

TOKIN

The World's Most Advanced Passive Components

Fine Ceramics

Piezoelectric Ceramics • NEPEC® NPM

Piezo Actuators

Piezoelectric Inverter for Cold-Cathode Fluorescent Lamps

Piezoelectric Ceramics

• NEPEC® NPM



Tokin's Piezoelectric NEPEC® NPM materials are multi-component solid ceramics, developed from conventional lead zirco-titanate ceramics. They are available with a wide range of specifications for a variety of applications. The primary application for these materials is in inkjet printers and medical equipment.

In addition to ceramics, Tokin also produces a variety of actuators and acoustic generators.

Standard Material Characteristics

Material		N-6	N-8	N-10	N-21	N-61	
Relative Dielectric Constant	$\epsilon_{33}^T / \epsilon_0$	1400	900	5440	1800	1400	
	$\epsilon_{11}^T / \epsilon_0$	1050	1450	5000	1960	1300	
Loss Factor	$\tan \delta$ (%)	0.3	0.4	1.0	1.0	0.3	
Frequency Constant*	N_1 [Radial] (kHz-m)	2160	2240	2040	1960	2160	
	N_2 [Transverse] (kHz-m)	1600	1670	1410	1410	1570	
	N_3 [Longitudinal]	1510	1520	1370	1310	1490	
	N_4 [Thickness] (kHz-m)	1960	2000	1800	1940	2010	
	N_5 [Shear] (kHz-m)	960	930	760	860	780	
Electromechanical Coupling Coefficient**	k_r [Radial]	(0.65) 0.55	(0.67) 0.56	(0.57) 0.50	(0.78) 0.62	(0.67) 0.56	
	k_{31} [Transverse]	0.34	0.34	0.34	0.38	0.33	
	k_{33} [Longitudinal]	0.68	0.67	0.68	0.73	0.67	
	k_t [Thickness]	0.55	0.52	0.62	0.52	0.52	
	k_{15} [Shear]	0.71	0.78	0.66	0.77	0.66	
Elastic Constant	S_{11}^E ($\times 10^{12} \text{m}^2/\text{N}$)	12.7	11.2	14.8	16.5	13.1	
	S_{33}^E ($\times 10^{12} \text{m}^2/\text{N}$)	15.4	15.2	18.1	19.9	15.6	
	Y_{11}^E ($\times 10^{10} \text{N}/\text{m}^2$)	7.9	8.9	6.8	6.1	7.6	
	Y_{33}^E ($\times 10^{10} \text{N}/\text{m}^2$)	6.5	6.6	5.5	5.0	6.4	
Piezoelectric Constant	d_{31} ($\times 10^{-12} \text{m}/\text{V}$)	-133	-99	-287	-198	-132	
	d_{33} ($\times 10^{-12} \text{m}/\text{V}$)	302	226	635	417	296	
	d_{15} ($\times 10^{-12} \text{m}/\text{V}$)	419	652	930	711	464	
	g_{31} ($\times 10^{-3} \text{Vm}/\text{N}$)	-10.4	-13.1	-6.0	-12.1	-10.7	
	g_{33} ($\times 10^{-3} \text{Vm}/\text{N}$)	23.5	30.0	13.2	25.4	23.8	
	g_{15} ($\times 10^{-3} \text{Vm}/\text{N}$)	45.1	44.4	21.0	41.0	39.4	
Poisson Ratio	δ	0.32	0.24	0.34	0.34	0.31	
Temperature Coefficient***	TK (fr) (PPm/°C)	-20 ~ -20°C	300	-250	200	-300	600
		20 ~ -60°C	300	-550	900	-150	400
	TK (°C) (PPm/°C)	-20 ~ -20°C	1800	3700	3800	3500	700
		20 ~ -60°C	3400	7500	3500	4500	3000
Aging Rate***	fr (%/10 years)	0.4	0.5	0.5	0.1	0.4	
	C (%/10 years)	-2	-5	-5	-5	-2	
Mechanical Quality Factor	Q_m	1500	1600	70	75	1800	
Curie Temperature	T_c (°C)	325	320	145	330	315	
Density	D ($\times 10^3 \text{kg}/\text{m}^3$)	7.73	7.72	8.00	7.82	7.79	
Thermal Expansion Coefficient	($\times 10^{-7} / ^\circ\text{C}$) (Room Temperature -200°C)	30	11	14	29	12	

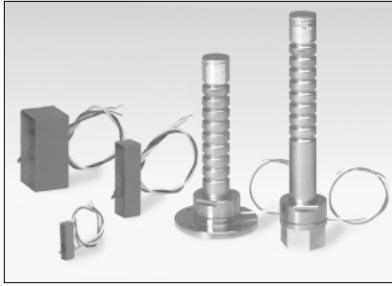
* Frequency constant as shown:

$$\begin{aligned}
 N_1 &= fr \times d \\
 N_2 &= fr \times \ell \\
 N_3 &= fr \times \ell \\
 N_4 &= fr \times t \\
 N_5 &= fr \times t
 \end{aligned}
 \quad \text{where} \quad
 \begin{aligned}
 fr &: \text{Resonant frequency} \\
 d &: \text{Material diameter} \\
 \ell &: \text{Material length} \\
 t &: \text{Material thickness}
 \end{aligned}$$

** Values in paranthesis are approximate.

*** Samples tested are $\phi 17.7 \text{mm} \times 11 \text{mm}$ ring material; values are measured in the radial direction.

Piezo Actuators



Tokin Piezoelectric Actuators utilize the piezoelectric longitudinal effect to transform electrical energy into mechanical energy. Features such as high speed drive, small size and low voltage requirement offer advantages for many applications, including mechatronics.

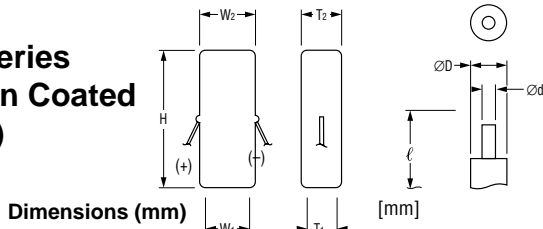
Features

- Large force generation: typical clamping stress = 3500 N/cm²
- Fast response time: can be driven to a third of the self resonant frequency
- Low power consumption: 65% electromechanical coupling factor
- Small size: less than 1/10 volume of conventional stack type actuators
- Low noise: solid state construction decreases noise levels
- Precise positioning: can be controlled in order of nanometer

Applications

- Wire driving element for impact printer
- Pickup and tracking control of magnetic heads for HDD (Hard Disk Drive Unit)
- Driving element for relay opening and closing
- Positioning of mirror or prism of laser device
- Driving element for nozzle flapper of servo valve

AE Series (Resin Coated Type)



AE Series Dimensions (mm)

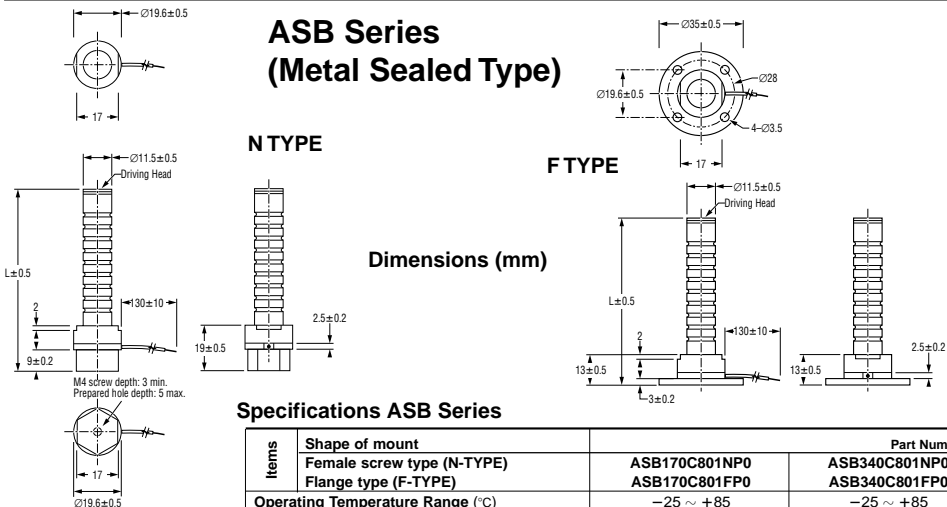
Model Number	T ₁	W ₁	H	T ₂	W ₂	φd	φD	φℓ
AE0203D08	2±0.1	3±0.1	10±0.1	3.5 max.	4.5 max.	0.3	0.5	100
AE0203D16	2±0.1	3±0.1	20±0.1	3.5 max.	4.5 max.	0.3	0.5	100
AE0505D08	5±0.1	5±0.1	10±0.1	6.5 max.	6.5 max.	0.3	0.5	100
AE0505D16	5±0.1	5±0.1	20±0.1	6.5 max.	6.5 max.	0.5	0.8	100
AE1010D16	10±0.1	10±0.1	20±0.1	11.5 max.	11.5 max.	0.5	0.8	100

φd = Diameter of lead wire φD = Outer diameter including the thickness of coating ℓ = Length of lead wire

Specifications AE Series Resin Coated

Item	Part Number	AE0203D08	AE0203D16	AE0505D08	AE0505D16	AE1010D16
Operating temperature range (°C)		-25 ~ +85	-25 ~ +85	-25 ~ +85	-25 ~ +85	-25 ~ +85
Maximum drive voltage (V.DC)		150	150	150	150	150
Recommended drive voltage (V.DC)		100	100	100	100	100
Displacement (μm)		9.1 ± 1.5	17.4 ± 2.0	9.1 ± 1.5	17.4 ± 2.0	18.4 ± 3.5
Displacement (μm)		6.1 ± 1.5	11.6 ± 2.0	6.1 ± 1.5	11.6 ± 2.0	12.3 ± 3.5
Insulation resistance (MΩ) min.		100	50	50	10	5
Capacitance (μF)		0.18 ± 20%	0.35 ± 20%	0.75 ± 20%	1.4 ± 20%	5.4 ± 20%
Generated force (compression force) (N)		200	200	850	850	3500
Resonance frequency (kHz)		138	69	138	69	69

ASB Series (Metal Sealed Type)



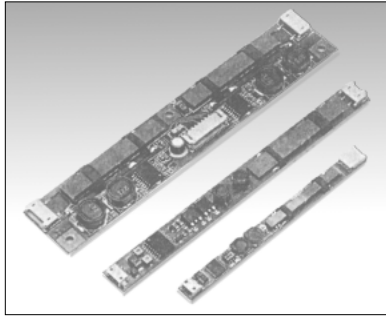
ASB Series Dimensions (mm)

Model Number	Product Code	L(mm)
ASB170C801NP0	ASB001A	38.4
ASB340C801NP0	ASB002A	58.4
ASB610C801NP0	ASB003A	78.4
ASB680C501NP0	ASB014A	98.4
ASB170C801FP0	ASB007A	32.4
ASB340C801FP0	ASB008A	52.4
ASB510C801FP0	ASB009A	72.4
ASB680C801FP0	ASB018A	92.4

Specifications ASB Series

Items	Shape of mount	Part Number			
	Female screw type (N-TYPE) Flange type (F-TYPE)	ASB170C801NP0 ASB170C801FP0	ASB340C801NP0 ASB340C801FP0	ASB510C801NP0 ASB510C801FP0	ASB680C801NP0 ASB680C801FP0
Operating Temperature Range (°C)		-25 ~ +85	-25 ~ +85	-25 ~ +85	-25 ~ +85
Maximum Drive Range (V.DC)		150	150	150	150
Recommended Drive Voltage (V.DC)		100	100	100	100
Displacement at Maximum Voltage (μm)		17.0 ± 3	34 ± 6	51.0 ± 9	68.0 ± 12
Displacement at Recommended Voltage (μm)		12.0 ± 3	24.0 ± 6	36.0 ± 9	48.0 ± 12
Hysteresis (% of Generated Displacement)		Less than 15	Less than 15	Less than 15	Less than 15
Generated Force (Compression Resistance) (N)		Less than 800 (= 80[Kgfl])	Less than 800 (= 80[Kgfl])	Less than 800 (= 80[Kgfl])	Less than 800 (= 80[Kgfl])
Compliance (μm/N)		0.017	0.034	0.051	0.068
Dissipation Factor (tan δ)		Less than 0.05	Less than 0.05	Less than 0.05	Less than 0.05
Insulation Resistance (IR) (MΩ) min.		30	15	10	5
Withstand Voltage (TV) (V.DC)		165	165	165	165
Sealing Properties (atm. cc/sec.)		Less than 1 x 10 ⁻⁸	Less than 1 x 10 ⁻⁸	Less than 1 x 10 ⁻⁸	Less than 1 x 10 ⁻⁸

Piezoelectric Inverter for Cold-Cathode Fluorescent Lamps



Tokin has successfully developed an inverter for back lights of Liquid Crystal Displays using a piezoelectric transformer. This inverter is constructed of a multilayer piezoelectric transformer and a driving circuit. The performance of this inverter is superior to the performance of an electromagnetic inverter. Tokin's unique technology is used, assuring the inverter's high efficiency, small size and low profile.

Features

- Series of 3 ~ 20W types. (Models with dual output ports are to be released)
- Transformer using multilayer piezoelectric vibrator (high step-up voltage ratio)
- Brightness control range from 10 to 100%
- High efficiency, small size and low profile.

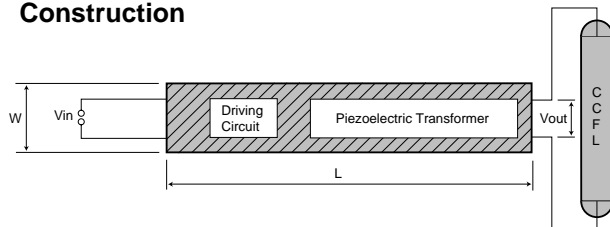
Applications

- LCD back lights
 - Notebook personal computers
 - Video cameras
 - Large monitors

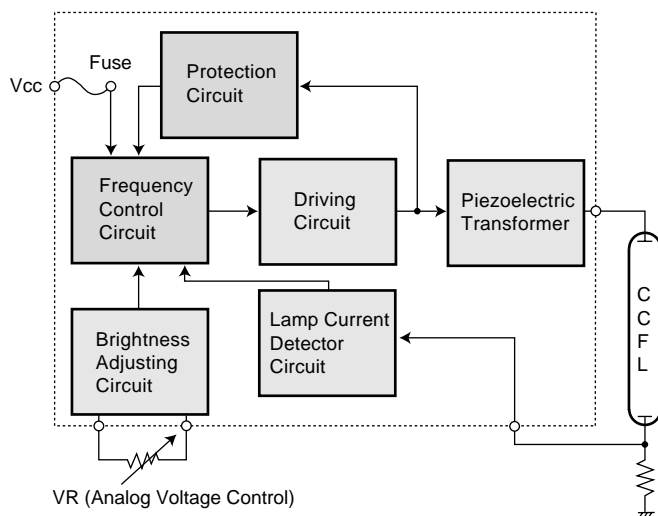
Specifications

Model	Input Voltage (VDC)	Output Power (W)	Output Voltage (Vrms)	Frequency (kHz)	Brightness Adjustment (%)	Efficiency (%)	Dimensions L × W × T (mm)	CCFL Ø 2.6 (mm)
PIT-3LD	3~20	3	>1500	80	10~100	85	103 × 8 × 6 (5)	220~290
PIT-3LS	3~20	3	>1500	80	10~100	85	129 × 8 × 5 (4)	220~290
PIT-20AW	10~20	20	>2500	60	10~100	85	160 × 8 × 7.5	350×4

Construction



Block Diagram



Application Examples

