

## 780 nm High Power Femtosecond Fiber Laser



### Applications

- Multiphoton microscopy
- Optical metrology
- Materials characterization
- Terahertz radiation
- 3D-microprinting
- Nonlinear spectroscopy
- Ophthalmology
- Replacement of a Ti:sapphire laser

### Features

- High power stability (up to 1W)
- < 90 fs pulse widths
- Outstanding beam quality ( $M^2 < 1.1$ )
- Exceptional beam pointing stability
- Optional negative GVD pre-chirp up to  $-62,000 \text{ fs}^2$
- All air-cooled, no chiller required
- Remote system diagnostics
- Expected lifetime > 10,000 hours

The Carmel X-series is a range of high power, air-cooled, fiber-based femtosecond lasers with output powers from 0.25 to greater than 2.5 W and pulse widths of less than 90 fs in the industry's most compact, user-friendly package. The Carmel X-780 provides the perfect 780 nm source for a wide range of ultrafast laser applications, including bio-imaging, multiphoton microscopy, optical metrology, 3D-micro/nanoprinting, terahertz imaging and ophthalmology. It is offered as both a scientific version with front panel controls and an OEM version controlled through an RS-232 interface. The Carmel X-780 can be configured for dual wavelength output to enable alternating access to 780 and 1550 nm outputs (see the Carmel X-780/1550 data sheet for details).

The system features a rack mountable controller with a robust armored cable interface to the compact laser head, which facilitates its incorporation into OEM designs. It is over 100 times smaller than many Ti:sapphire lasers with a similar output power level. A simple key switch interface provides for manual operation with full remote access through computer control. The X-series includes the capability of remote data logging, power monitoring, system diagnostics, and automated adjustments for prolonged lifetime and OEM preventative maintenance. The rugged design supports 24/7 operation with an expected lifetime of > 10,000 hours.

The building block of the X-series is Calmar's renowned ultrafast fiber seed laser platform, which utilizes the proprietary Mendocino saturable absorber technology developed and perfected over a twenty year period to deliver reproducible and reliable mode-locking at turn-on. The system provides an output pulse width of < 90 fs with minimal pulse pedestal and excellent long term pulse-to-pulse stability (< 1% rms) over a wide operating temperature range (17-38°C). An exceptional output beam quality ( $M^2 < 1.1$ ) enables a near diffraction-limited spot size with suitable microscope objectives for demanding multiphoton and 3D microprinting applications. Repetition rates can be specified from 10 to 80 MHz with an RF synchronization output provided as a trigger signal.

For multiphoton microscopy applications, the Carmel X-780 provides an ideal ultrafast laser solution for optimum two-photon fluorescence and second harmonic cellular tissue imaging with minimal scatter and reduced risk of photodamage. The compact laser head and associated armored fiber cable make for straight forward integration into existing microscopes with minimal delivery optics.

The X-780 now offers a new optional feature: the ability to incorporate a negative pre-chirp of up to  $-62,000 \text{ fs}^2$  in the output pulses. For many applications, femtosecond pulses can be significantly broadened by the optical beam delivery system. This is especially true for multiphoton bio-imaging applications, which use highly dispersive microscope objective lenses resulting in the use of higher average powers for optimum signal intensity with potential sample damage. The Carmel X-780 output pulses can now be tailored with up to  $-62,000 \text{ fs}^2$  of group velocity dispersion (GVD) to compensate for the positive GVD effects of downstream microscope components. This is accomplished in the same compact laser head and ensures the shortest optical pulses for optimal signal intensity are obtained at the sample region, resulting in the highest signal levels at the lowest average power.

If the performance parameters do not quite fit your application requirements or to learn more, please contact us at [sales@calmarlaser.com](mailto:sales@calmarlaser.com).

# 780 nm High Power Fiber Based Femtosecond Laser

## Technical Specifications<sup>1</sup>

Model Number	CFL-04RFF	CFL-05RFF	CFL-10RFF
<b>OPTICAL</b>			
Central Wavelength (nm)	780 ± 3		
Pulse Width <sup>2</sup> (fs)	< 90		
Optional Pre-chirp in Output Pulse <sup>3</sup> (fs <sup>2</sup> )	~ -62,000		
Average Power (W)	0.25	0.50	1.0
Repetition Rate <sup>4</sup> (MHz)	50 or 80	50 or 80	80
Pulse Energy <sup>5</sup> (nJ)	> 5 or 3	> 10 or 6	> 12.5
Spectrum Width (FWHM, nm)	8 - 10		
Power Stability over 8 hours <sup>6</sup> (% , RMS)	< 1.0		
Beam Quality (M <sup>2</sup> )	< 1.1		
Beam Diameter at Exit (typical, mm)	1.25		
Beam Roundness (%)	> 90		
Polarization Extinction Ratio (dB)	> 20		
Output/Termination	Free space, collimated beam		
<b>ELECTRICAL</b>			
Electrical Synchronization (V)	~ 0.5, SMA connector		
Supply Voltage	85 - 264 VAC at 47 – 63 Hz, autoranging		
Power Consumption (W)	200		
<b>MECHANICAL</b>			
Operating Temperature (°C)	17 - 38		
Storage Temperature (°C)	0 - 50		
Connection between Controller and Head <sup>7</sup>	1 m fixed armored cable		
Laser Head Dimensions (cm)	9.0(W) x 18(D) x 3.5(H)		
Laser Controller Dimensions (cm)	48.2(W) x 46.7(D) x 10(H); 19 inch 2U		
Laser Head Weight (kg)	0.8 (typical)		
Laser Controller Weight (kg)	13.6 (typical)		
Cooling	Controller air-cooled by low noise fan		
Warm-up Time (min)	~ 10		
<b>I/O CONTROL</b>			
Communication Interface <sup>8</sup>	RS-232 Serial Port, Monitor Port		
Front Panel Control Interface	Power Switch, Laser Key Switch, Emergency Stop Button		

1. Due to our continuous improvement philosophy, all product specifications are subject to change without prior notice. Please contact sales@calmarlaser.com for customized specifications.

2. A sech<sup>2</sup> pulse shape (deconvolution factor of 0.65) is used to determine the pulse width from the second harmonic autocorrelation trace.

3. The output pulse can be prepared with an optional negative pre-chirp of up to -62,000 fs<sup>2</sup>. This option must be specified at the time of purchase, please contact sales@calmarlaser.com.

4. For the -04 and -05 models, the repetition rate needs to be specified at the time of purchase. For other repetition rates, please contact sales@calmarlaser.com.

5. The absolute pulse energy will depend on the version and specified repetition rate.

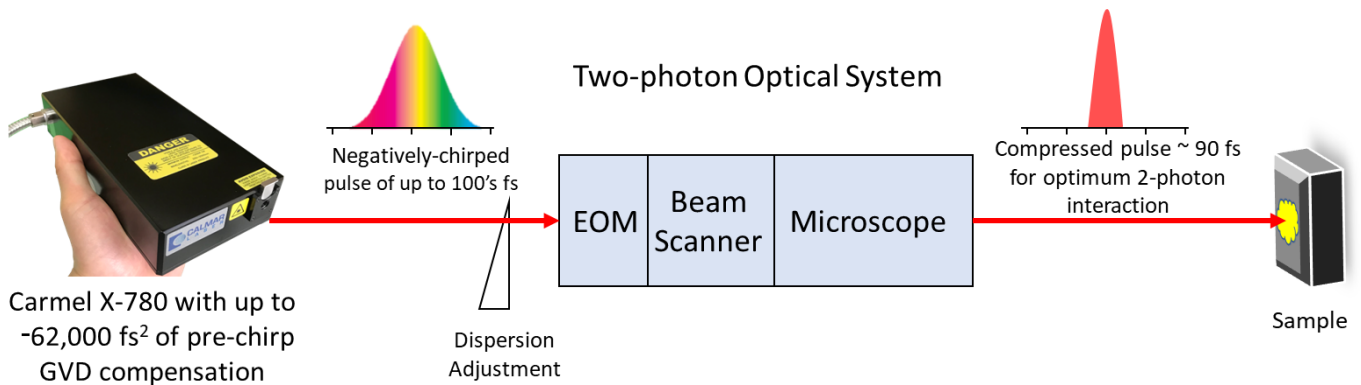
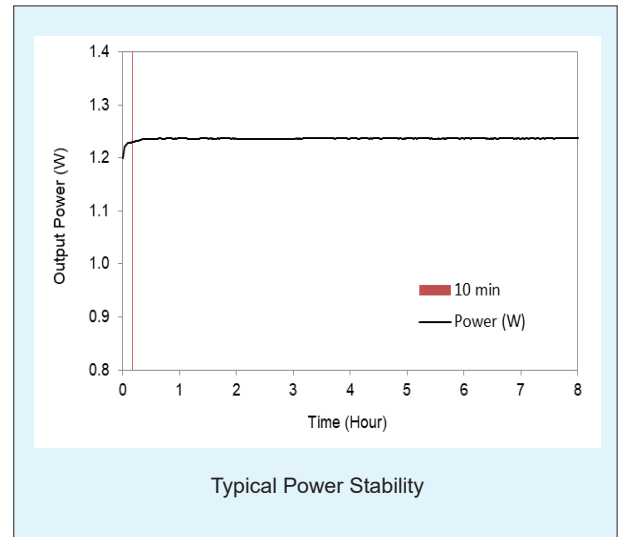
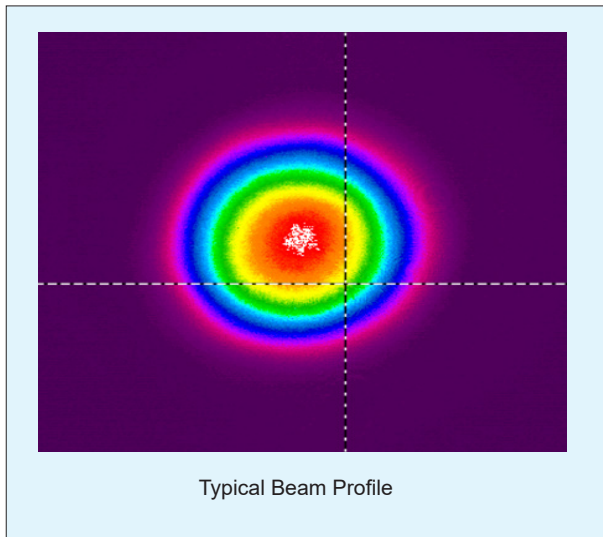
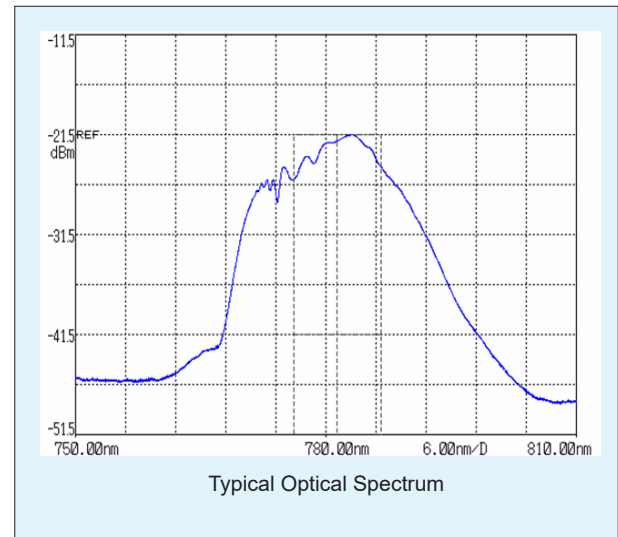
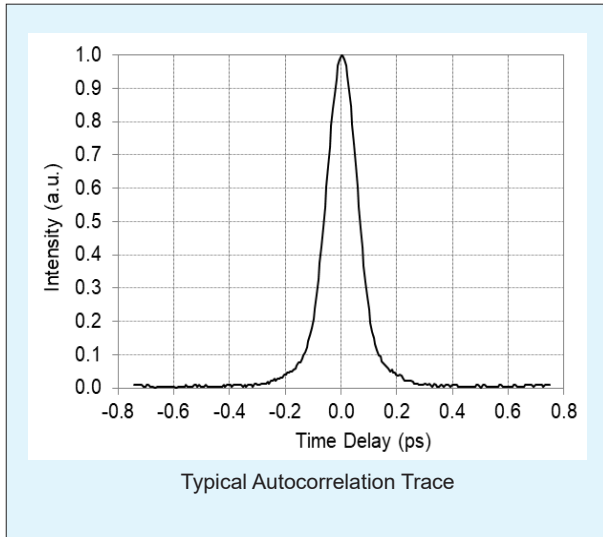
6. Requires an ambient temperature control of ± 1.0°C and appropriate mounting for the laser head.

7. For other cable length options, please contact sales@calmarlaser.com.

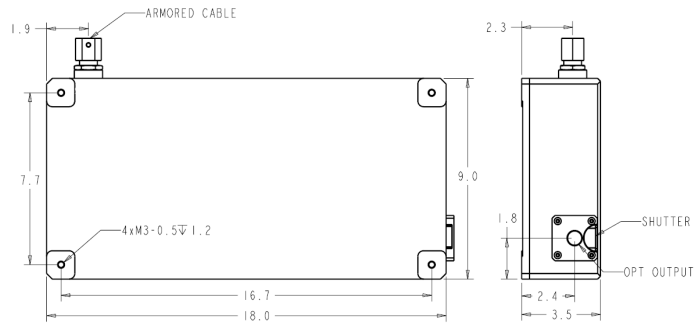
8. Standard on the OEM version, for the scientific version please contact sales@calmarlaser.com.



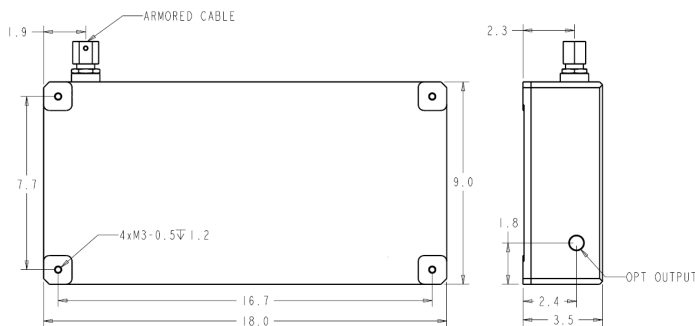
## Optical Characterization



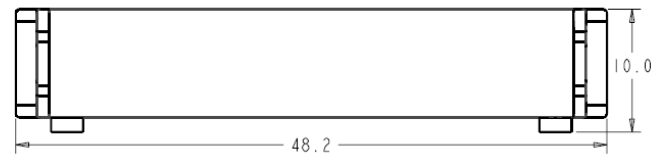
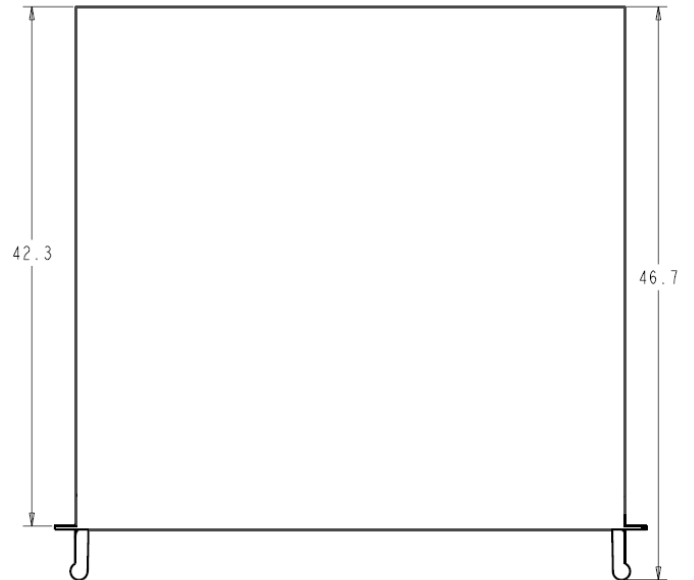
## Mechanical Dimensions



Dimensions of Laser Head for Scientific Model (cm)



Dimensions of Laser Head for OEM Model (cm)



Dimensions of Laser Controller (cm)

