TRS PIEZOELECTRIC SINGLE CRYSTALS FULL MATRIX

MEASURED AND DERIVED ELASTIC COMPLIANCE CONSTANTS, s_{ij} (10^{-12} m^2/N), AND ELASTIC STIFFNESS CONSTANTS, c_{ij} (10^{10} N/m^2)

Material	s_{11}^E	s_{12}^E	s_{13}^E	s_{33}^E	s_{44}^E	s_{66}^E	s_{11}^D	s_{12}^D	s_{13}^D	s_{33}^D	s_{44}^D	s_{66}^D
TRS X2B (L)	41.6	-16.0	-22.0	46.2	14.6	14.0	32.2	-25.4	-3.2	9.0	13.0	14.0
TRS X2B (H)	49.9	-16.5	-29.9	62.3	15.3	10.6	35.9	-30.5	-2.7	9.4	13.2	10.6
TRS X4B (L)	42.3	-24.7	-18.4	47.3	15.1	33.3	35.1	-31.9	-2.1	10.2	14.3	33.3
TRS X4B (H)	54.3	-32.0	-25.7	68.0	15.0	34.7	45.4	-40.9	-3.0	10.1	14.3	34.7
TRS X6B (L)	43.8	-25.0	-19.7	49.7	14.3	28.2	36.5	-32.2	-2.6	9.9	13	28.2
TRS X6B (H)	64.6	-40.9	-27.0	69.4	14.6	30.7	54.5	-50.9	-2.3	8.8	13	30.7
Material	c_{11}^E	c_{12}^E	c_{13}^E	c_{33}^E	c_{44}^E	c_{66}^E	c_{11}^D	c_{12}^D	c_{13}^D	c_{33}^D	c_{44}^D	c_{66}^D
TRS X2B (L)	11.4	9.7	10.0	11.7	6.8	7.2	12.1	10.4	8.1	16.9	7.7	7.2
TRS X2B (H)	11.4	9.9	10.2	11.4	6.5	9.4	12.1	10.6	8.2	17.0	7.6	9.4
TRS X4B (L)	16.3	14.7	12.1	11.5	6.6	3.0	17.2	15.7	10.0	16.4	7.0	3.0
TRS X4B (H)	17.8	16.6	13.0	11.3	6.6	2.9	18.8	17.6	10.7	16.2	7.0	2.9
TRS X6B (L)	16.1	14.6	12.2	11.6	6.9	3.5	17.1	15.7	9.9	16.4	7.7	3.5
TRS X6B (H)	19.0	18.0	14.4	12.6	6.8	3.2	20.1	19.2	11.8	18.7	7.7	3.2

Piezoelectric Coefficients, d_{ij} (pC/N), e_{ij} (C/m^2), g_{ij} (10^{-3}Vm/N), h_{ij} (10^8V/m), and Electromechanical Coupling Factors, k_{ij},

Material	d_{33}	d_{31}	d_{15}		e_{33}	e_{31}	e_{15}
TRS X2B (L)	1270	-639	161		20.3	-7.6	11.0
TRS X2B (H)	1645	-847	193		19.6	-7.1	12.6
TRS X4B (L)	1125	-496	94		17.8	-7.7	6.2
TRS X4B (H)	1560	-612	92		17.0	-7.8	6.1
TRS X6B (L)	1329	-568	160		19.5	-9.1	11.2
TRS X6B (H)	1795	-733	156		19.3	-8.4	10.7

Material	g_{33}	g_{31}	g_{15}		h_{33}	h_{31}	h_{15}
TRS X2B (L)	29.3	-14.8	10.0		25.8	-9.6	9.1
TRS X2B (H)	32.2	-16.6	10.8		28.4	-10.3	11.7
TRS X4B (L)	33.0	-14.5	8.1		27.4	-11.8	7.3
TRS X4B (H)	37.1	-14.5	8.5		28.7	-13.2	7.7
TRS X6B (L)	30.0	-12.8	8.3		24.35	-11.4	8.5
TRS X6B (H)	33.7	-13.8	9.8		31.19	-13.2	9.8

Material	k_{33}	k_{31}	k_{15}		k_t	k_{31} (45°)
TRS X2B (L)	0.90	0.48	0.33		0.56	0.74
TRS X2B (H)	0.92	0.53	0.37		0.57	0.78
TRS X4B (L)	0.89	0.41	0.23		0.55	0.73
TRS X4B (H)	0.92	0.40	0.23		0.55	0.77
TRS X6B (L)	0.90	0.41	0.31		0.54	0.72
TRS X6B (H)	0.93	0.40	0.33		0.57	0.82

Dielectric Constants, ε_{ij} (ε_0), and Dielectric Impermeability Constants, β ($10^{-4}/\varepsilon_0$)

Material	ε_{33}^T	ε_{11}^T	ε_{33}^S	ε_{11}^S	β_{33}^T	β_{11}^T	β_{33}^S	β_{11}^S
TRS X2B (L)	4888	1811	889	1363	2.0	5.5	11.2	7.3
TRS X2B (H)	5775	2011	778	1211	1.7	4.9	12.8	8.2
TRS X4B (L)	3856	1305	733	965	5.4	3.9	2.5	5.1
TRS X4B (H)	4750	1215	669	902	5.9	3.1	2.3	5.2
TRS X6B (L)	5009	2169	906	1483	2.0	4.6	11.0	6.7
TRS X6B (H)	6016	1753	700	1231	1.6	5.7	14.2	8.1

Phase transition temperatures (°C) and Coercive fields (kV/cm)

Material	Density (g/cm^3)	T_C	T_{rt}	E_C
TRSX2B	8.16	120-145	85-98	1.9-2.5
TRS X4B	8.21	150-200	105-130	4.5-6.0
TRS X6B*	8.22	140-190	80-100	4.5-6.0

(* T_C, T_{rt} and E_C are Preliminary data)

Notes:

"L" means the samples taken from near low PT% end of the crystal

"H" means the samples taken from near high PT% end of the crystal