CTS® WIRELESS COMPONENTS

PZT Piezoelectric Materials

Technical Data (Typical Values)

Property	Symbol	Units	Material Type (Typical Values)			
			3195	3195HD	3203	3203HD
Dielectric Constant (1KHz)	K_3^T		1800	1900	3250	3800
Dielectric Loss Factor (1KHz)	$\tan\delta_e$	%	1.8	1.8	2.0	2.4
Density	p	g/cm^3	7.7	7.8	7.7	7.8
Curie Point	T_c	°C	350	350	235	225
Mechanical Quality Factor	Q_m		80	80	30	30
Coercive Field*	E_c	KV/cm	14.9	12.0	10.6	8.0
Remanent Polarization	P_r	$\mu Coul/cm^2$	39.2	39.0	37.2	39.0
Coupling Coefficients	K_p		.63	.65	.69	.75
	K_{33}		.70	.72	.73	.75
	K_{31}		.35	.36	.41	.43
	K_t		.49	.48	.53	.55
	K_{15}			.59		.72
Piezoelectric Charge Coefficient	d_{31}	$\frac{\text{Coul.}}{\text{Newton}} \times 10^{-12}$	-175	-190	-275	-320
(Displacement Coefficient)	d_{33}	(or) $\frac{\text{meters}}{\text{volt}} \times 10^{-12}$	350	390	550	650
Piezoelectric Voltage Coefficient	g_{33}	$\frac{\text{volt meters}}{\text{Newton}} \times 10^{-3}$	24.2	24.0	19.0	19.0
(Voltage Coefficient)	g_{31}		-11.0	-11.3	-9.6	-9.5
Elastic Modulus	Y_{11}^E	$\frac{\text{Newton}}{\text{meter}^2} \times 10^{10}$	6.9	6.7	6.3	6.2
	Y_{33}^E		5.5	5.3	5.0	4.9
Frequency Constants Radial	N_r	KHz-cm	202		192	
Resonant Thickness	N_{tr}	KHz-cm	204	211	191	202
Anti-Resonant Thickness	N_{ta}	KHZ-cm	229	236	222	236

Formulas:

Disc Capacitance = $\frac{d^2 \times K_3^T}{5.67 \times t}$ Disc $K_3^T = \frac{5.662 \times c \times t}{d^2}$

Plate Capacitance = $\frac{l \times w \times K_3^T}{4.45 \times t}$ Plate $K_3^T = \frac{4.447 \times c \times t}{l \times w}$

f_r (radial) = Nr/2.54 d

f_r (length) = Nr/2.54 l

f_r (width) = Nr/2.54 w

f_t (thickness) = Nt/2.54 t

Note: Formula length, width, and diameter are for electroded area only.

*Measured at less than 1 Hz.

Definitions

$\tan\delta_e$ - Dielectric Loss Factor

p - Mass Density of Ceramic

T_c - Curie Point

d_{33} - Direct Charge Coefficient

d_{31} - Transverse Charge Coefficient

E_c - Coercive Field

g_{33} - Direct Voltage Coefficient

g_{31} - Transverse Voltage Coefficient

K_p - Planar Electromechanical Coupling Coefficient

C - Capacitance (nF)

l - Length (in.)

w - Width (in.)

d - Diameter (in.)

t - Thickness (10^{-3} in.)

K_{33} - Direct Electromechanical Coupling Coefficient

K_{31} - Transverse Electromechanical Coupling Coefficient

K_3^T - Free Dielectric Constant Measured Along Poling Axis

N_r - Radial Frequency Constant

N_t - Thickness Mode Frequency Constant

P_r - Remanent Polarization

Q_m - Mechancial Q (Quality Factor)

Y_{33}^E - Direct Youngs Modulus

Y_{11}^E - Elastic Modulus

f_r - Resonant Frequency

f_a - Anti-Resonant Frequency

CTS PZT Piezoelectric Materials, with a fine grain and low porosity microstructure are especially suited for medical ultrasound, ink jet, and other demanding applications. A wide variety of sizes, shapes and metallizations are available, and custom programs are welcome.

Physical and Mechanical Properties

Property	**Symbol**	**Units**	3203 HD (PZT Type 5H) **Value**	3195 HD (PZT Type 5A) **Value**
Thermal Expansion (Perpendicular to poling)	α	ppm / °C	3.5	3.0
Specific Heat	C_p	J / Kg - °C	420	440
		J/ mol - °C	138	145
Thermal Conductivity	K_d	watts / cm ^{2} - °C	1.9 - 2.3	1.9 - 2.3
		watts / m ^{2} - °K	1.2	1.2
with Au Electrodes		watts / m ^{2} - °K	1.45	1.45
Poisson's Ratio	υ		0.31	0.31
Elastic Constants				
Short Circuit	S_{11}^E	x 10 $^{-12}$m ^{2} /N	16.6	16.2
	S_{33}^E		21.0	18.6
Elastic Constants	S_{11}^D	x 10 $^{-12}$m ^{2} / N	13.9	14.6
Open Circuit	S_{33}^D		8.8	9.6
Elastic Constants	Y_{11}^E	x 10 $^{-10}$ N / m ^{2}	6.2	6.7
Short Circuit	Y_{33}^E		4.9	5.3
Elastic Constants	Y_{11}^D	x 10 $^{-10}$ N /m ^{2}	7.0	6.8
Open Circuit	Y_{33}^D		11.0	10.6

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