Light Emitting Diode Drivers Selection Guide

Pages 506-523

ITEM#	WAVELENGTH	POWER	VIEWING HALF ANGLE	PACKAGE	PAGE
LED341W	340nm	0.35mW	7.5°	TO-39	507
LED370E	375nm	2.5mW	19°	T-1 3/4	507
LED405E	405nm	6mW	5°	T-1 3/4	507
LEDC2	455nm	239.85mW	-	Leica DMI Microscope	508
LEDC3	455nm	323.94mW	-	Nikon Eclipse Microscope	508
LEDC4	455nm	339.19mW	-	Zeiss Axioskop Microscope	508
LEDC1	455nm	438mW	-	Olympus BX & IX Microscopes	508
MRMLED	455nm	730mW	75°	SM1	508
LED470E	470nm	8.5mW	7.5°	T-1 3/4	509
LEDC6	470nm	205.35mW	-	Leica DMI Microscope	509
LEDC7	470nm	277.35mW	-	Nikon Eclipse Microscope	509
LEDC8	470nm	290.4mW	-	Zeiss Axioskop Microscope	509
LEDC5	470nm	375mW	-	Olympus BX & IX Microscopes	509
MBLED	470nm	625mW	75°	SM1	510
LEDC10	505nm	138mW	-	Leica DMI Microscope	510
LEDC11	505nm	186.38mW	-	Nikon Eclipse Microscope	510
LEDC12	505nm	195.15mW	-	Zeiss Axioskop Microscope	510
LEDC9	505nm	252mW	-	Olympus BX & IX Microscopes	510
MCLED	505nm	420mW	-	SM1	511
LED521M	525nm	2mW	55°	TO-18	512
LED525E	525nm	2.6mW	7.5°	T-1 3/4	512
LEDC14	530nm	90.35mW	-	Leica DMI Microscope	512
LEDC15	530nm	122.03mW	-	Nikon Eclipse Microscope	512
LEDC16	530nm	127.78mW	-	Zeiss Axioskop Microscopex	512
LEDC13	530nm	165mW	-	Olympus BX & IX Microscopes	512
MGLED	530nm	275mW	75°	SM1	512
LED528E	535nm	1.5mW	10°	T-1 3/4	513
LEDRGBE	540nm	6.2mW	12.5°	T-1 3/4	513
LEDC18	540nm	164.28mW	-	Leica DMI Microscope	514
LEDC19	540nm	221.88mW	-	Nikon Eclipse Microscope	514
LEDC20	540nm	232.32mW	-	Zeiss Axioskop Microscope	514
LEDC17	540nm	300mW	-	Olympus BX & IX Microscopes	514
MWLED	540nm	500mW	75°	SM1	514
LEDWE-15	white	1mW	7.5°	T-1 3/4	515
LEDWE-10	white	2.6mW	10°	T-1 3/4	515
LEDWE-50	white	3.7mW	25°	T-1 3/4	515
LED591E	590nm	2mW	10°	T-1 3/4	516
LED631E	635nm	4mW	10°	T-1 3/4	516
LED630E	639nm	7.2mW	7.5°	T-1 3/4	516
LED661L	655nm	1.7mW	6°	TO-18	517
LED661W	670nm	0.45mW	15°	TO-18	517
LED781W	780nm	6mW	55°	TO-18	517
LED780E	780nm	18mW	10°	T-1 3/4	518
LED851W	850nm	8mW	10°	TO-18	518
LED851L	850nm	18mW	10°	TO-18	518
LED870E	870nm	22mW	10°	T-1 3/4	519
LED940E	940nm	18mW	10°	T-1 3/4	519
LED1050E	1050nm	2.5mW	15°	T-1 3/4	520
LED1200E	1200nm	2.5mW	15°	T-1 3/4	520
LED1300E	1300nm	2mW	15°	T-1 3/4	520
LED1450E	1450nm	2mW	15°	T-1 3/4	520
LED1550E	1550nm	2mW	15°	T-1 3/4	521
LED1650P	1650nm	0.9mW	<10°	TO-18R	521
LED2050P	2050nm	1.1mW	<10°	TO-18R	521
LED3100P	3100nm	14μW	<10°	TO-18R	521
LED4600P	4500nm	6μW	<10°	TO-18R	521

Light Emitting Diode Technologies

Radiometric vs. Photometric Units

For many applications, light emitting diodes (LEDs) provide a low cost, reliable alternative to traditional light sources such as the incandescent light bulb, halogen bulbs, or arc lamps. Applications involving these former light sources gave rise to photometric measures for power, brightness, etc. Since Thorlabs typically provides radiometric specifications for our laser diodes, this overview is to serve as the bridge between the two regimes.

Depending on the LED, the specifications might be given using any of the following radiometric quantities: power (also called radiant flux and measured in watts (W)), irradiance (measured in W/m^2), radiant intensity (measured in watts per steradian (W/sr)), and radiance (measured in $W/m^2 \cdot sr$). The corresponding photometric quantities, which are listed in the table below, are based on the SI unit for luminous intensity, the candela (cd). Values reported in candelas are weighted by a spectral luminous efficiency function, which represents the human eye's sensitivity to the light at a given wavelength. Hence, candelas are a photometric unit, thereby giving information about the perceived brightness of a source; in contrast, power, irradiance, radiant intensity, and radiance are radiometric units, thus providing information about the absolute brightness of a source.

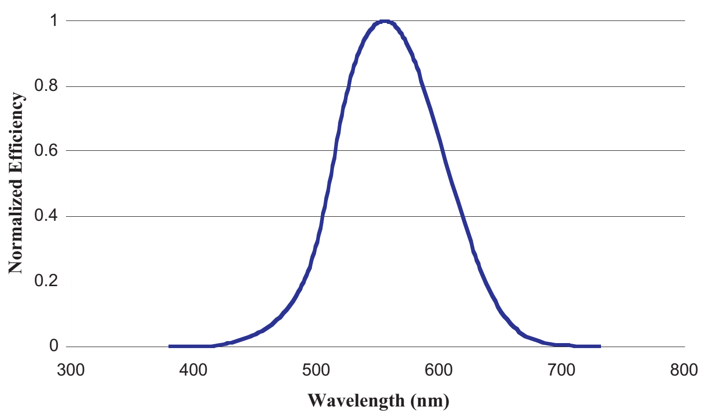
Based on the candela, three other photometric quantities are also commonly used to specify power measurements for LEDs: luminance (measured in cd/m^2, which is also sometimes referred to as a Nit), luminous flux (whose SI unit is the lumen (lm)), and illuminance (whose SI unit is the lux (lx)). Therefore, each radiometric quantity has a photometric counterpart, which is weighted by the spectral response of the human eye.

To convert between radiometric and photometric units, one needs to know the photopic spectral luminous efficiency curve V(λ), which gives the spectral response of the human eye to various wavelengths of light. The original curve, which is shown below, was adopted by the Commission on Illumination (CIE) as the standard in 1924 and is still used today even though modifications have been suggested.

QUANTITY	RADIOMETRIC	PHOTOMETRIC
Power	W	Lumen (lm) = cd·sr
Power Per Unit Area	W/m^2	Lux (lx) = $cd \cdot sr/m^2 = lm/m^2$
Power Per Unit Solid Angle	W/sr	Candela (cd)
Power Per Unit Area Per Unit Solid Angle	$W/m^2 \cdot sr$	$cd/m^2 = lm/m^2 \cdot sr$ = nit

Empirical data shows that the curve has a maximum value of unity at 555nm, which is the wavelength of light at which the human eye is most sensitive, and trails off to levels below 10^{-5} for wavelengths below 370nm and above 780nm.

Photopic Spectral Luminous Efficiency Curve



A non-linear regression fit to the experimental data yields the approximation,

$$V(\lambda) = 1.019e^{-285.4(\lambda - 0.559)^2},$$

where the wavelength is in micrometers.

According to the definition for a candela, there are 683 lumens per watt for 555nm light that is propagating in a vacuum. Hence, for a monochromatic light source, it is fairly simple to convert from watts to lumens; simply multiply the power in watts by the appropriate V(λ) value, and use the conversion factor from the definition for a candela.

For example, the photometric power of a 5mW red (λ = 650nm) laser pointer, which corresponds to V(λ) = 0.096, is 0.096 x 0.005W x 683lm/W = 0.33lm, whereas the value for a 5mW green (λ = 532nm) laser pointer is 0.828 x 0.005W x 683lm/W = 2.83lm. Thus, although both laser pointers have the exact same radiant flux, the green laser pointer will appear approximately 8.5 times brighter than the red one assuming both have the same beam diameter.

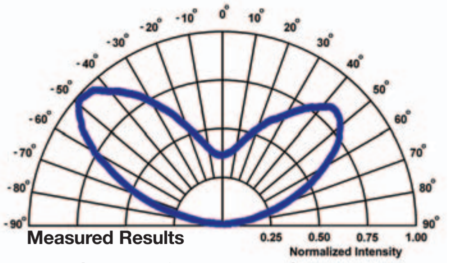
Conversion from radiometric to photometric units becomes more complex if the light source is not monochromatic. In this case, the mathematical quantity of interest is

$$\Phi_V = K_m \int_{\lambda=380}^{\lambda=830} \Phi_E(\lambda) V(\lambda) \delta\lambda$$

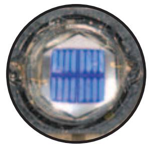
where Φv is the luminous flux in lumens, Km is a scaling factor equal to 683 lumens per watt, $\Phi_E(\lambda)$ is the spectral power in watts per nanometer, and V(λ) is the photopic spectral luminous efficiency function. Note that the integration is only carried out over the wavelengths for which V(λ) is non-zero (i.e. λ = 380 - 830nm). Since V(λ) is given by a table of empirical values, it is best to do the integration numerically.

Light Emitting Diode Technologies

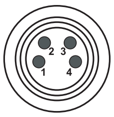
λ = 470nm P = 625mW, Mounted LED



- Uncollimated, Lambertian Radiation Pattern
- High-Power LED, 625mW
- Mounted on Heat Sink
- Internal SM1 Lens Tube Compatible Threading
- Average Lifetime: 100,000 Hours



16 Emitters



Pin	Description
1	LED +ve
2	LED -ve
3	Not Connected
4	Not Connected

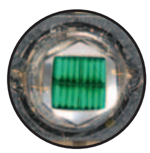
Characteristics (T_c=25°C, I=700mA)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.
Peak Wavelength	λ_p	450nm	470nm	500nm
Output Power	P	–	–	625mW
Spectral Half Width	HW	–	25nm	–
Operation Voltage	V_{op}	5.43V	6.84V	8.31V
DC Forward Current	I_{fw}	–	–	700mA
Peak Pulsed Forward Current	$I_{fw\text{-}pls}$	–	–	1000mA
Temperature Coefficient of Dominant Wavelength	$\Delta\lambda_o/\Delta T_j$	–	0.04nm/°C	–
Viewing Half Angle	$\theta_{1/2}$	–	75°	–
Dynamic Resistance	R_D	–	1.0	–
Operating Temperature	T_{op}	-40°C	–	120°C
Storage Temperature	T_{st}	-40°C	–	120°C

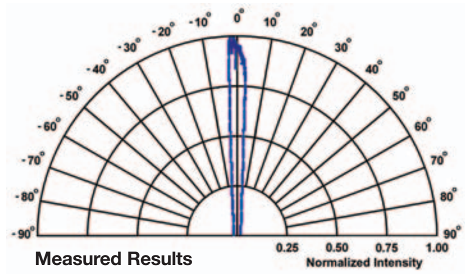
ITEM#	$	£	€	RMB	DESCRIPTION
MBLED	$ 127.50	£ 80.30	€ 118,60	¥ 1,217.60	470nm, 625mW, SM1-Mounted LED
LEDD1	$ 249.00	£ 156.90	€ 231,60	¥ 2,378.00	T-Cube LED Driver

λ = 505nm, P >138mW Collimated LEDs

LEDC12
Shown



16 Emitters

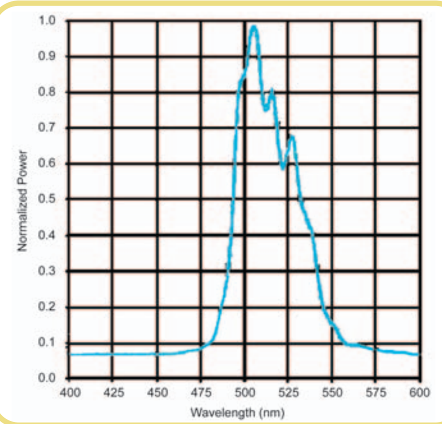


- Closely Collimated Beam
- High Power Density
- Designed to Integrate Into Standard Microscopes
- High-Power (up to 252mW)
- Average Lifetime: 100,000 Hours

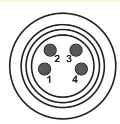
LEDD1
See Page 525 For Details

Characteristics (T_c=25°C, I=700mA)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.
Wavelength	λ_p	485nm	505nm	550nm
Spectral Half Width	HW	–	30nm	–
Operation Voltage	V_{op}	5.43V	6.84V	8.31V
DC Forward Current	I_{fw}	–	–	700mA
Peak Pulsed Forward Current	$I_{fw\text{-}pls}$	–	–	1000mA
Temperature Coefficient of Dominant Wavelength	$\Delta\lambda_o/\Delta T_j$	–	0.04nm/°C	–
Dynamic Resistance	R_D	–	1.0	–
Operating Temperature	T_{op}	-40°C	–	120°C
Storage Temperature	T_{st}	-40°C	–	120°C



ITEM#	MICROSCOPE	POWER IN BEAM	BEAM DIAMETER	BEAM AREA
LEDC9	Olympus BX/IX	252mW	50mm	1960mm²
LEDC10	Leica DMI	138mW	37mm	1080mm²
LEDC11	Nikon F Mount	186mW	43mm	1450mm²
LEDC12	Zeiss Axioskop	195mW	44mm	1520mm²



Pin	Description
1	LED +ve
2	LED -ve
3	Not Connected
4	Not Connected

ITEM#	$	£	€	RMB	DESCRIPTION
LEDC9	$ 331.50	£ 208.80	€ 308,30	¥ 3,165.80	Collimated Cyan LED (505nm) for Olympus BX & IX Microscopes
LEDC10	$ 331.50	£ 208.80	€ 308,30	¥ 3,165.80	Collimated Cyan (505nm) LED for Leica DMI Microscopes
LEDC11	$ 374.00	£ 235.60	€ 347,80	¥ 3,571.70	Collimated Cyan (505nm) LED for Nikon Eclipse (F Mount) Microscopes
LEDC12	$ 331.50	£ 208.80	€ 308,30	¥ 3,165.80	Collimated Cyan (505nm) LED for Zeiss Axioskop Microscopes
LEDD1	$ 249.00	£ 156.90	€ 231,60	¥ 2,378.00	T-Cube LED Driver