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12X Zoom

Navitar's Highest Combination of Zoom Range and Resolution in an Optical System



For high magnification applications requiring the optimal balance between optical performance, large zoom range and price, the 12X is an ideal choice. The 12X Zoom incorporates all the mechanical flexibility of the Zoom 6000 with extended zoom range, higher NA and unbeatable accuracy and repeatability for the most demanding applications. This outstanding combination of zoom range, coupled with large field coverage, means that you will now be able to view a wider range of parts with a single video inspection system and eliminate the need for bulky microscopes.

- Incredible 12X (0.58-7X) magnification for inspection of a wider range of parts.
- Increased resolution with 0.018-0.1 NA.
- Variable working distance from 13 to 341 mm.
- Field of view from 0.006 mm to 85.71 mm with attachments.
- Unmatched edge flatness and clarity.
- Works with 1/4", 1/3", 1/2" and 2/3" format cameras.
- The 12X Zoom System utilizes existing Zoom 6000 adapter tubes.
- Available with internal coaxial illumination. Review matrix on page 36 for FOV specifications. See the 12X Zoom system diagram on pages 22-23.



12X UltraZoom

Unmatched Optical Quality for High Magnification Applications

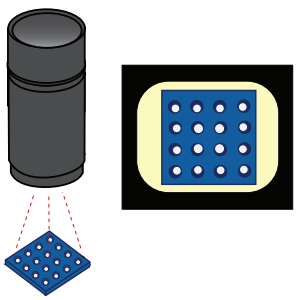
Navitar's 12X UltraZoom incorporates infinity corrected objectives in an advanced design that offers long working distances and outstanding edge flatness and clarity. The system's resolution exceeds 1,650 lines per mm, depending on the objective used. The UltraZoom is also available with fine focus or with fine focus and coaxial illumination.

12X Telecentric

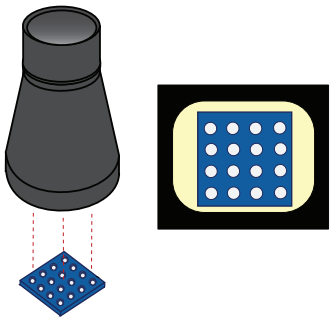
Navitar offers a 12X Telecentric zoom system that allows users to reach a true telecentric condition to within 0.3 degrees, while maintaining constant perspective and magnification. Ideal for a wide range of applications, including precise dimensional measurement of objects or pattern recognition.

There are three telecentric adapters available for use with the 12X Zoom lens: straight (no coax), straight with coax, and right-angle folded with coax. Each has a working distance of anywhere between 166 mm and 188 mm. Magnifications range from 0.16X to 1.94X with the upper 1X adapter, and 0.32X to 3.88X with the 2X adapter. Maximum field of view is 50 mm. An upper 2X F-mount adapter may be used to couple a F-Mount camera. Please contact Navitar for detailed specifications.

Conventional Lens



12X Telecentric Lens



Motorized Solutions

More Robust Design

Navitar's motorization design, available on the 12X and Zoom 6000 systems, integrates magnetic Hall Effect sensors with reference position location. Hall Effect sensors are solid state devices with no moving parts.

Discovered by Edwin Hall in 1879, the Hall Effect is the production of a voltage difference across a conductor. A Hall Effect-sensing mechanism utilizes a magnetic field to trigger a pulse in a semiconductor circuit. Compared with photo-electric sensors, Hall Effect sensors are not affected by harsh, dirty or dusty environments, ambient room light, or variation in system voltages.

Users can choose to motorize both the zoom and focus axis, or just the zoom. Navitar offers three different motor types:

- 2-Phase Stepping Motor (Faulhaber)
- 5-Phase Stepping Motor (Oriental, Vexta)
- DC Servo with Encoder (Faulhaber)

Most motorized lenses are built to order, which may affect standard lead times.

Integrated Hall Effect Solid State Sensor Technology

- Unaffected by ambient light
- Unaffected by environmental contamination
- Unaffected by line voltage



Motorized 12X Zoom Options

	Motor Type		
Fine Focus Type	2 ø Stepper	5 ø Stepper	Encoded/Servo
12 mm Motorized Fine Focus	1-51188	1-52000	1-51190
3 mm Motorized Fine Focus w/ Coax	1-51200	1-52002	1-51202
12 mm Manual Fine Focus	1-51319	1-52004	1-51337
3 mm Manual Fine Focus w/ Coax	1-51311	1-52006	1-51338
Non Fine Focus, Non Coax	1-51314	1-52008	1-51335
Non Fine Focus w/ Coax	1-51318	1-52010	1-51336

Motorized 12X UltraZoom Options

	Motor Type		
Fine Focus Type	2 ø Stepper	5 ø Stepper	Encoded/Servo
12 mm Motorized Fine Focus	1-51192	1-52013	1-51194
3 mm Motorized Fine Focus w/ Coax	1-51196	1-52015	1-51198
12 mm Manual Fine Focus	1-51325	1-52017	1-51333
3 mm Manual Fine Focus w/ Coax	1-51326	1-52019	1-51334
Non Fine Focus, Non Coax	1-51320	1-52021	1-51331
Non Fine Focus w/ Coax	1-51324	1-52023	1-51332

Controller Options

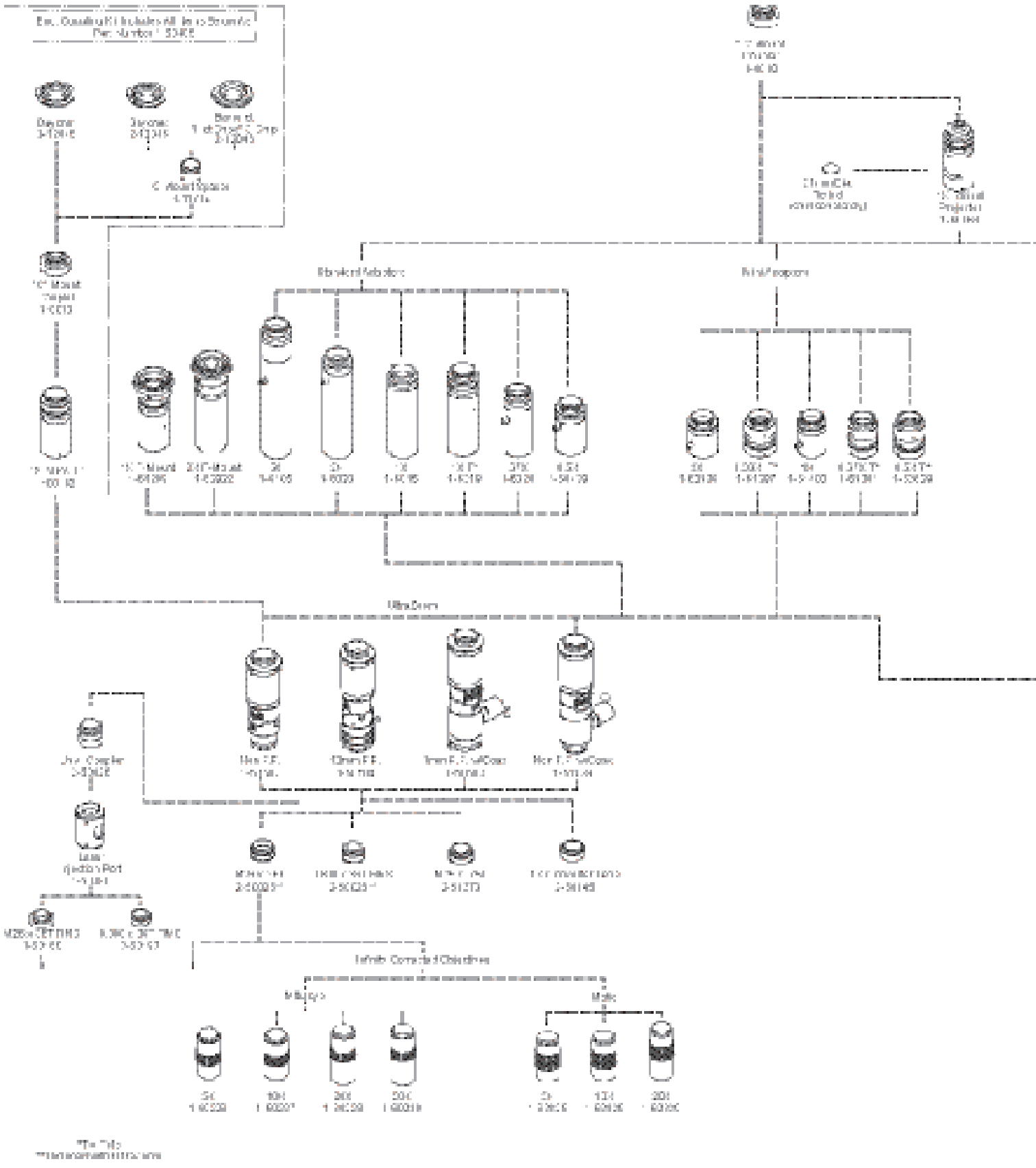
HE Manual Motor Controller: Navitar's Hall Effect manual motor controller (1-62823) is designed to allow manual operation of any of the Navitar Hall Effect motorized lenses.

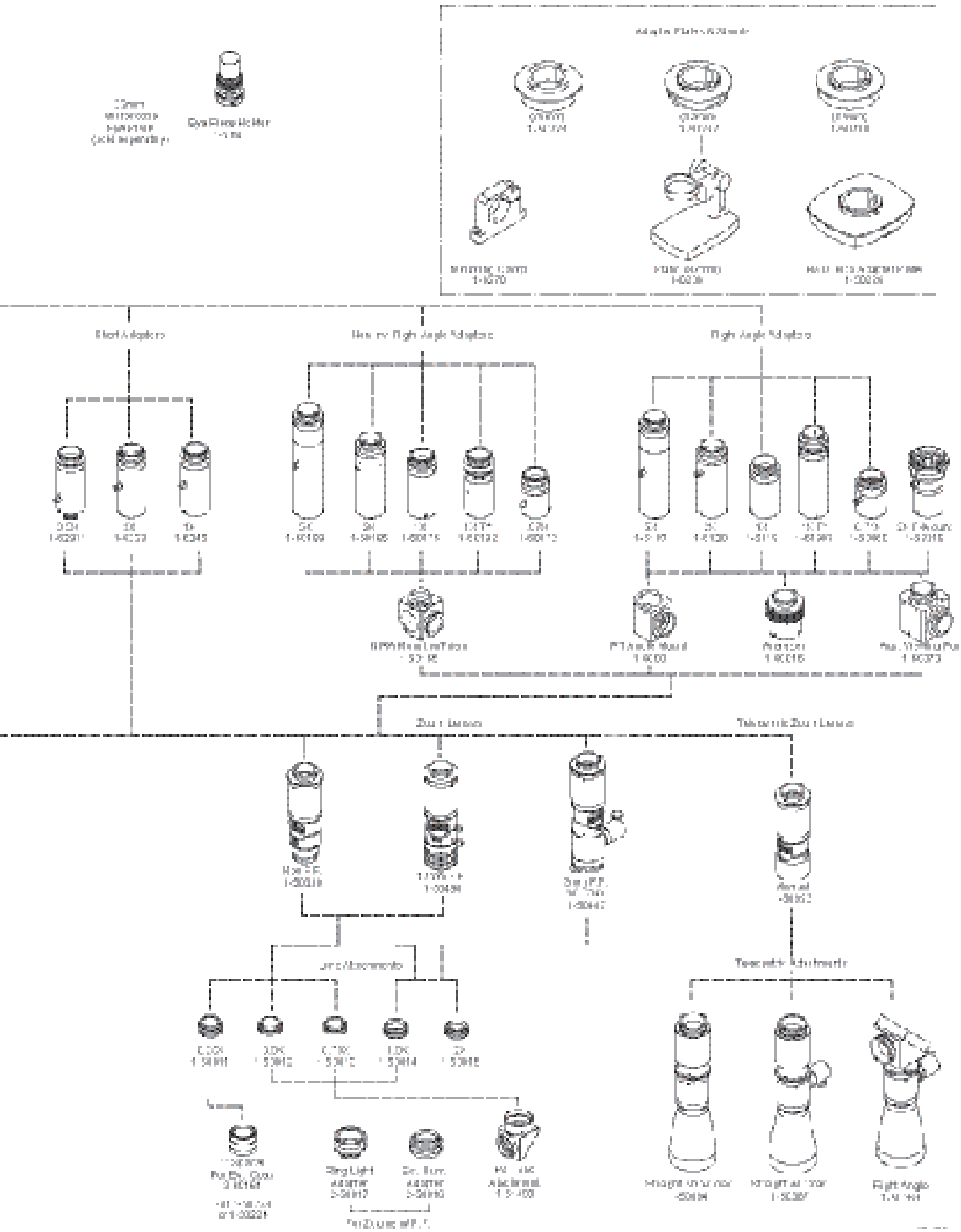
Motorized Control System: Motorized controllers feature single or dual axis control via serial RS-232 or USB. Control systems are available as table-top or board level for the OEM. Software includes LabVIEW VI and Windows Graphical User Interface (GUI) for simple axis control.

Contact Navitar for part numbers and further specifications.

12X Zoom

System Diagram





Illumination Products

Lighting Accessories

Illumination has proven to be one of the most important components when designing a successful imaging system. Navitar understands that the correct lighting can only enhance the performance of our industry leading vision systems. We offer LED ring lights, Brightlight LED coaxial illuminators, fiber optic illuminators, and power supplies.

Fiber Optic Illumination

Fiber optic illuminators are the most versatile on the market today. Consisting of a high-powered light source, Navitar's fiber optic illuminators can be used with ring lights or flexible light pipes for oblique or coaxial illumination.

Navitar offers a series of high-intensity fiber optic illuminators and accessories that allow you to position your light for best possible viewing. These fiber optic illuminators consist of a halogen illumination system with a variable light intensity control. They accept a single or dual light pipe or an attachable ring light for illuminating a wider area.



LED Illumination

Navitar's LED-based ring lights and coaxial lights were designed with careful consideration for the standard working distances that most of our customers use. The components are low profile and provide bright, even illumination to complement the performance of your vision system.



Benefits Include:

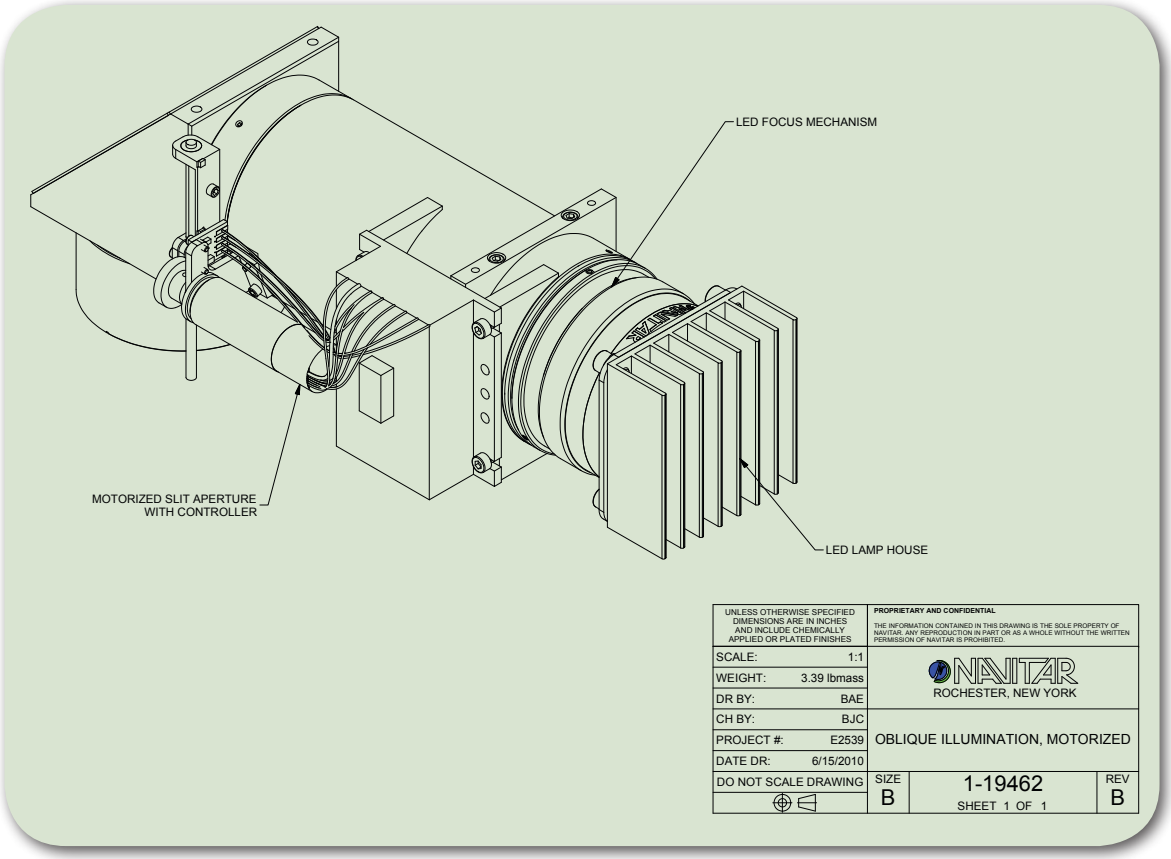
- Longer life.
- Minimum power loss.
- Narrow wavelength band (red), constant color temperature (white).
- Small packaging with optimal heat management.
- No fan vibration.
- Lower cost.





Custom Illumination

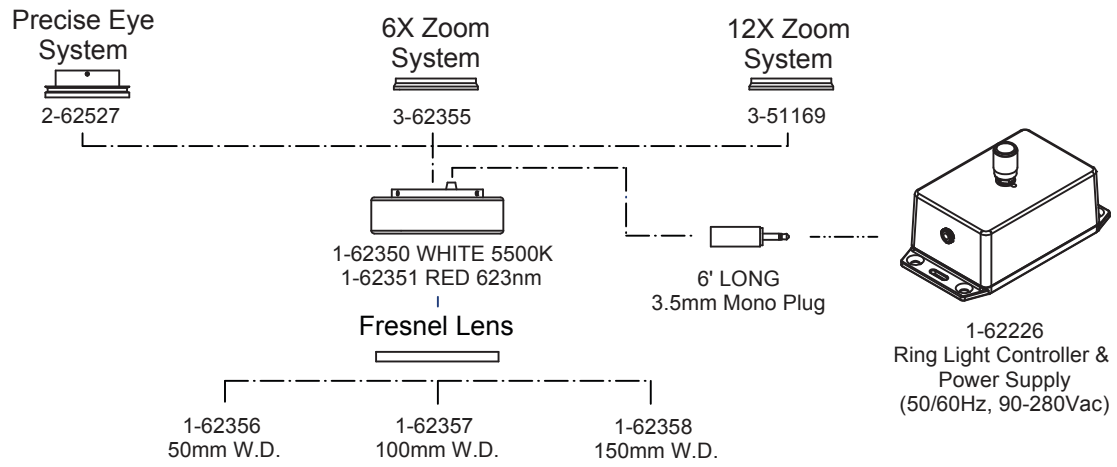
Navitar designs and manufactures custom illumination systems specific to your application. Contact one of our application engineers to discuss your unique project requirements.



Illumination

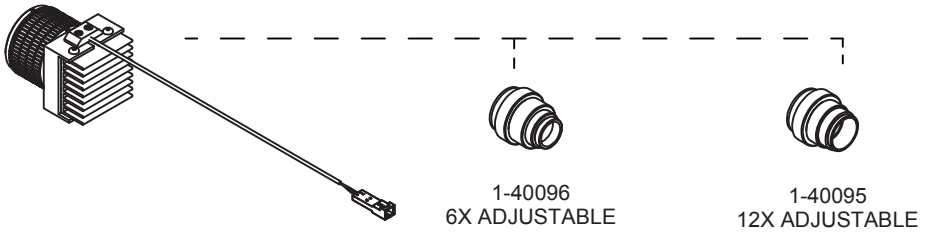
System Diagram

RING LIGHT SYSTEMS



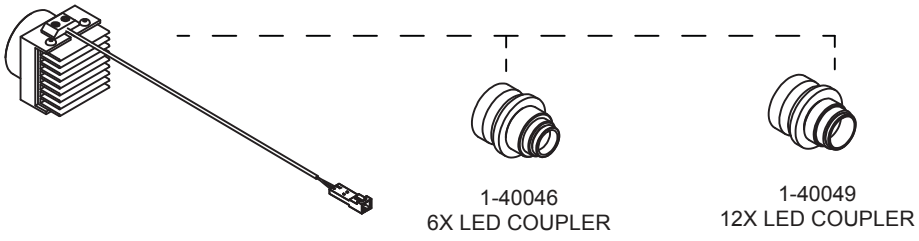
ADJUSTABLE COAXIAL LED ASSEMBLIES

IILLUMINATORS:
1-40086 NEUTRAL WHITE (4100K)
1-40087 COOL WHITE (6500K)
1-40088 WARM WHITE (3100K)
1-40089 GREEN (530nm)
1-40090 CYAN (505nm)
1-40091 BLUE (470nm)
1-40092 ROYAL BLUE (447.5nm)
1-40106 RED (627nm)
1-40093 RED-ORANGE (617nm)
1-40094 AMBER (590nm)

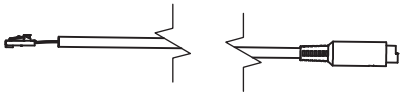


COAXIAL LED ASSEMBLIES

ILLUMINATORS:
1-40028 NEUTRAL WHITE (4100K)
1-40029 COOL WHITE (6500K)
1-40030 WARM WHITE (3100K)
1-40031 GREEN (530nm)
1-40032 CYAN (505nm)
1-40033 BLUE (470nm)
1-40034 ROYAL BLUE (447.5nm)
1-40035 RED (627nm)
1-40036 RED- ORANGE (617nm)
1-40037 AMBER (590nm)

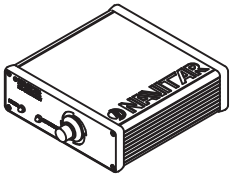


CONTROLLERS

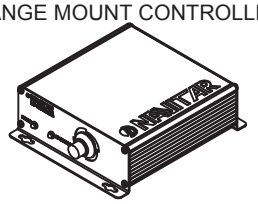


INTERFACE CABLES:
1-40181 LED CABLE (.5 meter)
1-40182 LED CABLE (1 meter)
1-40183 LED CABLE (2 meters)
1-40184 LED CABLE (3 meters)

1-40042
350mA/700 mA
DESKTOP CONTROLLER



1-40045
350mA/700mA
FLANGE MOUNT CONTROLLER



12X Zoom Field of View Matrix

(In mm)

Lens Attachment	Working Distance	Camera Formats/ Parameters	0.5X Adapter Low-High	0.67X Adapter Low-High	1X Adapter Low-High	1.33X Adapter Low-High	2X Adapter Low-High	3.3X Adapter Low-High	Resolve Limit (Microns) Low-High	Depth of Field (mm) Low-High
0.25X (2)0.005 - 0.025 NA 1-50011	341	Mag.	0.07X - 0.87X	0.10X - 1.20X	0.15X - 1.75X	0.19X - 2.33X	0.29X - 3.50X	0.50X - 5.78X	66.66 - 13.34	20.00 - 0.80
		Field 1/4"	57.14 - 4.59	41.16 - 3.40	27.60 - 2.28	21.05 - 1.72	13. 9 - 1.14	8.36 - 0.69	66.66 - 13.34	20.00 - 0.80
		Field 1/3"	85.71 - 6.89	61.73 - 5.10	41.38 - 3.42	31.57 - 2.57	20.69 - 1.71	12.54 - 1.04	66.66 - 13.34	20.00 - 0.80
		Field 1/2"	—	82.32 - 6.80	55.16 - 4.56	42.10 - 3.43	27.58 - 2.28	16.72 - 1.38	66.66 - 13.34	20.00 - 0.80
		Field 2/3"	—	(1) 72.00 - 9.35	75.88 - 6.28	57.89 - 4.72	37.94 - 3.14	22.99 - 1.90	66.66 - 13.34	20.00 - 0.80
0.5X 0.009 - 0.051 N.A. 1-50012	165	Mag	0.14X - 1.75X	0.20X - 2.40X	0.29X - 3.50X	0.39X - 4.66X	0.58X - 7.00X	0.96X - 11.55X	37.04 - 6.66	6.17 - 0.19
		Field 1/4"	28.57 - 2.28	20.58 - 1.70	13.79 - 1.14	10.25 - 0.86	6.90 - 0.76	4.18 - 0.35	37.04 - 6.66	6.17 - 0.19
		Field 1/3"	42.85 - 3.42	30.87 - 2.55	20.69 - 1.71	15.38 - 1.29	10.34 - 0.86	6.27 - 0.52	37.04 - 6.66	6.17 - 0.19
		Field 1/2"	—	41.16 - 3.40	27.58 - 2.28	20.51 - 1.72	13.79 - 1.14	8.36 - 0.69	37.04 - 6.66	6.17 - 0.19
		Field 2/3"	—	(1) 36.0 - 4.68	37.94 - 3.14	28.20 - 2.36	18.97 - 1.57	11.50 - 0.95	37.04 - 6.66	6.17 - 0.19
0.75X 0.014 - 0.076 N.A. 1-50013	108	Mag.	0.22X - 2.62X	0.29X - 3.50X	0.44X - 5.30X	0.58X - 6.98X	0.87X - 10.50X	1.45X - 17.49X	23.80 - 4.44	2.55 - 0.09
		Field 1/4"	18.18 - 1.52	13.72 - 1.14	9.19 - 0.76	6.89 - 0.57	4.60 - 0.38	2.78 - 0.23	23.80 - 4.44	2.55 - 0.09
		Field 1/3"	27.27 - 2.29	20.58 - 1.70	13.79 - 1.14	10.34 - 0.85	6.89 - 0.57	4.18 - 0.35	23.80 - 4.44	2.55 - 0.09
		Field 1/2"	—	27.44 - 2.27	18.34 - 1.52	13.79 - 1.14	9.19 - 0.76	5.56 - 0.46	23.80 - 4.44	2.55 - 0.09
		Field 2/3"	—	(1) 24.30 - 3.12	25.30 - 2.09	18.96 - 1.57	12.64 - 1.05	7.67 - 0.63	23.80 - 4.44	2.55 - 0.09
None 0.019 - 0.101 N.A.	86	Mag.	0.29X - 3.49X	0.39X - 4.70X	0.58X - 7.00X	0.77X - 9.31X	1.16X - 14.00X	1.91X - 23.1X	18.52 - 3.34	1.39 - 0.05
		Field 1/4"	13.79 - 1.14	10.29 - 0.85	6.90 - 0.57	5.19 - 0.43	3.45 - 0.29	2.09 - 0.17	18.52 - 3.34	1.39 - 0.05
		Field 1/3"	20.69 - 1.72	15.44 - 1.28	10.34 - 0.86	7.79 - 0.64	5.18 - 0.43	3.13 - 0.26	18.52 - 3.34	1.39 - 0.05
		Field 1/2"	—	20.58 - 1.70	13.79 - 1.14	10.39 - 0.86	6.90 - 0.57	4.18 - 0.35	18.52 - 3.34	1.39 - 0.05
		Field 2/3"	—	(1) 18.20 - 2.34	18.97 - 1.57	14.28 - 1.18	9.49 - 0.78	5.75 - 0.48	18.52 - 3.34	1.39 - 0.05
1.5X 0.028 - 0.151 N.A. 1-50014	50	Mag.	0.43X - 5.23X	0.58X - 7.00X	0.87X - 10.50X	1.16X - 14.0X	1.74X - 21.00X	2.87X - 34.65X	12.34 - 2.24	0.64 - 0.02
		Field 1/4"	9.30 - 0.76	6.86 - 0.57	4.60 - 0.38	3.44 - 0.28	2.30 - 0.19	1.39 - 0.12	12.34 - 2.24	0.64 - 0.02
		Field 1/3"	13.95 - 1.14	10.29 - 0.85	6.89 - 0.57	5.17 - 0.44	3.45 - 0.29	2.09 - 0.17	12.34 - 2.24	0.64 - 0.02
		Field 1/2"	—	13.72 - 1.13	9.19 - 0.76	6.89 - 0.57	4.60 - 0.38	2.78 - 0.23	12.34 - 2.24	0.64 - 0.02
		Field 2/3"	—	(1) 12.20 - 1.55	12.64 - 1.05	9.48 - 0.78	6.33 - 0.52	3.83 - 0.32	12.34 - 2.24	0.64 - 0.02
2.0X 0.038 - 0.202 N.A. 1-50015	37	Mag.	0.58X - 6.98X	0.78X - 9.40X	1.16X - 14.00X	1.54X - 18.6X	2.32X - 28.00X	3.83X - 46.2X	9.00 - 1.66	0.35 - 0.01
		Field 1/4"	6.89 - 0.57	5.14 - 0.43	3.45 - 0.29	2.59 - 0.21	1.73 - 0.15	1.05 - 0.09	9.00 - 1.66	0.35 - 0.01
		Field 1/3"	10.34 - 0.85	7.72 - 0.64	5.18 - 0.43	3.89 - 0.32	2.59 - 0.22	1.57 - 0.13	9.00 - 1.66	0.35 - 0.01
		Field 1/2"	—	10.29 - 0.85	6.90 - 0.57	5.19 - 0.43	3.45 - 0.29	2.09 - 0.17	9.00 - 1.66	0.35 - 0.01
		Field 2/3"	—	(1) 9.10 - 1.17	9.49 - 0.78	7.14 - 0.59	4.75 - 0.40	2.88 - 0.24	9.00 - 1.66	0.35 - 0.01

(1) Vignetting occurs at zoom settings less than 0.9X.
(2) NA varies depending on zoom setting.

12X UltraZoom Field of View Matrix

1-50502, 1-50503 and 1-50504 (In mm)

Objective Lens (Mitutoyo) Long W.D.	W.D. (mm)	Camera Formats/ Parameters	1X Adapter Low - High	1.33X Adapter Low - High	2X Adapter Low - High	3.5X Adapter Low - High
5X 0.14 NA* 1-60226	34	Mag.	(1) 3.57X - 16.66X	(2) 3.26X - 22.16X	2.77X - 33.31X	4.80X - 58.30X
		Sensor 1/4"	1.12 - 0.24	1.22 - 0.18	1.44 - 0.12	0.83 - 0.07
		Sensor 1/3"	1.68 - 0.36	1.84 - 0.27	2.17 - 0.18	1.25 - 0.10
		Sensor 1/2"	2.24 - 0.48	2.45 - 0.36	2.89 - 0.24	1.66 - 0.14
		Sensor 2/3"	—	2.45 - 0.49	3.97 - 0.33	2.29 - 0.19
10X 0.28 NA* 1-60227	33	Mag.	(1) 7.14X - 33.31X	(2) 6.50X - 44.30X	5.54X - 66.63X	9.70X - 116.60X
		Sensor 1/4"	0.56 - 0.12	0.61 - 0.09	0.72 - 0.06	0.41 - 0.03
		Sensor 1/3"	0.84 - 0.18	0.92 - 0.13	1.08 - 0.09	0.62 - 0.05
		Sensor 1/2"	1.12 - 0.24	1.23 - 0.18	1.44 - 0.12	0.82 - 0.07
		Sensor 2/3"	—	1.23 - 0.25	1.99 - 0.17	1.13 - 0.09
20X 0.42 NA* 1-60228	20	Mag.	(1) 14.28X - 64.63X	(2) 13.10X - 85.96X	11.08X - 133.25X	19.40X - 233.20X
		Sensor 1/4"	0.28 - 0.06	0.30 - 0.04	0.36 - 0.03	0.21 - 0.02
		Sensor 1/3"	0.42 - 0.09	0.46 - 0.07	0.54 - 0.04	0.31 - 0.03
		Sensor 1/2"	0.56 - 0.12	0.61 - 0.09	0.72 - 0.06	0.41 - 0.03
		Sensor 2/3"	—	0.61 - 0.13	0.99 - 0.08	0.57 - 0.05
50X 0.55 NA* 1-60229	13	Mag.	(1) 35.69X - 166.57X	(2) 40.00X - 221.54X	27.50X - 333.13X	48.10X - 583.00X
		Sensor 1/4"	0.11 - 0.02	0.10 - 0.02	0.14 - 0.01	0.08 - .006
		Sensor 1/3"	0.17 - 0.04	0.15 - 0.05	0.22 - 0.02	0.12 - 0.01
		Sensor 1/2"	0.22 - 0.05	0.20 - 0.04	(2) 0.17 - 0.03	0.16 - 0.01
		Sensor 2/3"	—	0.20 - 0.05	0.40 - 0.03	0.23 - 0.02

Note: This system is not recommended for use with a 2/3" CCD.
*(1) Zoom setting at 1.5X. (2) Zoom setting at 1.0X. *NA at full zoom. NA varies with zoom setting.*

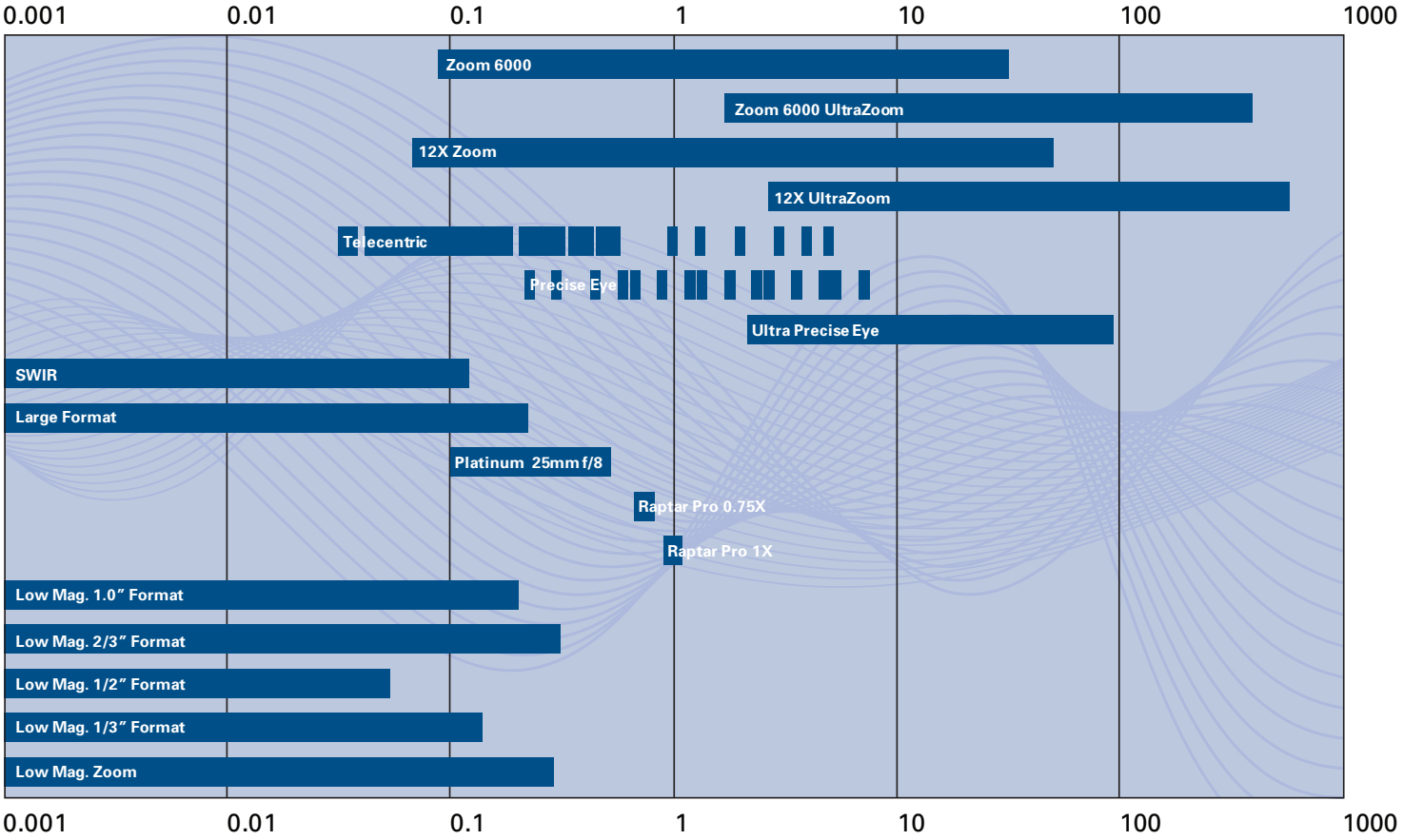
12X Zoom Field of View Matrix for Internal Coaxial Zoom

1-50487 (In mm)

Lens Attachment	W. D.	Camera Formats/ Parameters	.67X Adapter Low - High	1X Adapter Low - High	1.33X Adapter Low - High	2X Adapter Low - High	3.5X Adapter Low - High
None 0.019 - 0.101 NA	86	Mag.	0.39X - 4.70X	0.58X - 7.00X	0.77X - 9.31X	1.16X - 14.00X	2.03X - 24.50X
		Sensor 1/4"	10.29 - 0.85	6.90 - 0.57	5.19 - 0.43	3.45 - 0.29	1.97 - 0.16
		Sensor 1/3"	15.44 - 1.28	10.34 - 0.86	7.80 - 0.64	5.18 - 0.43	2.95 - 0.24
		Sensor 1/2"	20.58 - 1.70	13.79 - 1.14	10.39 - 0.86	6.90 - 0.57	3.94 - 0.32
		Sensor 2/3"	(1) 16.38 - 2.34	18.97 - 1.57	14.28 - 1.18	9.49 - 0.78	5.41 - 0.45
1.5X 0.028 - 0.151 NA 1-50014	50	Mag.	0.58X - 7.00X	0.87 - 10.50X	1.16X - 14.00X	1.74X - 21.00X	3.05X - 36.80X
		Sensor 1/4"	6.86 - 0.57	4.60 - 0.38	3.45 - 0.29	2.30 - 0.19	1.31 - 0.11
		Sensor 1/3"	10.29 - 0.85	6.89 - 0.57	5.17 - 0.43	3.45 - 0.29	1.96 - 0.16
		Sensor 1/2"	13.72 - 1.13	9.19 - 0.76	6.89 - 0.57	4.60 - 0.38	2.62 - 0.22
		Sensor 2/3"	(1) 10.92 - 1.55	12.64 - 1.05	9.48 - 0.79	6.33 - 0.52	3.61 - 0.30
2.0X 0.038 - 0.202 NA 1-50015	37	Mag.	0.78X - 9.40X	1.16X - 14.00X	1.54X - 18.6X	2.32X - 28.00X	4.06X - 49.00X
		Sensor 1/4"	5.14 - 0.43	3.45 - 0.29	2.59 - 0.22	1.73 - 0.15	0.98 - 0.08
		Sensor 1/3"	7.72 - 0.64	5.18 - 0.43	3.89 - 0.32	2.59 - 0.22	1.47 - 0.12
		Sensor 1/2"	10.29 - 0.85	6.90 - 0.57	5.19 - 0.43	3.45 - 0.29	1.97 - 0.16
		Sensor 2/3"	(1) 8.19 - 1.17	9.49 - 0.78	7.14 - 0.59	4.75 - 0.40	2.71 - 0.22

The internal coax will illuminate a circular area of about 14 mm in diameter. Any field of view larger than 14 mm will have darkened corners.
Low power lens attachments can be used but produce increasing vingetting. (1) Zoom Setting at 1.0=X. (2) NA varies depending on zoom setting

Magnification Overview of Navitar Lenses



General Lens Formulas

Focal Length
FL = CCD x WD/FOV

Magnification
m = Image Size/Object Size

Object to Image Distance
OI = [FL x $(1+m)^2$]/m
OI = m(FL) + (FL+VOA+BF) + FL/m
VOA = Vertex to Vertex Lens Length

Object to Lens Distance
OL = FL + FL(m)

Lens to Image Distance
LI = FL + FL/m

(Approximate distance to the nodal points: FL + FL(m) to the front vertex.)

F/# = 1/(2NA)
F/# = FL / Entrance Pupil Diameter
NA = 1/2 F/#
NA = sin θ/2

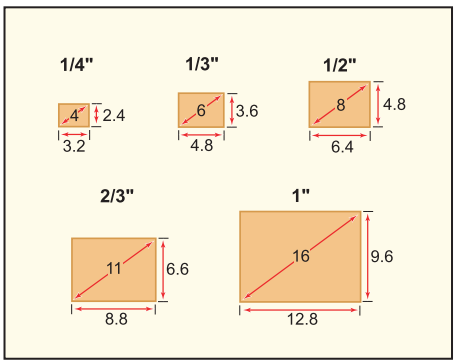
Effective F/#
Eff. F/# = F/# (m+1)

Clear Aperture (Minimum)
Aperture = FL/(F/#)

Depth of Focus
DoF = 0.00002/NA^2 (in inches)
DoF= 0.0005/NA^2 (In mm)

Conversion Factors
1 inch = 25.4 millimeters
1 meter = 39.37 inches
1 degree = Π/180 radians
1 degree = 0.0174533 radians
1 micron (μ) = 0.001 millimeter
1 micron (μ) = 1,000 nanometers (nm)
1 micron (μ) = 10,000 angstroms (Å)

Image Sensor Size (units in mm)



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