

## PHRKIT - September 14, 2023

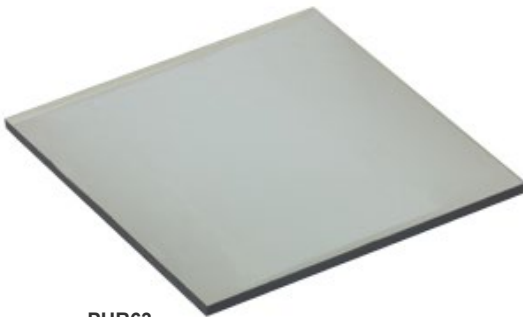
Item # PHRKIT was discontinued on September 14, 2023. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

### HOLOGRAPHY PLATES AND SUPPLIES

- Green- and Red-Sensitive Holography Plates
- Red-Sensitive Developer Chemicals
- 63 mm x 63 mm Plates
- Record Transmission or Reflection Holograms

#### Application Idea

See the *Creating Holograms* Tab for Details



**PHR63**

Pack of 6 Red-Sensitive Holography Plates



**PHRKIT**

Chemical Development Packets for Red-Sensitive Holography Plates



#### OVERVIEW

##### Features

- Holography Plates for 532 nm and 633 nm
- Record Transmission or Reflection Holograms
- All Development Chemicals Available for Red-Sensitive Holograms
- Kits Provide Complete Experimental Setup for Creating Holograms

This page contains Thorlabs' selection of holography plates and developer chemical packets. In addition, we offer a kit that includes plates, developer chemical packets, a laser source, and accessories that are ideal for creating reflection holograms.

##### Holography Plates

Thorlabs' Holography Plates measure 63 mm x 63 mm (2.48" x 2.48") and are available in either green- (532 nm) or red- (633 nm) sensitive formats. These plates are manufactured using sodium silicate glass with one side coated with a sticky emulsion layer and are sold in packs of 6. Upon exposure to red or green laser light, the emulsion will be exposed, and a hologram can be recorded. Please see the *Creating Holograms* tab for suggestions on how to make holograms.

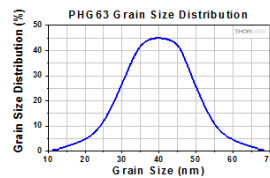
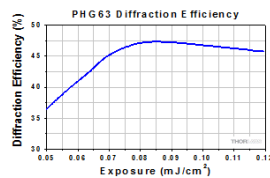
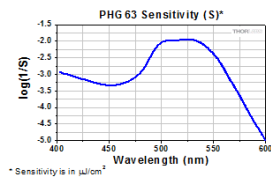
##### Chemicals for Hologram Development

Also available are chemical packets for developing the red-sensitive plates holography plates. This development set includes all the chemicals required to develop 20 red-sensitive holographic plates and only requires deionized or distilled water to create the chemical baths. Directions for mixing the chemicals and processing the holographic plates are provided with the chemicals.

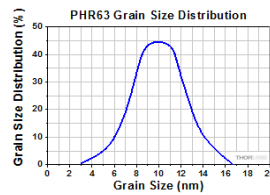
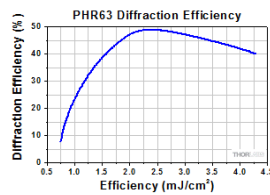
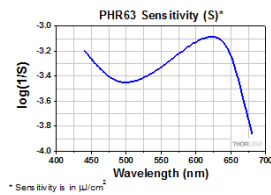
Thorlabs sells lasers, mounts, and optics ideal for making holograms. Recommended options for beginning holography are listed on the *Creating Holograms* tab. Additional options for laser sources, optics, and accessories are listed on the *Other Components* tab. For our red holography plates, we also offer a preselected assortment of items that can be purchased with one click (see the last two product groupings on this page).

## GRAPHS

### PHG63 Green-Sensitive Holography Plate Graphs



### PHR63 Red-Sensitive Holography Plate Graphs



## CREATING HOLOGRAMS

This tutorial offers suggestions for making reflection holograms. While the plates offered by Thorlabs are capable of producing both types of holograms, the plates are optimized for creating reflection holograms.

### Introduction

In traditional photography, a three-dimensional object is reduced to a two-dimensional image; while the camera is capable of recording the amplitude of the light originating at the object, it yields no information about the phase of the waves. If both the phase and amplitude of the light are recorded, then the image would appear to be exactly the same as the original object when viewed under the same light. Holograms are created by illuminating a photographic plate with two coherent beams: one is a reference beam, while the other either reflects off of or diffracts around an object. For each point on the object, the two interfering beams expose a concentric-ring interference pattern onto the holographic plate. Once developed, illumination of the plate with the same wavelength of light used to expose it will produce a virtual holographic image; this image is formed by light diffraction from the light and dark bands on the plate. This virtual image will have the same intensity and phase information as the light originally incident on the object.\*

### Creating Holograms

There are two basic ways to create holograms: through reflection or transmission. These designations refer to how the holography plates are arranged with respect to the object. For reflection holograms, the object and the source are on opposite sides of the plate, while for transmission holograms, the source and the object are on the same side of the plate. Since Thorlabs plates are optimized for the recording of reflection holograms, we will focus on a simple setup for this technique.

### Reflection Holograms

Thorlabs offers several laser sources that can be used to create holograms. For our red-sensitive plates, our 635 nm fiber-coupled laser source (S1FC635) with an FC/PC-terminated patch cable (P1-630A-FC-1) makes a good source. The light will diverge from the end of the fiber and can illuminate the whole plate at once. Other alternate light sources, such as laser diodes or HeNe lasers, can be used; for more details, please see the *Other Components* tab above. A recommended light source for our green-sensitive plates is also listed on the *Other Components* tab.

Figure 1 shows the setup we used to create our holograms. To minimize reflections from the optical table, we placed coins on a matte black surface (e.g., a small piece of TB4 black hardboard). Since holography can suffer greatly from vibrations, it may be beneficial to use our vibration isolation plates (S913B or S913A) along with a sheet of sorbothane (SB12B or SB12A). The light emanating from the fiber tip can be aimed at the plate using our SL20 articulated base. A complete parts list is shown in the table below.

In this configuration, the plate is placed directly next to the object to be imaged, while the laser beam is incident on the other side of the plate. As an initial object, we recommend using coins or another reflective object. In this configuration, the beam directly incident on the plate forms the reference beam, while the beam reflected off of the object interferes with this reference beam to form the interference pattern on the holography plate.

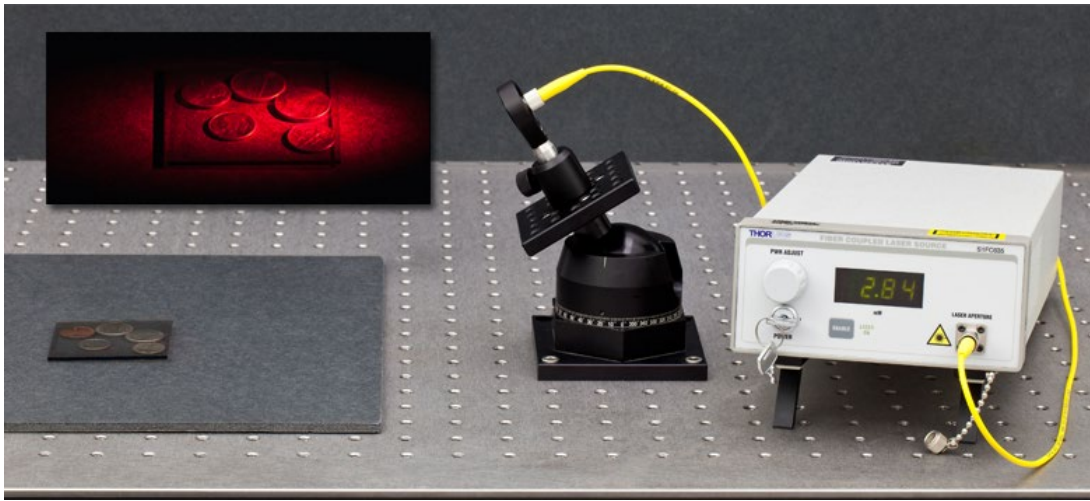


Figure 1: Setup for simple reflection holography, with the holography plate on top of the coins, and the fiber-coupled laser source incident on the plate. The inset shows the laser light incident on the plate with the room darkened.

Imperial Item # <sup>a</sup>	Metric Item # <sup>a</sup>	Description	Quantity
<b>PHR63</b>		Red-Sensitive Holographic Plates, 6 Pack	1
<b>PHRKIT</b>		Chemical Developer for Red-Sensitive Holographic Plates	1
<b>S1FC635</b>		Fabry-Perot Benchtop Laser Source, 635 nm, 2.5 mW, FC/PC	1
<b>P1-630A-FC-1</b>		Fiber Patch Cable, 1 m, 600 - 800 nm, FC/PC	1
<b>SL20</b>	<b>SL20/M</b>	Super Base Mounting Platform, High Precision Ball & Socket Mounting Platform	1
<b>PH1</b>	<b>PH30/M</b>	Post Holder with Spring-Loaded Hex-Locking Thumbscrew, L = 1.00"	1
<b>TR1</b>	<b>TR30/M</b>	Ø1/2" x 1" Stainless Steel Optical Post (Used to Mount LMR1)	1
<b>LMR1</b>	<b>LMR1/M</b>	SM1-Threaded Mount (Used to Hold SM1FC2 Fiber Adapter)	1
<b>SM1FC2</b>		Narrow-Key <sup>b</sup> FC/PC Fiber Adapter with External SM1 (1.035"-40) Thread	1

- a. These items may be purchased with one click below. Please note this part list does not include optional items such as the TB4 hardboard or common lab supplies such as screws.
- b. For details on narrow versus wide key fiber connectors, please see our Intro to Fiber tutorial.

The entire setup should be in a fairly dark room, and any light should be blocked from reaching the holography setup. Set up the object and the laser. Turn on the laser, and adjust the beam direction until it covers the objects. Turn off the laser, and place the holographic plate in position with the emulsion (sticky) side of the plate touching the objects. Then turn on the laser with the "enable" button for between 5 to 10 seconds. Disable the laser output, and process the plate.

### Developing Holograms

The holograms can be developed using either our PHRKIT chemical packets for red-sensitive plates. Instructions for developing the holograms are included with the chemical sets.

### Viewing Reflection Holograms

The reflection holograms can be viewed with a point source of white light, such as from a flashlight, LED, or unfrosted incandescent light bulb (in Figures 2 and 3, we used a small LED array). There are two ways of viewing reflection holograms. The hologram can be illuminated from the front so that light reflects off of the surface and into the viewer's eye. By adjusting the angle of the light, the hologram can be viewed and will be visible with the wavelength used to record the hologram, as can be seen in Figure 2.

The reflection hologram can also be viewed with a point source located so that the light transmits through the plate. Again, the angle of the light source and the viewer will need to be adjusted. The results are shown in Figure 3.

Transmission holograms must be illuminated with the laser used to expose the plates in order for the image to be visible.



Figure 2: A reflection hologram viewed by reflecting light off of the plate.



Figure 3: A reflection hologram viewed by transmitting light through the plate.

\*More information on the theory and history of holograms may be found in Hecht, Eugene, *Optics*, 4th Ed., Addison Wesley, 2002.

## OTHER COMPONENTS

The *Creating Holograms* tab and the Complete Red Reflection Hologram Kit section below suggest a set of components that can be utilized to create reflection holograms. This tab has additional Thorlabs components that can be utilized in the creation of holograms. Thorlabs stocks many other components that could be useful for holography. Our tech support staff is available to answer any questions you may have about configuring a system to record holograms.

### Light Sources for Red-Sensitive Plates

In order to easily create holograms, the laser must have a large enough beam to fill the holographic plate. Since a diverging beam is acceptable, we recommend using our fiber-coupled laser source, since the light will spread broadly from the fiber tip and fill the plate if placed at a sufficient distance. If a collimated laser source is used, we recommend using a lens to diverge the light.

Product Family	Description	Comments
Red HeNe Lasers	633 nm Output with Power Ranging from 0.8 to 22.5 mW	Requires Lens to Diverge Light, Such as LD2060-B
Red Laser Diodes	635 nm Output with Power Ranging from 2.5 mW to 15 mW	Requires Laser Diode Mount and Controller

### Light Sources for Green-Sensitive Plates

For our green-sensitive holography plates, Thorlabs offers two options. A lens is required to diverge the light so that the laser beam fills the plate.

Item #	Description	Comments
DJ532-10	532 nm Output with 10 mW Output	Requires Lens to Diverge Light, Such as LD2060-A as well as Laser Diode Mount and Controller
CPS532	532 nm Laser Diode Module with 4.5 mW Output	Requires Lens to Diverge Light, Such as LD2060-A

### Mounts for Holography Plates

For larger objects where it would be more desirable to have the plate mounted vertically, Thorlabs offers several mounts. For the most stable mounting of the holography plate, the SFH3 filter holder can be used; however, this decreases the clear aperture of the plate to 1.64" (41.7 mm) in the horizontal direction. Our CH2B cylindrical lens mount will allow the entire clear aperture of the plate to be exposed, but the plate may not be as stable, leading to reduced hologram quality. To increase the stability, two CH2B mounts may be used.

## Green Holography Plates



The PHG63 green-sensitive holography plates are designed to be exposed with green laser light near 532 nm. While they can be used for both reflection and transmission holograms, they are ideal for reflection holograms. For details on techniques to make reflection

holograms, please see the *Creating Holograms* tab above. We recommend storing these plates in a refrigerator; the plates have an 18 month shelf life at 4 °C (39.2 °F) and are sold in a pack of 6.

PHG63 Specifications	
Peak Sensitivity	75 $\mu\text{J}/\text{cm}^2$ at 532 nm
Wavelength Range	400 nm - 600 nm
Size (L x H x W)	63.0 mm x 63.0 mm x 2.0 mm (2.48" x 2.48" x 0.08")
Clear Aperture	90% of Height and Length
Resolution	>3000 Lines/mm
Diffraction Efficiency	>40%
Grain Size	40 nm
Number of Plates	6
Shelf Life at 4 °C (39.2 °F)	18 Months

Part Number	Description	Price	Availability
PHG63	Green-Sensitive Holography Plates, 63 mm x 63 mm, 6 Pack	\$47.74	Today

### Red Holography Plates and Chemical Developer



The PHR63 red-sensitive holography plates are designed to be exposed with red laser light near 633 nm. While they can be used for both reflection and transmission holograms, they are ideal for reflection holograms. For details on techniques to make both reflection holograms, please see the *Creating Holograms* tab above. We recommend storing these plates in a refrigerator; the plates have a 12 month shelf life at 4 °C (39.2 °F) and are

sold in a pack of 6.

In addition to the plates, Thorlabs also offers the PHRKIT chemical developer packets. The chemicals come in seven packets and must be mixed with distilled or deionized water. Three 1 liter glass or plastic bottles, 2 small (just large enough to hold the holographic plate) glass or plastic trays, and 2 large (capable of holding 1 liter) plastic or glass trays are required for mixing the chemicals and must be provided by the user. The mixed chemicals may be stored in tightly sealed bottles and will last for several months. The chemicals should be carefully labeled as not safe for consumption and should not be stored near food.

Specifications	
Peak Sensitivity	1.5 - 2.0 $\text{mJ}/\text{cm}^2$ at 633 nm
Wavelength Range	500 nm - 690 nm
Size (L x H x W)	63.0 mm x 63.0 mm x 2.0 mm (2.48" x 2.48" x 0.08")
Clear Aperture	90% of Height and Length
Resolution	>5000 Lines/mm
Diffraction Efficiency	>45%
Grain Size	8 - 12 nm
Number of Plates	6
Shelf Life at 4 °C (39.2 °F)	12 Months

Please note that the PHRKIT is classified as a dangerous good in some countries. Depending on the delivery location, this item may need to be shipped separately from the rest of your order at an additional charge. Please contact our sales department if there are questions or concerns when placing an order for this item.

Part Number	Description	Price	Availability
PHR63	Red-Sensitive Holography Plates, 63 mm x 63 mm, 6 Pack	\$47.74	Lead Time
PHRKIT	Chemical Development Packets for PHR63 Holographic Plates	\$41.64	Today

### Complete Red Reflection Hologram Kit, Imperial

The items in the table below are Thorlabs' recommendations to create reflection holograms using flat, thin objects (such as coins), as described on the *Creating Holograms* tab above. There are many other options for laser sources, mounts, and optics that can be used for additional holography configurations. Please see the *Other Components* tab for more details.

Please see the *Creating Holograms* tab for suggested optional items not included in this kit. Common lab supplies, such as screws, are also not included in the kit.

To order the complete Red Holography Kit in the recommended quantities, please click the "Add Kit" button at the bottom of the Ordering Area. If you desire to remove an item from the kit (for example, if you already own the component), simply change the value in the "QTY" box to 0. Quantities of a given item may also be increased. Once you have adjusted the quantities, press the "Add Kit" button to upload all of the requested products to your shopping cart at once.

Part Number	Description	Price	Availability
PHR63	Red-Sensitive Holography Plates, 63 mm x 63 mm, 6 Pack	\$47.74	Lead Time
PHRKIT	Chemical Development Packets for PHR63 Holographic Plates	\$41.64	Today
S1FC635	Fabry-Perot Benchtop Laser Source, 635 nm, 2.5 mW, FC/PC	\$1,631.65	7-10 Days
P1-630A-FC-1	Single Mode Patch Cable, 633 - 780 nm, FC/PC, Ø3 mm Jacket, 1 m Long	\$78.73	Today
SM1FC2	FC/PC Fiber Adapter Plate with External SM1 (1.035"-40) Threads, Narrow Key (2.0 mm)	\$33.77	Today
SL20	Articulating Base Ball Stage, High Precision Ball & Socket Mounting Platform	\$344.74	Today
PH1	Ø1/2" Post Holder, Spring-Loaded Hex-Locking Thumbscrew, L = 1"	\$8.17	Today
TR1	Ø1/2" Optical Post, SS, 8-32 Setscrew, 1/4"-20 Tap, L = 1"	\$5.38	Today
LMR1	Lens Mount with Retaining Ring for Ø1" Optics, 8-32 Tap	\$16.47	Today

### Complete Red Reflection Hologram Kit, Metric

The items in the table below are Thorlabs' recommendations to create reflection holograms using flat, thin objects (such as coins), as described on the *Creating Holograms* tab above. There are many other options for laser sources, mounts, and optics that can be used for additional holography configurations. Please see the *Other Components* tab for more details.

Please see the *Creating Holograms* tab for suggested optional items not included in this kit. Common lab supplies, such as screws, are also not included in the kit.

To order the complete Red Holography Kit in the recommended quantities, please click the "Add Kit" button at the bottom of the Ordering Area. If you desire to remove an item from the kit (for example, if you already own the component), simply change the value in the "QTY" box to 0. Quantities of a given item may also be increased. Once you have adjusted the quantities, press the "Add Kit" button to upload all of the requested products to your shopping cart at once.

Part Number	Description	Price	Availability
SL20/M	Articulating Base Ball Stage, High Precision Ball & Socket Mounting Platform, Metric	\$344.74	Today
PH30/M	Ø12.7 mm Post Holder, Spring-Loaded Hex-Locking Thumbscrew, L=30 mm	\$8.17	Today
TR30/M	Ø12.7 mm Optical Post, SS, M4 Setscrew, M6 Tap, L = 30 mm	\$5.38	Today
LMR1/M	Lens Mount with Retaining Ring for Ø1" Optics, M4 Tap	\$16.47	Today
PHR63	Red-Sensitive Holography Plates, 63 mm x 63 mm, 6 Pack	\$47.74	Lead Time
PHRKIT	Chemical Development Packets for PHR63 Holographic Plates	\$41.64	Today
S1FC635	Fabry-Perot Benchtop Laser Source, 635 nm, 2.5 mW, FC/PC	\$1,631.65	7-10 Days
P1-630A-FC-1	Single Mode Patch Cable, 633 - 780 nm, FC/PC, Ø3 mm Jacket, 1 m Long	\$78.73	Today
SM1FC2	FC/PC Fiber Adapter Plate with External SM1 (1.035"-40) Threads, Narrow Key (2.0 mm)	\$33.77	Today