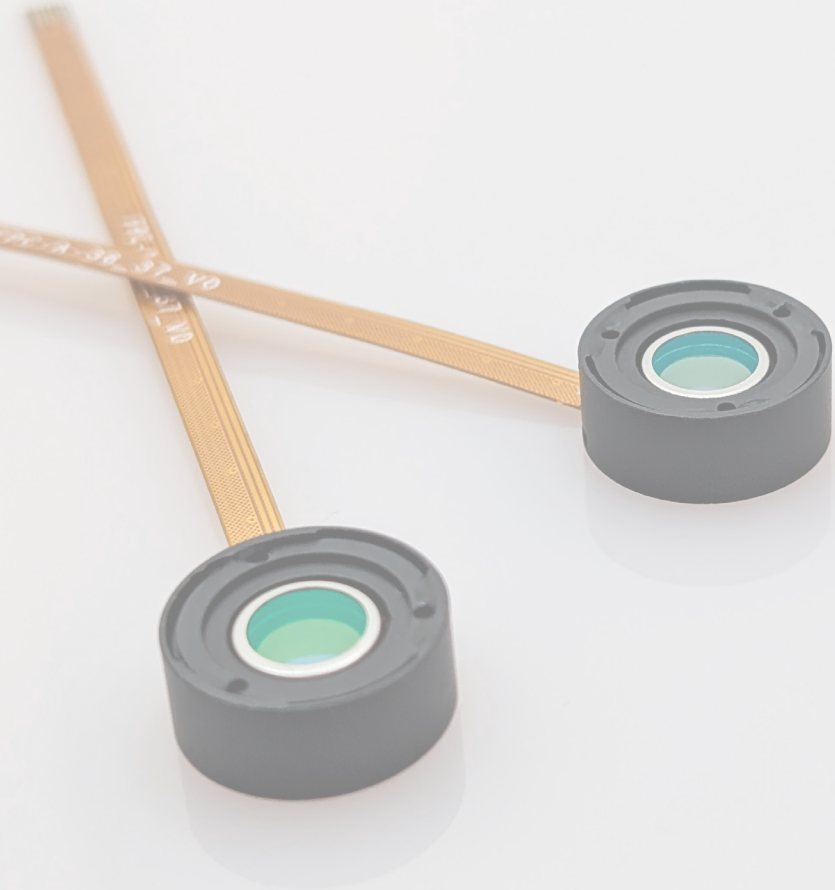

CORNING
Corning® Varioptic® Lenses
Step in Focus



CORNING | Varioptic® Lenses

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About Corning

Corning is one of the world's leading innovators in materials science. For more than 170 years, Corning has applied its unparalleled expertise in glass science, ceramic science, and optical physics to develop products that transform industries and enhance people's lives.

Corning succeeds through sustained investment in R&D, a unique combination of material and process innovation, and close collaboration with customers to solve tough technology challenges.

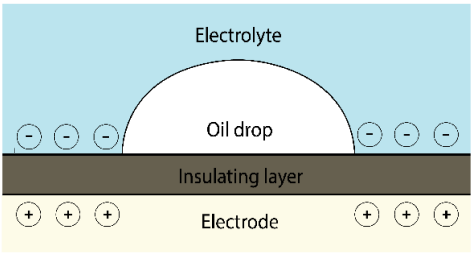
Corning's businesses and markets are constantly evolving. Today, Corning's products enable diverse markets such as mobile consumer electronics, display, optical communications, automotive, and life sciences vessels.

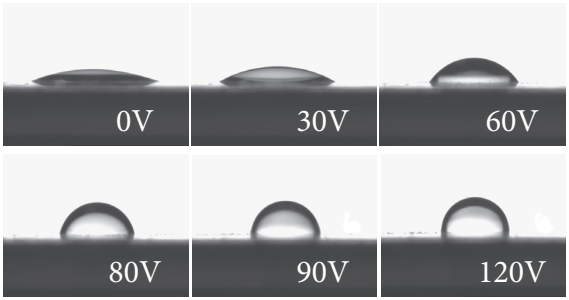
Corning® Varioptic® Lenses are optical devices that adjust voltage to change the shape of a liquid interface. This technology addresses demanding markets for industrial imaging applications. The technology was originally developed by Bruno Berge when he founded Varioptic in 2002, and Corning acquired the company in 2017.

Corning® Varioptic® Lenses is part of the Advanced Optics Division, a global leader in providing cutting-edge material and optical solutions that serve a variety of commercial markets including semiconductor manufacturing, microfabrication, consumer electronics, and more.

Electrowetting : focus only

Electrowetting occurs when a drop of insulating liquid (e.g. oil drop) is deposited on a flat surface, made of a conductive material covered with an insulating and hydrophobic layer, and then both the drop and surface are immersed in a conductive liquid (e.g. electrolyte). Voltage is then applied between the conductive substrate and the conductive liquid
causing the liquid drop to change shape. This effect is known as electrowetting.





The shape of the drop then changes as voltage increases

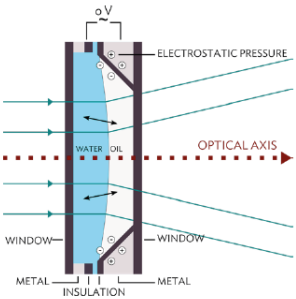
Lens Structure

The design of the adjustable lens structure ensures:

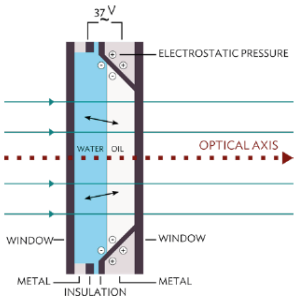
- Stable optical axis, by a conical centering of the drop
- Non sensitivity to orientation, by using two liquids of equal density
- High shock resistance, by a simple mechanical structure and equal density

Depending on the voltage applied, the lens can be a divergent lens, a flat lens, or a convergent lens.

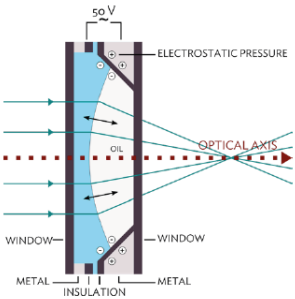
Divergent Lens



Flat Lens



Convergent Lens



Electrowetting : Variable Focus and Astigmatism

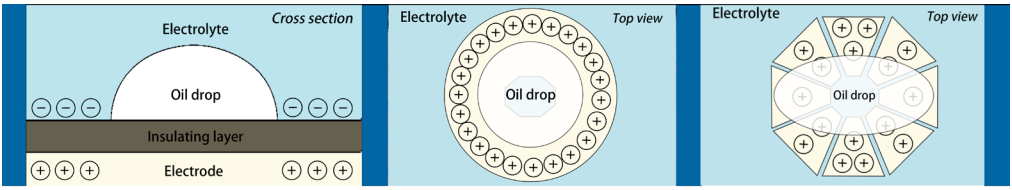
Corning® Varioptic® Multi electrode Lenses exploit the same electrowetting principle as single-electrode lenses, but with an enhanced design that integrates multiple electrodes. This architecture enables more precise control of the liquid interface, allowing for advanced optical functionalities such as beam steering, astigmatism correction, or dynamic aberration compensation.

These lenses can be reconfigured on demand by applying different voltages to each electrode, enabling complex and adaptive optical behaviors in real time.

Key benefits :

- Advanced optical shaping and astigmatism correction
- Beam steering capabilities without mechanical movement
- Dynamic aberration correction for improved image quality
- Control of the optical axis
- No moving parts, ensuring high reliability and robustness
- Compact and lightweight design, ideal for embedded systems
- Low power consumption and silent operation

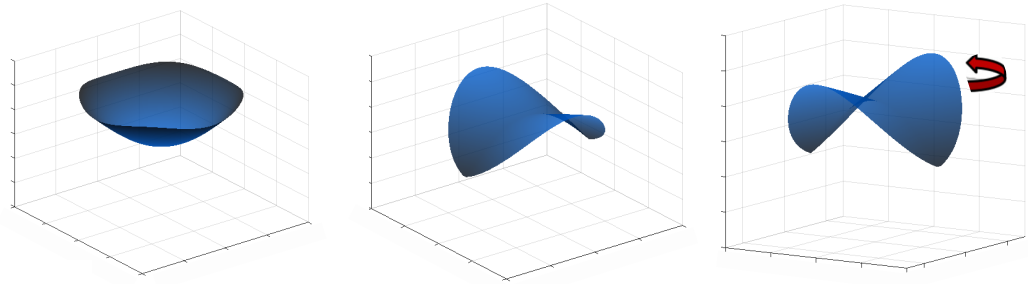
Lens Structure



Electrowetting A-Series :
Sphere only

Electrowetting multi electrode:
Variable sphere, cylinder and axis

Providing Sphere, Cylinder and Axis variation :



From left to right Sphere, cylinder, axis

Advantages of Corning® Varioptic® Lenses

The traditional way to perform the auto focus function is to mechanically move the lens module to adjust the back focal length (distance to the image sensor) depending on the object distance. This method presents several drawbacks:

- Requires bulky and fragile motors
- Friction of small parts leading to damage and malfunction after a few hundreds of thousands of actuations
- Noise and high power consumption while moving the mass of the lens module

The unique characteristics of Corning Varioptic Lenses offer the following:

- No moving parts
- Hundreds of millions of cycles endurance
- Speed: much faster than mechanical actuators
- Robustness and unmatched mechanical shock resistance: tested at 6500g / 0.19ms / 24 times (3 axis)
- Close focus ability: from infinity to below 5 cm
- Low power consumption: up to few mW at lens level
- Silent operation

Applications

- Barcode readers
- Consumer devices
- Lasers
- Augmented and Virtual Reality
- Biometrics
- Machine vision

Bare lens

From left to right : A-16F, A-25H, A-39N, A-58N

Corning Varioptic's variable focus lens products are all based on its core and proprietary electrowetting based liquid lens bare component. It relies on a single electrode design.
This component gives the fundamental electro-optical characteristics of the lenses and defines among other parameters, the clear aperture and the available refractive power dynamic range of the final products.

These lenses are available under various integration levels (as a single optical element or integrated in imaging lenses) tailored to meet the variety of supported applications while ensuring the ease of use, the optimum performance of the lenses and limiting the development effort on the user side.

Available through : A-PE,C-S,C-SE,C-C,C-u,C-H,C-T Series

Variable focus and astigmatism lenses

Unlike the variable focus lens that is based on a single electrode structure, the variable focus & astigmatism lens features a multiple electrode design on the top of the lens allowing not only to control the sphere but also the cylinder (and associated axis) of the resulting refractive power with absolutely no moving parts.

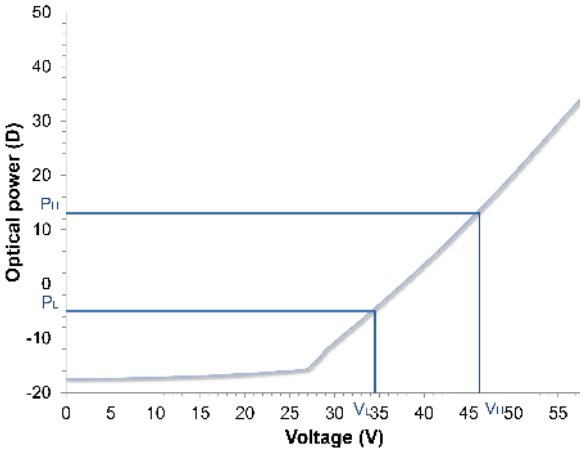
These lenses are available as a single optical element and also benefit from Corning Varioiptic's proprietary driving technology enabling optimum performance and ease of use.

Available through : V-PE Series

Key Performances

Optical Power vs. Voltage

The optical power of Corning® Varioptic® Lenses is a linear response versus voltage.

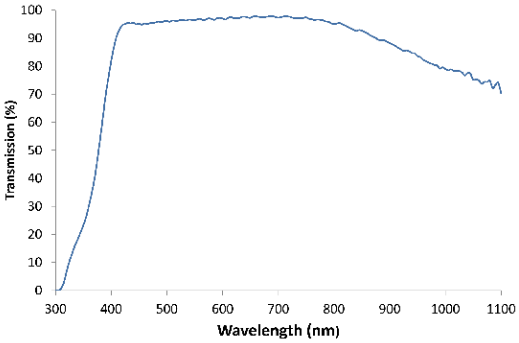


Optical Quality

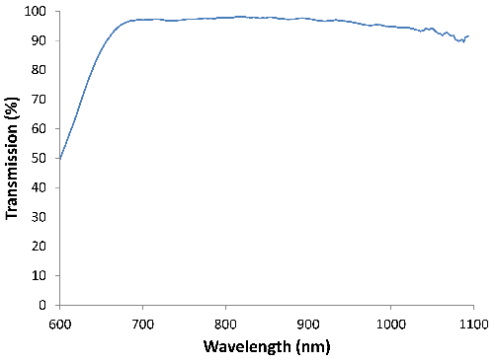
The optical quality of each adjustable lens is specified by the Wave Front Error (WFE). The WFE characterizes the deviation of the actual shape of the lens compared to a perfectly spherical lens – and measured in nanometers rms. The typical WFE of the lens is in the range of 50 nm rms, which is the equivalent of a lambda/10 lens.

Transmission

The standard version of each lens comes with an anti-reflective (AR) coating which is optimized in the visible range. Therefore, the transmission drops slightly in the near infrared. The loss of transmission below 400nm is linked both to the anti-reflective coating and to the glass that is used in the lenses, which is a standard borosilicate glass.



A-25H0 – AR coating optimized in the visible range



A-25H1 – AR coating optimized in the near-infrared range

With an anti-reflective coating optimized in the near infrared, the transmission curve flattens from 700nm to 1100 nm.

System Integration

Corning® Varioptic® Lenses can be used in several types of systems:

- Manual focus: the user adjusts the focus manually, with a knob for example
- Closed-loop: this is the standard auto focus method, where a processor runs a contrast optimization loop to maximize the sharpness of the image
- Open-loop: this is a mode where the focus command is directly sent to the lens, from an external distance measurement for instance
- Mixed mode: a combination of open loop for coarse search, and closed loop for fine tuning of the focus
- Sweep mode: this mode performs a continuous sweep of the full range of the optical power of the liquid lens

Closed-loop Auto Focus

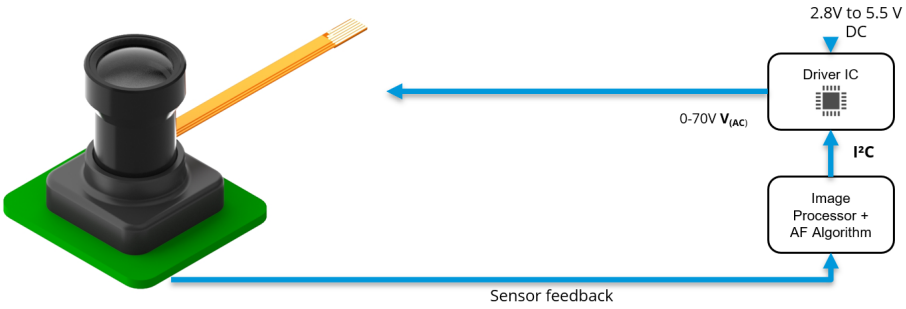
A closed-loop system consists of:

- An image sensor
- An optical lens consisting of fix-focus optics and an adjustable lens
- An adjustable lens driver IC
- A processor (ISP, FPGA...)

The processor performs the following tasks:

- Contrast measurement on the image output by the sensor
- Modification of the driver IC command to maximize this image contrast.

Corning Varioptic Lenses interfaces auto focus algorithms that have been optimized for the adjustable lens. The overall performance depends on many system parameters such as sensor frame rate and processing speed; typically, the complete auto focus loop can be completed in 8 to 12 frames.



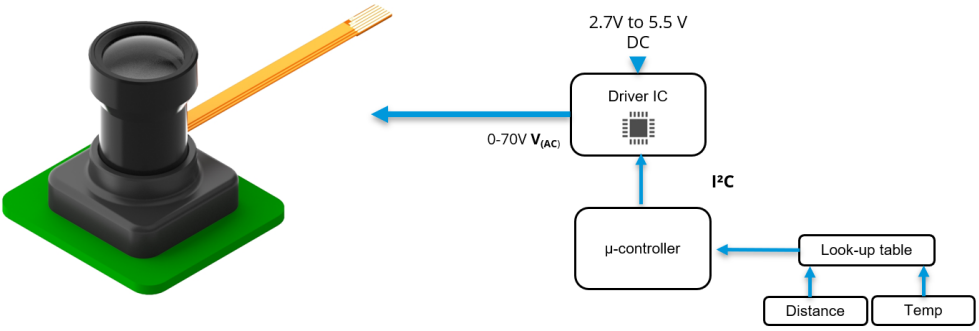
Open-loop Driving

Although the adjustable lens closed-loop is fast, there are situations where it is not possible to acquire several frames to perform a focusing loop. In this case, the solution is to use open-loop focusing, where the sensor feedback is not used.

Open-loop focusing is based on a look-up table where the desired focusing distance is linked to the driver IC command. This look-up table is initially calibrated. Focusing is then triggered through an external external device, for instance:

- A distance measurement device that measures object position.
- A predetermined set of distances, etc.

Through the addition of this extra device, open-loop driving enables ultra-fast focusing where focus can be achieved within one frame only.



Closed-loop vs. Open-loop

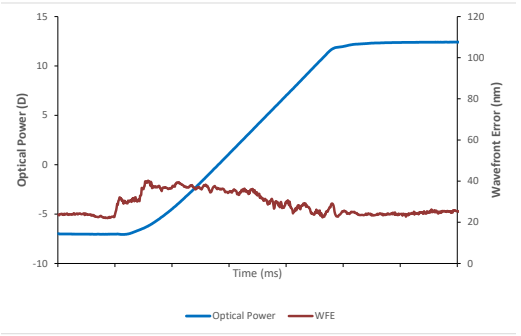
The main advantage of the closed-loop system is its simplicity of integration. Indeed, an open-loop system will need:

- A distance measurement device
- A temperature sensor
- A calibration of the device during production

Also, an open-loop system may be susceptible to any variation in the system. For optimum performances, open-loop and closed-loop should be combined: open-loop for coarse search and closed-loop for fine search.

Sweep mode

This mode is particularly suited for applications where the image does not need to remain in focus, typically like on the fly decoding applications. The focus ramp is a linear change of the optical power of the liquid lens with time, allowing the acquisition of images while the liquid lens is still moving, with virtually no settling time. The principle is to cover the full optical power range of the liquid lens such as having the focus moving between infinity and short distance making sure to have any targeted object focused at least on one image. The collected images can then be analyzed and decoded in parallel. This method can be extremely fast since it doesn't require any settling time between 2 focus positions relying on the unique property of the Liquid Lens which is, being able to provide high optical quality even while the optical power is being changed.



A-16F0 – Sweep example

Parameters can be tuned to meet application requirements (rise time, diopter range etc...).

Lens driving

Corning® Varioptic® liquid lenses require specific electrical driving signals to ensure both reliable operation and optimum optical performance. Leveraging its deep expertise and advanced characterization capabilities, Corning has developed proprietary algorithms that simplify lens integration while maximizing performance.

To support these requirements, Corning® Varioptic® has introduced the A-PE controller board—a highly integrated and proprietary electronic platform designed to facilitate the seamless integration of liquid lenses into end-user systems and products.

The lenses can be controlled via I^2C or RS232 interfaces, offering flexibility for integration into a wide range of electronic systems.

Unified Control Architecture

Initially launched with the A-25H0 lens, the A-PE controller is now deployed across the entire liquid lens portfolio, and will be extended to the C-S Series. The same platform is also embedded in the latest C-Mount lens portfolio (C-C-39N0-A1 Series), with feature rollouts planned progressively.

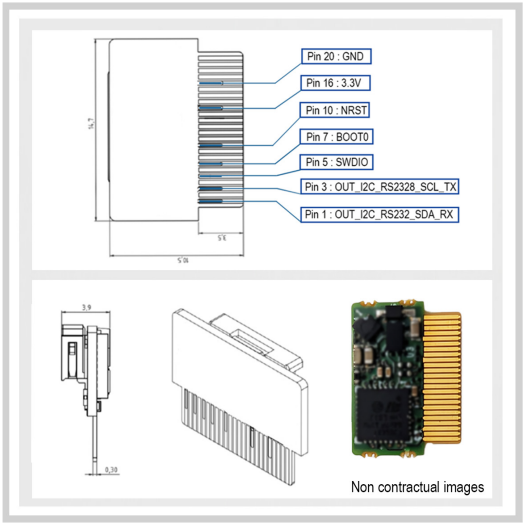
Key Functionalities

Multipoint Calibration : Individual lens characteristics are stored on the micro-controller, enabling direct optical power commands for precise control.

V-Speed : Proprietary algorithm that significantly reduces lens response time, enhancing dynamic performance.

V-Temp : Temperature compensation algorithm that maintains consistent lens behavior across varying environmental conditions.

V-Sweep : Pre-formatted optical power sweeps that preserve optical quality during transitions.



Variable Focus Lenses (A-PE Series)

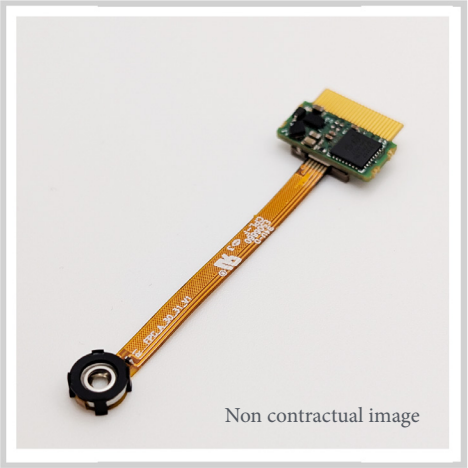
Corning® Varioptic® Lenses enable variable focus functionality when designed into imaging or beam shaping lenses. They offer a high degree of design freedom for mechanical, electrical, and optical integration. A-PE Series lenses are available with clear aperture sizes ranging from 1.6mm to 5.8m

A-PE-16F-31

Our A-PE-16F-31 Variable Focus Lens is the smallest member of the A-PE Series family. It is specifically designed for ultra-compact cameras, such as barcode engines, industrial, etc. A-PE-16F-31 is based on our breakthrough lens technology, enabling variable focus with absolutely no moving parts.

The packaged version without electronics is available under conditions (A-P Series).

Please contact the sales for the availability of the A-PE functionalities (V-Speed,V-Sweep,V-Temp,...)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Ordering Information:

- A-PE-16F0-31: with an anti-reflective coating optimized in the visible range
- A-PE-16F1-31: with an anti-reflective coating optimized in the near infrared

Key Features:

- 1.6 mm clear aperture
- Excellent optical quality and fast response time
- Focus range from 5 cm to ∞
- Easy to integrate

Specifications:

Typical performance at 25°C

Useful aperture at 0° field of view	1.6 mm
Low optical power	-5 diopters (m^{-1})
High optical power	+15 diopters (m^{-1})
Wave Front Error on 1.6mm aperture	20 nm (rms)
Transmission at 587nm (or 850nm for F1)	97%
Storage temperature	from -40 to 85°C
Operating temperature	from-20 to 60°C

A-PE-25H-33

Our A-PE-25H-33 Variable Focus Lens is an excellent fit for low footprint systems requiring fast response time and large focusing range, and is especially suitable for miniature industrial cameras. It provides a fast-track to market for product designers who need an easy to integrate, high-performance auto focus solution.

A-PE-25H-33 is based on Corning Varioptic's breakthrough lens technology, allowing variable focus with absolutely no moving parts.

A-PE-25H-33 comes with two different AR coating options. The packaged versions without electronics are available under conditions (A-P Series).

Please contact the sales for the availability of the A-PE functionalities (V-Speed,V-Sweep,V-Temp,...)

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Ordering Information:

- A-PE-25H0-33: with an anti-reflective coating optimized in the visible range
- A-PE-25H1-33 : with an anti-reflective coating optimized in the near infrared

Key Features:

- 2.5 mm clear aperture
- Silent
- Focus range from 5 cm to ∞
- Easy to integrate

Specifications:

Typical performance at 25°C

Useful aperture at 0° field of view	2.5 mm
Low optical power	-5 diopters (m^{-1})
High optical power	+13 diopters (m^{-1})
Wave Front Error on 2.5mm aperture	30 nm (rms)
Transmission at 587nm (or 850nm for H1)	97%
Storage temperature	from -40 to 85°C
Operating temperature	from-30 to 85°C

A-PE-25H-D0-33

Our A-PE-25HX-D0-33 variable focus lens features the same clear aperture and similar platform to the A-PE-25H-33 lens, now with three times higher dynamic range. It uses adjustable lens technology enabling variable focus with absolutely no moving parts. This lens is optimized with extended dynamic range, low power consumption, high shock resistance, and fast focus ability.

It is used as a component in very close auto focus or continuous auto focus applications in portable devices, where it will deliver outstanding performance, as well as in laser applications or lighting applications, where it will enable variable focus and expansion control.
A-PE-25H-D0-33 comes with two different AR coating options. The packaged versions without electronics are available under conditions (A-P Series).

Please contact the sales for the availability of the A-PE functionalities (V-Speed,V-Sweep,V-Temp,...)


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Ordering Information:

- A-PE-25H-D0-33: with an anti-reflective coating optimized in the visible range
- A-PE-25H1-D0-33 : with an anti-reflective coating optimized in the near infrared

Key Features:

- 2.5 mm clear aperture
- Silent
- Focus range from 1,5 cm to ∞
- Easy to integrate

Specifications:

Typical performance at 25°C

Useful aperture at 0° field of view	2.5 mm
Low optical power	-35 diopters (m^{-1})
High optical power	+35 diopters (m^{-1})
Wave Front Error on 2.5mm aperture	70 nm (rms)
Transmission at 587nm (or 850nm for H1)	97%
Storage temperature	from -40 to 85°C
Operating temperature	from -20 to 60°C

A-PE-39N-A1-35

Our A-PE-39N-A1-45 Variable Focus Lens is designed specifically for variable focus products needing a large clear aperture, long focal objectives, large sensors, C-Mount objective lenses, laser beam shaping, etc. It is perfectly suited for applications such as industrial vision, optical equipment and biometric devices.
A-PE-39N-A1-35 is based on Corning Varioptic's breakthrough lens technology, allowing variable focus with absolutely no moving parts.

A-PE-39N-A1-35 features 15 diopters of dynamic range, guaranteeing 7 cm focus ability and offers the same low power consumption, high shock resistance and fast focus ability that have led to the success of the liquid lens technology.

A-PE-39N-A1-35 comes with two different AR coating options, the packaged versions without electronics is available under conditions (A-P Series).
Please contact the sales for the availability of the A-PE functionalities (V-Speed,V-Sweep,V-Temp,...)


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Ordering Information:

- A-PE-39N0-A1-35: with an anti-reflective coating optimized in the visible range
- A-PE-39N1-A1-35: with an anti-reflective coating optimized in the near infrared

Key Features:

- 3.9 mm clear aperture
- Silent
- Focus range from 7 cm to ∞
- Easy to integrate

Specifications:

Typical performance at 25°C

Useful aperture at 0° field of view	3.9 mm
Low optical power	-5 diopters (m^{-1})
High optical power	+10 diopters (m^{-1})
Wave Front Error on 3.5mm aperture	50 nm (rms)
Transmission at 587nm (or 850nm for N1)	95%
Storage temperature	from -40 to 85°C
Operating temperature	from -20 to 70°C

A-PE-58N-37

The A-PE-58N-37 Variable Focus Lens features a large aperture with large dynamic range and a low WFE (Typ. 0.1λ Max. 0.2λ), without compromising on the form factor or ease of integration A-PE-58N-37 is based on Corning Varioptic's breakthrough lens technology, allowing variable focus with absolutely no moving parts.

A-PE-58N-37 features 15 diopters of dynamic range, guaranteeing 7 cm focus ability and offers the same low power consumption, high shock resistance, and fast focus ability that have led to the success of the A-PE Series Variable Focus Lenses.

A-PE-58N-37 comes with two different AR coating options, the packaged version without electronics is available under conditions (A-P Series).

Please contact the sales for the availability of the A-PE functionalities (V-Speed,V-Sweep,V-Temp,...)


Non contractual image

Ordering Information:

- A-PE-58N0-37: with an anti-reflective coating optimized in the visible range
- A-PE-58N1-37: with an anti-reflective coating optimized in the near infrared

Key Features:

- 5.8 mm clear aperture
- Compact & Low WFE
- Focus range from 7 cm to ∞
- Easy to integrate
- Without moving parts or internal heating

Specifications:

Typical performance at 25°C

Useful aperture at 0° field of view	5.8 mm
Low optical power	-5 diopters (m^{-1})
High optical power	+10 diopters (m^{-1})
Wave Front Error on 5mm aperture	80 nm (rms)
Transmission at 587nm (or 850nm for N1)	97%
Storage temperature	from -40 to 85°C
Operating temperature	from -20 to 50°C

Variable Focus and Astigmastism Lens (V-PE Series)

V-PE-80R0-07

The V-PE-80R0-07 is based on Corning® Varioptic® liquid lens providing variable focus tilt and astigmatism. It is provided with a complete calibration of the spherical and cylindrical power.

The new V-PE-80R0-07 liquid lens is built around a brand new 8+1 electrodes design and based on Corning Varioptic breakthrough technology.

The extra electrodes provide new functionalities to this liquid lens in addition to the sphere variation : It is now possible to adjust astigmatism and axis by controlling the voltage with absolutely no moving parts.

Ordering Information:

- V-PE-80R0-07

Key Features:

- 8 mm clear aperture
- Up to 24 diopters of spherical power
- Up to 5 diopters of cylindrical power
- Combined sphere, cylinder, and axis variation
- Easy to integrate
- Silent
- Without moving parts or internal heating

Specifications:

Typical performance at 25°C

Useful aperture at 0° field of view	8 mm
Sphere only optical power	-12 ... +12 diopters (m-1)
Sphere optical power range using cylinder	-6 ... +6 diopters (m-1)
Cylinder optical power range	-5 ... 0 diopters (m-1)
Transmission at 587nm	96%
Operating temperature	from 10 to 35°C

Auto Focus Modules (C-Series)

Corning® Varioptic® Lenses enable auto focus functionality when a fixed lens module and a variable focus lens are integrated into a Corning Varioptic receptacle mount.

C-S-Series

Integrates a fixed lens module and an embedded liquid lens providing variable focus in an M12 receptacle (S-mount). It can be easily mounted onto a standard M12 sensor board and driven by our liquid lens proprietary driver IC or electronic boards.

Key Features:

- M12x0.5 thread
- Flex Cable compatible with 0.5 mm pitch connector
- Compatible FPC connectors:
  - — 525590652 from Molex
  - — 5034800600 from Molex
- Built in auto focus actuator
- Built in IR cut filter for -IR version

Ordering Information:

- C-S-25H0-026-42: EFL = 2.6 mm, include a FPC-A-42
- C-S-25H0-033-43: EFL = 3.3 mm, includes a FPC-A-43
- C-S-25H0-036-43: EFL = 3.6 mm, includes a FPC-A-43
- C-S-25H0-047-43: EFL = 4.7 mm, includes a FPC-A-43
- C-S-25H0-075-43: EFL = 7.5 mm, includes a FPC-A-43
- C-S-25H0-096-43: EFL = 9.6 mm, includes a FPC-A-43
- C-S-39N0-158-45: EFL = 15.8 mm, includes a FPC-A-45
- C-S-39N0-250-45: EFL = 25 mm, includes a FPC-A-45

For module with IR cut filter (650 nm cut-off wave-length), please add I to one of the above reference when ordering

C-SE-Series

Integrates a fixed lens module and an embedded liquid lens providing variable focus in an M12 receptacle (S-mount). It can be easily mounted onto a standard M12 sensor board and driven by the same driver board as the A-PE Series.

Key Features:

- Provided with driving electronics
- Controlled via I2C or RS232
- M12x0.5 thread
- Compatible with : 24 pins ZIF connector 24FLT-SM2-TB(LF)(SN)
- Built in auto focus actuator
- Built in IR cut filter for -IR version

Ordering Information:

- C-SE-25H0-026-42: EFL = 2.6 mm, include a FPC-A-42
- C-SE-25H0-033-43: EFL = 3.3 mm, includes a FPC-A-43
- C-SE-25H0-036-43: EFL = 3.6 mm, includes a FPC-A-43
- C-SE-25H0-047-43: EFL = 4.7 mm, includes a FPC-A-43
- C-SE-25H0-075-43: EFL = 7.5 mm, includes a FPC-A-43
- C-SE-25H0-096-43: EFL = 9.6 mm, includes a FPC-A-43

For module with IR cut filter (650 nm cut-off wavelength), please add I to one of the above reference when ordering

C-H-Series

Integrates a fixed lens module and an A-16F variable focus lens in an M8 receptacle. It can be easily mounted into a standard M8 sensor board. It is the smallest formfactor auto focus lens module available among Corning® Varioptic® Lenses.

Key Features:

- M8x0.5 thread
- Flex Cable compatible with 1 mm pitch 4 pins connector
- Compatible FPC connectors:
  —SFW4S-2STE9LF from FCI
  —04FMN-BTK-A (LF)(SN) from JST
- Built in auto focus actuator
- Built in IR cut filter for -IR version

Ordering Information:

- C-H-16F0-036-12: includes A-16F0 and straight Flex Cable without thermistor (4 pins) (FPC-A-12), EFL = 3.6 mm

For module with IR cut filter (650nm cut-off wavelength), please add I to one of the above reference when ordering

Specifications:
Typical performance at 25°C

	C-S-25H0-026	C-S-25H0-033	C-H-16F0-036	C-S-25H0-036	C-S-25H0-047	C-S-25H0-075	C-S-25H0-096	C-S-39N0-158	C-S-39N0-250
Effective Focal Length	2.6 mm	3.3 mm	3.6 mm	3.6 mm	4.7 mm	7.5 mm	9.6 mm	15.8 mm	25 mm
Format	M12		M8	M12					
F-number	2.5	2.8	2.2	1.8	2	2.9	3.7	4	4 or 8
Chief Ray Angle (CRA)	17°	12.8°	33.7°	33.7°	34.4°	16.5°	12.5°	5.5°	5°
Focusing range	4 mm to ∞	5 cm to ∞							15 cm to ∞

FOV vs. Sensor Format	C-S-25H0-026	C-S-25H0-033	C-H-16F0-036	C-S-25H0-036	C-S-25H0-047	C-S-25H0-075	C-S-25H0-096	C-S-39N0-158	C-S-39N0-250
1/4”	86°	62°	63°	63°	46°	33°	26°	16°	9°
1/3”	134°	85°	79°	79°	65°	44°	35°	22°	13°
1/2.7”	152°	91°	-	-	71°	48°	39°	-	15°
1/2.5”	160°	95°	-	-	75°	51°	41°	-	16°
1/2”	-	101°	-	-	-	-	45°	-	18°
1/1.8”	-	-	-	-	-	-	50°	-	20°

	C-S-25H0-026	C-S-25H0-033	C-H-16F0-036	C-S-25H0-036	C-S-25H0-047	C-S-25H0-075	C-S-25H0-096	C-S-39N0-158	C-S-39N0-250
Back Focal (no IR)	5.26 mm	1.95mm	0.53 mm	0.53 mm	0.83 mm	4.07 mm	6.12 mm	6.02 mm	3.27 mm
Back Focal (IR filter)	5.36 mm	2.07mm	0.59 mm	0.59 mm	0.69 mm	4.26 mm	6.3 mm	6.2 mm	3.4 mm
Image circle diameter	7.2 mm	7.5 mm	6 mm	6 mm	7.5 mm	7.2 mm	9 mm	6 mm	9 mm
Sensor compatibility	1/2.5”	1/2.3”	1/3”	1/3”	1/2.4”	1/2.5”	1/1.8”	1/3”	1/1.8”

Setting Procedure

For optimum performance of the module, please refer to the setting procedure detailed in the Technical Data Sheets of the C-H and C-S-Modules.

C-C-Series

Electronically focused, controllable C-mount module embedding the Corning Liquid lens technology.

The C-C-Series incorporates all necessary electronic components to drive the lenses and only requires a DC power supply and a serial interface.

Key Features:

- Integrated driving electronics
- Silent
- Supports I²C, RS232, and SPI interfaces
- Supports closed-loop operations

Ordering Information:

- C-C-39N0-A1-XXX : supports I²C,SPI and RS232

XXX = 120,160,250 or 350 for 12mm, 16mm, 25mm, 35mm EFL

Specifications:

Typical performance at 25°C

	C-C-39N0-A1-120	C-C-39N0-A1-160	C-C-39N0-A1-250	C-C-39N0-A1-350
Effective Focal Length	12 mm	16 mm	25 mm	35 mm
Manual Iris	No	No	Yes	Yes
F-number	4.7	3.8	5 to 22	5.5 to 22
Focus range	15 cm to ∞	15 cm to ∞	20 cm to ∞	20 cm to ∞
Image circle diameter	17,6 mm			
Sensor compatibility	1.1”			
Pixel size / Resolution	2.74µm/20MP			
DC power supply	3.3-24 VDC			
Current consumption	10 to 50 mA			
Connector	6 pin jST SHR-06V-S-B			
Communication	32 bits			

C-C-39N0-A1-250

C-C-39N0-A1-350

C-C-39N0-A1-120

C-T-Series

Electronically focused, controllable telecentric module embedding the Corning Liquid lens technology.
The C-T-Series incorporates all necessary electronic components to drive lenses and only requires a DC power supply. The C-T-Series lenses can be mounted on C-mount cameras.

Key Features:

- Variable focus
- Silent
- Supports I^2C and RS232 interfaces
- Supports closed-loop operations

Ordering Information:

- C-T-39N0-A1-XXX

XXX = 005 or 010 for 0.5 X or 1 X magnification

Specifications:

Typical performance at 25°C

	C-T-39N0-A1-005	C-T-39N0-A1-010
Mount	C-Mount	
Connector	Hirose 6-pin HR10A-7R-6SB	
Magnification	0.5 X	1 X
Image circle diameter	16mm	16mm
WD (mm)	116-128	102-118
TV Distortion	≤ 0.1%	≤ 0.1%
Resolution	8.8 µm	5.5 µm
Telecentricity	≤ 0.1°	≤ 0.1°

C-T-39N0-A1-005

C-T-39N0-A1-010

C-u-Series

Combined with the use of specific adapters, either for C-Mount or M12, an inexpensive Auto Focus microscope can be built. It uses the same FPC cable as the C-S series, and therefore requires the same FPC connectors.

Ordering Information:

- C-u-25H0-075-43: inverted C-S-25H0-075

The C-uE version including electronics and features similar as the A-PE series is also available - please contact us to know more.

Non contractual image

Specifications:

Typical performance at 25°C

	Extension Ring		
Magnification	X2	X4	X5
Working distance	7 mm	6 mm	5 mm
Focusing range	±0.85 mm	± 0.7 mm	± 0.65 mm
Mechanical Back Focal	15 mm	22 mm	37 mm

C-u Microscopy Set :

Allows customers to achieve various magnifications, both for M12 and C-Mount cameras. This set is delivered with the C-Microscopy development kit.

- 1 microscope spacer
- 1 set of M12 and C-Mount adapters allowing X2, X3 and X5 magnifications
- 1 locking nut for M12 adapters

Driver

Maxim MAX14574

Corning has qualified the Maxim MAX14574 for the use with Corning® Varioptic® Lenses.

- Compatible with A-P Series, C-S-Series and C-u-Series
- It is also possible to read the temperature of an external thermistor, through the I²C interface

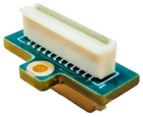
Corning is the exclusive worldwide reseller of the Maxim MAX14574, to purchase, please contact Corning Varioptic Lenses at varioptic@corning.com or an approved Corning Varioptic Lenses distributor.

Performance Summary:

	MAX14574
Maximum Voltage	70 V
Resolution	10 bits
Interface	I²C
Size (mm)	1.6 x 2.6
External Components	5
Output Waveform	PWM
Maximum Power Consumption	40 mW
Package	15 bump WLP
Temperature Reading	Yes
Input Voltage Range	+ 2.7 V to +5.5 V

Driver Boards

Breakout board



This board embeds a wire-to-board and ZIF connectors, and allows users to easily connect A-PE and V-PE Series boards to their system via some wires without risks of damaging A-PE and V-PE Series boards by doing some direct pad soldering. The board is provided with an SHR-09V-S-B connector and 150mm long wires with JST terminals on the other end.

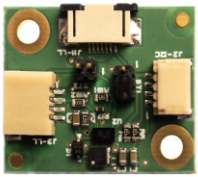
Board size : 18.2 x 12.5 mm.

USB-M Universal

This board includes a Maxim driver and various FPC connectors for the A-PE-Series, C-S-Series, C-SE-Series C-H-Series and C-u-Series. Due to the FocusLab Software, it is easily driven through USB and delivered with the development kits. Its very small form factor enables the use of this board directly with any PC-driven application with no extra hardware development. This board is an evolution of our former "USB-M Flexiboard". It also provides a compatibility with our C-C-39N0-A1 20Mpx product line.

Board size : 48 x 35 x 8 mm.

Maxim Drivboard



This board includes a Maxim driver and the needed FPC connectors (4 and 6 pins) to accommodate the A-P-Series, C-S-Series and C-u-Series. It has a 4 pin JST connector for DC power supply and for I^2C communication. It has been designed for fast driving of the adjustable lens directly from a microcontroller, an FPGA, a DSP, etc. A cabled JST connector is supplied with the board.

Board size : 23 x 18 x 8 mm.

Communication Devices

Flex Cables

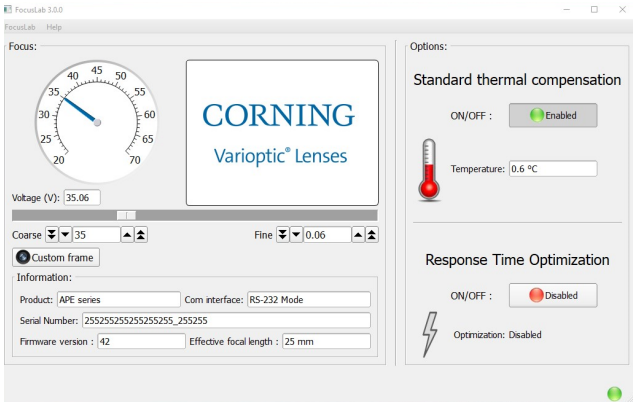
	Pins	Pitch	Thermistor	Shape	Lenght(*)
FPC-A-31	6	0.5 mm	YES	Straight	46 mm
FPC-A-33	6	0.5 mm	YES	Straight	63 mm
FPC-A-35	6	0.5 mm	YES	Straight	91 mm
FPC-A-37	6	0.5 mm	YES	Straight	91 mm
FPC-A-12	4	1 mm	NO	Straight	71 mm
FPC-A-42	6	0.5 mm	NO	Bent	60 mm
FPC-A-43	6	0.5 mm	YES	Bent	60 mm
FPC-A-45	6	0.5 mm	YES	Bent	61 mm

(*) : Longest dimension of the FPC

Software

FocusLab

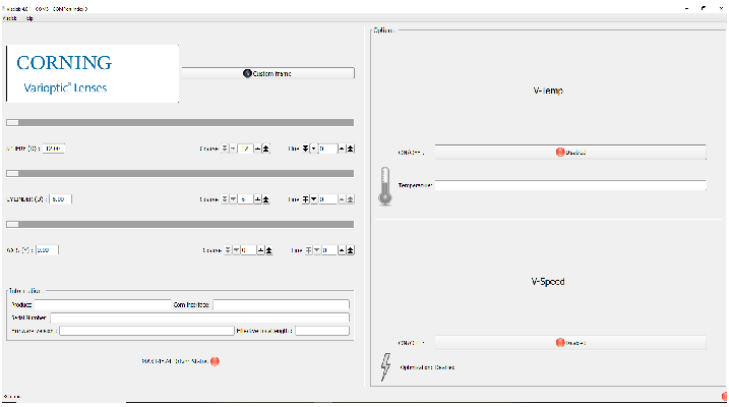
FocusLab allows customers to control the liquid lens through the USB Boards.
The software controls the output voltage on the liquid lens. A specific dialog box allows for sending advanced commands to the liquid lens controller. A specific documented DLL integrates this in a C-code program.



FocusLab windows interface

VisaLab

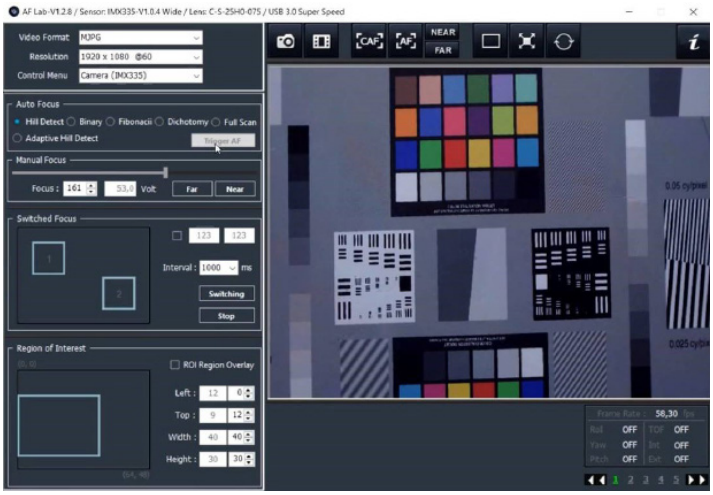
Visalab allows customers to control the new V-PE Series. The software controls the output voltage on the liquid lens electrodes to control the sphere, cylinder and axis. A specific documented DLL integrates this in a C-code program. Visalab also allows the control of the V-PE Series through the USB-M Universal.



VisaLab windows interface

AFLab

AFLab Software is provided together with the Corning® Varioptic® AF Explorer Development Kit, it allows to select the various AF modes & algorithms, change the basic sensor settings, as well as image & video acquisition among others.



Development Kits

Development Kits are specially designed to speed up the evaluation and design process.

D-A-PE Kits

- 1 A-PE lens (choose one) :
- 1 breakout board
- 1 USB-M Universal, USB cable
- FocusLab Software
- Documentation Package

Lens Model	Ordering code
A-PE-16FX-31	D-A-PE-16FX, X=0,1,
A-PE-25HX-33	D-A-PE-25HX, X=0,1
A-PE-25HX-D0-33	D-A-PE-25HX-D0, X=0,1
A-PE-39NX-A1-35	D-A-PE-39NX-A1, X=0,1
A-PE-58NX-37	D-A-PE-58NX, X=0,1

D-H Kits

Ordering code:

- D-H-16F0-036, no filter
- D-H-16F0-036I, with IR-Cut filter

- 2 C-H Modules
- 1 Maxim Drivboard
- 1 USB-M Universal, USB cable
- FocusLab Software
- Documentation Package

D-S Kits (C-S-25H0-XXX)

Ordering code:

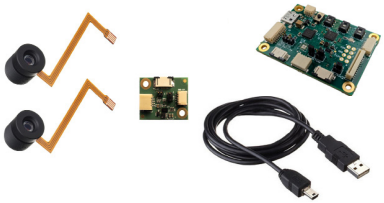
- D-SE-25H0-XXX, XXX= 026/033/036/047/075/096, no filter
- D-SE-25H0-XXXI, XXX= 026/033/036/047/075/096,with IR-Cut filter

- 2 C-SE Modules
- 1 Breakout Board
- 1 USB-M Universal, USB cable
- FocusLab Software
- Documentation Package

D-S Kits (C-S-39N0-XXX)

Ordering code:

- D-S-39N0-XXX, XXX=158/250 no filter
- D-S-39N0-XXXI, XXX=158/250 with IR-Cut filter



- 2 C-S-39N0-XXX Modules
- 1 Maxim Drivboard
- 1 USB-M Universal, USB cable
- FocusLab Software
- Documentation Package

D-C Kits 20MP | 1.1”

Ordering code
D-C-39N0-A1-120
D-C-39N0-A1-160
D-C-39N0-A1-250
D-C-39N0-A1-350

- 1 C-C-39N0-A1-XXX
- 1 USB-M Universal and cable
- FocusLab Software
- Documentation Package

RS232 12V requires dedicated shifter board

D-T Kits

Ordering code: D-T-39N0-A1-XXX
XXX = 005 or 010

- 1 C-T-39N0-A1-XXX
- 1 Cable
- FocusLab Software
- Documentation Package

D-uE-25H0-075

Ordering code: D-uE-25H0-075

- 1 C-uE-25H0-075
- 1 Breakout board
- 1 C-Series Microscopy Set
- 1 USB-M Universal, USB cable
- FocusLab Software
- Documentation Package

D-u-39N0-160

Ordering code: D-u-39N0-160-YYY
YYY= R12, R33, SPI, I²C

- 1 C-C-39N0-160-YYY
- 1 C-C Com board and cable
- 1 Adaptor ring
- 2 C-mount tubes (20 & 50 mm length)
- FocusLab Software
- Documentation Package

D-V-PE-80R0

Ordering code: D-V-PE-80R0

- 1 V-PE-80R0-07
- 1 USB-M Universal, USB cable
- VisaLab Software
- Documentation Package

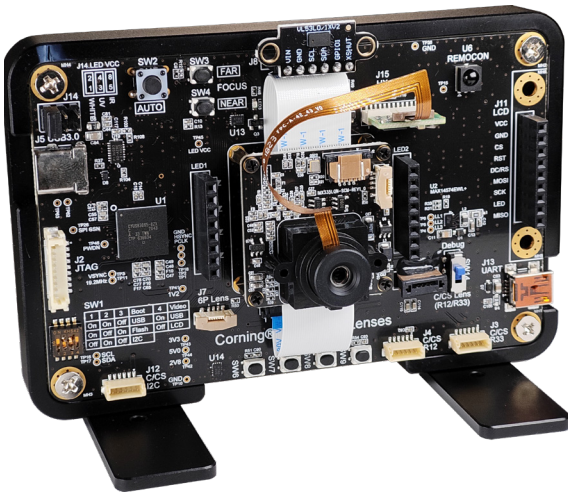
Corning® Varioptic® AF Explorer Development Kit

The Corning® Varioptic® AF Explorer is a comprehensive platform that produces fast and reliable auto focus based on Corning Varioptic liquid lens technology. The kit consists of several PCB boards with associated software and is provided in a ready-to-use format, including a USB camera system allowing straight-forward evaluation of Corning liquid lens products. The main structure is based on:

- an Image Signal Processor (ISP)
  can be purchased separately for use in other designs
- a Cypress EZ-USB® CX3 USB 3.0 chip
- an image sensor board
- an integrated Time of Flight (TOF) sensor for distance measurement
- different lighting options
  white, blue, and NIR LEDs (are included in the kit : White LEDs only)
- AF Lab Software that enables basic sensor settings, AF mode selection, AF algorithm, and more

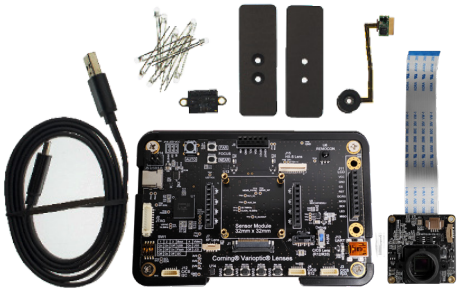
The kit is suited for camera developers wishing to study characteristics of the liquid lens. It offers various focus options, including manual focus, switched focus, closed-loop AF and open-loop AF - both triggered and continuous.

This kit can also be used as a reference design and a starting point for system designers, reducing time spent on development.



Default Configuration

D-AF-EXP-STD-075 is the default configuration of the Corning Varioptic AF Explorer kit. It is based on the Sony® IMX 335 sensor and Corning Varioptic C-SE-25H0-075 Auto Focus Lens Module and includes:



- Main board
- Sensor board (Sony IMX 335 - 5MP 1/2.8")
- C-SE-25H0-075 auto focus lens module
- TOF sensor
- Dedicated software
- Several options available
  (added sensors, TFT LCD, ...)

Additional Options

The standard configuration of the Varioptic AF Explorer can be modified with these additional options:

- Sensor board with Sony IMX307 (2MP 1/2.8")
- Sensor board with Sony IMX335 (5MP 1/2.8")
- 2.8-inch LCD display to visualize live output of the camera system

These kit configurations can be used with C-C-series lenses and C-S- series lenses from Corning Varioptic Lenses. Select combinations are more compatible than others as listed in the chart below:

		Sensors	
		IMX307	IMX335
	Resolution	2 Mpx	5 Mpx
	Pixel Size	2.9 µm	2 µm
	Format	1/2.8"	1/2.8"
C-series modules	C-S-25H0-026	147°	
	C-S-25H0-033	89°	
	C-S-25H0-036	85°	
	C-S-25H0-047	69°	
	C-S-25H0-075	47°	
	C-S-25H0-096	37°	
	C-S-39N0-158	24°	
	C-S-39N0-250	15°	

Compatibility	
Good	
Partial *(CRA mismatch, vignetting, ect.)*	

Documentation Package

With each Development Kit, Corning® Varioptic® Lenses deliver a complete set of application notes to assist the integration and development of the customer's product.

User Guides

- FocusLab user guide
- Board user guides (USB-M Universal, Maxim DrivBoard, C-Com board, AF Explorer)
- Microscopy user guide
- Tutorial videos

Integration

- Mechanical and opto-electrical integration guide
- Design and assembly rules
- Driver implementation guide
- Driver IC data sheets

Extended Details on Technology

- Marketing data sheet
- ZEMAX model: Focus configurations, n(λ) specifications
- IGES/STEP models: 3D design and opto-mechanical integration

General

- Optical Wave Front Error
- Cosmetic specification
- Laser Applications

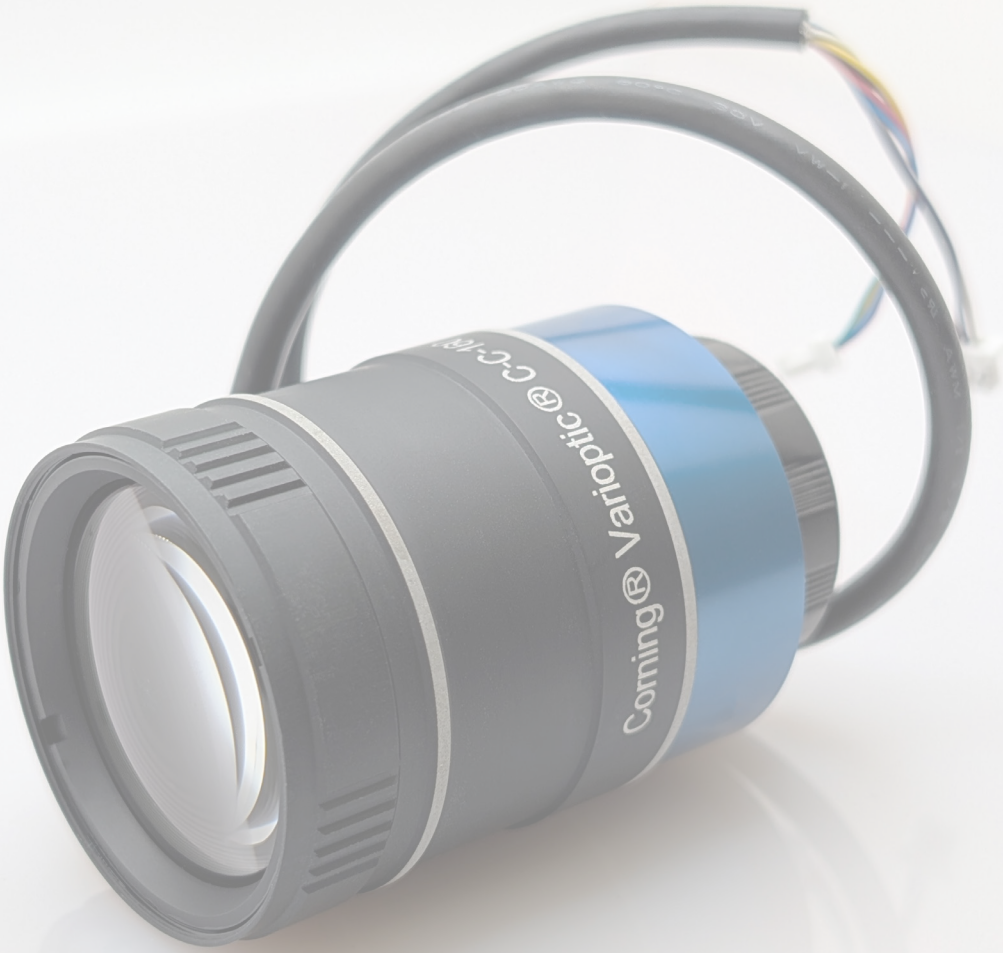
Reference table Corning® Varioptic® Lenses

Series	Codes	Description	Page
A-PE Series	A-PE-16F0-31	1.6mm CA, Packaged with electronics and FPC-A-31, 20 diopters dynamic + VIS	12
	A-PE-16F1-31	1.6mm CA, Packaged with electronics and FPC-A-31, 20 diopters dynamic + NIR	
	A-PE-25H0-33	2.5mm CA, Packaged with electronics and, FPC-A-33, 18 diopters dynamic + VIS	13
	A-PE-25H1-33	2.5mm CA, Packaged with electronics and FPC-A-33, 18 diopters dynamic + NIR	
	A-PE-25H0-D0-33	2.5mm CA, Packaged with electronics and FPC-A-33, 70 diopters dynamic + VIS	14
	A-PE-25H1-D0-33	2.5mm CA, Packaged with electronics and FPC-A-33, 70 diopters dynamic + NIR	
	A-PE-39N0-A1-35	3.9mm CA, Packaged with electronics and FPC-A-35, 15 diopters dynamic + VIS	15
	A-PE-39N1-A1-35	3.9mm CA, Packaged with electronics and FPC-A-35, 15 diopters dynamic + NIR	
	A-PE-58N0-37	5.8mm CA, Packaged with electronics and FPC-A-37, 15 diopters dynamic + VIS	16
	A-PE-58N1-37	5.8mm CA, Packaged with electronics and PC-A-37, 15 diopters dynamic + NIR	
V-PE Series	V-PE-80R0-07	Packaged V-80R0 with electronics and FPC-V-07	17
C-S Series *	C-S-25H0-026-42	Imaging module (M12) EFL = 2.6 mm, FPC-A-42	18
	C-S-25H0-033-43	Imaging module (M12) EFL = 3.3mm, FPC-A-43	
	C-S-25H0-036-43	Imaging module (M12) EFL = 3.6 mm, FPC-A-43	
	C-S-25H0-047-43	Imaging module (M12) EFL = 4.7 mm, FPC-A-43	
	C-S-25H0-075-43	Imaging module (M12) EFL = 7.5 mm, FPC-A-43	
	C-S-25H0-096-43	Imaging module (M12) EFL = 9.6 mm, FPC-A-43	
	C-S-39N0-158-45	Imaging module (M12) EFL = 15.8 mm, FPC-A-45	
	C-S-39N0-250-45	Imaging module (M12) EFL = 25 mm, FPC-A-45	
C-SE Series *	C-SE-25H0-026-42	Imaging module (M12) EFL = 2.6 mm, FPC-A-42, with packaged and electronics	19
	C-SE-25H0-033-43	Imaging module (M12) EFL = 3.3mm, FPC-A-43, with packaged and electronics	
	C-SE-25H0-036-43	Imaging module (M12) EFL = 3.6 mm, FPC-A-43, with packaged and electronics	
	C-SE-25H0-047-43	Imaging module (M12) EFL = 4.7 mm, FPC-A-43, with packaged and electronics	
	C-SE-25H0-075-43	Imaging module (M12) EFL = 7.5 mm, FPC-A-43, with packaged and electronics	
	C-SE-25H0-096-43	Imaging module (M12) EFL = 9.6 mm, FPC-A-43, with packaged and electronics	
	C-SE-39N0-158-45	Imaging module (M12) EFL = 15.8 mm, FPC-A-45, with packaged and electronics	
	C-SE-39N0-250-45	Imaging module (M12) EFL = 25 mm, FPC-A-45, with packaged and electronics	

Series	Codes	Description	Page
C-H-Series *	C-H-16F0-036-12	Imaging module (M8), EFL = 3.6mm, FPC-A-12	20
C-C-Series	C-C-39N0-A1-120	Imaging module (C-mount) EFL = 12 mm, 2.74µm/20MP, 1.1"	22
	C-C-39N0-A1-160	Imaging module (C-mount) EFL = 16 mm, 2.74µm/20MP, 1.1"	
	C-C-39N0-A1-250	Imaging module (C-mount) EFL = 25 mm, 2.74µm/20MP, 1.1"	
	C-C-39N0-A1-350	Imaging module (C-mount) EFL = 35 mm, 2.74µm/20MP, 1.1"	
C-T- Series	C-T-39N0-A1-005	Telecentric lens (C-mount), Supports I2C and RS232, 0.5X magnification	23
	C-T-39N0-A1-010	Telecentric lens (C-mount), Supports I2C and RS232, 1X magnification	
C-u-Series	C-uE-25H0-075-43	Inverted C-SE-25H0-075	24
Driver Boards	71020301B (USB-M Universal)	This board includes a Maxim driver and various FPC connectors for the A-PE Series, C-SE Series, C-H-Series and C-u-Series. It is driven through USB and delivered with the development kits. (compatible with our software FocusLab)	26
	71020132B (Maxim Drivboard)	This board includes a Maxim driver and the needed FPC connectors (4 and 6 pins). It has been designed for fast driving of the adjustable lens directly from a microcontroller, an FPGA, a DSP, etc.	
	71020405A Breakout board	This board embeds a wire-to-board and ZIF connectors, and allows users to easily connect A-PE and V-PE Series boards to their system via some wires without risks of damaging A-PE and V-PE Series boards by doing some direct pad soldering. The board is provided with an SHR-09V-S-B connector and 150mm long wires with JST terminals on the other end.	
AF Explorer	D-AF-EXP-STD-075	D-AF-EXP-STD-075 is the default configuration of the Corning Varioptic AF Explorer kit. It is based on the Sony IMX 335 sensor and Corning Varioptic C-SE-25H0-075 Auto Focus lens module	32

* C-S, C-SE and C-H are also available with IR-cut filter

CORNING | Varioptic® Lenses



CORNING | Varioptic® Lenses

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V33