Nikon Mini Steppers

For MEMS, LEDs, and More

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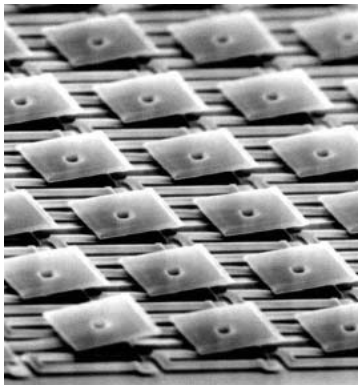
Background

Nikon Engineering Co. Ltd. released the first NES PrA Mini Stepper lithography systems more than a decade ago. These simplified, small scale steppers have evolved over time for use in Research and Development applications and to address the specific manufacturing requirements of Air Bearing Surface (ABS) fabrication for magnetic heads. The enhanced NES1 Mini Stepper platform was subsequently launched in 2007. After achieving market leadership in this area, in 2009 Nikon expanded the NES product line to also satisfy the unique process challenges of Micro Electro Mechanical Systems (MEMS), while delivering maximum stepper yield at the lowest possible cost. Most recently, Nikon has begun shipping the NES2 line of Mini Steppers, which support 200 mm wafer capabilities to further increase customer productivity and efficiency.

Although MEMS do not have the same aggressive requirements for imaging or overlay capabilities that are demanded by semiconductors, they necessitate that lithography systems are able to handle extremely warped wafers and very thick films, and accommodate significant step heights. In addition, bulk MEMS applications often need precise alignment to marks located on the backside of the wafer surface. Nikon NES Mini Steppers fully satisfy the critical requirements of these markets as well as those of Light Emitting Diodes (LED), optoelectronics, discrete semiconductors and crystal oscillator manufacturing, and well over 100 Mini Steppers are being used around the world today.

Sample MEMS Device

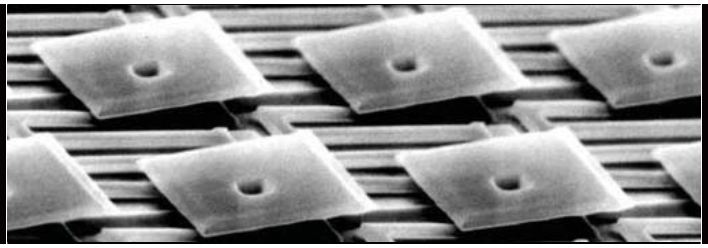


Sample IR sensor from Nikon Corporation.

Mini Steppers Deliver Optimal Performance at Lowest Possible Cost

Nikon Mini Steppers use h-line illumination (405 nm wavelength) to reduce cost of ownership (CoO) by avoiding problems with resist outgassing and lens clouding/damage that can occur with i-line illumination. This is coupled with low lens numerical apertures (NA) specially optimized for MEMS-type applications and die-to-die autofocus, enabling these steppers to deliver the necessary resolution with tremendous depth of focus (DOF). Proven stepper technology ensures optimal CD uniformity across the wafer and the projection lens design also eliminates costly mask contamination/defectivity issues experienced with contact or proximity printing methods.

Nikon Mini Steppers provide an unprecedented level of alignment flexibility for MEMS and ABS applications. All of the NES Mini Steppers utilize Enhanced Global Alignment (EGA) with FIA alignment capabilities. These systems have long been employed on traditional Nikon Step and Repeat equipment, to provide optimal overlay accuracy. The Mini Steppers also provide Pattern Matching Alignment capabilities that enable alignment to any uniquely patterned structures, as compared to only NES specific alignment marks. The majority of the NES systems also support critical Backside Alignment (BSA) capabilities and enable BSA accuracy to 0.8 µm and below to satisfy specific requirements for customers' processes. All of these critical functions are delivered on user-friendly, high productivity stepper platforms, with dramatically reduced system footprints to minimize equipment cost and cleanroom floor space usage. Further, due to their simplified body designs, Mini Stepper installations can be completed in less than a week to ensure the fastest path to manufacturing.



Comparison of Yield and Productivity Factors

Litho System Capabilities	NES1 or NES2 Reduction Stepper	Aligner or Proximity System
Resolution in Mass Production ≤ 2 µm	Yes	No
Optimal CD Uniformity	Yes	No
Accommodates Wafer Warpage up to 200 µm	Yes	No (<< 200)
Advanced Autofocus Capabilities	Yes (Die-by-die)	No (Single point per wafer)
Sophisticated Alignment Systems	Yes (EGA and Pattern Matching)	Varied Capabilities
Frequent Mask Cleaning Required?	Not Required	Required
Mask Lifetime	Unlimited	≤ 50 Cycles (Between Cleans)
Uptime	Target 97%	Varied Capabilities
Parts Costs	Low	Varies - Lens Degradation/Replacements, etc
Customizable for Fab-Specific/Dynamic Requirements	Yes. Many add-on capabilities offered as well.	Varied Capabilities

NES Mini Steppers provide significant productivity and yield advantages when compared to Aligner or Proximity systems.

Continued Focus on New Products and Capabilities

The diverse capabilities of the Nikon NES Mini Stepper product line have been extremely successful in meeting our customers' unique requirements for not only ABS and MEMS, but also LEDs, discretes, and more; and Nikon continues to focus on expanding system capabilities and reducing cost to customers. Newly developed Mini Steppers support larger wafer sizes, enhance imaging, and maximize productivity, while a multitude of add-on functions further boost system performance and yield.

Nikon NES Mini Stepper Product Overview

Details	NES2-h06	NES2-h04	NES1-h04	NES1W-h04A	NES1-h02
Lens-NA	0.11	0.16	0.16	0.20	0.16
Exposure Area (mm)	22 mm square 17.9 (H) x 25.2 (V) mm	15 mm square 11.23 (H) x 18 (V) mm	15 mm square 11.23 (H) x 18 (V) mm	15 mm square 11.23 (H) x 18 (V) mm	11 mm circle
Reduction Ratio	1/1.8	1/2.5	1/2.5	1/2.5	1/5
Resolution (µm)	3.0	2.0	2.0	1.6	2.5
Depth of Focus (µm)	26.0	12.0	12.0	8.0	12.0
Overlay Accuracy M+3σ (µm)	0.35	0.35	0.30	0.30	0.30
Backside Alignment M+3σ (µm)	0.80	0.80	0.80	0.80	N/A
Throughput: 0.2 mm x 0.8 mm spot size; 5 point EGA	200 msec; 200 mm – 44 shots/wafer = 70 WPH	125 msec ; 200 mm – 112 shots/wafer = 35 WPH	100 msec ; 150 mm – 57 shots/wafer = 70 WPH	100 msec ; 150 mm – 57 shots/wafer = 70 WPH	50 msec; 3" – 49 shots/wafer = 70 WPH
Substrate Sizes (mm)	150 and 200 •	150 and 200 •	≤ 150	≤ 150	≤ 150
Reticle	5"	5"	5"	5"	5"

Notes:
Overlay Accuracy assumes the Environmental Chamber is utilized (this is an optional function for the NES1-h02).
Backside Alignment is an optional function.
**Overlay specifications will be different when aligning to non-standard marks.*
•Manual wafer size change.

Nikon Mini Steppers

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Nikon NES2-h06

Key Benefits

26 µm Depth of Focus Accommodates Extreme Process Requirements

Thick films, warped wafers, and extreme step heights have been problematic for traditional contact or proximity printing systems that have been used in the past. Therefore, the NES2-h06 Mini Stepper utilizes a 0.11 numerical aperture (NA) projection lens with 1.8x reduction that was specifically designed to address the unique process challenges presented by MEMS and LED applications. The innovative NES2-h06 lens design enables a depth of focus up to 26 µm with resolution down to 3.0 µm, while its advanced autofocus system provides die-by-die focus capabilities that further increase yield for these difficult processes.

Delivers Maximum Productivity with 70 WPH Throughput (200 mm)

To accommodate customers' process transitions and maximize manufacturing productivity, the NES2-h06 supports wafer sizes up to 200 mm and can process 70 wafers per hour (44 exposure shots at 22 mm step pitch). In addition, the NES2-h06 minimizes total fab costs with the control system and thermal chamber actually built into the main body to enable a remarkably small footprint of only 3.3 m^2 – including the wafer loader unit.

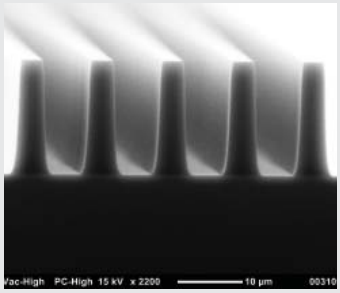
22 mm Field Size Enhances Mix and Match with NSR Steppers

Historically, a common problem when trying to match patterns exposed on different types of steppers was matching the field sizes. The NES2-h06 makes use of advanced lens technology to enable the same 22 mm x 22 mm exposure field as traditional 5x reduction steppers, simplifying mix-and-match applications while boosting productivity. To further simply matching and reticle design, it is also possible to use the same alignment marks (FIA X/Y simultaneous marks) on the NES2 systems as on traditional NSR steppers.

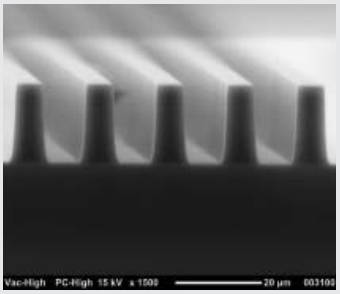
Excellent Imaging Using Thick Photoresists

Resist TOK P-CA1000PM - 19 µm thickness, 280 mJ dose.

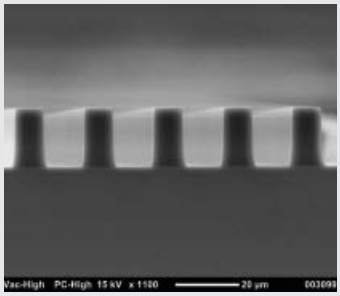
5.5 µm L/S



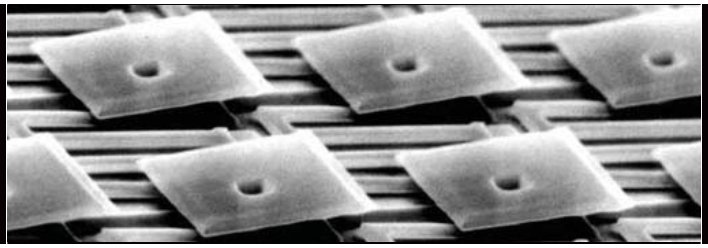
8.3 µm L/S



11.1 µm L/S



The 0.11 NA h06 lens design provides tremendous depth of focus and enables excellent imaging for extremely thick photoresist processes. In addition, the optional variable illumination function further extends processing capabilities.



Provides 0.35 µm Overlay Performance for Large Field

While the overlay requirements for MEMS and LEDs are nowhere near as stringent as those of today's leading-edge semiconductors, they present challenges with regard to wafer deformation and process-induced shrinkage, etc. The NES2-h06 employs enhanced global alignment (EGA), which has been used on many generations of traditional Nikon steppers, to optimize overlay accuracy to 0.35 µm for the large 22 mm field. EGA functions by utilizing multiple alignment marks across the wafer to ensure best fit alignment and thereby compensate for rotation issues or process-induced deformations. Pattern Matching Alignment capabilities are also available to provide increased flexibility for reticle design.*

Standard Specifications

Subsystem	NES2-h06
Lens-NA	0.11
Exposure Area (mm)	22 mm square 17.9 (H) x 25.2 (V) mm
Reduction Ratio	1/1.8
Resolution (µm)	3.0
Depth of Focus (µm)	26.0
Overlay Accuracy [M + 3σ] (µm)	0.35
Distortion (µm)	± 0.40
Backside Alignment [M + 3σ (µm)	0.80
Throughput: 200 msec; 0.2 mm x 0.8 mm AF spot size; 5 point EGA	200 mm: 70 WPH 44 shots at 22 mm step pitch
Substrate Sizes (mm) Reticle	150 and 200 • 5"
Dimensions (WxDxH) / Weight	1,440 x 2,289 x 2,100 mm / 2,000 kg

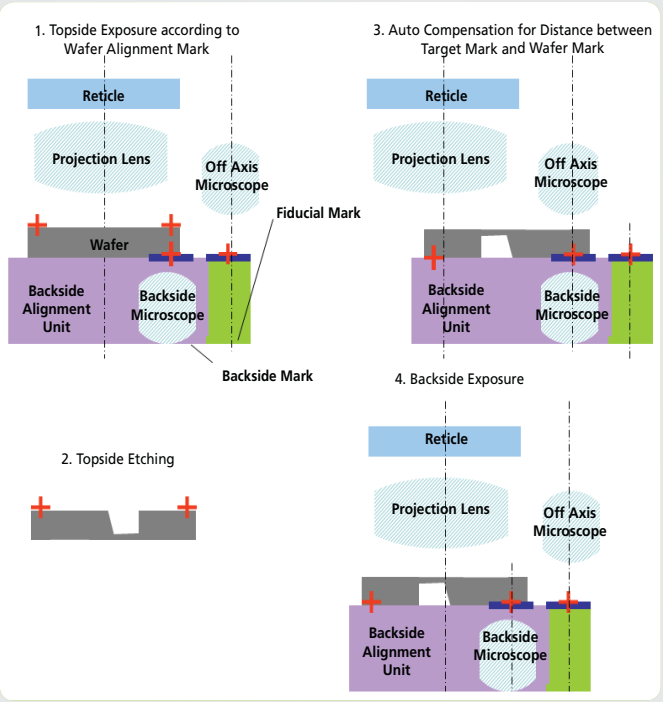
**Overlay specifications will be different when aligning to non-standard marks.*
•Manual wafer size change
Note: Backside Alignment is an optional function.

Available Options Include:

Custom Sample Holder, Sample Barcode Reader, Reticle Barcode Reader, Backside Alignment, Illumination System Sigma Variable Mechanism and more. See NES Functions and Options Availability table for detailed information.

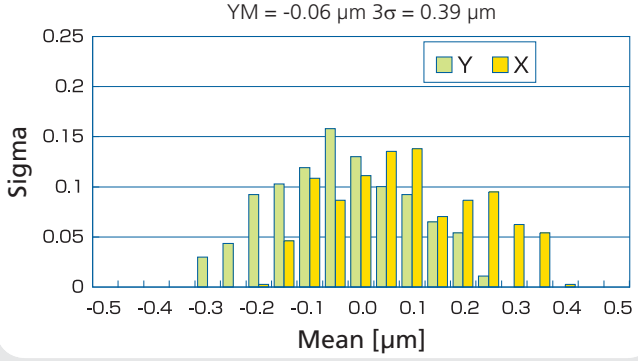
Backside Alignment Overview and Performance Data

Bulk MEMS applications often need precise alignment to marks located on the backside of the wafer surface. The Nikon BSA function easily satisfies this critical requirement.



NES1-h04 BSA Accuracy Example

XM = +0.06 µm 3σ = 0.42 µm
YM = -0.06 µm 3σ = 0.39 µm



Nikon Mini Steppers

For MEMS, LEDs, and More

Nikon NES2-h04

Key Benefits

Enables 2.0 µm Resolution with Large Depth of Focus for Enhanced Yield

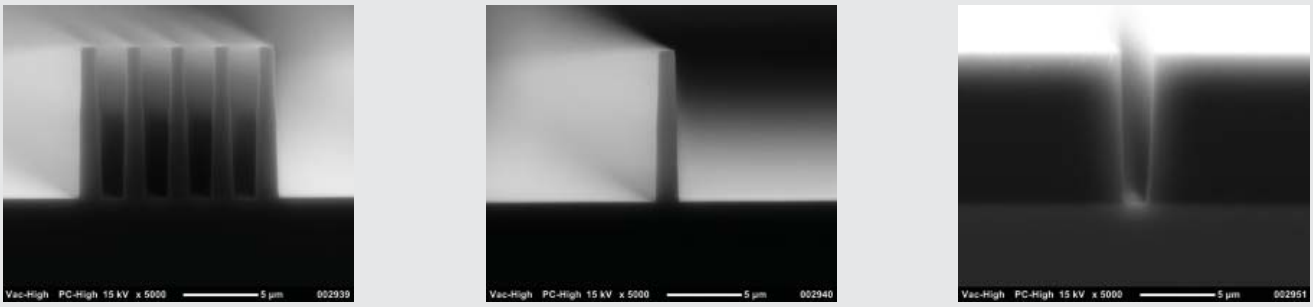
The NES2-h04 Mini Stepper system utilizes a lens design already well-proven on the previous generation NES1 systems. With a 0.16 numerical aperture (NA) projection lens and 2.5x reduction, the NES2-h04 delivers critical resolution down to 2.0 µm with a 12 µm depth of focus to easily satisfy patterning requirements for MEMS and LEDs. The advanced NES autofocus design provides further imaging benefits with die-by-die focus capabilities to maximize stepper yield.

Delivers Overlay Accuracy ≤ 0.35 µm for Non-IC Applications

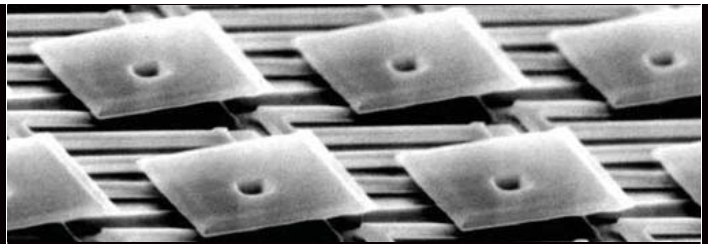
MEMS and LEDs present unique challenges with regard to processing effects such as wafer deformation and shrinkage, etc. The NES2-h04 utilizes EGA, long employed on traditional Nikon steppers to optimize overlay accuracy to 0.35 µm. EGA enhances performance by utilizing multiple alignment marks across the wafer to ensure best fit alignment and heightened accuracy. In addition, for increased flexibility, Pattern Matching Alignment to non-standard marks is also supported.*

Excellent Imaging with 0.16 Numerical Aperture; σ = 1.0; 1.5 µm L/S x 5 Lines and Isolated Positive and Negative Lines

Resist TOK TMMR PW1000 – 10 µm thickness

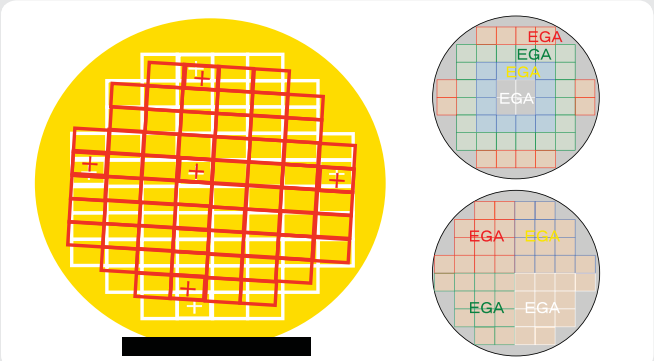


The proven 0.16 NA h04 lens design easily delivers resolution capabilities below 2 µm to satisfy customers' most critical imaging requirements.

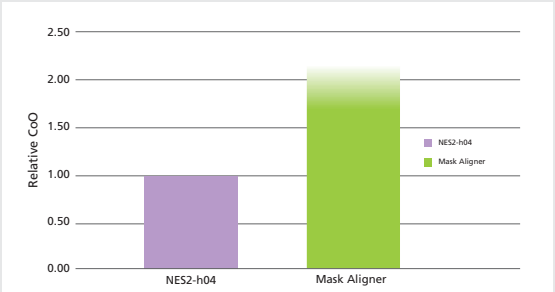


Enhanced Global Alignment (EGA)

Using Enhanced Global Alignment, marks can be set to ensure the best fit alignment to compensate for process-induced deformations or process-related signatures. By specifying the optimal statistical algorithm for a particular recipe, alignment accuracy will be enhanced compared with die-to-die alignment – while also being much faster. Such capabilities are particularly vital when aligning non-silicon surfaces such as GaAs and AlGaAs, as well as with warped LED substrates, etc.



Relative CoO Comparison



NES Mini Steppers enable marked improvements in cost of ownership compared to mask aligners.

Standard Specifications

Subsystem	NES2-h04
Lens-NA	0.16
Exposure Area (mm)	15 mm square 11.23 (H) x 18 (V) mm
Reduction Ratio	1/2.5
Resolution (µm)	2.0
Depth of Focus (µm)	12.0
Overlay Accuracy [M + 3σ] (µm)	0.35
Distortion (µm)	± 0.25
Backside Alignment [M + 3σ] (µm)	0.80
Throughput: 125 msec; 0.2 mm x 0.8 mm AF spot size; 5 point EG	200 mm: 35 WPH 112 shots at 15 mm step pitch
Substrate Sizes (mm) Reticle	150 and 200 • 5"
Dimensions (WxDxH) / Weight	1,440 x 2,289 x 2,100 mm / 2,000 kg

**Overlay specifications will be different when aligning to non-standard marks.*
•Manual wafer size change
Note: Backside Alignment is an optional function.

High Productivity 200 mm Stepper with Small Footprint
To increase productivity and efficiency for customers, the NES2-h04 supports wafer sizes up to 200 mm and can process 35 wafers per hour (112 exposure shots at 15 mm step pitch). In addition, the NES2-h04 minimizes total fab costs because the control system and thermal chamber are built into the main body. This saves costly floor space and reduces expenses for maintenance and utilities. Including the wafer loader unit, the NES2-h04 has an extremely compact footprint of only 3.3 m^2.

Available Options Include:
Custom Sample Holder, Sample Barcode Reader, Reticle Barcode Reader, Backside Alignment, Illumination System Sigma Variable Mechanism and more. See NES Functions and Options Availability table for detailed information.

Nikon Mini Steppers

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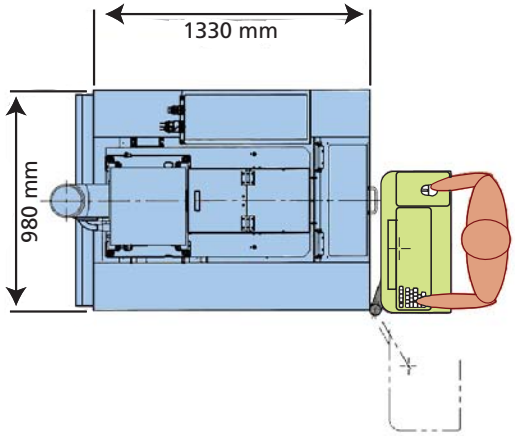
Nikon NES1-h04

Small Fab Footprint for Optimal Value



Mini Steppers provide optimal value by delivering high productivity and requiring a small fab footprint. As shown above, the NES1-h04 footprint is 1.33 m^2. This will be 2.2 m^2 including the wafer loader.

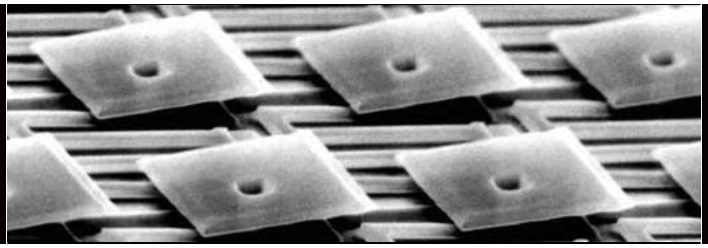
Key Benefits

Delivers High Throughput and Excellent Value

To provide optimal productivity and value for customers, the NES1-h04 dramatically reduces total fab costs with an ultra-small fab footprint. By eliminating the need for a separate control rack, the NES1-h04 can be fit in only 2.2 m^2 of floor space, including its wafer loader. The versatile NES1-h04 supports wafer sizes up to 150 mm and can process 70 wafers per hour (57 exposure shots at 15 mm step pitch) to deliver a high productivity solution with very low cost of ownership for manufacturers.

Enables 2.0 µm Resolution and Wide Process Window

The NES1-h04 Mini Stepper system utilizes a lens specifically designed for MEMS, LED, optoelectronics, and discrete semiconductor fabrication. With a 0.16 numerical aperture (NA) projection lens and 2.5x reduction, the NES1-h04 delivers critical resolution down to 2.0 µm with a 12 µm depth of focus. When considering 10 µm line/space patterns, NES1-h04 DOF can be on the order of 90 µm. The projection lens design coupled with the advanced die-by-die autofocus system enables the Mini Stepper to accommodate the process challenges and thick resists that traditional proximity steppers and aligners are unable to handle.

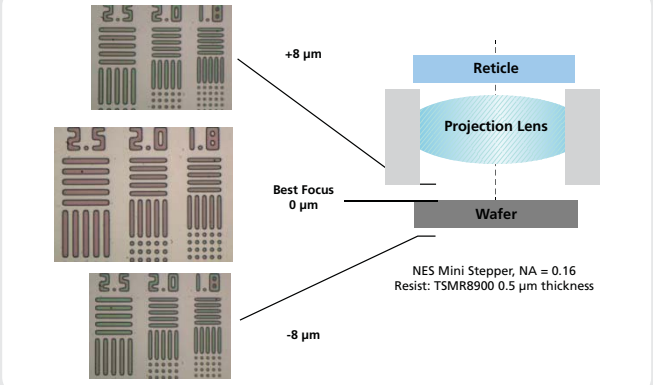


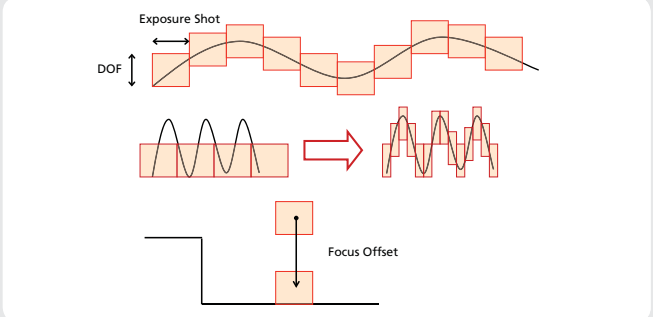
Enhanced Global Alignment (EGA) Ensures Excellent Overlay Performance

MEMS and LED applications present unique challenges with regard to processing effects such as wafer deformation and process-induced shrinkage, etc. The NES1-h04 employs enhanced global alignment to optimize overlay accuracy to 0.30 µm. EGA uses multiple alignment marks across the wafer to ensure best fit alignment, compensating for processing or rotation-related issues to enhance yield. In addition, by specifying the optimal statistical algorithm, alignment accuracy will be enhanced compared with die-to-die alignment – while also being much faster. Also, if traditional alignment marks cannot be included in the customer's layout, Pattern Matching Alignment capabilities are supported as well.*

Large DOF and Die-by-Die Autofocus Accommodate Warped Wafers and Process Variability

The NES Mini Stepper large depth of focus coupled with die-by-die autofocus capabilities compensate for wafer warpage and process-induced focus variation to maximize process latitude and enhance yield.





Standard Specifications

Subsystem	NES1-h04
Lens-NA	0.16
Exposure Area (mm)	15 mm square 11.23 (H) x 18 (V) mm
Reduction Ratio	1/2.5
Resolution (µm)	2.0
Depth of Focus (µm)	12.0
Overlay Accuracy [M + 3σ] (µm)	0.30
Distortion (µm)	± 0.25
Backside Alignment [M + 3σ (µm)	0.80
Throughput: 100 msec; 0.2 mm x 0.8 mm AF spot size; 5 point EGA	150 mm: 70 WPH 57 shots at 15 mm step pitch
Substrate Sizes (mm) Reticle	≤ 150 5"
Dimensions (WxDxH) / Weight	980 x 1,330 x 2,100 mm /1,600 kg

**Overlay specifications will be different when aligning to non-standard marks.*
Note: Backside Alignment is an optional function.

Available Options Include:

Custom Sample Holder, Sample Barcode Reader, Reticle Barcode Reader, Backside Alignment, Illumination System Sigma Variable Mechanism and more. See NES Functions and Options Availability table for detailed information.

Nikon Mini Steppers

For MEMS, LEDs, and More

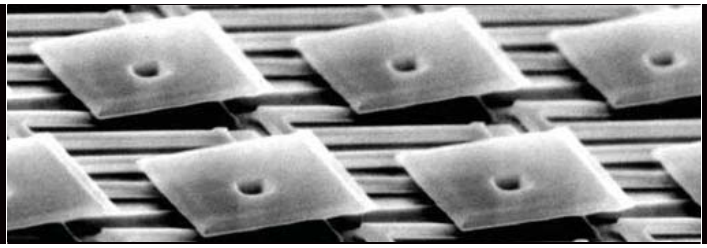
Nikon NES1W-h04A

Key Benefits

0.20 Numerical Aperture Lens Provides Optimal Resolution
The newly released NES1W-h04A Mini Stepper utilizes an advanced 0.20 numerical aperture (NA) lens to deliver resolution ≤ 1.6 µm with an 8.0 µm depth of focus (DOF). The NES1W-h04A projection lens design is coupled with an established die-by-die autofocus system that optimizes yield for unique LED and MEMS processes.

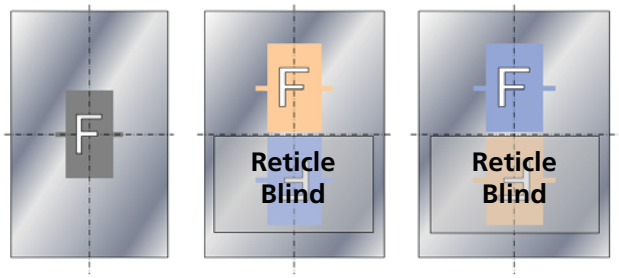
Delivers Maximized Productivity and Complies with Global Safety Specifications
The high throughput NES1W-h04A Mini Stepper can process 70 wafers per hour (57 exposure shots at 15 mm step pitch), and provides great flexibility with support for wafer sizes up to 150 mm. In addition, this stepper reduces reticle costs with the Dual Exposure Area for a Single Reticle function, which makes it possible to utilize two separate exposure patterns on a single reticle by rotating the reticle according to programmable settings. Reticle blinds are then used to control the actual exposure area. The NES1W-h04A also minimizes total fab costs with an ultra-small fab footprint. By eliminating the need for a separate control rack, the NES1W-h04A and its accompanying wafer loader can fit in only 2.2 m^2 of floor space. In addition to delivering these critical productivity benefits to ensure low cost of ownership for manufacturers, the NES1W-h04A stepper also satisfies global safety compliance specifications.

Flexible Alignment System Mitigates Process Effects and Enables Overlay Accuracy ≤ 0.30 µm
Processing effects such as wafer deformation and process-induced shrinkage can be challenges for MEMS and LED manufacturing. The NES1W-h04A stepper employs enhanced global alignment (EGA) to deliver overlay accuracy to 0.30 µm. EGA uses multiple alignment marks across the wafer to ensure best fit alignment and compensates for processing or rotation-related issues to enhance yield. In addition to being much faster, alignment accuracy is enhanced compared with die-to-die alignment by enabling setting of the optimal statistical algorithm for the specific application. If traditional alignment marks cannot be included in the customer's layout, Pattern Matching Alignment capabilities are supported as well.*



Dual Exposure Area for Single Reticle Function

The NES1W-h04A supports the Dual Exposure Area for a Single Reticle function, which makes it possible to utilize two separate exposure patterns on a single reticle by rotating the reticle according to programmable settings.



Standard Specifications

Subsystem	NES1W-h04A
Lens-NA	0.20
Exposure Area (mm)	15 mm square 11.23 (H) x 18 (V) mm
Reduction Ratio	1/2.5
Resolution (µm)	1.6
Depth of Focus (µm)	8.0
Overlay Accuracy [M + 3σ] (µm)	0.30
Distortion (µm)	± 0.25
Backside Alignment [M + 3σ (µm)	0.80
Throughput: 100 msec; 0.2 mm x 0.8 mm AF spot size; 5 point EGA	150 mm: 70 WPH 57 shots at 15 mm step pitch
Substrate Sizes (mm) Reticle	≤ 150 5"
Dimensions (WxDxH) / Weight	980 x 1,330 x 2,100 mm /1,600 kg

**Overlay specifications will be different when aligning to non-standard marks.*
Note: Backside Alignment is an optional function.

Available Options Include:

Custom Sample Holder, Sample Barcode Reader, Reticle Barcode Reader, Backside Alignment, Illumination System Sigma Variable Mechanism and more. See NES Functions and Options Availability table for detailed information.

Nikon Mini Steppers

For MEMS, LEDs, and More

Nikon NES1-h02

Key Benefits

Simple, Quick Setup Stepper for ABS Processing and More

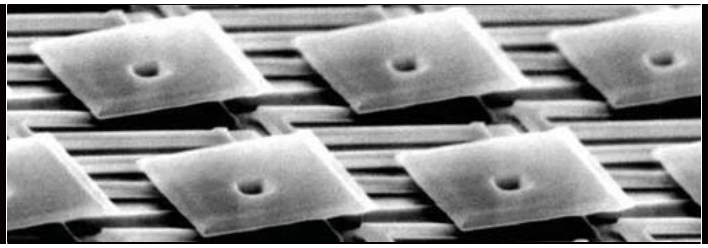
Nikon first released the NES1-h02 to provide a small, simple, and low cost stepper solution to be used in Air Bearing Surface (ABS) fabrication for magnetic heads, as well as Research and Development (R&D) applications. The user-friendly NES1-h02 system is a basic stepper that provides quick system setup and startup times, with installations able to be completed in under 5 days. It satisfies the critical ABS resolution and overlay requirements while delivering 70 (3") wafers per hour, and accommodates substrates up to 150 mm in diameter. Nikon has achieved leadership in this market, with a cumulative total of 75 NES1-h02 and PrAll (previous generation Mini Stepper) units in use today. While the majority of these are employed in ABS applications, many are also utilized in MEMS manufacturing and R&D work.

Delivers Excellent Imaging and Low Cost of Ownership

The NES1-h02 stepper utilizes a projection lens design to fully satisfy customers' imaging requirements while maintaining low cost of ownership. This design eliminates costly issues with mask contamination or defectivity that can result from contact or proximity methods historically used. The 0.16 NA lens delivers 5x reduction to enable resolution down to 2.5 µm with a wide 12 µm depth of focus, and die-by-die autofocus maximizes stepper yield by compensating for problematic process deviations and wafer warpage, etc.

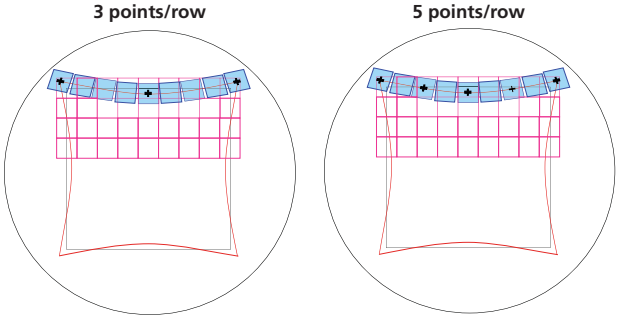
Off-Axis Alignment and EGA Enable 1.0 µm Overlay Capabilities and Beyond**

The NES1-h02 Mini Stepper was the first model to employ off-axis wafer alignment. This design eliminated chromatic aberration issues, and improved distortion as well as alignment performance. EGA is also utilized to ensure best fit alignment, and thereby compensate for rotation issues or any process-induced deformation to enable 1.0 µm** overlay accuracy. Pattern Matching Alignment capabilities are also supported if traditional alignment marks cannot be included in the customer's layout.*



NES Advantages for Air Bearing Surfaces

The advanced alignment capabilities of the NES systems compensate for the effects of even the extreme warpage of ABS substrates. By sampling a limited number of points per exposure row, the NES system establishes virtual profile coordinates and then determines the best fit alignment to compensate for variations such as pincushion distortion. Further, NES Pattern Matching make it possible to align to any unique pattern. This includes using certain points on the pole mark of the magnetic head, where the pole mark positions are employed to create the virtual profiles that are used for alignment.



Pink: ideal grid; Red: distortion; +: alignment points; Blue: exposed.

Standard Specifications

Subsystem	NES1-h02
Lens-NA	0.16
Exposure Area (mm)	11 mm circle
Reduction Ratio	1/5
Resolution (µm)	2.5
Depth of Focus (µm)	12.0
Overlay Accuracy [M + 3σ] (µm)	1.0 **
Distortion (µm)	± 0.50
Throughput: 50 msec; 0.2 mm x 0.8 mm AF spot size; 5 point EGA	3": 70 WPH 49 shots at 7.5 mm step pitch
Substrate Sizes (mm) Reticle	≤ 150 5"
Dimensions (WxDxH)/Weight	980 x 1,330 x 2,100 mm/1,600 kg

**Overlay specifications will be different when aligning to non-standard marks.*
***Overlay accuracy can be enhanced to 0.3 µm with addition of the optional Environmental Chamber.*

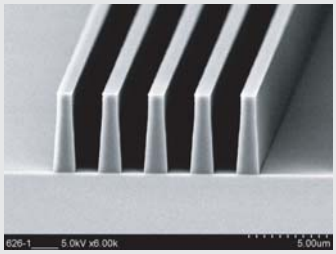
Available Options Include:

Automated Sample Loader, Custom Sample Holder, Environmental Chamber, and more. See NES Functions and Options Availability table for detailed information.

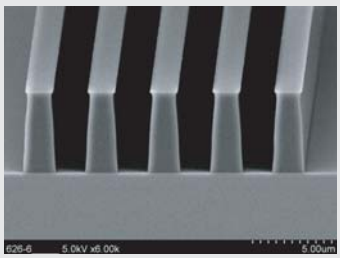
NES1-h02 Imaging Capabilities with 0.16 NA

Resist TOK TMMR PW1000 – 5 µm thickness. Pictures below taken by the NES1-h02 system itself.

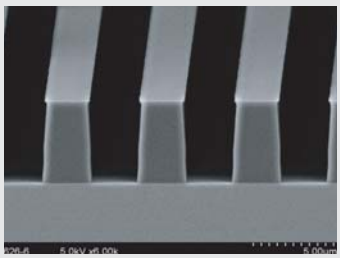
1.5 µm L/S



2.0 µm L/S



3.0 µm L/S



NES1 and NES2 systems can also reduce metrology costs with overlay accuracy able to be measured by the Mini Steppers themselves using the optional Standard Reticle for Calibration Package.

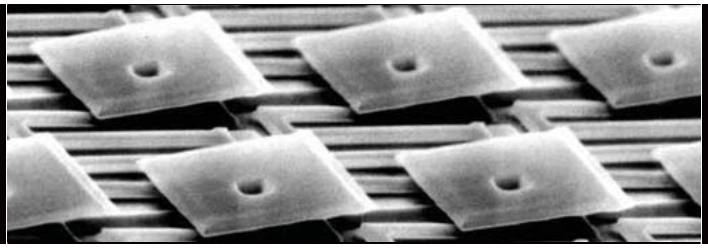
Nikon Mini Steppers

For MEMS, LEDs, and More

S = Standard O = Optional N/A = Not Available

NES Functions and Options Availability

Main Body	NES2-h06	NES2-h04	NES1-h04	NES1W-h04A	NES1-h02
Environmental Chamber	S	S	S	S	O
Vacuum Pump	O	O	O	O	O
Automated Sample Loader	S	S	S	S	O
Custom Sample Holder	O	O	O	O	O
Sample Barcode Reader	O	O	O	O	O
Ring Mask for Wafer	N/A	N/A	O	O	N/A
Reticle Blind	S	S	S	S	N/A
Quadrant Reticle Rotator	N/A	N/A	N/A	N/A	S
Dual Exposure Area in One Reticle	N/A	N/A	N/A	S	N/A
Manual Reticle Loader	N/A	N/A	S	N/A	S
Automated Reticle Loader	N/A	N/A	O	S	N/A
Automatic Reticle Loader with Reticle Library	S	S	N/A	N/A	N/A
Reticle Cassette Barcode Reader	O	O	N/A	O	N/A
Reticle Barcode Reader	O	O	O	O	S
Standard Reticle for Calibration	O	O	O	O	O
Alignment and Overlay	**NES2-h06**	**NES2-h04**	**NES1-h04**	**NES1W-h04A**	**NES1-h02**
EGA Alignment	S	S	S	S	S
ERA Alignment	O	O	O	O	S
Pattern Matching Alignment	S	S	S	S	S
Backside Alignment	O	O	O	O	N/A
Illumination	**NES2-h06**	**NES2-h04**	**NES1-h04**	**NES1W-h04A**	**NES1-h02**
Manual Sigma Aperture	O	O	O	O	O
Illumination System Sigma Variable Mechanism	O	O	O	O	N/A
Annular Illumination	O	O	O	O	O
Microlens Array	S	S	S	S	S
System Management	**NES2-h06**	**NES2-h04**	**NES1-h04**	**NES1W-h04A**	**NES1-h02**
Remote Recipe Editor	O	O	O	O	O
Communications	O	O	O	O	O
Log File Exportation	O	O	O	O	O
Shot Map Viewer	O	O	O	O	O



Main Body

Environmental Chamber: Compact and efficient unit that maintains precise temperature control for optimal tool performance and stability.

Vacuum Pump: Maintains the vacuum that keeps the wafer substrate on the holder and minimizes problematic wafer warpage effects.

Automated Sample Loader: Utilizes a robot arm transport system to automatically exchange the wafers to ensure maximum throughput and productivity.

Custom Sample Holder: Customers may request holders for wafers of varied sizes as a special tool modification.

Sample Barcode Reader: Function that can automatically read the barcode on the wafer surface.

Ring Mask for Wafer: Used to pull down and thereby flatten the wafer to enable successful processing of excessively warped or distorted substrates.

Reticle Blind: Enables the user to expose only a portion of the reticle by "blinding down" on the area identified in the specific recipe.

Quadrant Reticle Loader: The 5" reticle can be divided into four areas for exposure of different patterns. This function enables the reticle to be rotated manually to support those capabilities.

Dual Exposure Area for Single Reticle: Reduces reticle costs by making it possible to utilize two separate exposure patterns on a single reticle by rotating the reticle according to programmable settings. Reticle blinds are then used to control the actual exposure area.

Manual Reticle Loader: Enables manual exchange of the reticles by the tool operator.

Automated Reticle Loader: Enables automatic reticle exchange to eliminate the potential for reticle mishandling or contamination during transfer.

Automatic Reticle Loader with Reticle Library: Enables automatic reticle exchange in accordance with what is specified in the recipe, as well as storage of up to twelve 5" reticles in their cases. This function maximizes operator and equipment productivity, and eliminates the potential for reticle contamination during transfer.

Reticle Cassette Barcode Reader: Enables automatic reading of the cassette's barcode and compares that to what is specified in the program to ensure the intended cassette is loaded.

Reticle Barcode Reader: Enables automatic reading of the reticle's barcode to ensure the reticle loaded matches the name specified in the exposure recipe. A notification will be given if there is a mismatch, and the system will automatically change to the correct reticle.

Standard Reticle for Calibration: This 5" reticle is packaged together with the necessary coordinate calibration data and software for exposure/self-measurement of NES alignment accuracy and distortion, etc.

Alignment and Overlay

Enhanced Global Alignment (EGA): Alignment method used on many generations of traditional Nikon steppers. Functions by utilizing multiple alignment marks across the wafer to ensure best fit alignment, thereby compensating for rotation issues or any process-induced deformation.

Each Row-bar Alignment (ERA): Specialized alignment algorithm that measures multiple shots, typically 3 to 5 per row, and then calculates the approximate curve for each row and instructs the stepper to rotate the wafer stage and expose the second shot at the tangent angle to the approximation curve. Helps to correct for orthogonality and scaling signatures, and can markedly reduce rotation errors.

Pattern Matching Alignment: If customers are unable to design the recommended alignment marks into their reticles, this capability enables the Mini Stepper to align to other structures within the customer's standard patterns. (Overlay specifications will be different when aligning to non-standard marks.)

Backside Alignment (BSA): Many bulk MEMS processes require alignment for front and backside of the wafer. The innovative NES Backside Alignment system utilizes a proprietary design with direct visual observation to enable backside alignment accuracy to 0.8 µm and below (M + 3 σ).

Illumination

Manual Sigma Aperture: Enables manual switching of the aperture within the illumination system to satisfy process-specific imaging objectives.

Illumination System Sigma Variable Mechanism: The optional NA variable module for the illumination system enables automatic switching according to user defined illumination conditions. Enhances resolution and depth of focus on a process-specific basis.

Annular Illumination: Off-axis illumination capabilities provide enhanced imaging and process windows for a variety of structures.

Microlens Array: Fly's eye used in the illumination system to maintain illumination uniformity for optimal imaging.

System Management

Remote Recipe Editor: Enhances stepper productivity and user efficiency with the ability to create exposure recipes from the convenience of your office.

Communications: Machine status information can be sent to a PC or Host system. Additionally, the Remote Recipe Editor can access the machine through Windows Exchange.

Log File Exportation: Provides logged lot exposure data that can be exported in .csv format. Log files include details on lot ID and recipe, dose/focus, alignment data, errors, etc.

Shot Map Viewer: For customers wishing to expose multiple different patterns on a single wafer - this function makes it possible to show the varied shot maps at one time. Also enables shot data import and export capabilities.

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