

KTN* Varifocal lens

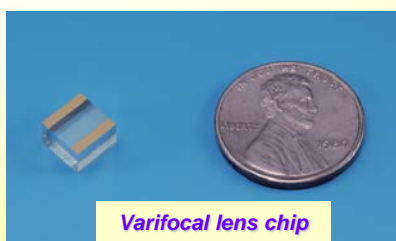
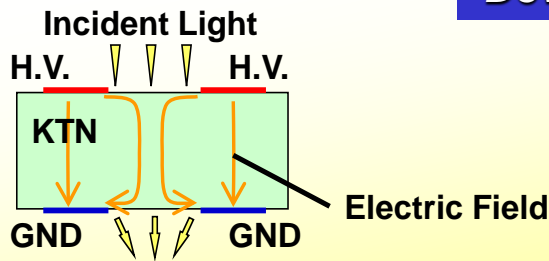
Highlights

- ✓ All solid state, electro-optic based varifocal lens
- ✓ Voltage-controlled continuous and step change of focal length
- ✓ High-speed focusing: 1 microsecond response

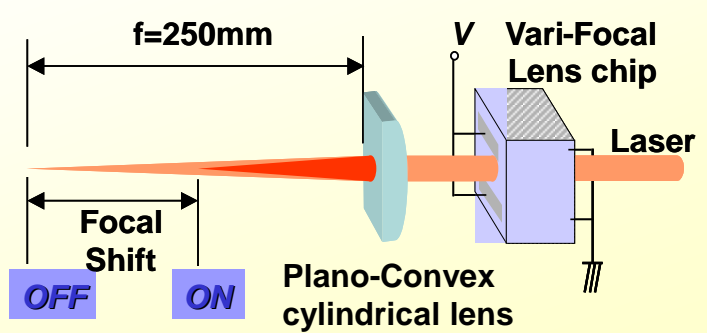
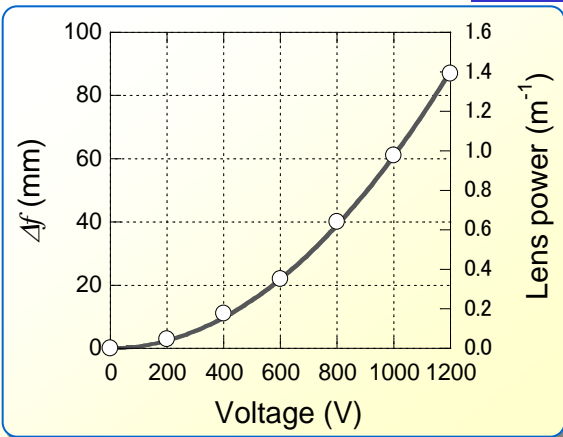
Applications

- ✓ Biomedical fields e.g. Two-photon microscopy
- ✓ Industrial fields e.g. Laser processing

Device structure



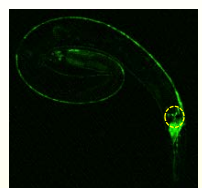
Focal shift results



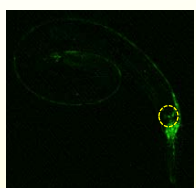
Varifocal lens was developed by NTT Device Innovation Center.

Two-photon imaging

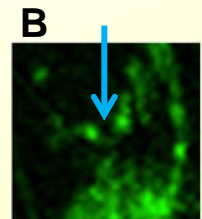
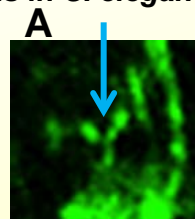
GFP was expressed in all neurons in *C. elegans*.



A:0V



B:~600V(Focal shift)



Close-up

Two-photon images were achieved by Junichi Nakai and Keiko Gengyo-Ando, Saitama University, Brain Science Institute.

*KTN (KTA_{1-x}Nb_xO₃) : Potassium Tantalate Niobate

Specifications of KTN vari-focal lens module

Model: KLMS2D1100-00

Parameters	Values	Unit
Operating Wavelength	690-1100	nm
Operating Frequency	DC - 10	kHz
Electrostatic capacitance(*1)	2	nF
Clear Aperture	φ3.0	mm
Lens power	0 - 0.5	m ⁻¹ (diopter)
Polarization	Linear	
Transmittance	95 (typ.)	%
Maximum Applied voltage	1000	V
Operation temperature	10 ~ 35	Celsius
Operating chip temperature(*2)	20 ~ 60	Celsius
Size (W x H x L) (*3)	97.5 x 85 x 32	mm

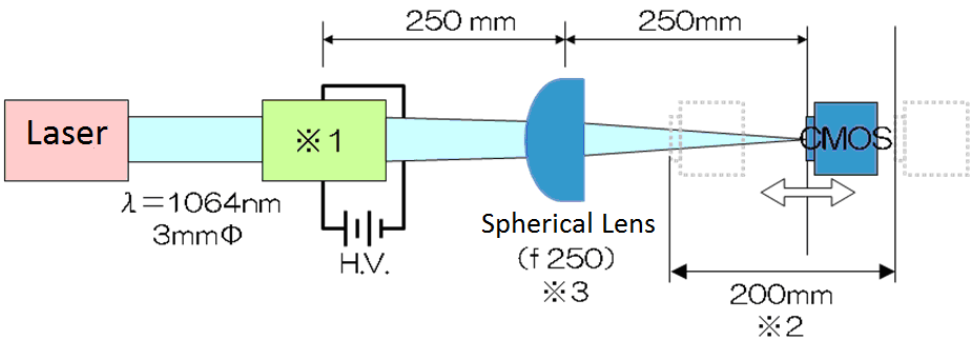
- *1 Two KTN chips of 1 nF are connected in parallel inside the module.
- *2 Each operating temperature of the KTN chip will be assigned in the data sheet within the range shown here.
- *3 Protrusions such as connector are excluded.

Notes:

We have not tested using a pulsed laser but CW lasers.

2 Appendixes

An example of the vari-focal lens performance is shown here.

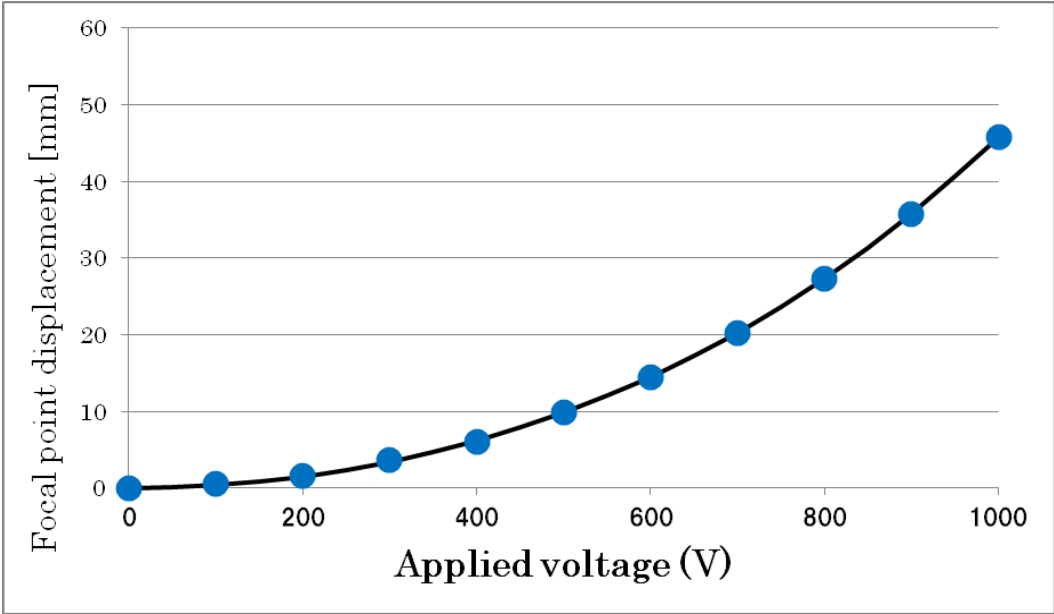


- ※1 : KTN Variable Collection Point Lens Module
- ※2 : Measurements in 2mm steps
- ※3 : Use a cylindrical lens when a 1 element simple drive is used

【Figure 1 Evaluation setup】



【Figure 2 Picture of a vari-focal lens module】



【Figure 3 Focal shift vs applied voltage】

Focal shift is approximated as $df(\text{mm}) = 3.7 \times 10^{-5} V^2 + 8.6 \times 10^{-12} V^4$
This is an example when the wavelength is 1064 nm.