

## R3L3S4P1 - April 4, 2018

Item # R3L3S4P1 was discontinued on April 4, 2018. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

### GRID DISTORTION TEST TARGETS

- ▶ Test Targets Help Identify Distortion in Imaging Systems
- ▶ Grid Spacings Available from 10  $\mu\text{m}$  to 2000  $\mu\text{m}$
- ▶ Combined Resolution and Distortion Targets Available

**R1L3S3P**  
 Multi-Frequency Grid  
 Distortion Target



**R1L3S5P**  
 Combined Resolution and  
 Distortion Test Target



**R2L2S3P4**  
 Fixed Frequency Grid  
 Distortion Target



**R1L1S1N**  
 Combined Resolution and  
 Distortion Test Target

[Hide Overview](#)

#### OVERVIEW

##### Features

- Fixed and Multi-Frequency Grid Distortion Test Targets
- Combined Resolution and Distortion Test Targets
- Distortion in Grid Image Allows for Image Correction
- Grids Available with Spacings of 10  $\mu\text{m}$  to 2000  $\mu\text{m}$

Thorlabs offers a variety of options for measuring the distortion of an optical system including targets with a single-frequency grid, multi-frequency grids, or distortion grids alongside a wide variety of other patterns for resolution measurement, calibration, and more. Combined, these targets offer grid spacings ranging from 10  $\mu\text{m}$  to 2000  $\mu\text{m}$ .

Each target is made from a soda lime glass substrate with vacuum-sputtered, low-reflectivity chrome in patterns of either horizontal and vertical lines or rows and columns of solid circles. Each pattern is manufactured using photolithography, allowing for edge features to be resolved down to approximately 1  $\mu\text{m}$ . Because the lines or rows and columns are perpendicular, they will be imaged as such by an ideal system. A distorted image will show the lines or rows and columns as bowed; this image allows the user to quantify the distortion and thus to correct for it using software built into programs such as LabVIEW or ImageJ.

##### Mounting

These distortion test targets can be mounted in one of four of our microscopy slide holders. Our MAX3SLH fixed slide holder provides two spring clips to



##### General Specifications

General Specifications	
<b>Chrome Thickness</b>	0.120 $\mu\text{m}$
<b>Chrome Optical Density</b>	OD $\geq 3$ at 430 nm
<b>Substrate Thickness</b>	0.06" (1.5 mm)
<b>Surface Flatness</b>	<5 $\mu\text{m}$
<b>Line Spacing Tolerance<sup>a</sup></b>	$\pm 1 \mu\text{m}$
<b>Line Width Tolerance<sup>a</sup></b>	$\pm 0.5 \mu\text{m}$
<b>Substrate</b>	Soda Lime Glass

- This tolerance is valid for the mask used to create these targets and may differ minimally for the targets themselves.

mount the optic and can be mounted to any of our 3-axis translation stages; this slide holder is only compatible with test targets greater than or equal to 2" wide and provides a clear aperture of 1", which may cover the chrome pattern on some of the test targets. Thorlabs also offers our XYFM1(M) test target positioning mount (see photo above), which is capable of translating a 1" (25.4) to 3" (76.2 mm) wide rectangular target over a 50 mm (1.97") x 30 mm (1.18") area. An adapter on the back of the mount contains five 8-32 (M4) taps for various post-mountable orientations. The XYFM1 uses nylon-tipped setscrews to secure the optic. This will slightly cover the edges of the optic and can, in some instances, cover the chrome pattern on test targets. For users of the MLS203 microscopy stage, we offer the MLS203P2 slide holder for inverted microscopes, which can mount slides that measure 25 mm to 26.5 mm in width and petri dishes that measure 30 mm to 60 mm in diameter.

Targets Selection Guide			
Resolution Test Targets	Distortion Test Targets	Slant Edge MTF Resolution Test Targets	Calibration Targets

[Hide Custom Targets](#)

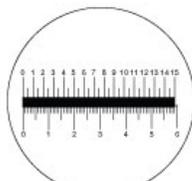
## CUSTOM TARGETS

### Custom Test Targets

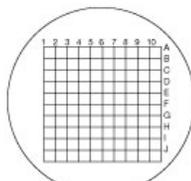
Thorlabs has extensive design and production capabilities for test targets and reticles. All of our test targets, stage micrometers, distortion grids, and reticles are manufactured in-house at our Thorlabs Quantum Electronics (TQE) division in Jessup, Maryland. In addition to the test targets that are offered from stock, we can provide custom patterns and sizes (circular, square, and rectangular), a sample of which are shown below. Please note that there is a significant tooling cost and lead time for custom test target patterns that makes the purchase of only a few pieces fairly costly.

We are also able to provide versions of our stock target patterns with an AR coating on the substrate or a higher or lower optical density. While most of our targets are sold from stock on soda lime glass, we are able to provide patterns on other substrates, such as opal.

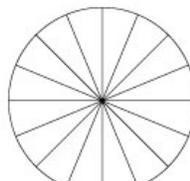
For more information about our photolithography production, please see our presentation on Thorlabs Semiconductor Manufacturing Capabilities. For a quote on custom test targets, please contact Tech Support.



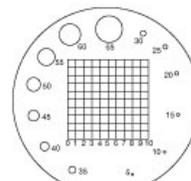
Micrometers



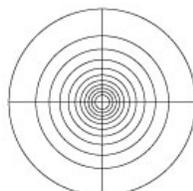
Grids



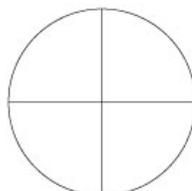
Protractors



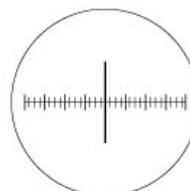
Pinholes



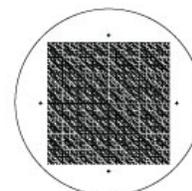
Concentric Circles



Crosshairs



Scales



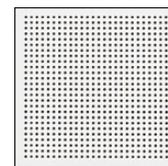
Binary Tests

[Hide Fixed Frequency Grid Distortion Targets. 1.5" x 1.5"](#)

### Fixed Frequency Grid Distortion Targets, 1.5" x 1.5"

- ▶ One Grid Array on a 1.5" x 1.5" (38.1 mm x 38.1 mm) Soda Lime Glass Substrate
- ▶ 125  $\mu\text{m}$ , 250  $\mu\text{m}$ , 500  $\mu\text{m}$ , or 1000  $\mu\text{m}$  Grid Spacings
- ▶  $\text{\O}62.5 \mu\text{m}$ ,  $\text{\O}125 \mu\text{m}$ ,  $\text{\O}250 \mu\text{m}$ , or  $\text{\O}500 \mu\text{m}$  Dots
- ▶ Ideal for Machine Vision Applications of Stage Calibration and Distortion Detection

These distortion grid arrays each feature a single 25.0 mm x 25.0 mm (0.98" x 0.98") grid of dots fabricated from the deposition of vacuum-sputtered, low-reflectivity chrome on a soda lime glass substrate. The available grid spacings, which are measured from the center of any dot to the center of any adjacent dot, range from 125  $\mu\text{m}$  to 1000  $\mu\text{m}$ , and the dot diameters range from 62.5  $\mu\text{m}$  to 500  $\mu\text{m}$ .



Click to Enlarge  
A Close Up of the Dot  
Pattern on the  
R2L2S3P4 Target



Click to Enlarge  
An R2L2S3P3 Target  
Post Mounted via an  
FFM1 Filter Mount and  
a B3C Cube Base for  
Use in a Custom

Grid arrays are used to determine the distortion of an imaging system. Ideally, the horizontal and vertical rows of dots should be perpendicular to each other. A distorted image will show the array as bowed; this image can then be used to correct for distortion.

Item #	Spacing <sup>a</sup>	Spacing Tolerance	Dot Size	Dot Size Tolerance	Pattern Size <sup>b</sup>	Pattern Size Tolerance	Pattern Optical Density	Substrate Size
R2L2S3P1	125 $\mu\text{m}$	$\pm 1 \mu\text{m}$	$\varnothing 62.5 \mu\text{m}$	$\pm 2 \mu\text{m}$	25.0 mm x 25.0 mm (0.98" x 0.98")	$\pm 4 \mu\text{m}$	OD $\geq 3$ at 430 nm	1.5" x 1.5" x 0.06" (38.1 mm x 38.1 mm x 1.5 mm)
R2L2S3P2	250 $\mu\text{m}$		$\varnothing 125 \mu\text{m}$					
R2L2S3P3	500 $\mu\text{m}$		$\varnothing 250 \mu\text{m}$					
R2L2S3P4	1000 $\mu\text{m}$		$\varnothing 500 \mu\text{m}$					

- Measured from the center of any dot to the center of any adjacent dot.
- Measured from corner to corner on the grid array.

Part Number	Description	Price	Availability
R2L2S3P1	Customer Inspired!Grid Distortion Target, 1.5" x 1.5", 125 $\mu\text{m}$ Grid Spacing	\$390.66	Today
R2L2S3P2	Customer Inspired!Grid Distortion Target, 1.5" x 1.5", 250 $\mu\text{m}$ Grid Spacing	\$333.54	Today
R2L2S3P3	Customer Inspired!Grid Distortion Target, 1.5" x 1.5", 500 $\mu\text{m}$ Grid Spacing	\$286.62	Today
R2L2S3P4	Customer Inspired!Grid Distortion Target, 1.5" x 1.5", 1000 $\mu\text{m}$ Grid Spacing	\$260.10	Today

#### [Hide Multi-Frequency Grid Distortion Target, 3" x 1"](#)

### Multi-Frequency Grid Distortion Target, 3" x 1"

- ▶ Four Grid Arrays on a 3" x 1" (76.2 mm x 25.4 mm) Soda Lime Glass Slide
- ▶ 10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 100  $\mu\text{m}$ , and 500  $\mu\text{m}$  Grid Spacings
- ▶ Ideal for Microscopy Applications of Stage Calibration and Distortion Detection
- ▶ Same Outer Dimensions as a Standard Microscope Slide



Click to Enlarge  
Close Up of the Four Grid  
Patterns on the R1L3S3P  
Target

The R1L3S3P grid distortion target features four arrays of horizontal and vertical lines spaced 10  $\mu\text{m}$ , 50  $\mu\text{m}$ , 100  $\mu\text{m}$ , and 500  $\mu\text{m}$  apart. This pattern is fabricated from the deposition of vacuum-sputtered, low-reflectivity chrome with an optical density (OD) of  $\geq 3$  at 430 nm on a 3" x 1" x 0.06" (76.2 mm x 25.4 mm x 1.5 mm) soda lime glass substrate. The dimensions of the glass substrate are the same as a standard microscope slide.

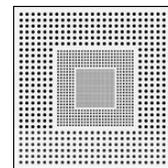
Grid arrays are used to determine the distortion of an imaging system. Ideally, the horizontal and vertical lines of the grid should be perpendicular to each other. A distorted image will show the lines as bowed; this image can then be used to correct for distortion.

Part Number	Description	Price	Availability
R1L3S3P	Grid Distortion Target, 3" x 1", 10, 50, 100, and 500 $\mu\text{m}$ Grid Spacings	\$234.60	Lead Time

#### [Hide Concentric Multi-Frequency Grid Distortion Target, 3" x 3"](#)

### Concentric Multi-Frequency Grid Distortion Target, 3" x 3"

- ▶ Three Grid Arrays on a 3.00" x 3.00" (76.2 mm x 76.2 mm) Soda Lime Glass Substrate
- ▶ Grid Spacings Between 500 and 2000  $\mu\text{m}$
- ▶ Dot Diameters Between 250 and 1000  $\mu\text{m}$
- ▶ Ideal for Machine Vision Applications of Stage Calibration and Distortion Detection



Click to Enlarge  
Close Up of the Three  
Grid Patterns on the  
R3L3S4P1

The R3L3S4P1 multi-frequency grid distortion target features grids of dots arranged as concentric squares with varying spacings between the dots. The low-reflectivity, vacuum-sputtered chrome pattern is available with grid spacings, i.e. distances from the center of a dot to any adjacent dot, of three different sizes (500, 1000, and 2000  $\mu\text{m}$ ). The pattern is offered on a 3.00" x 3.00" x 0.06" (76.2 mm x 76.2 mm x 1.5 mm) soda lime glass substrate.

Grid arrays are used to determine the distortion of an imaging system. Ideally, the horizontal and vertical rows of dots should be perpendicular to each other. A distorted image will show the array as bowed; this image can then be used to correct for distortion.

a	b	c

Item #	Grid Spacing	Dot Diameters	Pattern Size	Pattern Optical Density	Substrate	Thickness
R3L3S4P1	500, 1000, and 2000 $\mu\text{m}$	250, 500, and 1000 $\mu\text{m}$	50 mm x 50 mm	OD $\geq 3$ at 430 nm	Soda Lime Glass	0.06" (1.5 mm)

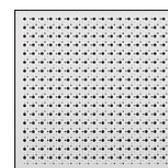
- Measured from the center of any dot to the center of any adjacent dot.
- Dot diameters are listed in order with respect to their corresponding grid spacings.
- Measured from corner to corner on the grid array.

Part Number	Description	Price	Availability
R3L3S4P1	Grid Distortion Target, 3" x 3", 500 to 2000 $\mu\text{m}$ Grid Spacings, Soda Lime	\$312.12	Lead Time

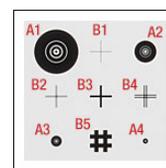
[Hide Concentric Circle and Crosshair Grid Target, 3" x 3"](#)

### Concentric Circle and Crosshair Grid Target, 3" x 3"

- ▶ Concentric Circles and Crosshair Patterns Arranged in a Grid
- ▶ Four Different Concentric Circle Sizes and Five Different Crosshair Sizes
- ▶ Measure Resolution and Distortion of an Imaging System
- ▶ 3" x 3" (76.2 mm x 76.2 mm) Soda Lime Glass Substrate



Click to Enlarge  
Close Up of Entire  
Pattern on the  
R3L3S5P Target



Click to Enlarge  
Close Up of the Smaller  
Grid on the R3L3S5P  
Target with Labels  
Added (See Tables  
Below)

Thorlabs' 3" x 3" (76.2 mm x 76.2 mm) Concentric Circle and Crosshair Grid Target offers 289 individual grids, arranged in a larger, 2" x 2" grid of 17 rows and 17 columns. The smaller grids each have four concentric circle patterns and five crosshair patterns of varying sizes. The concentric circle and crosshair patterns on the smaller grids are labeled in the image to the right but not on the target itself. Each concentric circle pattern features seven different radii, while the crosshairs each have a single or a double cross. For details on the dimensions of these patterns, see the tables below.

The pattern on this target is made from low-reflectivity, vacuum-sputtered chrome deposited on a 0.6" (1.5 mm) thick soda lime glass substrate to achieve an optical density of  $\geq 3$ . The dark pattern and clear substrate are useful for front-lit and general applications.

Concentric Circles							
Circle Pattern <sup>a</sup>	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>
A1	31.3 $\mu\text{m}$	62.5 $\mu\text{m}$	125 $\mu\text{m}$	140.6 $\mu\text{m}$	234.4 $\mu\text{m}$	242.2 $\mu\text{m}$	500 $\mu\text{m}$
A2	15.6 $\mu\text{m}$	31.3 $\mu\text{m}$	62.5 $\mu\text{m}$	70.3 $\mu\text{m}$	117.2 $\mu\text{m}$	121.1 $\mu\text{m}$	250 $\mu\text{m}$
A3	7.8 $\mu\text{m}$	15.6 $\mu\text{m}$	31.3 $\mu\text{m}$	35.2 $\mu\text{m}$	58.6 $\mu\text{m}$	60.5 $\mu\text{m}$	125 $\mu\text{m}$
A4	3.9 $\mu\text{m}$	7.8 $\mu\text{m}$	15.6 $\mu\text{m}$	17.6 $\mu\text{m}$	29.3 $\mu\text{m}$	30.3 $\mu\text{m}$	62.5 $\mu\text{m}$

- As indicated by the photo above and to the right.

Crosshairs			
Crosshair Pattern <sup>a</sup>	Single or Double Line	Length/Width	Line Width <sup>b</sup>
B1	Double	500 $\mu\text{m}$	6.25 $\mu\text{m}$
B2	Double	500 $\mu\text{m}$	12.5 $\mu\text{m}$
B3	Single	500 $\mu\text{m}$	50 $\mu\text{m}$
B4	Double	500 $\mu\text{m}$	25 $\mu\text{m}$
B5	Double	500 $\mu\text{m}$	100 $\mu\text{m}$

- As indicated by the photo above and to the right.
- The line width is equal to the spacing between the lines.

Part Number	Description	Price	Availability
R3L3S5P	Concentric Circle and Crosshair Grid Target, 3" x 3"	\$520.20	Lead Time

[Hide Combined Resolution and Distortion Test Targets, 18 mm x 18 mm](#)

### Combined Resolution and Distortion Test Targets, 18 mm x 18 mm

- ▶ Determine Resolution of an Optical System
- ▶ Measure Image Distortion, Astigmatism, and Other Aberrations
- ▶ 18 mm (0.71") Square, 1.5 mm Thick Soda Lime Substrate
- ▶ Includes 1951 USAF Pattern, Sector Star, Concentric Circles, Grids, and Ronchi Rulings
- ▶ Positive and Negative Patterns Available



Click to Enlarge  
Microscope Image of

Thorlabs offers positive and negative 18 mm x 18 mm x 1.5 mm combined resolution / distortion test targets that are made by plating the R1S1L1N Negative Test Target vacuum-sputtered, low-reflectivity chrome with an optical density (OD) of  $\geq 3$  at 430 nm on a soda lime glass substrate. They are ideal for calibration of imaging systems and microscope stages.

The test targets include a 1951 USAF pattern (Groups 2 - 7), a sector star, concentric circles, grids (100  $\mu\text{m}$ , 50  $\mu\text{m}$ , and 10  $\mu\text{m}$ ), and Ronchi rulings (30 - 150 lp/mm). These targets are useful for testing resolution, field distortion, focus errors, and astigmatism. The USAF 1951 targets are useful for measuring imaging resolution. The grids can be used to measure image distortion, while the concentric circles are ideal for identifying focus errors, astigmatism, and other aberrations existing in an imaging system. The Ronchi rulings are excellent for evaluating resolution, field distortion, and parfocal stability. For more information, please see our Resolution Targets page.

These resolution targets are offered in positive and negative versions. The R1L1S1P positive target consists of a chrome pattern plated on to a clear substrate and is useful for front-lit and general applications. Alternatively, the R1L1S1N negative target uses the same chrome coating to cover the substrate, leaving the pattern itself clear, and works well in back-lit and highly illuminated applications.

Target Feature	Details	Target Feature	Details
<b>1951 USAF Target</b>	Groups 2 - 7	<b>Concentric Circles</b>	10 Circles with Radii from 100 $\mu\text{m}$ to 1000 $\mu\text{m}$ in 100 $\mu\text{m}$ Intervals, Labeled 1 to 10
<b>Grids</b>	20 x 20 Arrays with 100 $\mu\text{m}$ , 50 $\mu\text{m}$ , and 10 $\mu\text{m}$ Pitch	<b>Ronchi Rulings</b>	13 Rulings from 30 lp/mm <sup>a</sup> to 150 lp/mm in 10 lp/mm Intervals
<b>Sector Star</b>	36 Bars through 360°, 10 $\mu\text{m}$ Radius Center Circle, and Ten Concentric Circles with Radii from 50 $\mu\text{m}$ to 500 $\mu\text{m}$ in 50 $\mu\text{m}$ Intervals		

- Line Pairs per Millimeter

Part Number	Description	Price	Availability
R1L1S1P	Customer Inspired!Positive Combined Resolution and Distortion Test Target, 18 mm Square	\$504.90	Today
R1L1S1N	Customer Inspired!Negative Combined Resolution and Distortion Test Target, 18 mm Square	\$504.90	Today

[Hide Combined Resolution and Distortion Test Target, 3" x 1"](#)

### Combined Resolution and Distortion Test Target, 3" x 1"

- ▶ 3" x 1" (76.2 mm x 25.4 mm) Soda Lime Substrate
- ▶ Includes NBS 1963A Pattern, Sector Star, Concentric Circles, Grids, Ronchi Rulings, and More (See Table Below)
- ▶ Determine Resolution of an Optical System
- ▶ Measure Image Distortion, Astigmatism, and Other Aberrations
- ▶ Compatible with our MLS203 Microscope Stages via MLS203P2 Slide Holder

Frequencies of NBS 1963A (cycles/mm)

• 4.5	• 10	• 23	• 51	• 114
• 5	• 11	• 25	• 57	• 128
• 5.6	• 12.5	• 29	• 64	• 144
• 6.3	• 14	• 32	• 72	• 161
• 7.1	• 16	• 36	• 81	• 181
• 8	• 18	• 40	• 91	• 203
• 9	• 20	• 45	• 102	• 228

Thorlabs offers positive 3" x 1" x 0.06" (76.2 mm x 25.4 mm x 1.5 mm) combined resolution / distortion test targets that are made by plating vacuum-sputtered, low-reflectivity chrome with an optical density (OD) of  $\geq 3$  at 430 nm on a soda lime glass substrate. They are ideal for calibration of imaging systems and microscope stages. They are sized to fit in our MLS203P2 stage slide holder for use with our MLS203 microscope stages.

The test targets include an NBS 1963A pattern, a sector (Siemens) star, concentric circles, grids, Ronchi rulings, and more (see table below). These targets are useful for testing resolution, field distortion, focus errors, and astigmatism. The NBS 1963A, sector star, and concentric circle targets are useful for measuring imaging resolution. The grids can be used to measure the distortion introduced by an imaging system. The Ronchi rulings are excellent for evaluating resolution, field distortion, and parfocal stability. For more information, please see our Resolution Targets page.

Target Feature	Details	Target Feature	Details
<b>NBS 1963A</b>	Frequencies from 4.5 cycles/mm to 228 cycles/mm (See List Above)	<b>Concentric Circles</b>	10 Circles with Radii from 100 $\mu\text{m}$ to 1000 $\mu\text{m}$ in 100 $\mu\text{m}$ Intervals
<b>Distortion Grid (Squares)</b>	3 Grids: 100 lp/mm <sup>a</sup> , 150 lp/mm, 200 lp/mm	<b>Fixed Ronchi Rulings</b>	3 Rulings:100 lp/mm, 150 lp/mm, and 200 lp/mm
<b>Distortion Grid (Dots)</b>	3 Grids: 400 $\mu\text{m}$ Pitch of $\varnothing 80 \mu\text{m}$ Dots, 200 $\mu\text{m}$ Pitch of $\varnothing 40 \mu\text{m}$ Dots, 100 $\mu\text{m}$ Pitch of $\varnothing 20 \mu\text{m}$ Dots	<b>Variable Ronchi Rulings</b>	20 Rulings (Each 1 mm x 1 mm): 10 lp/mm to 200 lp/mm in 10 lp/mm Intervals

<b>Two-Point Resolution Dots</b>	Ø25 µm, Ø20 µm, Ø15 µm, Ø12.5 µm, Ø10 µm, Ø7.5 µm, and Ø5 µm	<b>Pinholes</b>	Ø25 µm, Ø20 µm, Ø15 µm, Ø12.5 µm, Ø10 µm, Ø7.5 µm, and Ø5 µm
<b>Interdigitated Lines</b>	6.25 lp/mm, 12.5 lp/mm, 25 lp/mm, 50 lp/mm, 100 lp/mm, and 200 lp/mm	<b>Micrometers</b>	3 Rulers: 10 mm Scale with 50 µm Divs, 1 mm Scale with 10 µm Divs, and 1mm x 1 mm XY Scale with 50 µm Divs
<b>Sector Star</b>	36 Bars through 360°, 50 µm Radius Center Circle, and Ten Concentric Circles with Radii from 100 µm to 500 µm in 50 µm Intervals		

- The unit lp/mm is line pairs per millimeter.

Part Number	Description	Price	Availability
R1L3S5P	Customer Inspired!Positive Combined Resolution and Distortion Test Target, 3" x 1"	\$936.36	Lead Time