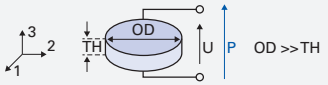
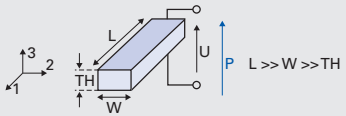
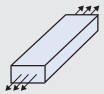
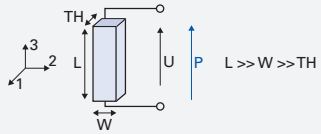
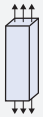
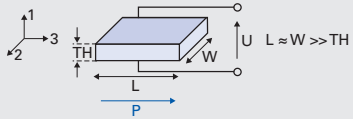
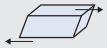
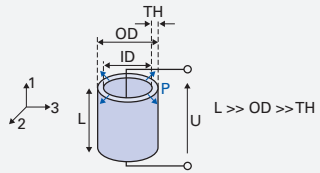
Dynamic Behavior

OSCILLATION MODES OF PIEZOCERAMIC ELEMENTS

Shape	Oscillations			Electrically induced displacement (small signal)	Mechanically induced voltage (small signal)
	Type	Mechanical deformation	Series resonance frequency		
Thin disk 	radial		$f_s = \frac{N_P}{OD}$	$\Delta OD = \frac{d_{31} OD}{TH} U$	
	thickness		$f_s = \frac{N_t}{TH}$	$\Delta TH = d_{33} U$	$U = -\frac{4 g_{33} TH}{\pi OD^2} F_3$
Plate 	transverse		$f_s = \frac{N_1}{L}$	$\Delta L = \frac{d_{31} L}{TH} U$	$U = -\frac{g_{31}}{W} F_1$
Rod 	longitudinal		$f_s = \frac{N_3}{L}$	$\Delta L = d_{33} U$	$U = -\frac{g_{33} L}{W TH} F_3$
Shear plate 	thickness shear		$f_s = \frac{N_5}{TH}$	$\Delta L = d_{15} U$	$U = -\frac{g_{15} TH}{L W} F_3$
Tube 	transversal		$f_s \approx \frac{N_1}{L}$	$\Delta L = \frac{d_{31} L}{TH} U$	
	thickness		$f_s \approx \frac{N_t}{TH}$	$\Delta TH = d_{33} U$	