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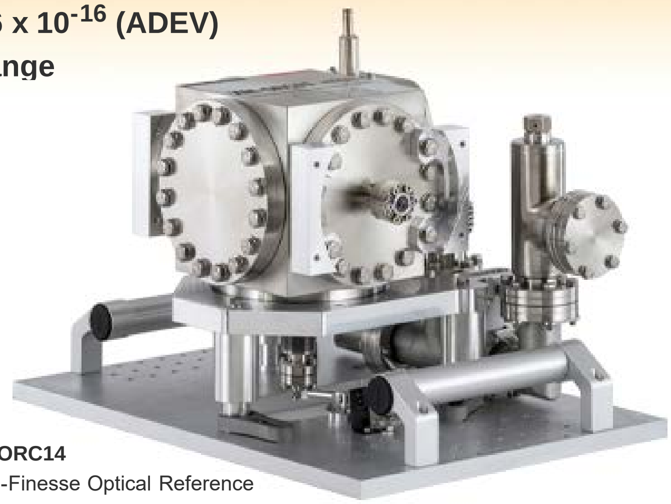
XM-ORC11 - September 26, 2023

Item # XM-ORC11 was discontinued on September 26, 2023. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

OPTICAL REFERENCE CAVITIES WITH CRYSTALLINE MIRRORS

- **High-Finesse Fabry-Perot Cavities for Active Frequency Stabilization**
- **Available with 1064 nm, 1397 nm, or 1550 nm Center Wavelength**
- **Thermal Noise Limit at 1.6 x 10^{-16} (ADEV)**
- **1.24 GHz Free Spectral Range**



XM-ORC14
High-Finesse Optical Reference Cavity, 1550 nm, >300 000 Finesse

System Incorporates xtal stable™ Coating Technology

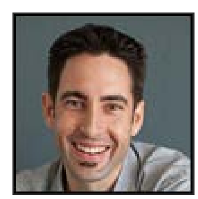
Hide Overview

OVERVIEW

Features

- Fused Silica, Crystalline-Coated Cavity Mirrors for Low Thermal Noise
- AR-Coated, Angled, and Wedged Incoupling and Outcoupling Windows
- Includes an Ultra-Low Expansion (ULE®†) Cavity Spacer
- Plano-Concave Mirror Configuration with a 1 m Radius of Curvature
- Integrated NTC and Peltier Elements for Active Temperature Control
- Includes Temperature Controller, Ion Getter Vacuum Pump, and Pump Controller

Click to Enlarge
Cylindrical Cavity with Optically-Contacted Crystalline-Coated Mirrors



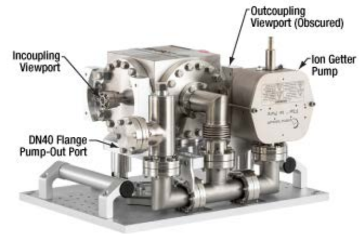
Garrett Cole
Technology Manager,
Thorlabs Crystalline Solutions
Feedback?
Questions?
Need a Quote?

Contact Me

Applications

- Laser Frequency Stabilization
- Optical Metrology
- Laser Cooling and Trapping
- High-Resolution Spectroscopy
- Quantum Computing

The XM-ORC Series of Optical Reference Cavities with Crystalline Mirrors are high-finesse Fabry-Pérot cavities ideal for active frequency stabilization of a single-mode CW laser. These optical cavities, designed together with Menlo Systems, integrate Thorlabs' high-performance supermirrors and are available with finesse values >100 000 at 1064 nm or >300 000 at 1397 nm or 1550 nm. With a thermal noise Allan deviation (ADEV) limit as low as 1.6 x 10^{-16} and a low frequency drift of ~150 mHz/s, the XM-ORC



Click to Enlarge
XM-ORC Stainless Steel Vacuum Chamber and Ion Getter Pump

reference cavities are ideal for applications that require cavity-stabilized lasers, such as high-resolution spectroscopy, quantum computing, and optical clocks. To inquire about reference cavities at other center wavelengths, please click on the *Contact Me* button to the right.

Each system is baked out during the assembly process and includes hardware for temperature control and maintaining a high vacuum; see the *Shipping List* tab for details. The base of the system is a breadboard that features countersunk #1/4" and M6 mounting holes, which can be used to secure the reference cavity to an optical table. For best performance, we recommend mounting the system on a vibration-isolation platform.

Optically Contacted Cavity
Each optical cavity includes a 12.1 cm cylindrical spacer made from ultra-low expansion (ULE) glass that is mounted horizontally on four support points within a sealed stainless steel vacuum housing. The incoupling and outcoupling cavity mirrors, which are concave and plano, respectively, are optically contacted and consist of Thorlabs' substrate-transferred crystalline coating (xtal stable™) on a fused silica substrate. ULE compensation rings are also included to ensure that room temperature operation will roughly correspond to the zero crossing of the thermal expansion coefficient for the assembled cavity.

Each pair of crystalline-coated mirrors is individually tested using a cavity ring-down setup to ensure extremely high reflectance and low transmission at the center wavelength. A data sheet is provided with each cavity; click here to view a sample.

To avoid etalons, the cavity is mounted in the vacuum chamber at a small angle to the incoupling and outcoupling viewports, which include AR-coated wedged windows. The optical axis of the system, which is measured from the bottom of the breadboard, is 8.00" (203.30 mm).

Environmental Isolation
The XM-ORC reference cavity is operated under high vacuum with active temperature stabilization to reduce length fluctuations and improve the frequency stability of the locked laser. To achieve a high vacuum, an ion getter pump with a 10 L/s nominal pump rate continually pumps the vacuum chamber to maintain a pressure of $<10^{-7}$ mbar. The vacuum chamber also features CF flange components, which utilize a knife-edge mechanism to create an airtight seal between mating pieces.

For active temperature control, the XM-ORC reference cavities include an NTC thermistor and Peltier heating element. A temperature controller is also provided, which is Thorlabs' TED200C temperature controller modified for the increased thermal load of the system. A cable to connect the NTC and Peltier elements to the temperature controller is included with each XM-ORC cavity.

Note: The ion getter pump included with the XM-ORC reference cavities only works up to pressures of 10^{-4} mbar. To establish a vacuum in the sealed chamber, a third-party dry pump with an ultimate base pressure of 10^{-4} mbar and pump rate of 10 L/hr is required. The vacuum chamber includes a DN40 flange on the back of the system for attaching an auxiliary pump.

Application
The XM-ORC reference cavity is one component of the system required to realize an ultra-stable laser; see the *Application* tab for an example of how the XM-ORC cavity can be used in a Pound-Drever-Hall locking scheme with Thorlabs' ULN15TK turnkey ultra-low-noise laser. To discuss the incoupling and outcoupling optics required for your specific application, please use the *Contact Me* button above.

†ULE is a registered trademark of Corning, Inc.

Note: We are pleased to partner with Menlo Systems, our strategic partner, to bring these items to market. They will fulfill orders within Germany. All other European-bound orders will ship direct from the United States.

Hide Specs

SPECS

Item #	XM-ORC11	XM-ORC23	XM-ORC14
Wavelength[a]	1064 nm	1397 nm	1550 nm
Finesse	>100 000	>300 000	>300 000

Cavity Length (ULE® Spacer)[b]		12.1 cm		
Cavity Mirrors	**Type**	xtal stable™ Crystalline Coating on Fused Silica Substrate		
	Incoupling Mirror Item #	XM11R8	XM23R8	XM14R8
	Outcoupling Mirror Item #	XM11P8	XM23P8	XM14P8
	Reflectance (Click Icon to View Graph)			
Free Spectral Range		1.24 GHz		
Windows		AR Coated, Angled and Wedged		
Thermal Shielding		Active		
Thermal Noise Allan Deviation (ADEV) Limit[c]		1.6×10^{-16}		
Linear Drift Rate		~150 mHz/s		
Ambient Temperature Sensitivity		~4 mK/°C		
Weight		~55 kg		

a. Non-standard wavelengths >900 nm are available upon request. Please contact Tech Support for more information.
b. Ultra-low expansion (ULE) glass is a registered trademark of Corning, Inc.
c. At 1 s of Averaging

Hide Damage Thresholds

DAMAGE THRESHOLDS

Damage Threshold Data for our Crystalline Supermirrors

The specification to the right applies to the Thorlabs crystalline mirrors used in the XM-ORC optical reference cavities. These values are typical and may vary, as each mirror is made to order.

Please note that the intra-cavity intensity is enhanced by Finesse/pi. Since the XM-ORC cavities can have >300 000 finesse, the externally applied power could increase by 100 000 times in the cavity.

Damage Threshold Specifications		
Coating Name	**Laser Type**	**Damage Threshold[a]**
xtal stable™	**CW[b]**	46.2 kW/cm (1064 nm, Ø5.5 mm)
	Pulsed	5 J/cm^2 (1030 nm, 10 ns, 10 Hz, Ø0.240 mm)

a. All diameters are the $1/e^2$ values.
b. The power density of your beam should be calculated in terms of W/cm. For an explanation of why the linear power density provides the best metric for long pulse and CW sources, please see the "Continuous Wave and Long-Pulse Lasers" section below.

Laser Induced Damage Threshold Tutorial

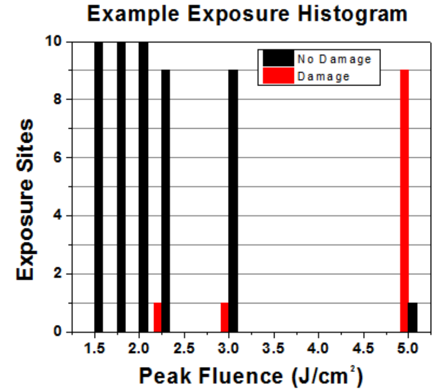
The following is a general overview of how laser induced damage thresholds are measured and how the values may be utilized in determining the appropriateness of an optic for a given application. When choosing optics, it is important to understand the Laser Induced Damage Threshold (LIDT) of the optics being used. The LIDT for an optic greatly depends on the type of laser you are using. Continuous wave (CW) lasers typically cause damage from thermal effects (absorption either in the coating or in the substrate). Pulsed lasers, on the other hand, often strip electrons from the lattice structure of an optic before causing thermal damage. Note that the guideline presented here assumes room temperature operation and optics in new condition (i.e., within scratch-dig spec, surface free of contamination, etc.). Because dust or other particles on the surface of an optic can cause damage at lower thresholds, we recommend keeping surfaces clean and free of debris. For more information on cleaning optics, please see our *Optics Cleaning* tutorial.

Testing Method

Thorlabs' LIDT testing is done in compliance with ISO/DIS 11254 and ISO 21254 specifications.

First, a low-power/energy beam is directed to the optic under test. The optic is exposed in 10 locations to this laser beam for 30 seconds (CW) or for a number of pulses (pulse repetition frequency specified). After exposure, the optic is examined by a microscope (~100X magnification) for any visible damage. The number of locations that are damaged at a particular power/energy level is recorded. Next, the power/energy is either increased or decreased and the optic is exposed at 10 new locations. This process is repeated until damage is observed. The damage threshold is then assigned to be the highest power/energy that the optic can withstand without causing damage. A histogram such as that below represents the testing of one BB1-E02 mirror.

The photograph above is a protected aluminum-coated mirror after LIDT testing. In this particular test, it handled 0.43 J/cm^2 (1064 nm, 10 ns pulse, 10 Hz, Ø1.000 mm) before damage.



Example Test Data			
Fluence	# of Tested Locations	Locations with Damage	Locations Without Damage
1.50 J/cm^2	10	0	10
1.75 J/cm^2	10	0	10
2.00 J/cm^2	10	0	10
2.25 J/cm^2	10	1	9
3.00 J/cm^2	10	1	9
5.00 J/cm^2	10	9	1

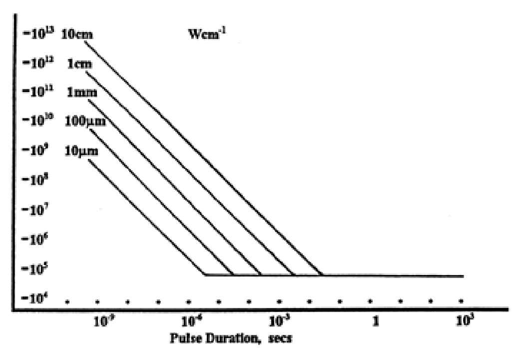
According to the test, the damage threshold of the mirror was 2.00 J/cm^2 (532 nm, 10 ns pulse, 10 Hz, Ø0.803 mm). Please keep in mind that these tests are performed on clean optics, as dirt and contamination can significantly lower the damage threshold of a component. While the test results are only representative of one coating run, Thorlabs specifies damage threshold values that account for coating variances.

Continuous Wave and Long-Pulse Lasers

When an optic is damaged by a continuous wave (CW) laser, it is usually due to the melting of the surface as a result of absorbing the laser's energy or damage to the optical coating (antireflection) [1]. Pulsed lasers with pulse lengths longer than 1 µs can be treated as CW lasers for LIDT discussions.

When pulse lengths are between 1 ns and 1 µs, laser-induced damage can occur either because of absorption or a dielectric breakdown (therefore, a user must check both CW and pulsed LIDT). Absorption is either due to an intrinsic property of the optic or due to surface irregularities; thus LIDT values are only valid for optics meeting or exceeding the surface quality specifications given by a manufacturer. While many optics can handle high power CW lasers, cemented (e.g., achromatic doublets) or highly absorptive (e.g., ND filters) optics tend to have lower CW damage thresholds. These lower thresholds are due to absorption or scattering in the cement or metal coating.

Pulsed lasers with high pulse repetition frequencies (PRF) may behave similarly to CW beams. Unfortunately, this is highly dependent on factors such as absorption and thermal diffusivity, so there is no reliable method for determining when a high PRF laser will damage an optic due to thermal effects. For beams with a high PRF both the average and peak powers must be compared to the equivalent CW power. Additionally, for highly transparent materials, there is little to no drop in the LIDT with increasing PRF.



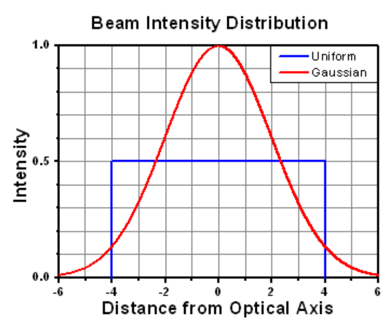
LIDT in linear power density vs. pulse length and spot size. For long pulses to CW, linear power density becomes a constant with spot size. This graph was obtained from [1].

In order to use the specified CW damage threshold of an optic, it is necessary to know the following:

1. Wavelength of your laser
2. Beam diameter of your beam (1/e^2)
3. Approximate intensity profile of your beam (e.g., Gaussian)
4. Linear power density of your beam (total power divided by 1/e^2 beam diameter)

Thorlabs expresses LIDT for CW lasers as a linear power density measured in W/cm. In this regime, the LIDT given as a linear power density can be applied to any beam diameter; one does not need to compute an adjusted LIDT to adjust for changes in spot size, as demonstrated by the graph to the right. Average linear power density can be calculated using the equation below.

$$\textit{Linear Power Density} = \frac{\textit{Power}}{\textit{Beam Diameter}}$$



The calculation above assumes a uniform beam intensity profile. You must now consider hotspots in the beam or other non-uniform intensity profiles and roughly calculate a maximum power density. For reference, a Gaussian beam typically has a maximum power density that is twice that of the uniform beam (see lower right).

Now compare the maximum power density to that which is specified as the LIDT for the optic. If the optic was tested at a wavelength other than your operating wavelength, the damage threshold must be scaled appropriately. A good rule of thumb is that the damage threshold has a linear relationship with wavelength such that as you move to shorter wavelengths, the damage threshold decreases (i.e., a LIDT of 10 W/cm at 1310 nm scales to 5 W/cm at 655 nm):

$$\text{Adjusted LIDT} = \text{LIDT Power}\left(\frac{\text{Your Wavelength}}{\text{LIDT Wavelength}}\right)$$

While this rule of thumb provides a general trend, it is not a quantitative analysis of LIDT vs wavelength. In CW applications, for instance, damage scales more strongly with absorption in the coating and substrate, which does not necessarily scale well with wavelength. While the above procedure provides a good rule of thumb for LIDT values, please contact Tech Support if your wavelength is different from the specified LIDT wavelength. If your power density is less than the adjusted LIDT of the optic, then the optic should work for your application.

Please note that we have a buffer built in between the specified damage thresholds online and the tests which we have done, which accommodates variation between batches. Upon request, we can provide individual test information and a testing certificate. The damage analysis will be carried out on a similar optic (customer's optic will not be damaged). Testing may result in additional costs or lead times. Contact Tech Support for more information.

Pulsed Lasers

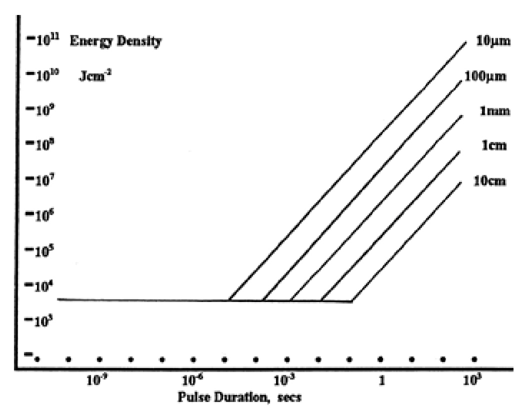
As previously stated, pulsed lasers typically induce a different type of damage to the optic than CW lasers. Pulsed lasers often do not heat the optic enough to damage it; instead, pulsed lasers produce strong electric fields capable of inducing dielectric breakdown in the material. Unfortunately, it can be very difficult to compare the LIDT specification of an optic to your laser. There are multiple regimes in which a pulsed laser can damage an optic and this is based on the laser's pulse length. The highlighted columns in the table below outline the relevant pulse lengths for our specified LIDT values.

Pulses shorter than 10^{-9} s cannot be compared to our specified LIDT values with much reliability. In this ultra-short-pulse regime various mechanics, such as multiphoton-avalanche ionization, take over as the predominate damage mechanism [2]. In contrast, pulses between 10^{-7} s and 10^{-4} s may cause damage to an optic either because of dielectric breakdown or thermal effects. This means that both CW and pulsed damage thresholds must be compared to the laser beam to determine whether the optic is suitable for your application.

Pulse Duration	$t < 10^{-9}$ s	$10^{-9} < t < 10^{-7}$ s	$10^{-7} < t < 10^{-4}$ s	$t > 10^{-4}$ s
Damage Mechanism	Avalanche Ionization	Dielectric Breakdown	Dielectric Breakdown or Thermal	Thermal
Relevant Damage Specification	No Comparison (See Above)	Pulsed	Pulsed and CW	CW

When comparing an LIDT specified for a pulsed laser to your laser, it is essential to know the following:

1. Wavelength of your laser
2. Energy density of your beam (total energy divided by $1/e^2$ area)
3. Pulse length of your laser
4. Pulse repetition frequency (prf) of your laser
5. Beam diameter of your laser ($1/e^2$)
6. Approximate intensity profile of your beam (e.g., Gaussian)



LIDT in energy density vs. pulse length and spot size. For short pulses, energy density becomes a constant with spot size. This graph was obtained from [1].

The energy density of your beam should be calculated in terms of J/cm^2. The graph to the right shows why expressing the LIDT as an energy density provides the best metric for short pulse sources. In this regime, the LIDT given as an energy density can be applied to any beam diameter; one does not need to compute an adjusted LIDT to adjust for changes in spot size. This calculation assumes a uniform beam intensity profile. You must now adjust this energy density to account for hotspots or other nonuniform intensity profiles and roughly calculate a maximum energy density. For reference a Gaussian beam typically has a maximum energy density that is twice that of the $1/e^2$ beam.

Now compare the maximum energy density to that which is specified as the LIDT for the optic. If the optic was tested at a wavelength other than your operating wavelength, the damage threshold must be scaled appropriately [3]. A good rule of thumb is that the damage threshold has an inverse square root relationship

2 2

with wavelength such that as you move to shorter wavelengths, the damage threshold decreases (i.e., a LIDT of 1 J/cm at 1064 nm scales to 0.7 J/cm at 532 nm):

$$Adjusted\ LIDT = LIDT\ Energy\sqrt{\frac{Your\ Wavelength}{LIDT\ Wavelength}}$$

You now have a wavelength-adjusted energy density, which you will use in the following step.

Beam diameter is also important to know when comparing damage thresholds. While the LIDT, when expressed in units of J/cm², scales independently of spot size; large beam sizes are more likely to illuminate a larger number of defects which can lead to greater variances in the LIDT [4]. For data presented here, a <1 mm beam size was used to measure the LIDT. For beams sizes greater than 5 mm, the LIDT (J/cm2) will not scale independently of beam diameter due to the larger size beam exposing more defects.

The pulse length must now be compensated for. The longer the pulse duration, the more energy the optic can handle. For pulse widths between 1 - 100 ns, an approximation is as follows:

$$Adjusted\ LIDT = LIDT\ Energy\sqrt{\frac{Your\ Pulse\ Length}{LIDT\ Pulse\ Length}}$$

Use this formula to calculate the Adjusted LIDT for an optic based on your pulse length. If your maximum energy density is less than this adjusted LIDT maximum energy density, then the optic should be suitable for your application. Keep in mind that this calculation is only used for pulses between 10^{-9} s and 10^{-7} s. For pulses between 10^{-7} s and 10^{-4} s, the CW LIDT must also be checked before deeming the optic appropriate for your application.

Please note that we have a buffer built in between the specified damage thresholds online and the tests which we have done, which accommodates variation between batches. Upon request, we can provide individual test information and a testing certificate. Contact Tech Support for more information.

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[1] R. M. Wood, Optics and Laser Tech. **29**, 517 (1998).
[2] Roger M. Wood, *Laser-Induced Damage of Optical Materials* (Institute of Physics Publishing, Philadelphia, PA, 2003).
[3] C. W. Carr *et al.*, Phys. Rev. Lett. **91**, 127402 (2003).
[4] N. Bloembergen, Appl. Opt. **12**, 661 (1973).

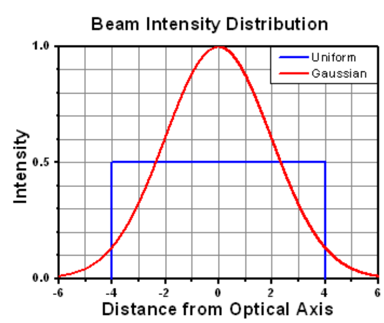
Hide LIDT Calculations

LIDT CALCULATIONS

LIDT Calculator

In order to illustrate the process of determining whether a given laser system will damage an optic, a number of example calculations of laser induced damage threshold are given below. For assistance with performing similar calculations, we provide a spreadsheet calculator that can be downloaded by clicking the button to the right. To use the calculator, enter the specified LIDT value of the optic under consideration and the relevant parameters of your laser system in the green boxes. The spreadsheet will then calculate a linear power density for CW and pulsed systems, as well as an energy density value for pulsed systems. These values are used to calculate adjusted, scaled LIDT values for the optics based on accepted scaling laws. This calculator assumes a Gaussian beam profile, so a correction factor must be introduced for other beam shapes (uniform, etc.). The LIDT scaling laws are determined from empirical relationships; their accuracy is not guaranteed. Remember that absorption by optics or coatings can significantly reduce LIDT in some spectral regions. These LIDT values are not valid for ultrashort pulses less than one nanosecond in duration.

CW Laser Example



Suppose that a CW laser system at 1319 nm produces a 0.5 W Gaussian beam that has a $1/e^2$ diameter of 10 mm. A naive calculation of the average linear power density of this beam would yield a value of 0.5 W/cm, given by the total power divided by the beam diameter:

$$Linear\ Power\ Density = \frac{Power}{Beam\ Diameter}$$

However, the maximum power density of a Gaussian beam is about twice the maximum power density of a uniform beam, as shown in the graph to the right. Therefore, a more accurate determination of the maximum linear power density of the system is 1 W/cm.

A Gaussian beam profile has about twice the maximum intensity of a uniform beam profile.

An AC127-030-C achromatic doublet lens has a specified CW LIDT of 350 W/cm, as tested at 1550 nm. CW damage threshold values typically scale directly with the wavelength of the laser source, so this yields an adjusted LIDT value:

$$Adjusted\ LIDT = LIDT\ Power \left(\frac{Your\ Wavelength}{LIDT\ Wavelength}\right)$$

The adjusted LIDT value of 350 W/cm x (1319 nm / 1550 nm) = 298 W/cm is significantly higher than the calculated maximum linear power density of the laser system, so it would be safe to use this doublet lens for this application.

Pulsed Nanosecond Laser Example: Scaling for Different Pulse Durations

Suppose that a pulsed Nd:YAG laser system is frequency tripled to produce a 10 Hz output, consisting of 2 ns output pulses at 355 nm, each with 1 J of energy, in a Gaussian beam with a 1.9 cm beam diameter ($1/e^2$). The average energy density of each pulse is found by dividing the pulse energy by the beam area:

$$Energy\ Density = \frac{Pulse\ Energy}{Beam\ Area}$$

As described above, the maximum energy density of a Gaussian beam is about twice the average energy density. So, the maximum energy density of this beam is ~0.7 J/cm^2.

The energy density of the beam can be compared to the LIDT values of 1 J/cm^2 and 3.5 J/cm^2 for a BB1-E01 broadband dielectric mirror and an NB1-K08 Nd:YAG laser line mirror, respectively. Both of these LIDT values, while measured at 355 nm, were determined with a 10 ns pulsed laser at 10 Hz. Therefore, an adjustment must be applied for the shorter pulse duration of the system under consideration. As described on the previous tab, LIDT values in the nanosecond pulse regime scale with the square root of the laser pulse duration:

$$Adjusted\ LIDT = LIDT\ Energy \sqrt{\frac{Your\ Pulse\ Length}{LIDT\ Pulse\ Length}}$$

This adjustment factor results in LIDT values of 0.45 J/cm^2 for the BB1-E01 broadband mirror and 1.6 J/cm^2 for the Nd:YAG laser line mirror, which are to be compared with the 0.7 J/cm^2 maximum energy density of the beam. While the broadband mirror would likely be damaged by the laser, the more specialized laser line mirror is appropriate for use with this system.

Pulsed Nanosecond Laser Example: Scaling for Different Wavelengths

Suppose that a pulsed laser system emits 10 ns pulses at 2.5 Hz, each with 100 mJ of energy at 1064 nm in a 16 mm diameter beam ($1/e^2$) that must be attenuated with a neutral density filter. For a Gaussian output, these specifications result in a maximum energy density of 0.1 J/cm^2. The damage threshold of an NDUV10A Ø25 mm, OD 1.0, reflective neutral density filter is 0.05 J/cm^2 for 10 ns pulses at 355 nm, while the damage threshold of the similar NE10A absorptive filter is 10 J/cm^2 for 10 ns pulses at 532 nm. As described on the previous tab, the LIDT value of an optic scales with the square root of the wavelength in the nanosecond pulse regime:

$$Adjusted\ LIDT = LIDT\ Energy \sqrt{\frac{Your\ Wavelength}{LIDT\ Wavelength}}$$

This scaling gives adjusted LIDT values of 0.08 J/cm^2 for the reflective filter and 14 J/cm^2 for the absorptive filter. In this case, the absorptive filter is the best choice in order to avoid optical damage.

Pulsed Microsecond Laser Example

Consider a laser system that produces 1 µs pulses, each containing 150 µJ of energy at a repetition rate of 50 kHz, resulting in a relatively high duty cycle of 5%. This system falls somewhere between the regimes of CW and pulsed laser induced damage, and could potentially damage an optic by mechanisms associated with either regime. As a result, both CW and pulsed LIDT values must be compared to the properties of the laser system to ensure safe operation.

If this relatively long-pulse laser emits a Gaussian 12.7 mm diameter beam ($1/e^2$) at 980 nm, then the resulting output has a linear power density of 5.9 W/cm and an energy density of 1.2×10^{-4} J/cm^2 per pulse. This can be compared to the LIDT values for a WPQ10E-980 polymer zero-order quarter-wave plate, which are 5 W/cm for CW radiation at 810 nm and 5 J/cm^2 for a 10 ns pulse at 810 nm. As before, the CW LIDT of the optic scales linearly with the laser wavelength, resulting in an adjusted CW value of 6 W/cm at 980 nm. On the other hand, the pulsed LIDT scales with the square root of the laser wavelength and the square root of the pulse duration, resulting in an adjusted value of 55 J/cm^2 for a 1 µs pulse at 980 nm. The pulsed LIDT of the optic is significantly greater than the energy density of the laser pulse, so individual pulses will not damage the wave plate. However, the large average linear power density of the laser system may cause thermal damage to the optic, much like a high-power CW beam.

Hide Shipping List

SHIPPING LIST

The XM-ORC Optical Reference Cavities ship with the following components:

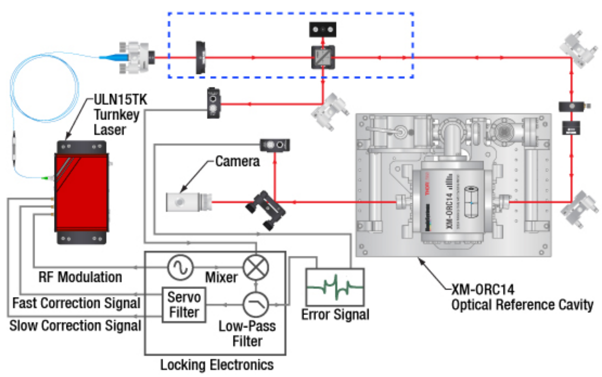
- XM-ORC Stainless Steel Vacuum Chamber with High-Finesse Cavity and Ion Getter Pump
- Ion Getter Pump Controller with Power Supply and Region-Specific Power Cord
- Connection Cable for Ion Getter Pump
- Benchtop Temperature Controller with Region-Specific Power Cord
- Temperature Stabilization Cable
- USB Stick with XM-ORC Manual
- USB Stick with Ion Getter Pump and Controller Manuals

Hide Application

APPLICATION

Laser Stabilization

The XM-ORC high-finesse cavities integrate Thorlabs' low-loss crystalline-coated mirrors into a standardized reference cavity that is mounted in a sealed vacuum housing engineered to provide low frequency drift. The figure to the right shows an example of how the Pound-Drever-Hall (PDH) locking scheme can be used to lock an external laser, such as our ULN15TK turnkey ultra-low noise laser, to the XM-ORC reference cavity, realizing an ultra-stable sub-Hz linewidth laser system. The resulting system is ideal for demanding applications, such as optical clocks and high-resolution spectroscopy.



Click for Details
Experimental Setup for Laser Stabilization

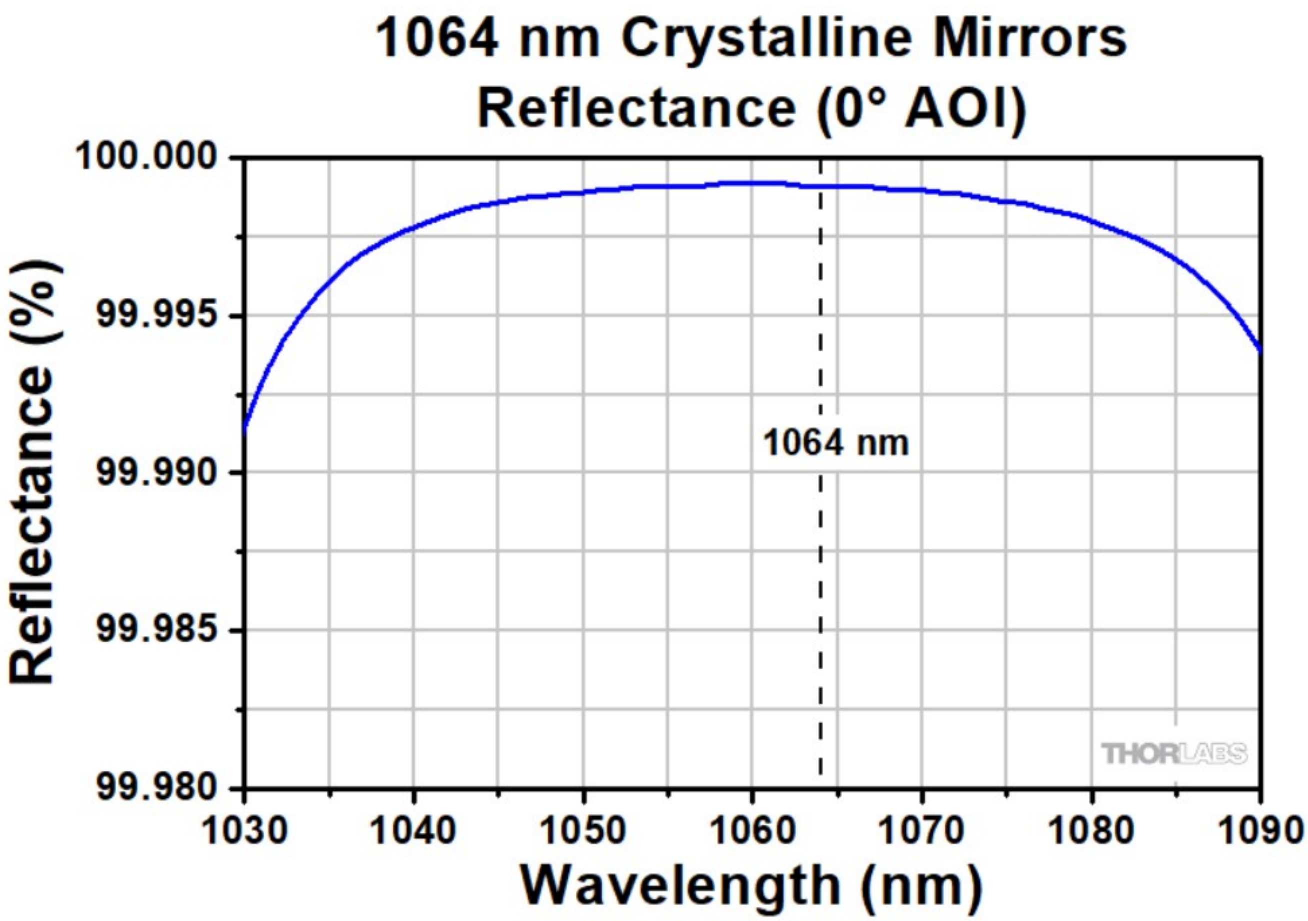
With appropriate locking electronics, direct RF modulation of the laser (or external electro-optic modulation of the laser light) enables PDH sidebands to be generated. Demodulation of the reflected signal from the XM-ORC cavity yields an error signal which can be processed with a servo filter to maintain resonance with the optical cavity. Additional inputs can be used to correct for fast fluctuations and slower temperature-induced drifts.

Hide Optical Reference Cavities with Crystalline Mirrors

Optical Reference Cavities with Crystalline Mirrors

Part Number	Description	Price	Availability
XM-ORC11	Optical Reference Cavity with Crystalline Mirrors, >100 000 Finesse, 1064 nm	$83,234.32	Lead Time
XM-ORC23	Optical Reference Cavity with Crystalline Mirrors, >300 000 Finesse, 1397 nm	$83,234.32	Lead Time

XM-ORC14	**Optical Reference Cavity with Crystalline Mirrors, >300 000 Finesse, 1550 nm**	**$83,234.32**	**Lead Time**



1064 nm Crystalline Mirrors
Reflectance (0° AOI)
100.000
99.995
99.990
99.985
99.980
Reflectance (%)
1030
1040
1050
1060
1070
1080
1090
Wavelength (nm)
1064 nm
THORLABS