

## M660F1 - May 15, 2019

Item # M660F1 was discontinued on May 15, 2019. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

### FIBER-COUPLED LEDs

- ▶ UV, Visible, and NIR Versions
- ▶ Optimized Heat Management Results in Stable Output
- ▶ Integrated Chip Stores LED Operating Parameters
- ▶ Accepts SMA Fiber Connector

**M625F2**  
625 nm Fiber-Coupled LED



Large Heat Sink for  
Optimized Heat Dissipation



**M385FP1**  
385 nm Fiber-Coupled LED

## Features

- Nominal Wavelengths Ranging from 285 nm to 1050 nm
- Warm White (4000 K), Cold White (6200 K), and Broadband (470 - 850 nm) LEDs Also Available
- Integrated Identification Chip (EEPROM) Stores LED Operating Parameters
- Optimized Thermal Properties Lead to Stable Output Power
- SMA Bulkheads are Ideal for use with Multimode Fiber Optic Patch Cables
- Versions with FC/PC Bulkheads Available Upon Request; Contact Tech Support for Details

Each fiber-coupled LED consists of a single LED that is coupled to the optical fiber using the butt-coupling technique. During this process, the fiber connector is positioned so that the end of the fiber will be as close as possible to the emitter, thereby minimizing losses at the fiber input and maximizing output power. The coupling efficiency is primarily dependent on the core diameter and the numerical aperture (NA) of the connected fiber. Larger core diameters and higher NA values give rise to reduced losses and increased output power at the end of the fiber. Additionally, high-OH content or solarization-resistant fibers are recommended for use with LED wavelengths below 400 nm (please refer to the table below for recommended patch cables).

The spectrum of each LED and associated data file can be viewed by clicking on the links in the table to the right. Multiple windows can be opened simultaneously in order to compare LEDs.

### Optimized Thermal Management

These fiber-coupled LEDs possess good thermal stability properties. The 34 mm long, passively-cooled heat sink used in most of our fiber-coupled LEDs is in direct contact with the metal-core circuit board on which the LED is mounted. This minimizes the degradation of optical output power caused by increased LED junction temperature. Some of our fiber-coupled LEDs with a higher power output (M365FP1, M385FP1, and M405FP1) are mounted to a 50 mm long heat sink for increased heat dissipation and thermal stability.

### White Light and Broadband LED

Our cold white and warm white LEDs feature broad spectra that span several hundred nanometers. The difference in appearance between these two LEDs can be described using the correlated color temperature, which indicates that the LEDs color appearance is similar to a black body radiator

Legend				
LED Mounted to a 50 mm Long Heat Sink			LED Mounted to a 34 mm Long Heat Sink	
Item #	Color (Click for Spectrum) <sup>a</sup>	Nominal Wavelength <sup>a,b</sup>	Ø200 µm Core Fiber Output (Typ.) <sup>c</sup>	Ø400 µm Core Fiber Output (Typ.) <sup>d</sup>
M285F4 <sup>e</sup>	Deep UV	285 nm	160 µW	590 µW
M300F2 <sup>e</sup>	Deep UV	300 nm	110 µW	320 µW
M340F3 <sup>e</sup>	Deep UV	340 nm	0.28 mW	1.06 mW
M365F1 <sup>e</sup>	UV	365 nm	1.0 mW	4.1 mW
M365FP1 <sup>e</sup>	UV	365 nm	5.29 mW	15.5 mW
M375F2 <sup>e</sup>	UV	375 nm	1.57 mW	4.23 mW
M385F1 <sup>e</sup>	UV	385 nm	2.68 mW	10.7 mW
M385FP1 <sup>e</sup>	UV	385 nm	7.7 mW	23.2 mW
M395F3 <sup>e</sup>	UV	395 nm	1.91 mW	6.8 mW
M405F1 <sup>e</sup>	UV	405 nm	0.93 mW	3.7 mW
M405FP1 <sup>e</sup>	UV	405 nm	7.7 mW	24.3 mW
M415F3 <sup>e</sup>	Violet	415 nm	7.0 mW	21.3 mW
M455F1	Royal Blue	455 nm	2.75 mW	11.0 mW
M455F3	Royal Blue	455 nm	5.4 mW	24.5 mW
M470F3	Blue	470 nm	7.0 mW	21.8 mW
M490F3	Blue	490 nm	0.97 mW	3.1 mW
M505F3	Cyan	505 nm	3.7 mW	11.7 mW
M530F2	Green	530 nm	3.2 mW	9.6 mW
MINTF4	Mint	554 nm	8.5 mW	28 mW
M565F3 <sup>f</sup>	Lime	565 nm	4.4 mW	13.5 mW
M590F2	Amber	590 nm	0.68 mW	2.73 mW
M590F3	Amber	590 nm	1.5 mW	4.6 mW
M595F2 <sup>f</sup>	Amber	595 nm	4.0 mW	11.5 mW
M617F2	Orange	617 nm	4.4 mW	13.2 mW
M625F2	Red	625 nm	5.7 mW	17.5 mW
M660F1	Deep Red	660 nm	3.63 mW	14.5 mW
M680F3	Deep Red	680 nm	0.7 mW	2.7 mW
M700F3	Deep Red	700 nm	0.4 mW	1.7 mW
M740F2	Far Red	740 nm	2.1 mW	6.0 mW
M780F2	IR	780 nm	1.15 mW	7.5 mW
M810F2	IR	810 nm	2.31 mW	6.5 mW
M850F2	IR	850 nm	3.35 mW	13.4 mW
M880F2	IR	880 nm	0.58 mW	3.4 mW
M940F1	IR	940 nm	1.6 mW	6.5 mW
M940F3	IR	940 nm	4.2 mW	14.2 mW
M970F3	IR	970 nm	2.4 mW	8.1 mW
M1050F1	IR	1050 nm	0.35 mW	1.4 mW
M1050F3	IR	1050 nm	0.92 mW	3.0 mW
MBB1F1 <sup>g</sup>	Broadband	470 - 850 nm <sup>h</sup>	0.30 mW	1.2 mW
MWWHF2 <sup>i</sup>	Warm White	4000 K <sup>j</sup>	7.9 mW	23.1 mW
MCWHF2 <sup>l</sup>	Cold White	6200 K <sup>j</sup>	8.8 mW	27.0 mW

<sup>a</sup>. Due to variations in the manufacturing process and operating parameters such as temperature and current, the actual spectral output of any given LED will vary. Output plots and nominal

at that temperature. In general, warm white LEDs offer a spectrum similar to a tungsten source, while cold white LEDs have a stronger blue component to the spectrum. Cold white LEDs are more suited for fluorescence microscopy applications or cameras with white balancing, because of a higher intensity at most wavelengths compared to warm white LEDs.

The MBB1F1 fiber-coupled LED has been designed to have relatively flat spectral emission over a wide wavelength range. Its FWHM bandwidth ranges from 500 nm to 780 nm, while the 10 dB bandwidth ranges between 470 nm and 850 nm. For more information on the spectrum of this broadband source, please see the table to the right.

#### Driver Options

Each LED is equipped with an integrated EEPROM (read-only memory) chip storing information about the LED (e.g., current limit, wavelength, and forward voltage) that can be read by Thorlabs' DC2200, DC4100, and DC4104 Controllers (the latter two require the DC4100-HUB). These drivers can automatically adjust the maximum current setting based on the information stored in the EEPROM chip to protect the connected LED. The DC4100 and DC4104 can modulate the LED at a rate up to 100 kHz while the DC2200 can provide modulation at up to 250 kHz if driven by an external source. A fourth driver, the LEDD1B, is capable of providing LED modulation frequencies up to 5 kHz, but is not capable of reading information from the EEPROM chip. For more information about all of these LED drivers, see the *LED Drivers* tab.

#### Optogenetics Applications

Our fiber-coupled LEDs are ideal light sources for optogenetics applications. They feature a variety of wavelength choices and a convenient interconnection to optogenetics patch cables. Additionally, up to four different light sources can be driven and modulated simultaneously with our DC4100 controller and DC4100-HUB hub. [Click here](#) for our entire line of optogenetics products.

- wavelength specs are only intended to be used as a guideline.
- b. For LEDs with a visible spectrum, the nominal wavelength indicates the wavelength at which the LED appears brightest to the human eye. The nominal wavelength for visible LEDs may not correspond to the peak wavelength as measured by a spectrometer.
- c. All LEDs except the M285F4, M300F2 and M340F3 were tested using MM Fiber with Ø200 µm core, 0.22 NA (Item # FG200UCC); the M285F4, M300F2 and M340F3 were tested using Item # FG200AEA.
- d. All LEDs except the M285F4, M300F2 and M340F3 were tested using MM Fiber with Ø400 µm core, 0.39 NA (Item # FT400EMT); the M285F4, M300F2, and M340F3 were tested with 0.22 NA fiber (Item # FG400AEA).
- e. Our 285 to 420 nm LEDs radiate intense UV light during operation. Precautions must be taken to prevent looking directly at the UV light and UV light protective glasses must be worn to avoid eye damage. Exposure of the skin and other body parts to the UV light should be avoided.
- f. These LEDs are phosphor-converted and may not turn off completely when modulated above 10 kHz at duty cycles below 50%.
- g. The MBB1F1 LED may not turn off completely when modulated at frequencies above 1 kHz with a duty cycle of 50%, as the broadband emission is produced by optically stimulating emission from phosphor. For modulation at frequencies above 1 kHz, the duty cycle may be reduced. For example, 10 kHz modulation is attainable with a duty cycle of 5%.
- h. 10 dB Bandwidth.
- i. The MWWHF2 and MCWHF2 LEDs may not turn off completely when modulated at frequencies above 5 kHz, as the white light is produced by optically stimulating emission from phosphor.
- j. Correlated Color Temperature

Recommended Fiber Patch Cables	
LED Wavelength	Recommended Fiber
<350 nm	M113L01 (Ø400 µm, 0.22 NA, Solarization Resistant, SMA-SMA)
350 - 400 nm	Custom Patch Cable Using FT400UMT (Ø400 µm, 0.39 NA, High-OH, SMA-SMA)
400 nm - 700 nm	M28L01 (Ø400 µm, 0.39 NA, Low-OH, SMA-SMA) Custom Patch Cable Using FT400UMT (Ø400 µm, 0.39 NA, High-OH, SMA-SMA)
>700 nm	M28L01 (Ø400 µm, 0.39 NA, Low-OH, SMA-SMA)

**Legend**

LED Mounted to a 50 mm Long Heat Sink

LED Mounted to a 34 mm Long Heat Sink

Item #	Color (Click for Spectrum and Data) <sup>a</sup>	Nominal Wavelength <sup>a,b</sup>	Typical Ø200 µm Core Fiber Output Power <sup>c</sup>	Minimum Ø400 µm Core Fiber Output Power <sup>d</sup>	Typical Ø400 µm Core Fiber Output Power <sup>d</sup>	Maximum Current (CW)	Forward Voltage	Bandwidth (FWHM)	Typical Lifetime
M285F4 <sup>e</sup>	Deep UV	285 nm	160 µW	420 µW	590 µW	500 mA	5.9 V	13 nm	>10 000 h
M300F2 <sup>e</sup>	Deep UV	300 nm	110 µW	320 µW	370 µW	350 mA	8.0 V	15 nm	>10 000 h
M340F3 <sup>e</sup>	Deep UV	340 nm	0.28 mW	0.85 mW	1.06 mW	700 mA	4.6 V	11 nm	>3 000 h
M365F1 <sup>e</sup>	UV	365 nm	1.0 mW	3.0 mW	4.1 mW	700 mA	4.4 V	7.5 nm	>10 000 h
M365FP1 <sup>e</sup>	UV	365 nm	5.29 mW	9.8 mW	15.5 mW	1400 mA	3.75 V	9 nm	>10 000 h
M375F2 <sup>e</sup>	UV	375 nm	1.57 mW	3.2 mW	4.23 mW	500 mA	4.5 V	9 nm	>10 000 h
M385F1 <sup>e</sup>	UV	385 nm	2.68 mW	9.0 mW	10.7 mW	700 mA	4.3 V	10 nm	>10 000 h
M385FP1 <sup>e</sup>	UV	385 nm	7.7 mW	18 mW	23.2 mW	1400 mA	3.65 V	12 nm	>10 000 h
M395F3 <sup>e</sup>	UV	395 nm	1.91 mW	4.8 mW	6.8 mW	500 mA	4.5 V	16 nm	>10 000 h
M405F1 <sup>e</sup>	UV	405 nm	0.93 mW	3.0 mW	3.7 mW	500 mA	3.6 V	12 nm	>10 000 h
M405FP1 <sup>e</sup>	UV	405 nm	7.7 mW	19.3 mW	24.3 mW	1400 mA	3.45 V	12 nm	>10 000 h
M415F3 <sup>e</sup>	Violet	415 nm	7.0 mW	14.4 mW	21.3 mW	1500 mA	3.1 V	14 nm	>10 000 h
M455F1	Royal Blue	455 nm	2.75 mW	9.5 mW	11.0 mW	1000 mA	3.2 V	25 nm	>10 000 h
M455F3	Royal Blue	455 nm	5.4 mW	17 mW	24.5 mW	1000 mA	3.5 V	14 nm	>10 000 h
M470F3	Blue	470 nm	7 mW	17.2 mW	21.8 mW	1000 mA	3.1 V	20 nm	>50 000 h
M490F3	Blue	490 nm	0.97 mW	2.3 mW	3.1 mW	350 mA	3.8 V	26 nm	>10 000 h
M505F3	Cyan	505 nm	3.7 mW	8.5 mW	11.7 mW	1000 mA	3.7 V	25 nm	>10 000 h
M530F2	Green	530 nm	3.2 mW	6.8 mW	9.6 mW	1000 mA	3.1 V	30 nm	>50 000 h
MINTF4	Mint	554 nm	8.5 mW	21 mW	28 mW	1225 mA	3.5 V	-	>10 000 h
M565F3 <sup>f</sup>	Lime	565 nm	4.4 mW	9.9 mW	13.5 mW	700 mA	2.85 V	105 nm	>10 000 h
M590F2	Amber	590 nm	0.68 mW	1.85 mW	2.73 mW	1000 mA	2.8 V	15 nm	>50 000 h
M590F3	Amber	590 nm	1.5 mW	3.3 mW	4.6 mW	1000 mA	2.6 V	16 nm	>10 000 h
M595F2 <sup>f</sup>	Amber	595 nm	4.0 mW	8.7 mW	11.5 mW	1000 mA	3.1 V	80 nm	>50 000 h
M617F2	Orange	617 nm	4.4 mW	10.2 mW	13.2 mW	1000 mA	2.2 V	15 nm	>50 000 h
M625F2	Red	625 nm	5.7 mW	13.2 mW	17.5 mW	1000 mA	2.2 V	15 nm	>50 000 h
M660F1	Deep Red	660 nm	3.63 mW	13.0 mW	14.5 mW	1000 mA	2.15 V	25 nm	>50 000 h
M680F3	Deep Red	680 nm	0.7 mW	2.0 mW	2.7 mW	600 mA	2.5 V	22 nm	>10 000 h
M700F3	Deep Red	700 nm	0.4 mW	1.3 mW	1.7 mW	500 mA	2.7 V	20 nm	>10 000 h
M740F2	Far Red	740 nm	2.1 mW	4.1 mW	6.0 mW	800 mA	2.7 V	22 nm	>10 000 h
M780F2	IR	780 nm	1.15 mW	5.5 mW	7.5 mW	800 mA	2.1 V	28 nm	>10 000 h
M810F2	IR	810 nm	2.31 mW	4.9 mW	6.5 mW	500 mA	3.6 V	25 nm	>10 000 h
M850F2	IR	850 nm	3.35 mW	10.5 mW	13.4 mW	1000 mA	3.0 V	30 nm	>50 000 h
M880F2	IR	880 nm	0.58 mW	2.7 mW	3.4 mW	1000 mA	1.7 V	50 nm	>10 000 h
M940F1	IR	940 nm	1.6 mW	5.5 mW	6.5 mW	1000 mA	1.4 V	30 nm	>50 000 h
M940F3	IR	940 nm	4.2 mW	10 mW	14.2 mW	1000 mA	3.8 V	60 nm	>50 000 h
M970F3	IR	970 nm	2.4 mW	5.9 mW	8.1 mW	1000 mA	1.9 V	60 nm	>10 000 h
M1050F1	IR	1050 nm	0.35 mW	1.1 mW	1.4 mW	700 mA	1.5 V	60 nm	>10 000 h
M1050F3	IR	1050 nm	0.92 mW	2.3 mW	3.0 mW	600 mA	1.4 V	37 nm	>10 000 h
MBB1F1 <sup>g</sup>	Broadband	470 - 850 nm <sup>h</sup>	0.30 mW	0.8 mW	1.2 mW	500 mA	3.6 V	280 nm	>10 000 h
MWWHF2 <sup>i</sup>	Warm White	4000 K <sup>j</sup>	7.9 mW	16.3 mW	23.1 mW	1000 mA	2.9 V	N/A	>50 000 h
MCWHF2 <sup>i</sup>	Cold White	6200 K <sup>j</sup>	8.8 mW	21.5 mW	27.0 mW	1000 mA	2.9 V	N/A	>50 000 h

- b. Due to variations in the manufacturing process and operating parameters such as temperature and current, the actual spectral output of any given LED will vary. Output plots and nominal wavelength specs are only intended to be used as a guideline.
- c. For LEDs with a visible spectrum, the nominal wavelength indicates the wavelength at which the LED appears brightest to the human eye. The nominal wavelength for visible LEDs may not correspond to the peak wavelength as measured by a spectrometer.
- d. All LEDs except the M285F4, M300F2, and M340F3 were tested using MM Fiber with Ø200 µm core, 0.22 NA (Item # FG200UCC); the M285F4, M300F2 and M340F3 were tested using Item # FG200AEA.
- e. All LEDs except the M285F4, M300F2 and M340F3 were tested using MM Fiber with Ø400 µm core, 0.39 NA (Item # FT400EMT); the M285F4, M300F2 and M340F3 were tested with 0.22 NA fiber (Item # FG400AEA).
- f. Our 285 to 420 nm LEDs radiate intense UV light during operation. Precautions must be taken to prevent looking directly at the UV light and UV light protective glasses must be worn to avoid eye damage. Exposure of the skin and other body parts to the UV light should be avoided.
- g. These LEDs are phosphor-converted and may not turn off completely when modulated above 10 kHz at duty cycles below 50%.
- h. The MBB1F1 LED may not turn off completely when modulated at frequencies above 1 kHz with a duty cycle of 50%, as the broadband emission is produced by optically stimulating emission from phosphor. For modulation at frequencies above 1 kHz, the duty cycle may be reduced. For example, 10 kHz modulation is attainable with a duty cycle of 5%.
- i. 10 dB Bandwidth.
- j. The MWWHF2 and MCWHF2 LEDs may not turn off completely when modulated at frequencies above 5 kHz, as the white light is produced by optically stimulating emission from phosphor.
- k. Correlated Color Temperature

## STABILITY

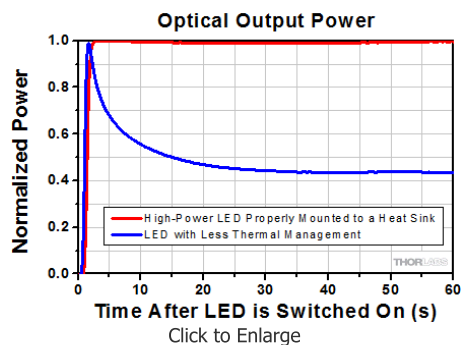
### LED Lifetime

One characteristic of LEDs is that they naturally exhibit power degradation with time. Often this power degradation is slow, but there are also instances where large, rapid drops in power, or even complete LED failure, occur. LED lifetimes are defined as the time it takes a specified percentage of a type of LED to fall below some power level. The parameters for the lifetime measurement can be written using the notation  $B_{XX}/L_{YY}$ ,

where XX is the percentage of that type of LED that will provide less than YY percent of the specified output power after the lifetime has elapsed. Thorlabs defines the lifetime of our LEDs as  $B_{50}/L_{50}$ , meaning that 50% of the LEDs with a given Item # will fall below 50% of the initial optical power at the end of the specified lifetime. For example, if a batch of 100 LEDs is rated for 150 mW of output power, 50 of these LEDs can be expected to produce an output power of  $\leq 75$  mW after the specified LED lifetime has elapsed.

### Optimized Thermal Management

The thermal dissipation performance of these fiber-coupled LEDs has been optimized for stable power output. The heat sink is directly mounted to the LED mount so as to provide optimal thermal contact. By doing so, the degradation of optical output power that can be attributed to increased LED junction temperature is minimized.



## LED Spectral Variation as a Function of Current

All LEDs will show some variation in their spectral profile and peak wavelength as a function of the drive current. For our fiber-coupled LEDs, we used an Optical Spectrum Analyzer (OSA) to track this wavelength shift as the current of the LED was increased from near zero to the maximum current.

LEDs have relatively broad, asymmetric emission profiles. The centroid wavelength of an LED is a weighted average of the wavelength across the emission profile (following a similar concept to center of mass calculations). It is defined as

$$\text{Centroid Wavelength} = \frac{\int_{\lambda_1}^{\lambda_2} \lambda \cdot I(\lambda) d\lambda}{\int_{\lambda_1}^{\lambda_2} I(\lambda) d\lambda}$$

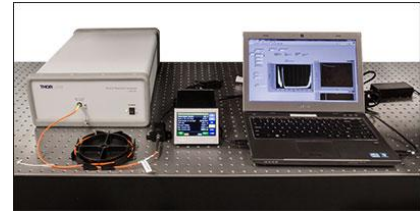
where  $I(\lambda)$  is the intensity at each wavelength,  $\lambda$ . As a result, we chose to follow each LED's centroid wavelength as the current was varied in order to capture effects of both the peak wavelength shift and any changes to the overall spectral profile. The OSA's Peak Track mode will automatically calculate the centroid wavelength of a spectral peak, using a user-set lower intensity limit to determine the upper and lower limits ( $\lambda_2$  and  $\lambda_1$ ) of the wavelength range included in the calculation. In our case, we set the lower limit to 6 dB below the peak intensity.

For each LED, a DC2200 High-Power LED Driver was used to drive the LED over a range of preset current values. At each current value, the OSA took five scans across the LED spectrum and combined them to create an average spectrum. The OSA identified the peak wavelength by finding the highest intensity value within 50 nm of the predicted peak wavelength and then calculated a centroid wavelength as described above. Centroid wavelengths were identified every 0.05 A up to the current limit of the LED. The entire process was repeated four times for each LED. All measurements were taken with the OSA in the absolute power and high-resolution spectrometer modes (for more information on the OSA operating modes, see the full web presentation).

The results of these measurements are provided in the table below and can be viewed by clicking on the graph icons. For each LED, the centroid wavelengths over all of the runs were averaged for each current point and plotted. To give a sense of possible variation in performance, the minimum and maximum wavelengths measured at each current point over all of the experimental runs are indicated by red error bars. At the lowest current values, the LED intensity was too weak to rise above the level of the noise and provide a reasonably accurate measurement of the wavelength. In these cases, we have omitted the affected currents from the graphs.

### Experimental Limitations

- Only one unit of each item # was tested. These plots are intended to provide a general sense of how the centroid wavelength changes with current and do not provide an absolute measure of the wavelength output; some variation in the centroid wavelength is expected for different LEDs with the same item #.
- The LEDs were not temperature controlled.













Click to Enlarge  
The setup for testing the relationship between LED wavelength and current. See the table below for a complete item list.

Item #	Description
-	Fiber-Coupled LED
-	SMA-to-FC/PC Fiber Patch Cable LEDs with Wavelengths $\leq 405$ nm: Custom Cable with FG105ACA Solarization Resistant Fiber LEDs with Wavelengths $>405$ nm: M16L01
DC2200	High-Power LED Driver, 2 A Current Limit
-	Fourier Transform Optical Spectrum Analyzer

Item #	Nominal Wavelength	Max Current (CW)	Centroid Wavelength vs. Current (Click for Plot)
M365F1 <sup>a</sup>	365 nm	700 mA	
M365FP1 <sup>a</sup>	365 nm	1400 mA	
M375F2 <sup>a</sup>	375 nm	500 mA	
M385F1 <sup>a</sup>	385 nm	700 mA	
M385FP1 <sup>a</sup>	385 nm	1400 mA	
M405F1 <sup>a</sup>	405 nm	500 mA	
M405FP1 <sup>a</sup>	405 nm	1400 mA	
M455F1	455 nm	1000 mA	
M470F3	470 nm	1000 mA	
M530F2	530 nm	1000 mA	

- <sup>a</sup> The spectra for these UV LEDs are close to the lower wavelength limit of the OSA201, where the noise floor of the instrument is highest. As a result, the larger error bars on the measurements at low currents are due to systematic noise in the measurement and not

indicative of the LED performance. The OSA201 was operated in absolute power mode for all measurements; more information on how the noise floor of the OSA varies with wavelength can be found here.

Item #	Nominal Wavelength	Max Current (CW)	Centroid Wavelength vs. Current (Click for Plot)
M595F2	595 nm	1000 mA	
M617F2	617 nm	1000 mA	
M625F2	625 nm	1000 mA	
M660F1	660 nm	1000 mA	
M740F2	740 nm	800 mA	
M780F2	780 nm	800 mA	
M810F2	810 nm	500 mA	
M850F2	850 nm	1000 mA	
M880F2	880 nm	1000 mA	
M1050F1	1050 nm	700 mA	

## PIN DIAGRAM





### Pin Connection

The diagram to the right shows the male connector of the fiber-coupled LED assembly. It is a standard M8 x 1 sensor circular connector. Pins 1 and 2 are the connection to the LED. Pin 3 and 4 are used for the internal EEPROM (electrically erasable programmable read-only memory) in these LEDs. If using an LED driver that was not purchased from Thorlabs, be careful that the appropriate connections are made to Pin 1 and Pin 2 and that you do not attempt to drive the LED through the EEPROM pins.



Pin	Specification	Color
1	LED Anode	Brown
2	LED Cathode	White
3	EEPROM GND	Black
4	EEPROM IO	Blue

LED DRIVERS

Compatible Drivers	LEDD1B <sup>a</sup>	DC2200 <sup>b</sup>	DC4100 <sup>b,c</sup>	DC4104 <sup>b,c</sup>
Click Photos to Enlarge				
LED Driver Current Output (Max)	1.2 A	LED1 Terminal: 10.0 A LED2 Terminal: 2.0 A <sup>d</sup>	1.0 A per Channel	1.0 A per Channel
LED Driver Forward Voltage (Max)	12 V	50 V	5 V	5 V
Modulation Frequency Using External Input (Max)	5 kHz <sup>d</sup>	250 kHz <sup>e,f,g,h</sup>	100 kHz <sup>f,g,h</sup> (Simultaneous Across all Channels)	100 kHz <sup>f,g,h</sup> (Independently Controlled Channels)
External Control Interface(s)	Analog (BNC)	USB 2.0 and Analog (BNC)	USB 2.0 and Analog (BNC)	USB 2.0 and Analog (8-Pin)
Main Driver Features	Very Compact Footprint 60 mm x 73 mm x 104 mm (W x H x D)	Touchscreen Interface with Internal and External Options for Pulsed and Modulated LED Operation	4 Channels <sup>c</sup>	4 Channels <sup>c</sup>
EEPROM Compatible: Reads Out LED Data for LED Settings	-	✓	✓	✓
LCD Display	-	✓	✓	✓

- a. The pictured cord is included for custom applications, and is not required for fiber-coupled LEDs.
- b. Automatically limits to LEDs max current via EEPROM readout.
- c. The DC4100 or DC4104 can power and control up to four LEDs simultaneously when used with the DC4100-HUB. The LEDs on this page all require the DC4100-HUB when used with the DC4100 or DC4104.
- d. The fiber-coupled LEDs sold below are compatible with the LED2 Terminal.
- e. Small Signal Bandwidth: Modulation not exceeding 20% of full scale current. The driver accepts other waveforms, but the maximum frequency will be reduced.
- f. The MBB1F1 LED may not turn off completely when modulated at frequencies above 1 kHz with a duty cycle of 50%, as the broadband emission is produced by optically stimulating emission from phosphor. For modulation at frequencies above 1 kHz, the duty cycle may be reduced. For example, 10 kHz modulation is attainable with a duty cycle of 5%.
- g. The MWWHF1 and MCWHF1 LEDs may not turn off completely when modulated at frequencies above 5 kHz, as the white light is produced by optically stimulating emission from phosphor.
- h. The M565F3 and M595F2 are phosphor-converted and may not turn off completely when modulated above 10 kHz at duty cycles below 50%.



**Light Emitting Diode (LED) Selection Guide**

(Click Representative Photo to Enlarge; Not to Scale)										
<b>Wavelength</b>	<b>Unmounted LEDs</b>	<b>Pigtailed LEDs</b>	<b>LEDs in SMT Packages</b>	<b>PCB-Mounted LEDs</b>	<b>Heatsink-Mounted LEDs</b>	<b>Collimated LEDs for Microscopy (Item # Prefix<sup>a</sup>)</b>	<b>Fiber-Coupled LEDs<sup>b</sup></b>	<b>High-Power LEDs for Microscopy</b>	<b>4-Wavelength LED Source Options<sup>c</sup></b>	<b>LED Arrays</b>

**Single Color LEDs**

245 nm	LED245W (0.07 mW)	-	-	-	-	-	-	-	-	-
250 nm	LED250J (1 mW Min)	-	-	-	-	-	-	-	-	-
255 nm	LED255J (1 mW Min)	-	-	-	-	-	-	-	-	-
260 nm	LED260W (0.3 mW) LED260J (1 mW Min)	-	-	-	-	-	-	-	-	-
265 nm	-	-	-	M265D2 (10 mW Min)	M265L3 (10 mW Min)	-	-	-	-	-
275 nm	LED275W (0.8 mW) LED275J (1 mW Min)	-	-	M275D2 (45 mW Min)	M275L4 (45 mW Min)	-	-	-	-	-
280 nm	LED280J (1 mW Min)	-	-	-	-	-	-	-	-	-
285 nm	LED285W (0.8 mW)	-	-	M285D3 (50 mW Min)	M285L5 (50 mW Min)	-	M285F4 (420 µW)	-	-	-
290 nm	LED290W (0.8 mW)	-	-	-	-	-	-	-	-	-
300 nm	LED300W (0.5 mW)	-	-	M300D3 (26 mW Min)	M300L4 (26 mW Min)	-	M300F2 (320 µW)	-	-	-
315 nm	LED315W (0.6 mW)	-	-	-	-	-	-	-	-	-
340 nm	LED341W (0.33 mW)	-	-	M340D3 (53 mW Min)	M340L4 (53 mW Min)	-	M340F3 (1.06 mW)	-	-	-
365 nm	-	-	-	M365D1 (190 mW Min)	M365L2 (190 mW Min)	M365L2 (60 mW) <sup>d</sup>	M365F1 (4.1 mW)	SOLIS-365C (3.0 W) <sup>e</sup>	Available (85 mW)	LIU365A (31 mW)
				M365D2 (1150 mW Min)	M365LP1 (11-50 mW Min)	M365LP1 (350 mW) <sup>d</sup>	M365FP1 (15.5 mW)			
375 nm	LED375L (1 mW)	-	-	M375D4 (1270 mW Min)	M375L4 (1270 mW Min)	-	M375F2 (4.23 mW)	-	-	-
	LED370E (2.5 mW)									
385 nm	LED385L (5 mW)	-	-	M385D1 (270 mW Min)	M385L2 (270 mW Min)	M385L2 (90 mW) <sup>d</sup>	M385F1 (10.7 mW)	SOLIS-385C (5.8 W) <sup>e</sup>	Available (95 mW)	-
				M385D2 (1650 mW Min)	M385LP1 (1650 mW Min)	M385LP1 (520 mW) <sup>d</sup>	M385FP1 (23.2 mW)			
395 nm	LED395L (6 mW)	-	-	M395D3 (400 mW Min)	M395L4 (400 mW Min)	-	M395F3 (6.8 mW)	-	-	-





**Light Emitting Diode (LED) Selection Guide**

760 nm	LED760L (24 mW)	-	-	-	-	-	-	-	-	-
770 nm	LED770L (22 mW)	-	-	-	-	-	-	-	-	-
780 nm	LED780E (18 mW)	-	-	M780D2 (200 mW Min)	M780L3 (200 mW Min)	M780L3 (130 mW) <sup>d</sup>	M780F2(7.5 mW)	-	-	LIU780A (315 mW)
	LED780L (22 mW)			M780D3 (800 mW Min)	M780LP1 (800 mW Min)					
800 nm	LED800L (20 mW)	-	-	-	-	-	-	-	-	-
810 nm	LED810L (22 mW)	EP810S04 (16 mW Min)	-	M810D2 (325 mW Min)	M810L3 (325 mW Min)	M810L3 (210 mW) <sup>d</sup>	M810F2 (6.5 mW)	-	-	-
		EP810S10 (90 mW Min)								
830 nm	LED830L (22 mW)	-	-	-	-	-	-	-	-	-
840 nm	LED840L (22 mW)	-	-	-	-	-	-	-	-	-
850 nm	LED851W (8 mW)	-	-	M850D2 (900 mW Min)	M850L3 (900 mW Min)	M850L3 (330 mW) <sup>d</sup>	M850F2 (13.4 mW)	SOLIS-850C (2.7 W) <sup>e</sup>	-	LIU850A (322 mW)
	LED851L (13 mW)			M850D3 (1400 mW)	M850LP1 (1400 mW Min)					
870 nm	LED870E (22 mW)	-	-	-	-	-	-	-	-	-
	LED870L (24 mW)									
880 nm	-	-	-	M880D2 (300 mW Min)	M880L3 (300 mW Min)	-	M880F2 (3.4 mW)	-	-	-
890 nm	LED890L (12 mW)	-	-	-	-	-	-	-	-	-
910 nm	LED910L (10 mW)	-	-	-	-	-	-	-	-	-
	LED910E (12 mW)									
930 nm	LED930L (15 mW)	-	-	-	-	-	-	-	-	-
940 nm	LED940E (18 mW)	-	-	M940D2 (800 mW Min)	M940L3 (800 mW Min)	M940L3 (320 mW) <sup>d</sup>	M940F1 (6.5 mW)	SOLIS-940C (2.5 W) <sup>e</sup>	-	-
							M940F3 (14.2 mW)			
970 nm	LED970L (5 mW)	-	-	M970D3 (600 mW Min)	M970L4 (600 mW Min)	-	M970F3 (8.1 mW)	-	-	-
<b>Wavelength</b>	<b>Unmounted LEDs</b>	<b>Pigtailed LEDs</b>	<b>LEDs in SMT Packages</b>	<b>PCB-Mounted LEDs</b>	<b>Heatsink-Mounted LEDs</b>	<b>Collimated LEDs for Microscopy (Item # Prefix<sup>a</sup>)</b>	<b>Fiber-Coupled LEDs<sup>b</sup></b>	<b>High-Power LEDs for Microscopy</b>	<b>4-Wavelength LED Source Options<sup>c</sup></b>	<b>LED Arrays</b>
<b>Single Color LEDs</b>										
1050 nm	LED1050E (2.5 mW)	-	-	M1050D1 (50 mW Min)	M1050L2 (50 mW Min)	-	M1050F1 (1.4 mW)	-	-	-
	LED1050L (4 mW)			M1050D3 (160 mW Min)	M1050L4 (160 mW Min)		M1050F3 (3 mW)			
1070 nm	LED1070L (4 mW)	-	-	-	-	-	-	-	-	-
	LED1070E (7.5 mW)									



**Light Emitting Diode (LED) Selection Guide**

Wavelength	Unmounted LEDs	Pigtailed LEDs	LEDs in SMT Packages	PCB-Mounted LEDs	Heatsink-Mounted LEDs	Collimated LEDs for Microscopy (Item # Prefix <sup>a</sup> )	Fiber-Coupled LEDs <sup>b</sup>	High-Power LEDs for Microscopy	4-Wavelength LED Source Options <sup>c</sup>	LED Arrays
<b>Multi-Color, Broadband, and White LEDs</b>										
455 nm (12.5% <sup>g</sup> ) and 640 nm	-	-	-	MPRP1D2 (275 mW Min)	MPRP1L4 (275 mW Min)	-	-	-	-	-
572 nm and 625 nm	LEDGR (0.09 mW and 0.19 mW)	-	-	-	-	-	-	-	-	-
588 nm and 617 nm	LEDRY (0.09 mW and 0.19 mW)	-	-	-	-	-	-	-	-	-
467.5 nm, 525 nm, and 627.5 nm	LEDRGBE (5.8 mW, 6.2 mW, and 3.1 mW)	-	-	-	-	-	-	-	-	-
430 - 660 nm (White)	LEDWE-15 (13 mW)	-	-	-	-	-	-	-	-	-
	LEDW7E (15.0 mW)	-	-	-	-	-	-	-	-	-
	LEDW25E (15.0 mW)	-	-	-	-	-	-	-	-	-
470 - 850 nm (Broadband)	-	-	-	MBB1D1 (70 mW Min)	MBB1L3 (70 mW Min)	-	MBB1F1 (1.2 mW)	-	-	-
6500 K (Cold White)	-	-	-	MCWHD2 (800 mW Min)	MCWHL5 (800 mW Min)	MCWHL5 (320 mW) <sup>d</sup>	-	SOLIS-1C (3.3 W) <sup>e</sup>	-	-
				MCWHD3 (2350 mW Min)	MCWHLP1 (2350 mW Min)					
6200 K (Cold White)	-	-	-	-	-	-	MCWHF2 (21.5 mW)	-	-	-
5000 K (Cold White)	-	-	LEDSW50 (110 mW)	-	-	-	-	-	-	-
4600 - 9000 K (Cold White)	-	-	-	-	-	-	-	-	-	LIUCWHA (250 mW)
4000 K (Warm White)	-	-	LEDSW40 (115 mW)	-	-	-	MWWHF2 (16.3 mW)	-	-	-
3000 K (Warm White)	-	-	LEDSW30 (100 mW)	MWWHD3 (2000 mW Min)	MWWHL4 (570 mW Min)	-	-	SOLIS-2C (3.2 W) <sup>e</sup>	-	-
					MWWHLP1 (2000 mW Min)					
5700 K (Day Light White)	-	-	-	-	-	-	-	SOLIS-3C (3.5 W)	-	-

- a. These Collimated LEDs are compatible with the standard and epi-illumination ports on the following microscopes: Olympus BX/IX (Item # Suffix: -C1), Leica DMI (Item # Suffix: -C2), Zeiss Axioskop (Item # Suffix: -C4), and Nikon Eclipse (Bayonet Mount, Item # Suffix: -C5).
- b. Typical power when used with MM Fiber with Ø400 µm core, 0.39 NA.
- c. Our LED4D 4-Wavelength LED Source is available with select combinations of the LEDs at these wavelengths.
- d. Typical power for LEDs with the Leica DMI collimation package (Item # Suffix: -C2).
- e. Minimum power for the collimated output of these LEDs. The collimation lens is installed with each LED.
- f. Typical power for LEDs with the Olympus BX and IX collimation package (Item # Suffix: -C1).
- g. Percentage of LED intensity that emits in the blue portion of the spectrum, from 400 nm to 525 nm.

## Fiber-Coupled LEDs

- ▶ Integrated EEPROM for Automated LED Settings with Compatible Thorlabs Controllers
- ▶ Long Lifetimes >10 000 Hours (Except M340F3; See *Specs* Tab for Details)
- ▶ Output can be Modulated with Suitable Controller (See *LED Drivers* Tab)
- ▶ Stable Output Intensity by Optimized Thermal Management
- ▶ Accepts SMA Fiber Connector



Click to Enlarge  
M365FP1, M385FP1, and  
M405FP1 are each mounted to a  
50 mm long heat sink.

These fiber-coupled LEDs each consist of an LED mounted to a heat sink with an SMA fiber bulkhead. They can be easily integrated into an optical setup using one of our SMA-terminated multimode fiber patch cables; when the patch cable is connected to the SMA bulkhead on the LED housing, the LED will be butt-coupled to the SMA fiber connector. For compatible drivers to power these LEDs, please see the *LED Drivers* tab. Please note that the minimum output powers specified below are for when the LED is used with a  $\varnothing 400\ \mu\text{m}$  core multimode fiber patch cable.

These fiber-coupled LEDs can also be configured with FC/PC bulkheads; contact Tech Support for details.

Part Number	Description	Price	Availability
M285F4	285 nm, 420 $\mu\text{W}$ (Min) Fiber-Coupled LED, 500 mA, SMA	\$1,153.60	Today
M300F2	300 nm, 320 $\mu\text{W}$ (Min) Fiber-Coupled LED, 350 mA, SMA	\$686.04	Today
M340F3	340 nm, 0.85 mW (Min) Fiber-Coupled LED, 700 mA, SMA	\$568.37	Today
M365F1	365 nm, 3.0 mW (Min) Fiber-Coupled LED, 700 mA, SMA	\$568.37	Today
M365FP1	365 nm, 9.8 mW (Min) Fiber-Coupled LED, 1400 mA, SMA	\$642.97	Today
M375F2	375 nm, 3.2 mW (Min) Fiber-Coupled LED, 500 mA, SMA	\$469.62	Today
M385F1	385 nm, 9.0 mW (Min) Fiber-Coupled LED, 700 mA, SMA	\$557.87	Today
M385FP1	385 nm, 18 mW (Min) Fiber-Coupled LED, 1400 mA, SMA	\$642.97	Today
M395F3	395 nm, 4.8 mW (Min) Fiber-Coupled LED, 500 mA, SMA	\$469.62	Today
M405F1	Customer Inspired! 405 nm, 3.0 mW (Min) Fiber-Coupled LED, 500 mA, SMA	\$469.62	Today
M405FP1	405 nm, 19.3 mW (Min) Fiber-Coupled LED, 1400 mA, SMA	\$642.97	Today
M415F3	415 nm, 14.4 mW (Min) Fiber-Coupled LED, 1500 mA, SMA	\$417.15	Today
M455F1	455 nm, 9.5 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$314.00	Today
M455F3	NEW! 455 nm, 17 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$415.00	Today
M470F3	470 nm, 17.2 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$397.13	Today
M490F3	490 nm, 2.3 mW (Min) Fiber-Coupled LED, 350 mA, SMA	\$461.21	Today
M505F3	505 nm, 8.5 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$386.25	Today
M530F2	530 nm, 6.8 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$397.13	Today
MINTF4	554 nm, 21 mW (Min) Fiber-Coupled LED, 1225 mA, SMA	\$515.00	Today
M565F3	565 nm, 9.9 mW (Min) Fiber-Coupled LED, 700 mA, SMA	\$451.14	Today
M590F2	590 nm, 1.85 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$397.13	Today
M590F3	590 nm, 3.3 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$452.00	Today
M595F2	595 nm, 8.7 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$397.13	Today
M617F2	617 nm, 10.2 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$397.13	Today
M625F2	625 nm, 13.2 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$397.13	Today
M660F1	660 nm, 13.0 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$404.48	Lead Time
M680F3	Customer Inspired! 680 nm, 2.0 mW (Min) Fiber-Coupled LED, 600 mA, SMA	\$407.63	Today
M700F3	700 nm, 1.3 mW (Min) Fiber-Coupled LED, 500 mA, SMA	\$407.63	Today
M740F2	740 nm, 4.1 mW (Min) Fiber-Coupled LED, 800 mA, SMA	\$469.62	Today
M780F2	780 nm, 5.5 mW (Min) Fiber-Coupled LED, 800 mA, SMA	\$404.48	Today
M810F2	810 nm, 4.9 mW (Min) Fiber-Coupled LED, 500 mA, SMA	\$449.66	Today
M850F2	850 nm, 10.5 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$404.48	Today
M880F2	880 nm, 2.7 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$404.48	Today
M940F1	940 nm, 5.5 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$314.00	Today
M940F3	940 nm, 10 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$400.00	Today
M970F3	970 nm, 5.9 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$355.35	Today
M1050F1	1050 nm, 1.1 mW (Min) Fiber-Coupled LED, 700 mA, SMA	\$469.62	5-8 Days
M1050F3	1050 nm, 2.3 mW (Min) Fiber-Coupled LED, 600 mA, SMA	\$561.35	Today

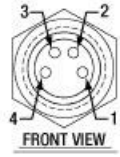
MBB1F1	Broadband (470 - 850 nm), 0.8 mW (Min) Fiber-Coupled LED, 500 mA, SMA	\$718.61	Today
MCWHF2	6200 K, 21.5 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$397.13	Today
MWWHF2	4000 K, 16.3 mW (Min) Fiber-Coupled LED, 1000 mA, SMA	\$397.13	5-8 Days

### Mounted LED Mating Connector

- ▶ Pico (M8) Receptacle
- ▶ Female 4-Pin for Front Mounting
- ▶ 0.5 m Long, 24 AWG Wires
- ▶ M8 x 0.5 Panel Mount Thread
- ▶ IP 67 and NEMA 6P Rated

The CON8ML-4 connector can be used to mate mounted LEDs featured on this page to user-supplied power supplies. We also offer a male 4-Pin M8 connector cable (Item # CAB-LEDD1).

Pin	Color	Specification
1	Brown	LED Anode
2	White	LED Cathode
3	Black	EEPROM GND
4	Blue	EEPROM IO

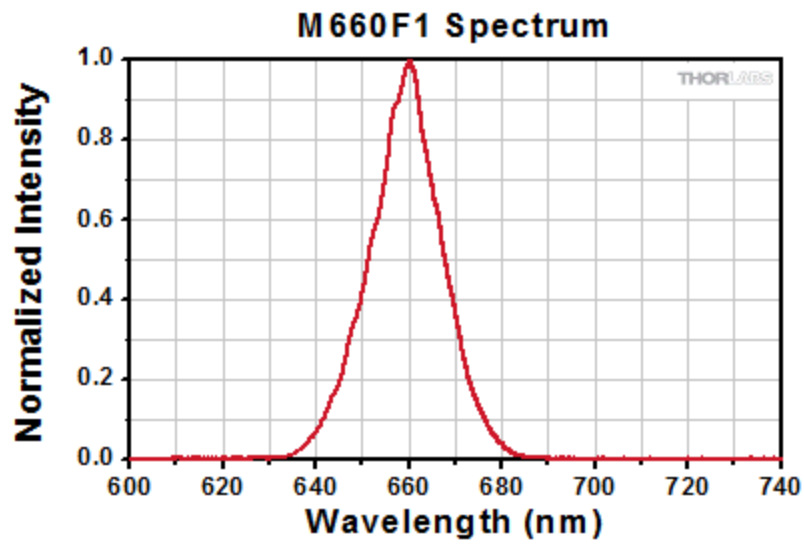



CON8ML-4 Shown Connected to the 4-Pin M8 Plug of Mounted LED

Part Number	Description	Price	Availability
CON8ML-4	4-Pin Female Mating Connector for Mounted LEDs	\$32.31	Today



Spectrum



Click [here](#) to download an Excel file containing the data shown in the graph above.

# M660F1 Wavelength vs. Current

Centroid Wavelength (nm)

