

R3L3S4P1-O - February 22, 2018

Item # R3L3S4P1-O was discontinued on February 22, 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 μm to 2000 μm
- ▶ Combined Resolution and Distortion Targets Available



R3L3S4P2-O
 Concentric Multi-Frequency
 Grid Distortion Target



R1L3S3P
 Multi-Frequency Grid
 Distortion 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 μm to 2000 μm
- Options Available on Soda Lime or White-Flashed Opal Substrates



Click to Enlarge
 An R1L3S5P Combined
 Resolution and Distortion
 Test Target Mounted in an
 XYFM1 Test Target
 Positioner

General Specifications		
Substrate	Soda Lime	Opal
Chrome Thickness	0.120 μm	
Chrome Optical Density	OD ≥ 3 at 430 nm	
Substrate Thickness	0.06" (1.5 mm)	0.12" (3.1 mm)
Surface Flatness	<5 μm	3 λ @ 632.8 nm
Line Spacing Tolerance ^a	$\pm 1 \mu\text{m}$	
Line Width Tolerance ^a	$\pm 0.5 \mu\text{m}$	

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

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 μm to 2000 μm .

Each target is made from either a soda lime glass or a white-flashed opal 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 μm . 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 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](#)

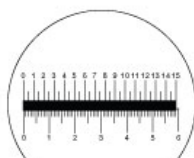
CUSTOM TARGETS

Custom Test Targets

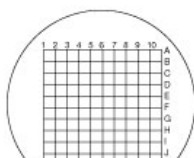
Thorlabs has extensive design and production capabilities for test targets and reticles. All of our test targets, stage micrometers, distortion grids, and reticles are manufactured in-house at our Thorlabs Quantum Electronics (TQE) division in Jessup, Maryland. In addition to the test targets that are 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.

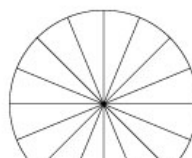
For more information about our photolithography production, please see our presentation on Thorlabs Semiconductor Manufacturing Capabilities. For a quote on custom test targets, please contact Tech Support.



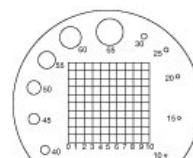
Micrometers



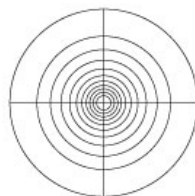
Grids



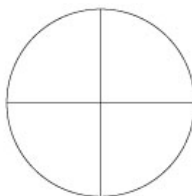
Protractors



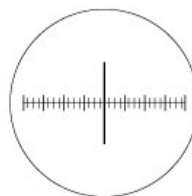
Pinholes



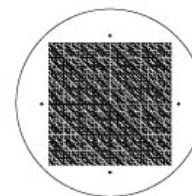
Concentric Circles



Crosshairs



Scales

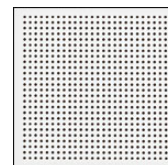


Binary Tests

[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 μm , 250 μm , 500 μm , or 1000 μm Grid Spacings
- ▶ \varnothing 62.5 μm , \varnothing 125 μm , \varnothing 250 μm , or \varnothing 500 μm 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 μm to 1000 μm , and the dot diameters range from 62.5 μm to 500 μm .

[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
Imaging System](#)

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 ^a	Spacing Tolerance	Dot Size	Dot Size Tolerance	Pattern Size ^b	Pattern Size Tolerance	Pattern Optical Density	Substrate Size
R2L2S3P1	125 μm	$\pm 1 \mu\text{m}$	$\varnothing 62.5 \mu\text{m}$	$\pm 2 \mu\text{m}$	25.0 mm x 25.0 mm (0.98" x 0.98")	$\pm 4 \mu\text{m}$	OD ≥ 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 μm		$\varnothing 125 \mu\text{m}$					
R2L2S3P3	500 μm		$\varnothing 250 \mu\text{m}$					
R2L2S3P4	1000 μm		$\varnothing 500 \mu\text{m}$					

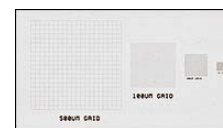
- Measured from the center of any dot to the center of any adjacent dot.
- Measured from corner to corner on the grid array.

Part Number	Description	Price	Availability
R2L2S3P1	Customer Inspired!Grid Distortion Target, 1.5" x 1.5", 125 μm Grid Spacing	\$390.66	Today
R2L2S3P2	Customer Inspired!Grid Distortion Target, 1.5" x 1.5", 250 μm Grid Spacing	\$333.54	Today
R2L2S3P3	Customer Inspired!Grid Distortion Target, 1.5" x 1.5", 500 μm Grid Spacing	\$286.62	Today
R2L2S3P4	Customer Inspired!Grid Distortion Target, 1.5" x 1.5", 1000 μm 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 μm , 50 μm , 100 μm , and 500 μm 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 μm , 50 μm , 100 μm , and 500 μm apart. This pattern is fabricated from the deposition of vacuum-sputtered, low-reflectivity chrome with an optical density (OD) of ≥ 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.

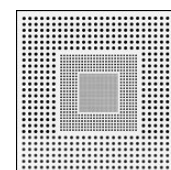
Grid arrays are used to determine the distortion of an imaging system. Ideally, the horizontal and vertical lines of the grid should be perpendicular to each other. A distorted image will show the lines as bowed; this image can then be used to correct for distortion.

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

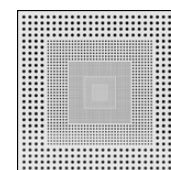
[Hide Concentric Multi-Frequency Grid Distortion Targets, 3" x 3"](#)

Concentric Multi-Frequency Grid Distortion Targets, 3" x 3"

- ▶ Three or Five Grid Arrays on a 3.00" x 3.00" (76.2 mm x 76.2 mm) Substrate
- ▶ Available on Soda Lime Glass or White-Flashed Opal
- ▶ Grid Spacings Between 125 and 2000 μm
- ▶ Dot Diameters Between 62.5 and 1000 μm
- ▶ Ideal for Machine Vision Applications of Stage Calibration and Distortion Detection



[Click to Enlarge
Close Up of the Three
Grid Patterns on the
R3L3S4P1-O](#)



[Click to Enlarge
Close Up of the Five
Grid Patterns on the
R3L3S4P2-O](#)

These multi-frequency grid distortion targets each feature grids of dots arranged as concentric squares with varying spacings between the dots. The low-reflectivity, vacuum-sputtered chrome patterns are available with grid

spacings, i.e. distances from the center of a dot to any adjacent dot, of either three different sizes (500, 1000, and 2000 μm) or five different sizes (125, 250, 500, 1000, and 2000 μm). Both patterns are offered on soda lime glass, which is transparent and useful for transmissive applications, or white-flashed opal, which is opaque and useful for reflective applications.

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 #	Grid Spacing ^a	Dot Diameters ^b	Pattern Size ^c	Pattern Optical Density	Substrate	Thickness
R3L3S4P1	500, 1000, and 2000 μm	250, 500, and 1000 μm	50 mm x 50 mm	OD ≥ 3 at 430 nm	Soda Lime Glass	0.06" (1.5 mm)
R3L3S4P1-O					White-Flashed Opal	0.12" (3.1 mm)
R3L3S4P2	125, 250, 500, 1000, and 2000 μm	62.5, 125, 250, 500, and 1000 μm	50 mm x 50 mm	OD ≥ 3 at 430 nm	Soda Lime Glass	0.06" (1.5 mm)
R3L3S4P2-O					White-Flashed Opal	0.12" (3.1 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 μm Grid Spacings, Soda Lime	\$312.12	Today
R3L3S4P1-O	Grid Distortion Target, 3" x 3", 500 to 2000 μm Grid Spacings, Opal	\$395.76	Lead Time
R3L3S4P2	Grid Distortion Target, 3" x 3", 125 to 2000 μm Grid Spacings, Soda Lime	\$364.14	3-5 Days
R3L3S4P2-O	Grid Distortion Target, 3" x 3", 125 to 2000 μm Grid Spacings, Opal	\$447.78	Lead Time

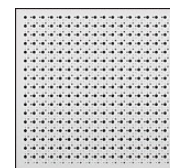
[Hide Concentric Circle and Crosshair Grid Target, 3" x 3"](#)

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

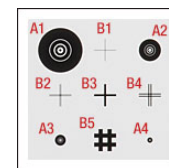
- ▶ Concentric Circles and Crosshair Patterns Arranged in a Grid
- ▶ Four Different Concentric Circle Sizes and Five Different Crosshair Sizes
- ▶ Measure Resolution and Distortion of an Imaging System
- ▶ 3" x 3" (76.2 mm x 76.2 mm) Soda Lime Glass Substrate

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 ≥ 3 . The dark pattern and clear substrate are useful for front-lit and general applications.



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)

Concentric Circles							
Circle Pattern ^a	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇
A1	31.3 μm	62.5 μm	125 μm	140.6 μm	234.4 μm	242.2 μm	500 μm
A2	15.6 μm	31.3 μm	62.5 μm	70.3 μm	117.2 μm	121.1 μm	250 μm
A3	7.8 μm	15.6 μm	31.3 μm	35.2 μm	58.6 μm	60.5 μm	125 μm
			15.6				62.5

Crosshairs			
Crosshair Pattern ^a	Single or Double Line	Length/Width	Line Width ^b
B1	Double	500 μm	6.25 μm
B2	Double	500 μm	12.5 μm
B3	Single	500 μm	50 μm
B4	Double	500 μm	25 μm
B5	Double	500 μm	100 μm

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

A4	3.9 μm	7.8 μm	μm	17.6 μm	29.3 μm	30.3 μm	μm
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- As indicated by the photo above and to the right.

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 the R1S1L1N Negative Test Target

Thorlabs offers positive and negative 18 mm x 18 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 ≥ 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 μm , 50 μm , and 10 μm), 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
1951 USAF Target	Groups 2 - 7	Concentric Circles	10 Circles with Radii from 100 μm to 1000 μm in 100 μm Intervals, Labeled 1 to 10
Grids	20 x 20 Arrays with 100 μm , 50 μm , and 10 μm Pitch	Ronchi Rulings	13 Rulings from 30 lp/mm ^a to 150 lp/mm in 10 lp/mm Intervals
Sector Star	36 Bars through 360°, 10 μm Radius Center Circle, and Ten Concentric Circles with Radii from 50 μm to 500 μm in 50 μm 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 Targets, 3" x 1"](#)

Combined Resolution and Distortion Test Targets, 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

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 ≥ 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.

- 8
- 18
- 40
- 91
- 203
- 9
- 20
- 45
- 102
- 228

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
NBS 1963A	Frequencies from 4.5 cycles/mm to 228 cycles/mm (See List Above)	Concentric Circles	10 Circles with Radii from 100 μm to 1000 μm in 100 μm Intervals
Distortion Grid (Squares)	3 Grids: 100 lp/mm ^a , 150 lp/mm, 200 lp/mm	Fixed Ronchi Rulings	3 Rulings: 100 lp/mm, 150 lp/mm, and 200 lp/mm
Distortion Grid (Dots)	3 Grids: 400 μm Pitch of $\varnothing 80 \mu\text{m}$ Dots, 200 μm Pitch of $\varnothing 40 \mu\text{m}$ Dots, 100 μm Pitch of $\varnothing 20 \mu\text{m}$ Dots	Variable Ronchi Rulings	20 Rulings (Each 1 mm x 1 mm): 10 lp/mm to 200 lp/mm in 10 lp/mm Intervals
Two-Point Resolution Dots	$\varnothing 25 \mu\text{m}$, $\varnothing 20 \mu\text{m}$, $\varnothing 15 \mu\text{m}$, $\varnothing 12.5 \mu\text{m}$, $\varnothing 10 \mu\text{m}$, $\varnothing 7.5 \mu\text{m}$, and $\varnothing 5 \mu\text{m}$	Pinholes	$\varnothing 25 \mu\text{m}$, $\varnothing 20 \mu\text{m}$, $\varnothing 15 \mu\text{m}$, $\varnothing 12.5 \mu\text{m}$, $\varnothing 10 \mu\text{m}$, $\varnothing 7.5 \mu\text{m}$, and $\varnothing 5 \mu\text{m}$
Interdigitated Lines	6.25 lp/mm, 12.5 lp/mm, 25 lp/mm, 50 lp/mm, 100 lp/mm, and 200 lp/mm	Micrometers	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
Sector Star	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