

## NCE59



Noliac piezoceramic material NCE59 has a very high sensitivity featuring extremely high permittivity, large coupling factor and piezoelectric constants.

## **SPECIFICATIONS**



Properties         Symbol & unit         NCE59*           DIELECTRIC PROPERTIES (tolerances +/- 10%)         2900           Relative Dielectric Constant         ε¹₃₃/ ε₀         2900           Dielectric Loss Factor at 400V/mm         tg6 [10⁴]         190           Dielectric Loss Factor at 400V/mm         tg6 [10⁴]		1		
Relative Dielectric Constant $ε^{T_{33}/ε0}$ 2900           Dielectric Loss Factor at 400V/mm $tgδ[10^{-4}]$ 190           ELECTROMECHANICAL PROPERTIES (tolerances +/-5%)           Electromech. Coupling Factors** $k_p$ 0.64           K31         0.37           K32         0.75           Recompliants $-d_{31}[10^{-12}C/N]$ 240           May [10^{-12}C/N]         575           Piezoelectric Charge Constants $-g_{31}[10^{-3}Vm/N]$ 10           Piezoelectric Voltage Constants $-g_{31}[10^{-3}Vm/N]$ 23           Prequency Constants $N^{E}_p[m/s]$ 1970           Notation of the properties of t	Properties	Symbol & unit	NCE59*	
Constant $ε^{T_{33}/ε0}$ 2900           Dielectric Loss Factor at 400V/mm $tgδ[10^{-4}]$ 190           ELECTROMECHANICAL PROPERTIES (tolerances +/-5%) $tgδ[10^{-4}]$ ELECTROMECHANICAL PROPERTIES (tolerances +/-5%)           Electromech. Coupling Factors** $k_p$ 0.64           k31         0.37         0.64           k32         0.75         0.62           Piezoelectric Charge Constants $-d_{31}[10^{-12}C/N]$ 240           d32 [10^{-12}C/N]         575           Piezoelectric Voltage Constants $-g_{21}[10^{-2}Vm/N]$ 10           g32 [10^{-3}Vm/N]         23           Frequency Constants $N^{F_p}[m/s]$ 1970 $N^{P_1}[m/s]$ 1970 $N^{P_1}[m/s]$ 1960 $N^{F_1}[m/s]$ 1410 $N^{P_3}[m/s]$ 1500           PHYSICAL PROPERTIES (tolerances +/- 5%)           Mechanical Quality Factor $Q_m$ 90           Density $ρ[10^3 kg/m^3]$ 7.45           Elastic Compliances $s^{F_{11}}[10^{-12}m^2/N]$ 23	DIELECTRIC PROPERTIES (tolerances +/- 10%)			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		ε <sup>T</sup> 33 / ε0	2900	
at 400V/mm         tgδ [10 <sup>-4</sup> ]           ELECTROMECHANICAL PROPERTIES (tolerances +/-5%)           Electromech. Coupling Factors**         kp         0.64           k31         0.37           k32         0.75           kt         0.52           Piezoelectric Charge Constants         -d31 [10 <sup>-12</sup> C/N]         240           d32 [10 <sup>-12</sup> C/N]         575           Piezoelectric Voltage Constants         -g31[10 <sup>-2</sup> Vm/N]         10           g32 [10 <sup>-3</sup> Vm/N]         23           Frequency Constants         N <sup>E</sup> <sub>p</sub> [m/s]         1970           N <sup>D</sup> <sub>t</sub> [m/s]         1960           N <sup>E</sup> <sub>1</sub> [m/s]         1410           N <sup>D</sup> <sub>3</sub> [m/s]         1500           PHYSICAL PROPERTIES (tolerances +/- 5%)           Mechanical Quality Factor         Qm         90           Density         ρ[10 <sup>3</sup> kg/m <sup>3</sup> ]         7.45           Elastic Compliances         s <sup>E</sup> <sub>11</sub> [10 <sup>-12</sup> m <sup>2</sup> /N]         17           s <sup>E</sup> <sub>33</sub> [10 <sup>-12</sup> m <sup>2</sup> /N]         23	Dielectric Loss Factor	tgδ [10 <sup>-4</sup> ]	190	
Electromech. Coupling Factors** k <sub>p</sub> 0.64    k <sub>31</sub> 0.37     k <sub>33</sub> 0.75     k <sub>1</sub> 0.52     Piezoelectric Charge Constants		tgδ [10 <sup>-4</sup> ]		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		k <sub>p</sub>	0.64	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		k31	0.37	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		k <sub>33</sub>	0.75	
$\begin{array}{c ccccc} \text{Constants} & -d_{31} \left[ 10^{-12}  \text{C/N} \right] & 240 \\ & d_{33} \left[ 10^{-12}  \text{C/N} \right] & 575 \\ \hline \\ \text{Piezoelectric Voltage} & -g_{31} \left[ 10^{-3}  \text{Vm/N} \right] & 10 \\ & g_{33} \left[ 10^{-3}  \text{Vm/N} \right] & 23 \\ \hline \\ \text{Frequency} & N^{E_p} \left[ \text{m/s} \right] & 1970 \\ & N^{D_t} \left[ \text{m/s} \right] & 1960 \\ & N^{E_1} \left[ \text{m/s} \right] & 1410 \\ & N^{D_3} \left[ \text{m/s} \right] & 1500 \\ \hline \\ \text{PHYSICAL PROPERTIES (tolerances +/- 5\%)} \\ \hline \\ \text{Mechanical Quality} & Q_m & 90 \\ \hline \\ \text{Density} & \rho \left[ 10^3  \text{kg/m}^3 \right] & 7.45 \\ \hline \\ \text{Elastic} & \\ \text{Compliances} & s^{E_{11}} \left[ 10^{-12}  \text{m}^2 / \text{N} \right] & 17 \\ \hline \\ \text{s}^{E_{33}} \left[ 10^{-12}  \text{m}^2 / \text{N} \right] & 23 \\ \hline \end{array}$		kt	0.52	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	_	-d <sub>31</sub> [10 <sup>-12</sup> C/N]	240	
$ \begin{array}{c ccccc} \text{Constants} & & -g_{31}[10^{-3}\text{Vm/N}] & & 10 \\ & & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & \\ & & & \\$		d <sub>33</sub> [10 <sup>-12</sup> C/N]	575	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		-g <sub>31</sub> [10 <sup>-3</sup> Vm/N]	10	
$\begin{array}{c ccccc} & N^{F}_{p}  [\text{m/s}] & 1970 \\ & N^{D}_{t}  [\text{m/s}] & 1960 \\ & N^{F}_{1}  [\text{m/s}] & 1410 \\ & N^{D}_{3}  [\text{m/s}] & 1500 \\ & & & & & & & & \\ \hline & & & & & & & \\ \hline & & & &$		g <sub>33</sub> [10 <sup>-3</sup> Vm/N]	23	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		N <sup>E</sup> <sub>p</sub> [m/s]	1970	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		N <sup>D</sup> t [m/s]	1960	
$\begin{array}{c cccc} \text{PHYSICAL PROPERTIES (tolerances +/- 5\%)} \\ \text{Mechanical Quality} & Q_m & 90 \\ \text{Density} & \rho \left[ 10^3  \text{kg/m}^3 \right] & 7.45 \\ \text{Elastic} & & & & & & & & & & & \\ \text{Compliances} & & & & & & & & & & \\ & & & & & & & & $		N <sup>E</sup> <sub>1</sub> [m/s]	1410	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		N <sup>D</sup> <sub>3</sub> [m/s]	1500	
$\begin{array}{cccc} Factor & Q_m & 90 \\ \\ Density & \rho \left[ 10^3  kg/m^3 \right] & 7.45 \\ \\ Elastic & \\ Compliances & s^E_{11} \left[ 10^{-12}  m^2/N \right] & 17 \\ \\ & s^E_{33} \left[ 10^{-12}  m^2/N \right] & 23 \\ \end{array}$	PHYSICAL PROPERTIES (tolerances +/- 5%)			
Elastic SE <sub>11</sub> [10 <sup>-12</sup> m <sup>2</sup> /N] 17 SE <sub>33</sub> [10 <sup>-12</sup> m <sup>2</sup> /N] 23		Qm	90	
Compliances $s_{11}^{E}[10^{-12}m^{2}/N]$ 17 $s_{33}^{E}[10^{-12}m^{2}/N]$ 23	Density	$\rho [10^3  kg/m^3]$	7.45	
		s <sup>E</sup> <sub>11</sub> [10 <sup>-12</sup> m <sup>2</sup> /N]	17	
Curie Temperature T <sub>c</sub> [°C] 235		s <sup>E</sup> <sub>33</sub> [10 <sup>-12</sup> m <sup>2</sup> /N]	23	
	Curie Temperature	T <sub>c</sub> [°C]	235	

<sup>\*</sup> For multilayer components only

The values listed are for reference purposes only and cannot be applied unconditionally to all shapes and

<sup>\*\*</sup> Measured in accordance with standard EN 50324



dimensions. Values vary depending on the actual shape, surface finish, shaping process and post-processing of the product.  $\frac{1}{2} \int_{-\infty}^{\infty} \frac{1}{2} \left( \frac{1}{2} \int_{-\infty}^{\infty} \frac{1}{2} \left($