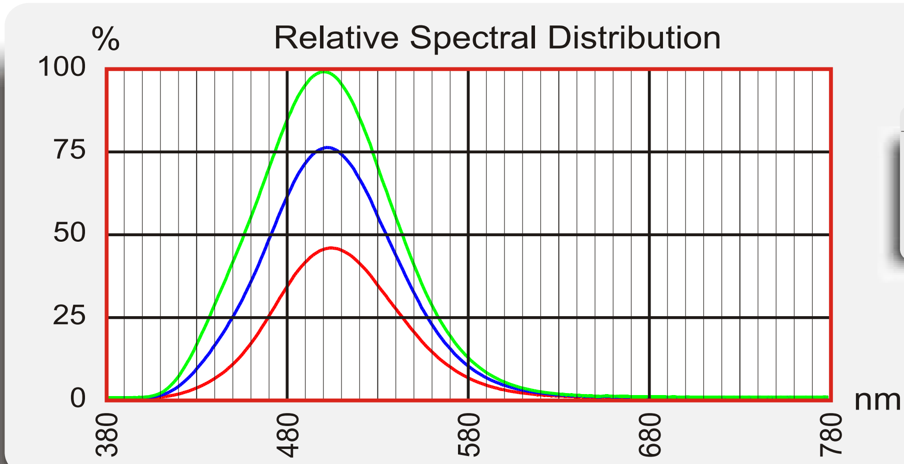
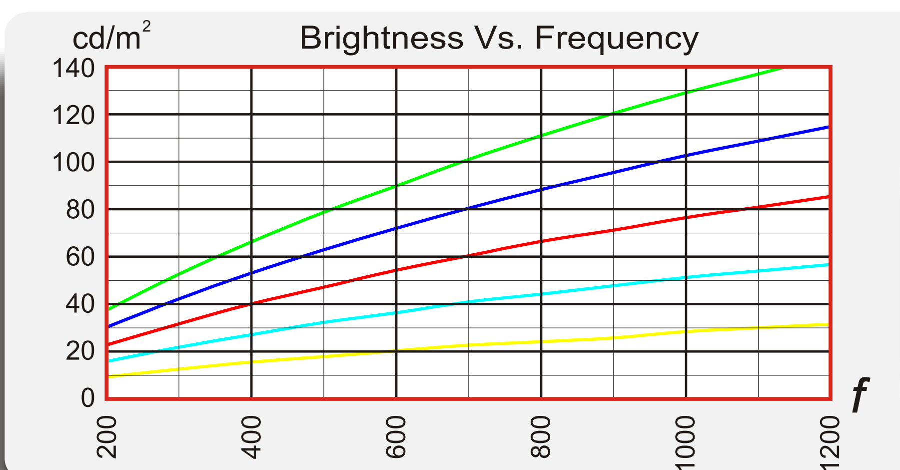
PHOTOMETRIC DATA
COLOR: 1702
Green



Peak Wavelength

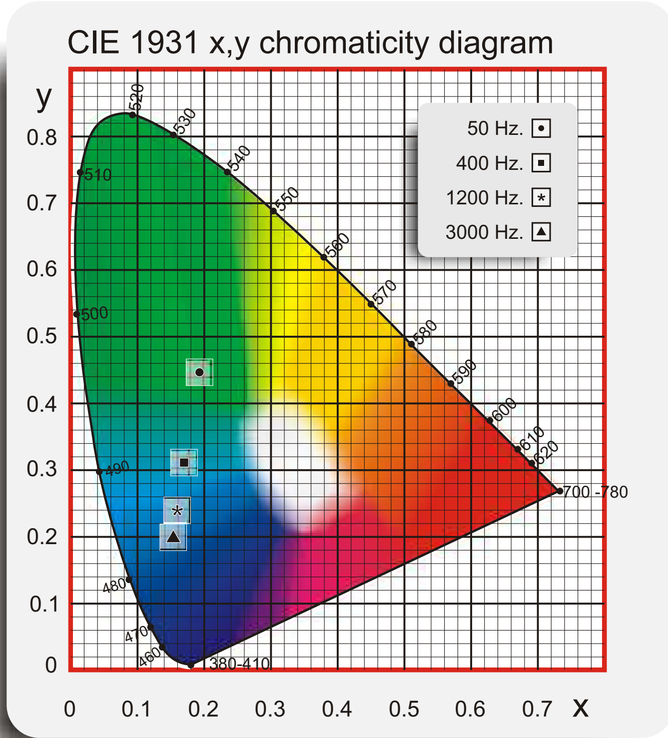
	freq.	nm_{max}
Green	1200 Hz.	500
Blue	800 Hz.	502
Red	400 Hz.	504

measured at 100 VAC



Applied
RMS Voltage

- 140 VAC
- 120 VAC
- 100 VAC
- 80 VAC
- 60 VAC



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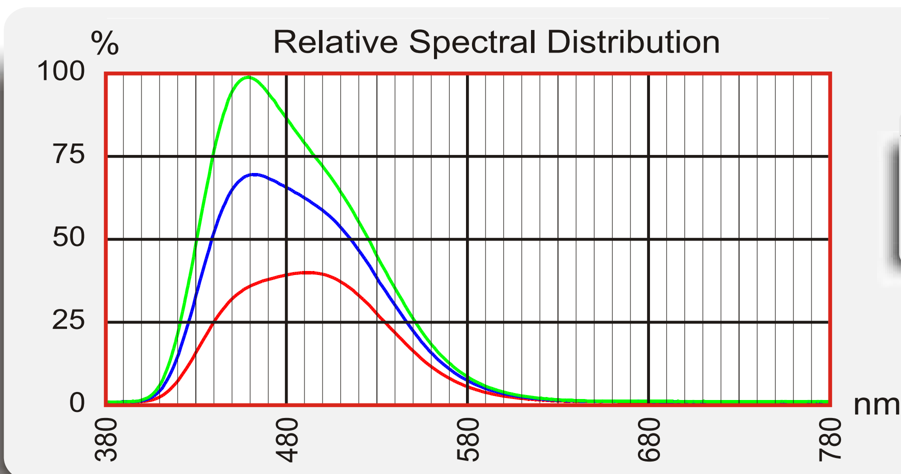
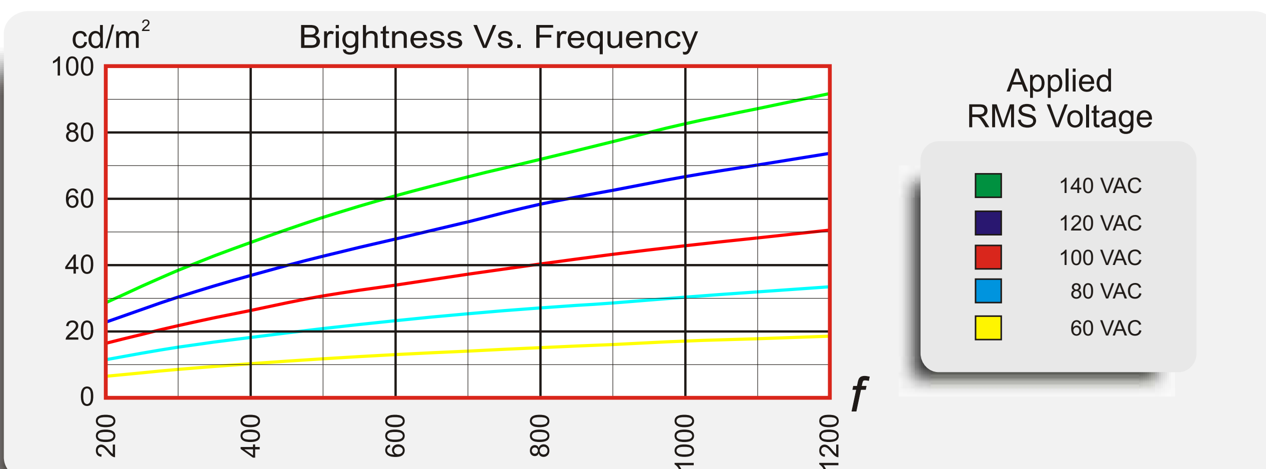
PHOTOMETRIC DATA
COLOR: 1704
Blue



Peak Wavelength

	freq.	nm_{max}
■ (green)	1200 Hz.	458
■ (blue)	800 Hz.	462
■ (red)	400 Hz.	558

measured at 100 VAC



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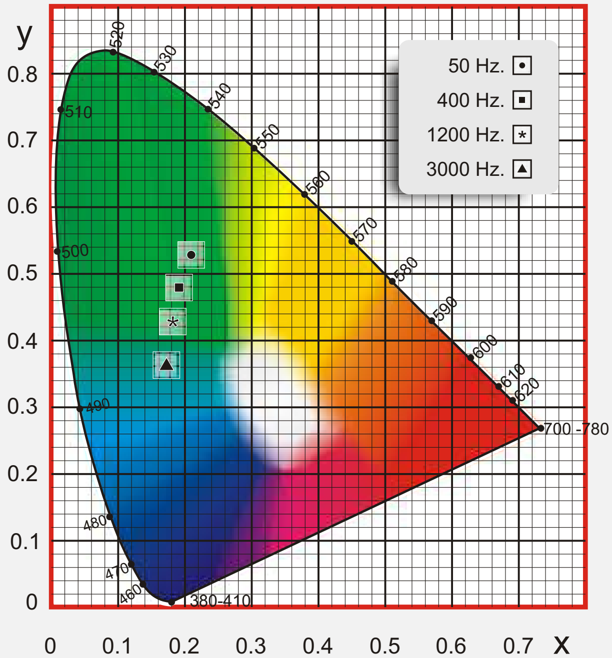
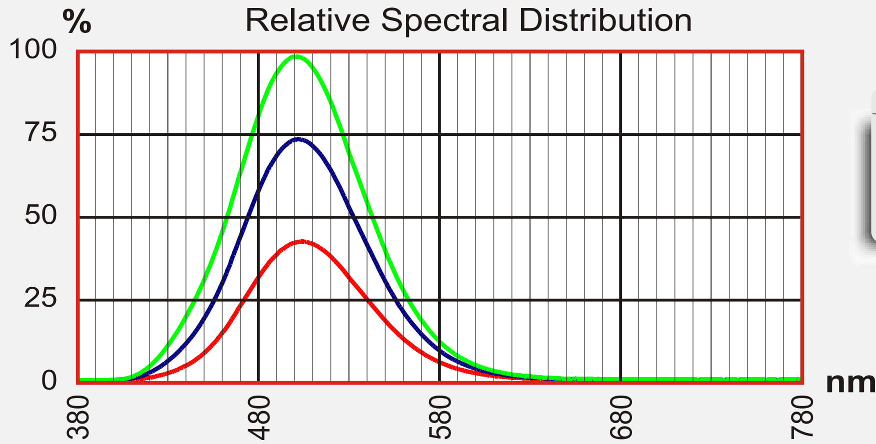
PHOTOMETRIC DATA
COLOR: 1705
Aviation Green

CIE 1931 x,y chromaticity diagram



Relative Spectral Distribution

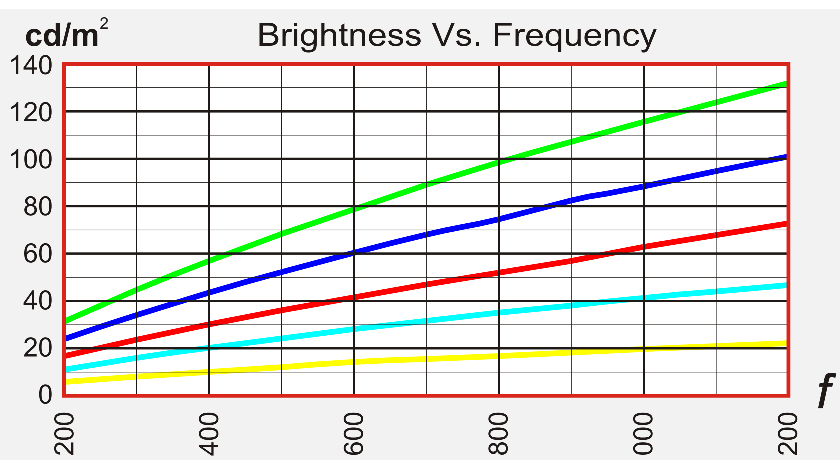


Peak Wavelength

	freq.	nm_{max}
(green)	1200 Hz.	500
(blue)	800 Hz.	502
(red)	400 Hz.	504

measured at 100 VAC

Brightness Vs. Frequency



Applied RMS Voltage

- 140 VAC
- 120 VAC
- 100 VAC
- 80 VAC
- 60 VAC

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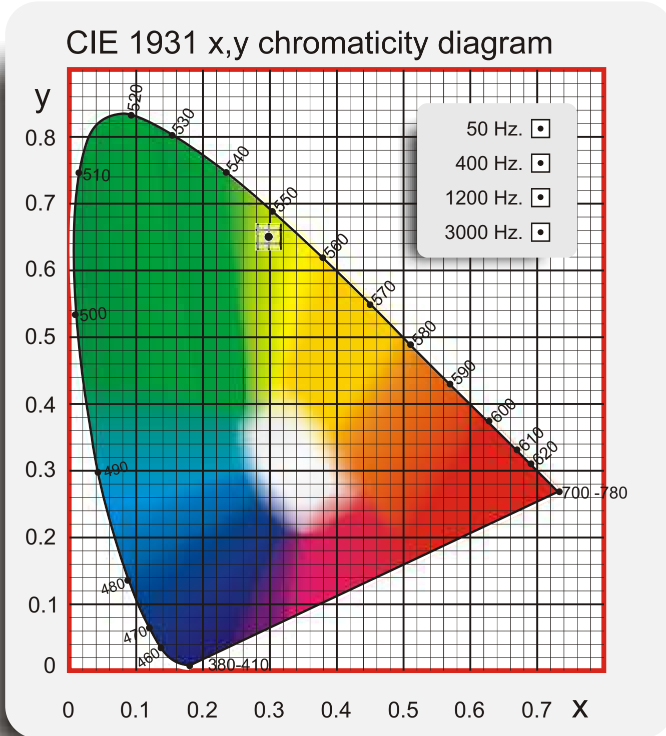

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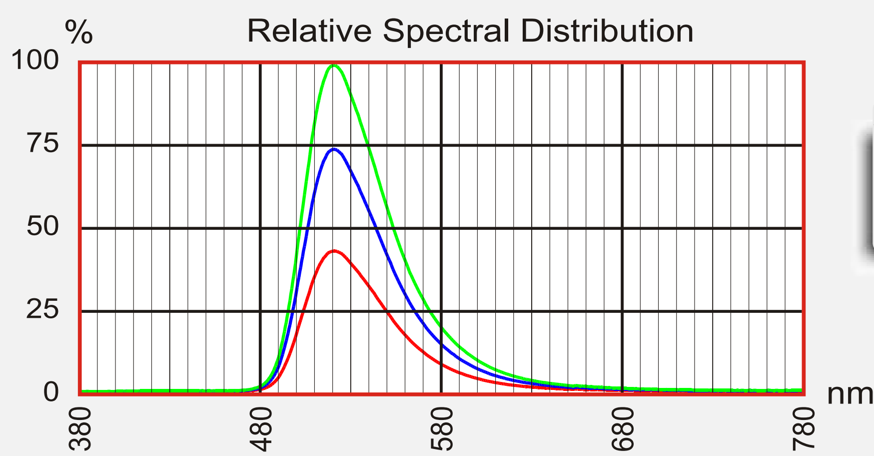
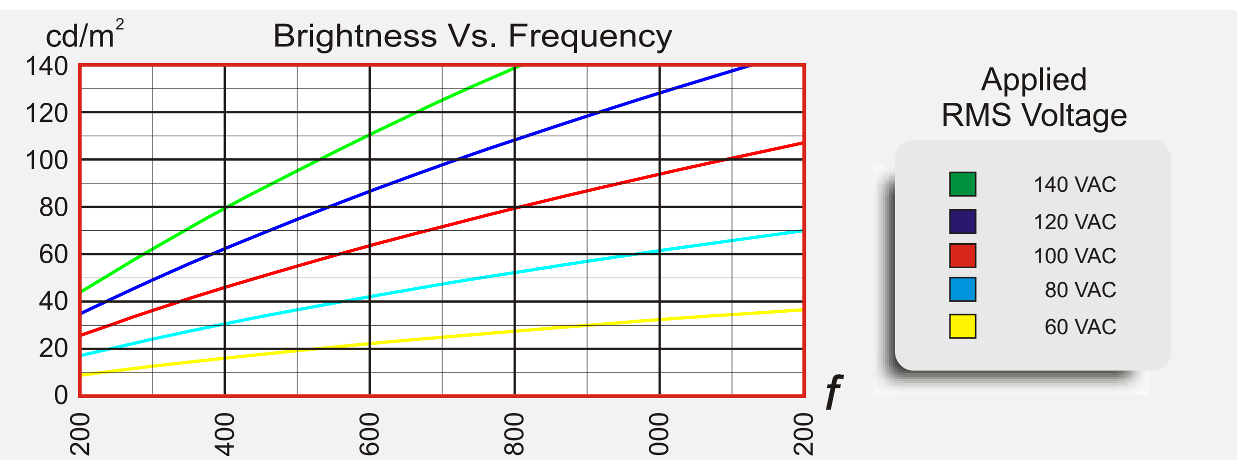
PHOTOMETRIC DATA
COLOR: 1706
Lime Green



Peak Wavelength

	freq.	nm_{max}
(green)	1200 Hz.	521
(blue)	800 Hz.	521
(red)	400 Hz.	521

measured at 100 VAC



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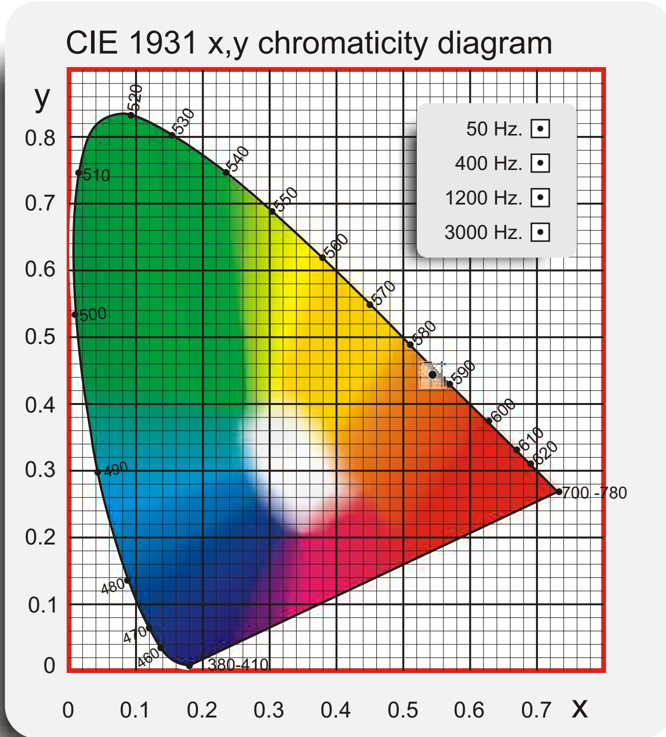

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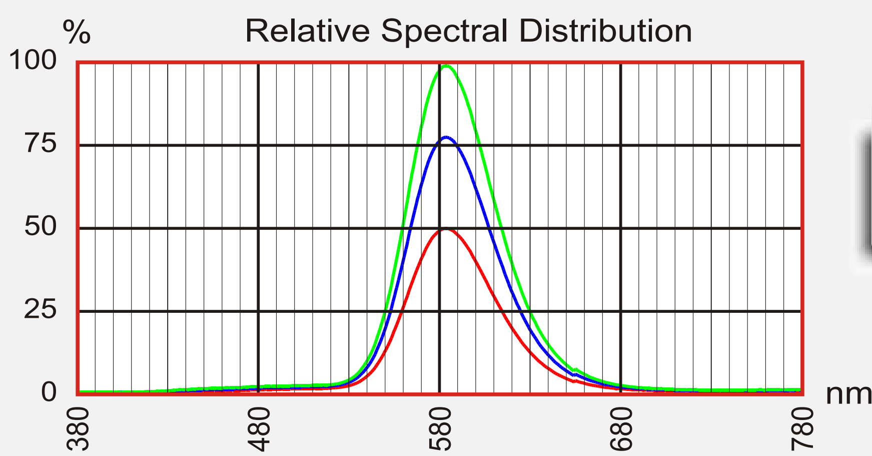
PHOTOMETRIC DATA

COLOR: 1720

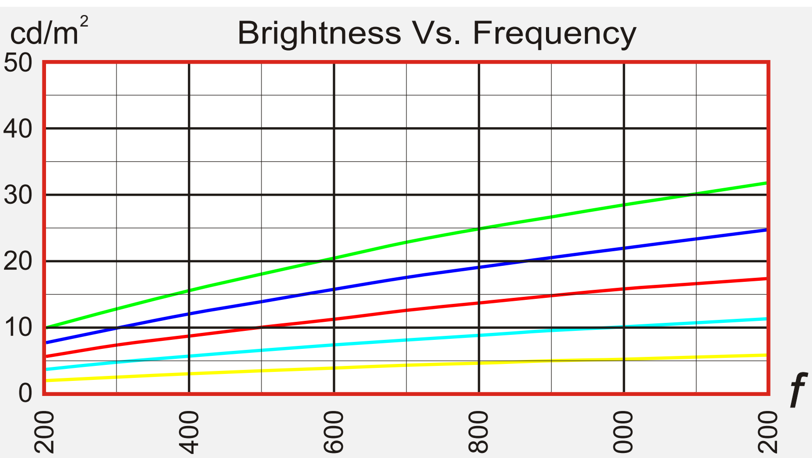
Amber



Peak Wavelength

	freq.	nm_{max}
Green	1200 Hz.	583
Blue	800 Hz.	583
Red	400 Hz.	583

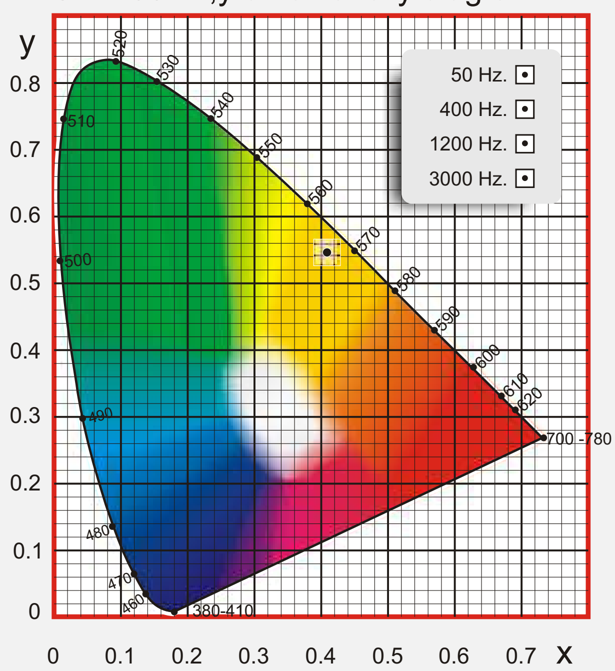
measured at 100 VAC



Applied RMS Voltage

- 140 VAC
- 120 VAC
- 100 VAC
- 80 VAC
- 60 VAC

CIE 1931 x,y chromaticity diagram



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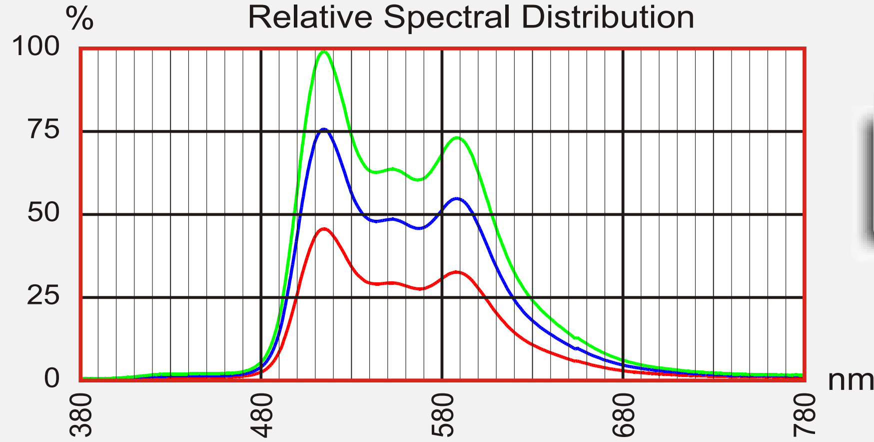
PHOTOMETRIC DATA
COLOR: 1725
Dye Conversion Yellow

Relative Spectral Distribution

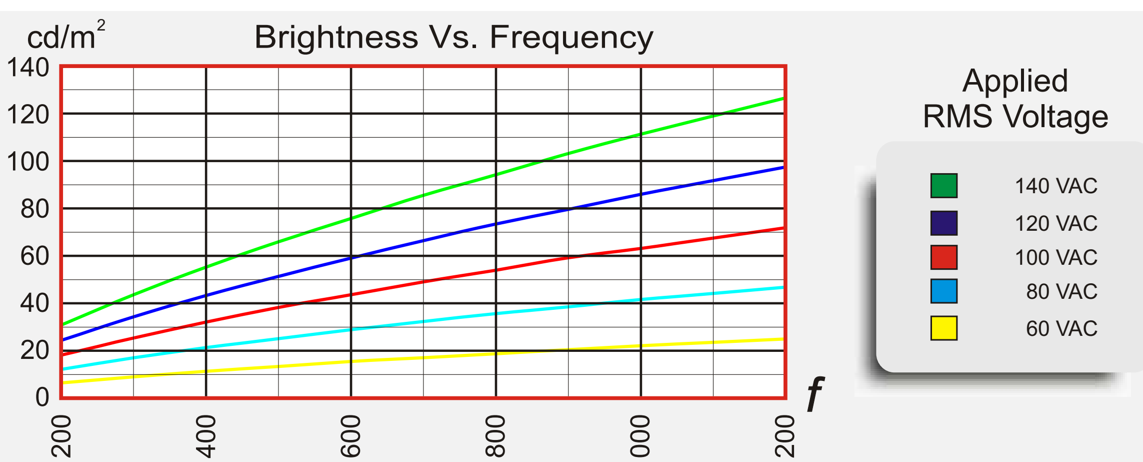


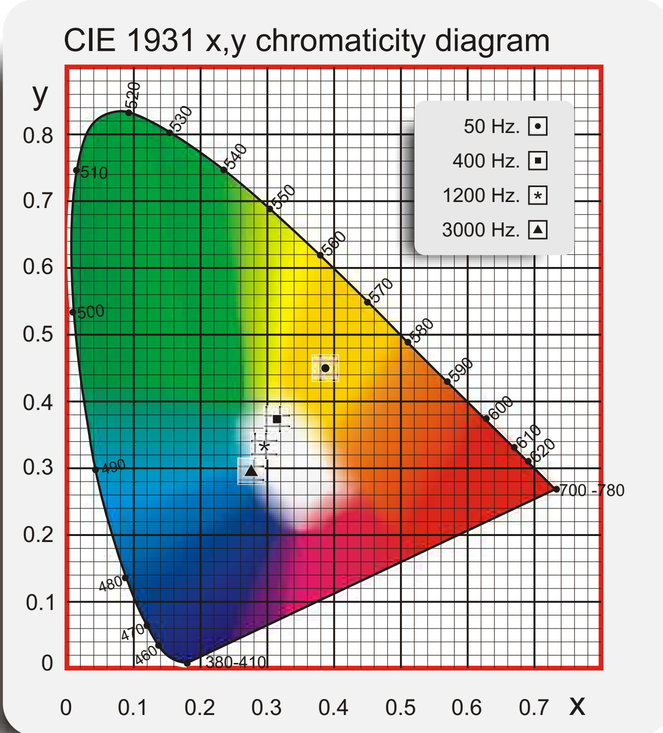
Peak Wavelength

	freq.	nm_{max}
■ (green)	1200 Hz.	514, 588
■ (blue)	800 Hz.	514, 588
■ (red)	400 Hz.	514, 588

measured at 100 VAC

Brightness Vs. Frequency





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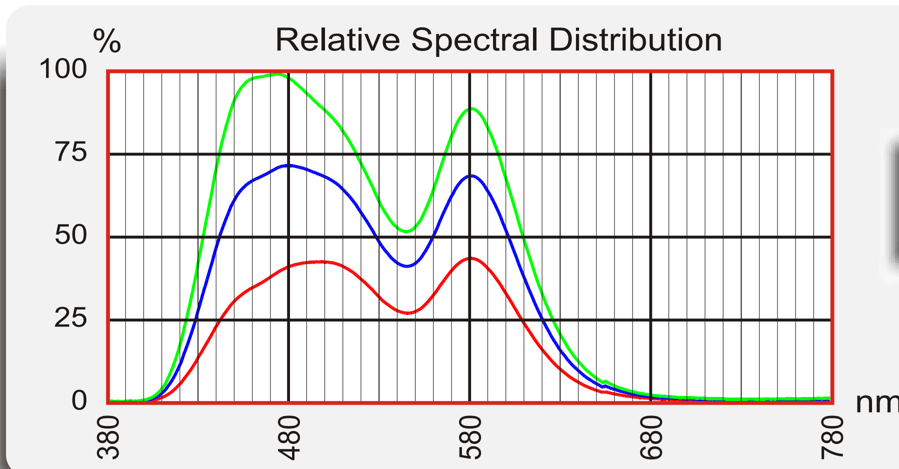
PHOTOMETRIC DATA

COLOR: 1741

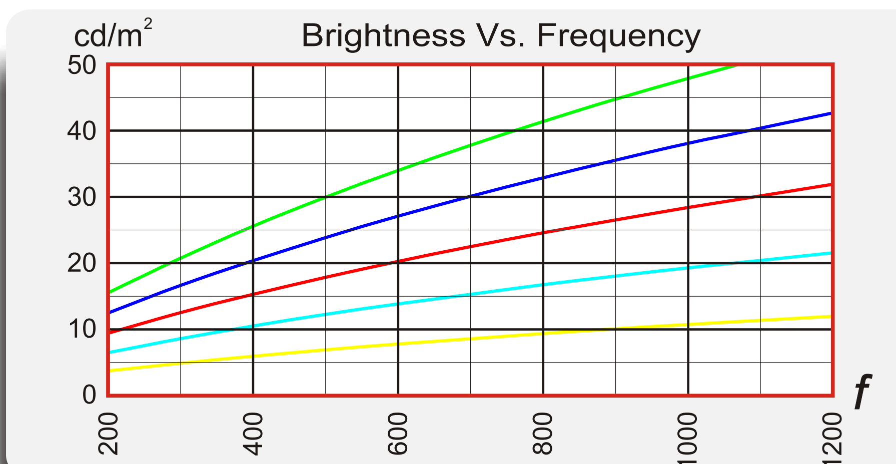
Phosphor White



Peak Wavelength

	freq.	nm_{max}
■ (green)	1200 Hz.	473, 580
■ (blue)	800 Hz.	480, 580
■ (red)	400 Hz.	497, 580

measured at 100 VAC



Applied
RMS Voltage

- 140 VAC
- 120 VAC
- 100 VAC
- 80 VAC
- 60 VAC

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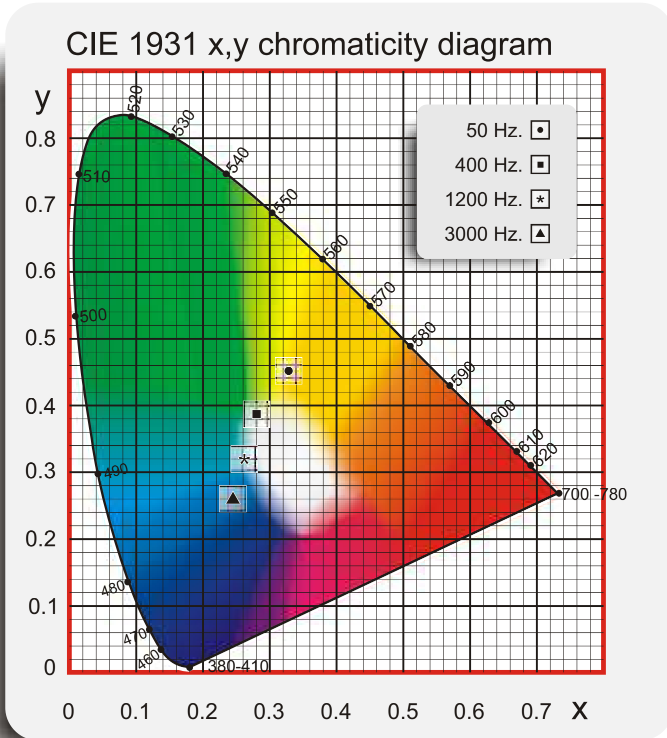
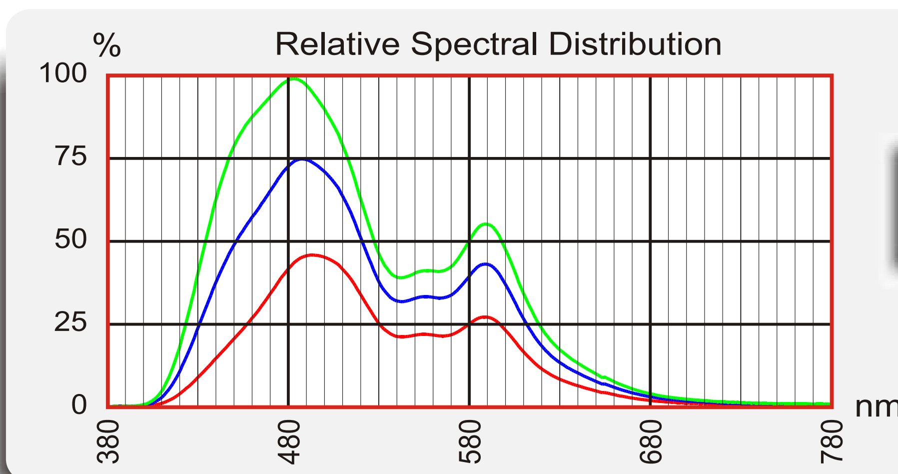
PHOTOMETRIC DATA
COLOR: 1755
Dye Conversion White

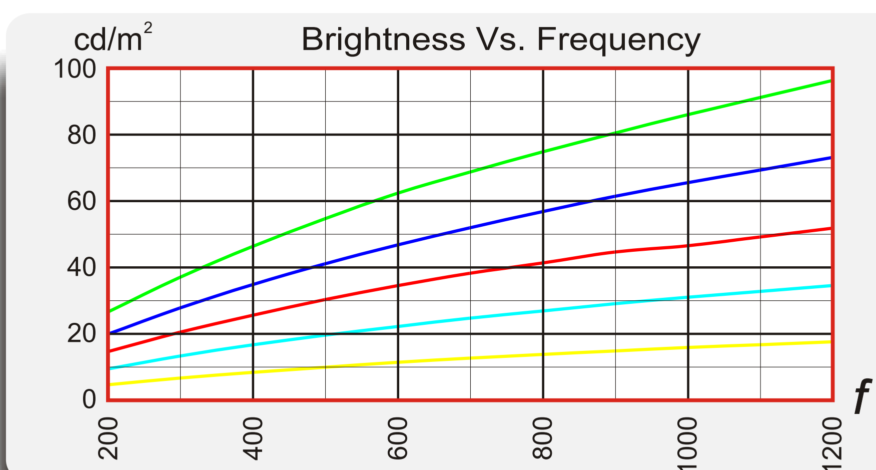




Peak Wavelength

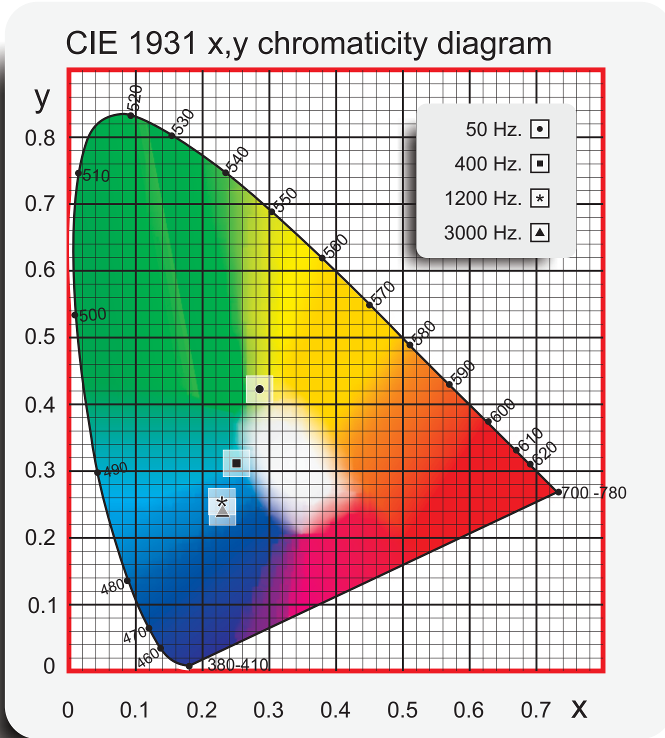
	freq.	nm$_{max}$
(green)	1200 Hz.	483, 589
(blue)	800 Hz.	488, 589
(red)	400 Hz.	493, 589

measured at 100 VAC



Applied RMS Voltage

- 140 VAC
- 120 VAC
- 100 VAC
- 80 VAC
- 60 VAC



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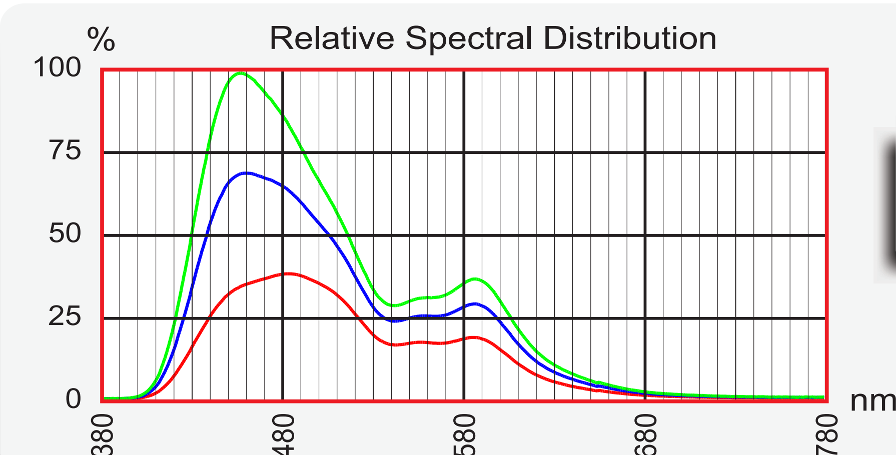
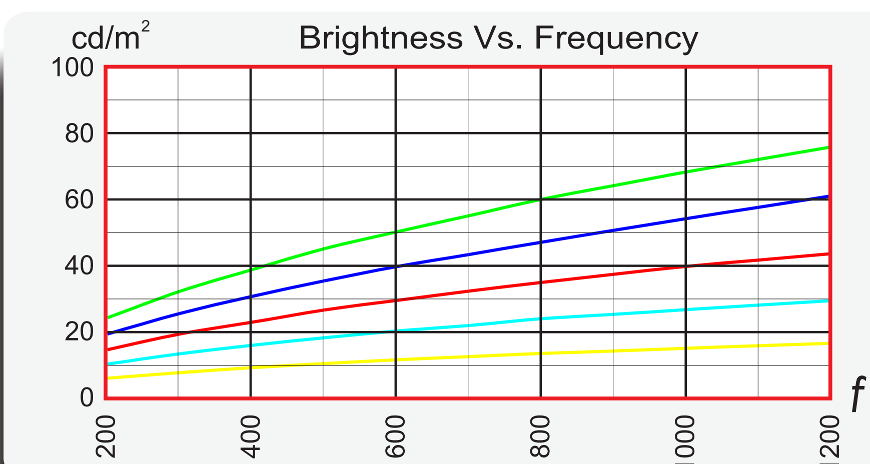
PHOTOMETRIC DATA
COLOR: 1757
Blue White



Peak Wavelength

	freq.	nm_{max}
(green)	1200 Hz.	482, 586
(blue)	800 Hz.	460, 586
(red)	400 Hz.	456, 586

measured at 100 VAC



Applied RMS Voltage

- 140 VAC (green)
- 120 VAC (blue)
- 100 VAC (red)
- 80 VAC (cyan)
- 60 VAC (yellow)

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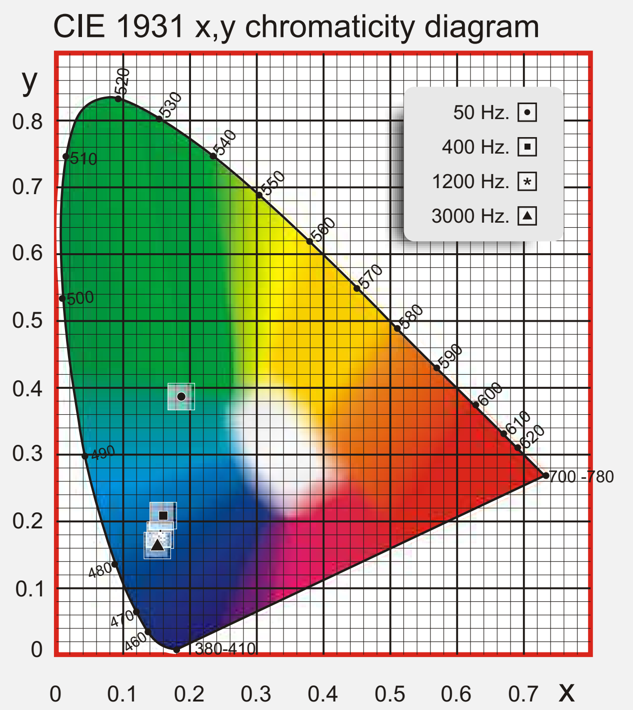
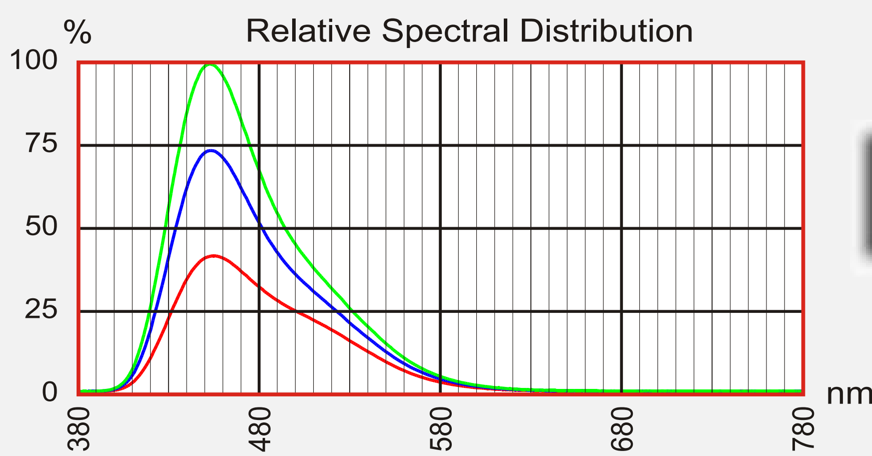


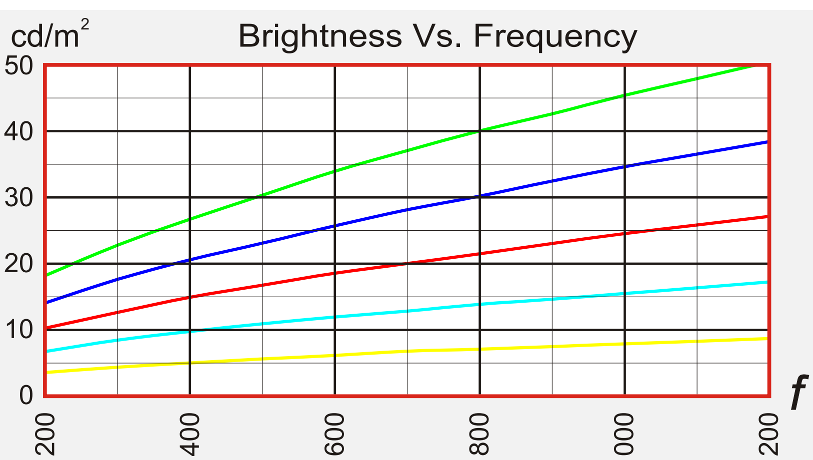
PHOTOMETRIC DATA
COLOR: 1760
Deep Blue



Peak Wavelength

	freq.	nm_{max}
(green)	1200 Hz.	452
(blue)	800 Hz.	453
(red)	400 Hz.	455

measured at 100 VAC



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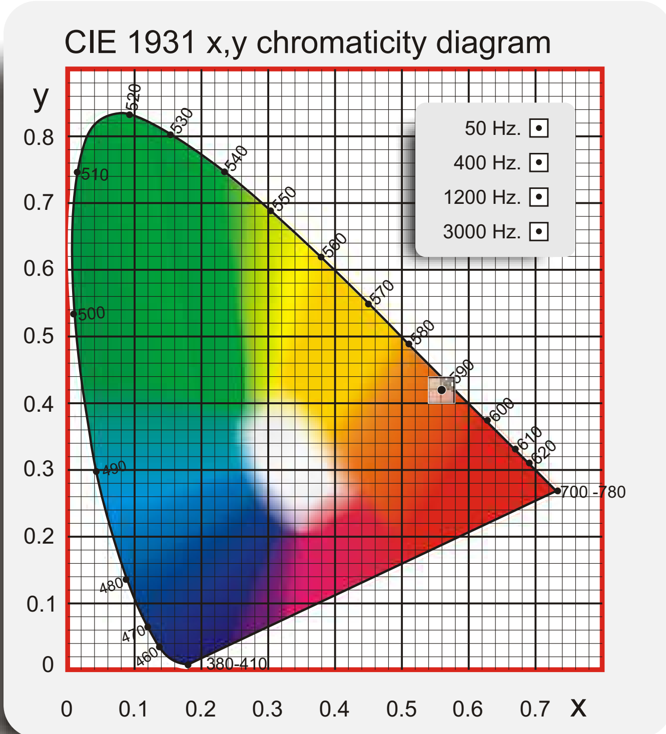
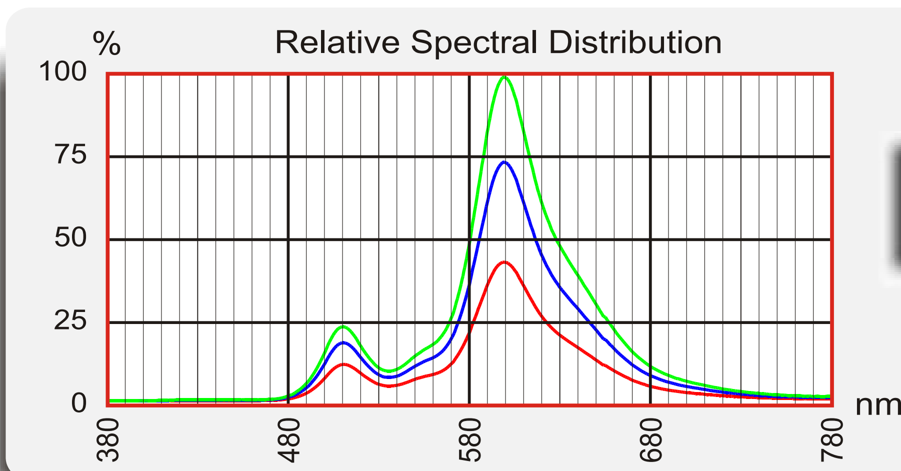
PHOTOMETRIC DATA
COLOR: 1785
Dye Conversion Orange

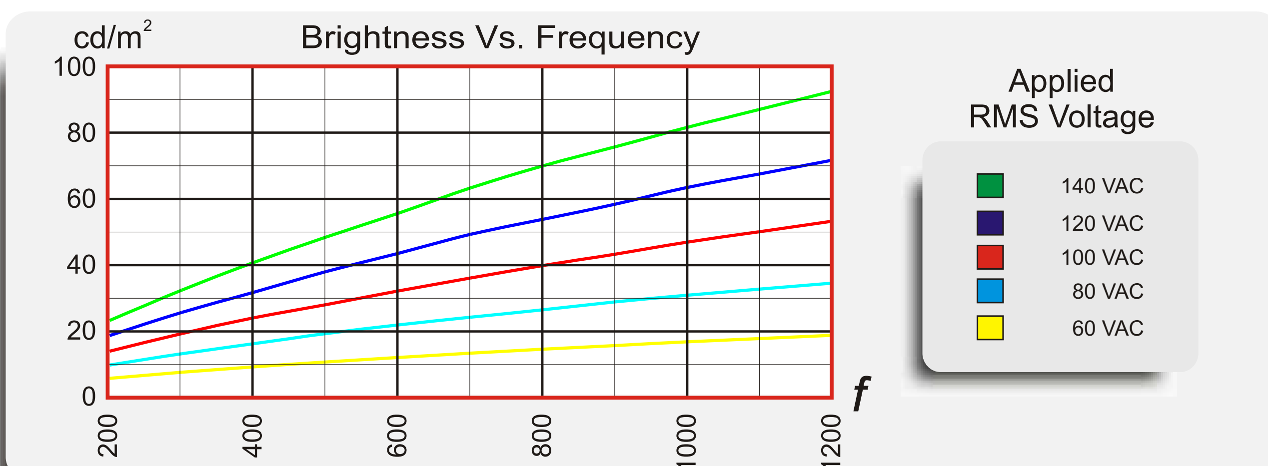




Peak Wavelength

	freq.	nm_{max}
■ (green)	1200 Hz.	599, 510
■ (blue)	800 Hz.	599, 510
■ (red)	400 Hz.	599, 510

measured at 100 VAC



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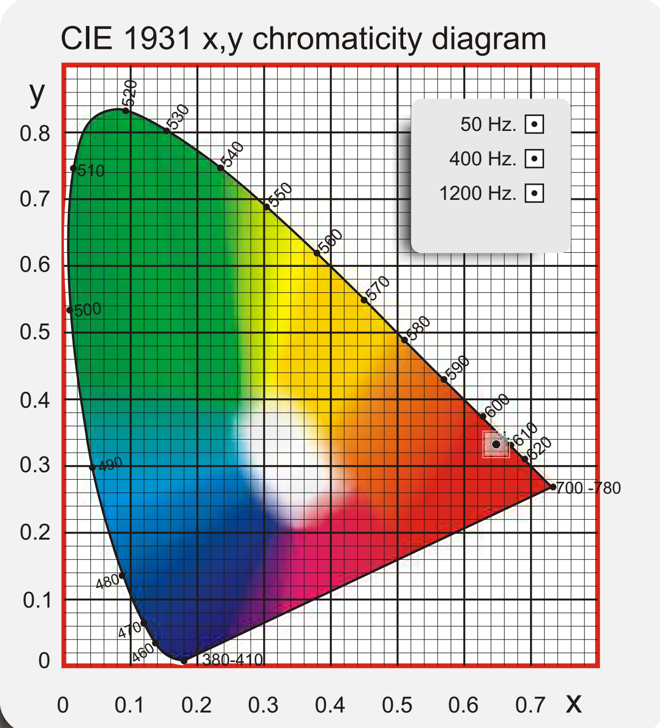

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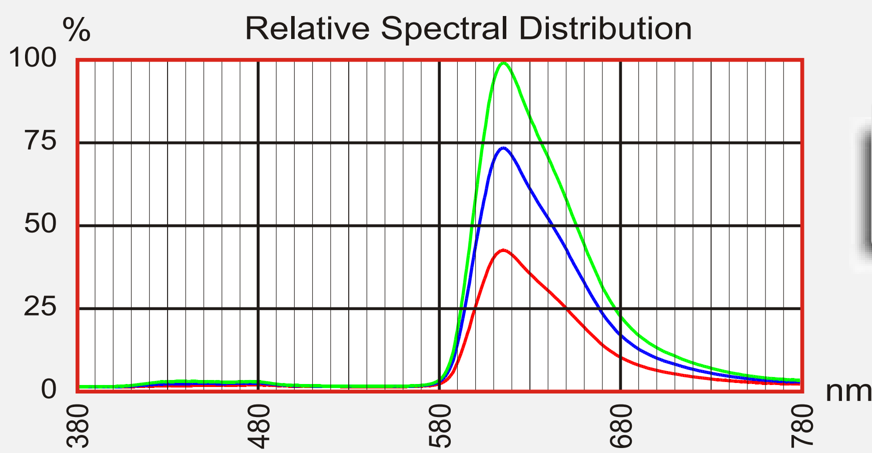
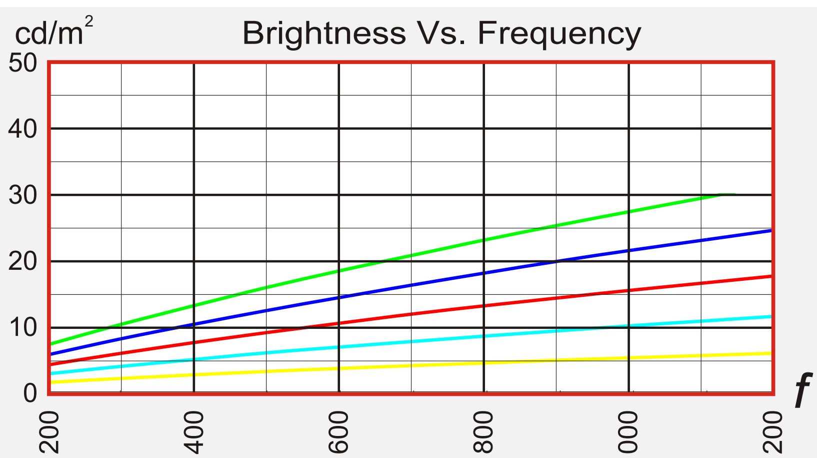
PHOTOMETRIC DATA
COLOR: 1790
Red



Peak Wavelength

	freq.	nm_{max}
green	1200 Hz.	615
blue	800 Hz.	615
red	400 Hz.	615

measured at 100 VAC



Applied RMS Voltage

- green: 140 VAC
- blue: 120 VAC
- red: 100 VAC
- light blue: 80 VAC
- yellow: 60 VAC