ULTRASONIC TRANSDUCER

Piezoelecric ceramics / Piezoelectric polymer film / Piezoelectric thin film

BOLT CLAMPED LANGEVIN TYPE TRANSDUCER

ULTRASONIC BUBBLE DETECTION SENSOR

ULTRASONIC SENSOR FOR FLOW METER

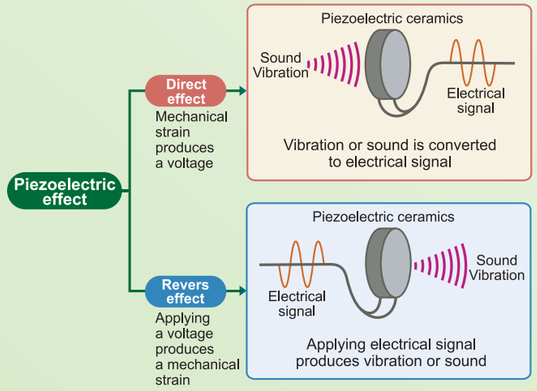
HONDA ELECTRONICS

What are piezoelectric ceramics?

- The special ceramics that can expand and shrink by applying voltage

Piezoelectric ceramics is a polycrystalline ceramics that is made by sintering high pure powder like titanium oxide and barium oxide. When piezoelectric ceramics is exerted forcefully (mechanical energy is applied), it generates electric voltage (the direct piezoelectric effect). Conversely, when voltage is applied to piezoelectric ceramics, it expands or shrinks depending on the polarity of voltage (the reverse piezoelectric effect). In this manner, piezoelectric ceramics can convert electric energy to mechanical energy, and vice versa (Piezoelectric effect). By applying polarization treatment (a DC high voltage is applied on ceramics under a high temperature to orientating the spontaneous polarization), ceramics has piezoelectric effect.

- Direct piezoelectric effect and reverse piezoelectric effect



Emitting ultrasound using piezoelectric ceramics

- Applying alternating voltage on a piezoelectric ceramics.....

By installing electrodes on a piezoelectric ceramics and applying an alternating voltage, the ceramics vibrates to emit sound due to the piezoelectric effect.
A vibration using a resonance frequency can generate ultrasound having a larger amplitude. As a resonant frequency depends on the shape of ceramics, a piezoelectric ceramics is made in a suitable shape for obtaining a necessary frequency.

ULTRASONIC APPLICATIONS

Communicative Applications

Flaw detection
Veterinary diagnoss for livestock
Ocular axial length measurement
Measurement
Flow meter
Sound pressure meter
Pregnancy diagnostic scanners
Observation scanners
Medical diagnostic scanners
Sensor for detecting bubbles in blood tanks
Gas flow meter
Thickness meter
Flow rate and flow velocity measuring for pipe
Fish finder
Wave height meter, wave meter and tide level meter
Fish counter
Berthing system for large ships
Liquid level indicater
Interface level indicater
Measuring apparatus for sludge of lakes and marshes floor
Sounder for divers
Detecting objects on a conveyer
Human tracking sensor for local airconditioning
Level meter for wastewater slugde tank
Level meter for food tank
Doppler speed meter
Underwater Measurement
Airborne Measurement
Sterilization and deodorization
Perfume emitters
Humidifier
Nebulizer
Face care apparatus
Atomization
Removing stains from clothing
Washing machine
Cleaning glasses
Cleaning semiconductor and LCD boards
Cleaning wafers
Cleaning
Cake cutter
Cutter
Sealing food packages
Machining
Sealing laminate tubes
Parts feeder
Foaming and degassing in the beer bottling process
Sensor for parking lots
Obstacle sensor for cars
Detecting car sensor for door opening
Obstacle and human sensors
Cutting height sensor for reaping machines
Level meter for gasoline tanks
Traffic volume examination apparatus
Obstacle sensor for gondola cranes

Piezoelectric Ceramics

Dynamic Applications

Piezoelectric ceramics, piezoelectric polymer film, and piezoelectric thin film are used as piezoelectric materials to generate ultrasound.

Piezoelectric ceramics ($BaTiO_3$ · PZT · $(Bi,Na)TiO_3$ · KNN)

Piezoelectric ceramics is polycrystal ceramics made by compressing a high pure powder such as titanium oxide or barium oxide and firing it at a high temperature.
The piezoelectric property is obtained through a polarization process.

Piezoelectric polymer film (P(VDF-TrFE))

A piezoelectric polymer film is produced by forming a film from molten polymer or its solution, and applying a polarization process to the film. This type of piezoelectric material is characterized by very low acoustic impedance, flexibility and ease of forming a thin film from a solution.

Piezoelectric thin film (ZnO)

A piezoelectric thin film is made by sputtering zinc oxide (ZnO).
To make an ultrasonic transducer, zinc oxide film is formed on a substrate such as quartz or sapphire in a C-axis orientation.

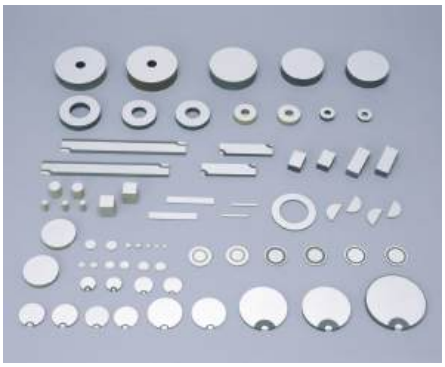
Table of physical properties

			Ceramics									Polymer film	Thin film
Property	Unit	Symbol	HC-60AH	HC-61AK	HC-62AK	HC-50GS	HC-51GS	HC-81GK	HC-30D	HC-70BN	HC-91KN	HP-CVFT	HT-ZO
Coupling Coefficients	%	k_p	58	65	72	60	61	54	25	13	46	—	—
		k_{31}	32	38	43	32	35	32	14	—	28	—	—
		k_{33}	68	74	77	67	70	65	28	—	52	30	20.0 to 26.0
		k_t	48	50	55	47	48	48	27	46	42	—	—
Dielectric constant		$\varepsilon_{33}^T/\varepsilon_0$	1900	2400	3800	1300	1350	1050	900	520	1470	6	7.5 to 10.0
Frequency Constants	Hz・m	N_p	2095	2000	1850	2035	2200	2300	3246	3010	2900	—	3000 to 3075
		N_{31}	1490	1450	1350	1600	1630	1700	—	—	2020	—	—
		N_{33}	1450	1360	1300	1660	1460	1600	—	—	2070	—	—
		N_t	2071	2250	2370	2100	2086	2250	2720	2220	2600	—	—
Piezoelectric Charge	$\times10^{-12}$ m/V	d_{31}	-162	-210	-330	-110	-132	-115	-36	—	-117	—	—
		d_{33}	380	550	830	290	312	230	140	110	265	—	—
Piezoelectric voltage Constants	$\times10^{-3}$ V・m/N	g_{31}	-10.0	-10.8	-10.0	-10.5	-11.1	-10.8	-4.5	—	-9.0	170	—
		g_{33}	24.0	24.0	20.0	32.0	26.1	25.2	18.0	23.8	20.2	-380	—
Youngs modulus	$\times10^{10}$ N/m²	Y_{33}^E	4.5	4.8	5	5.0	6.0	6.8	11	11.4	7.4	1.13	—
Mechanical Q		Q_m	75	80	60	1000	2500	1200	300	500	55	—	—
Dielectric Loss Factor	%	tanδ	1.6	2.0	2.0	0.5	0.3	0.3	2.0	0.66	2.4	0.15	—
Poisson's ratio		σ	0.36	0.36	0.27	0.32	0.30	0.31	0.32	0.26	0.35	—	—
Density	$\times10^3$ kg/m³	ρ	7.50	7.80	7.85	7.55	7.90	7.65	5.36	5.5	4.6	1.88	5.5
Curie Point	℃	T_C	320	290	220	320	320	310	160	260	325	—	—
Navy Type			Ⅱ	Ⅱ	Ⅵ	Ⅰ	Ⅰ	Ⅲ					
Applications			Flaw detection Thickness measurement Medical diagnosis Airborne level measurement Underwater measurement	Flaw detection Thickness measurement Medical diagnosis Airborne level measurement Underwater measurement	Flaw detection Thickness measurement Medical diagnosis Airborne level measurement Underwater measurement	Cleaning Machining Atomizing Welding	Cleaning Machining Atomizing Welding	Cleaning Machining Welding	Airborne level measurement Underwater measurement LEAD OFF™	Cleaning LEAD OFF™ Patented product	Airborne level measurement Underwater measurement LEAD OFF™ Patented product	Flaw detection	Microscopy Flaw detection

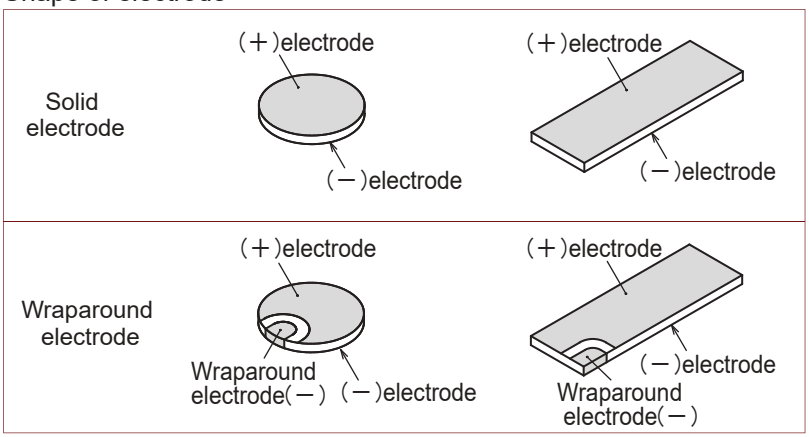
※Ceramics material and lead-free elements are not for sale.

Type of ultrasonic transducer

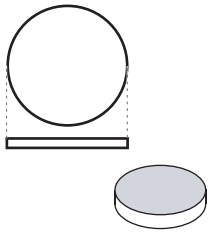
Piezoelectric ceramics transducer



Shape of electrode

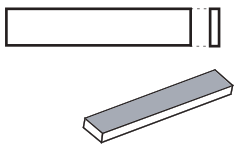


Disc



Model	Diameter (mm)	Thickness (mm)	Nominal frequency (MHz)	Measurement type	Dynamic type	Vibrational mode	Direction of polarization
HC−063	6	0.7	3	○		Thickness	Thickness
HC−103	10	0.7	3		○		
HC−162	16	1	2		○		
HC−202	20	1	2		○		
HC−301	30	2	1		○		
HC−501	50	2	1		○		

Rectangle



Model	Dimension (mm)	Thickness (mm)	Nominal frequency (MHz)	Measurement type	Dynamic type	Vibrational mode	Direction of polarization
HC−5015S12	50×15	1.7	1.2		○	Thickness	Thickness
HC−10015S12	100×15	1.7	1.2		○		
HC−11715S12	117×15	1.7	1.2		○		

※Please inquire for the detailed specifications and the application of the model mentioned above.

Piezoelectric polymer film / ZnO thin film

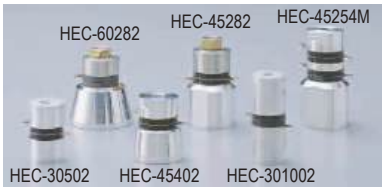
Application	Available frequency	Transducer
Ultrasonic flaw detector	10MHz to 100MHz	Polymer film
Ultrasonic microscope	100MHz to 400MHz	ZnO thin film

※These are make-to-order products. The lead time should be inquired.
※Please contact us for the customization.

Bolt clamped Langevin type transducer

BLT for Cleaner

Because piezoelectric ceramics is mechanically combined, the transducer is very durable free from damage even under the high amplitude vibrations. Furthermore, stable operation under high temperature is given because of high electroacoustic conversion efficiency and less heat generation.



	Model	Frequency (kHz)	Impedance (Ω)	Static capacity (pF)	Measurement voltage (Vrms)	Max. input power (W) ※1	Dimension (mm)	Length (mm)	Mass (g)	Joint screw size
PZT type	HEC-30502	50	30 or less	2100	1.0	30	31.5	50	130	M10 P1.0
	HEC-301002	108	50 or less	2600	1.0	30	30	74	175	M10 P1.0
	HEC-45282	28	35 or less	3300	1.0	50	45	80	395	M10 P1.0
	HEC-45402	40	35 or less	3300	1.0	50	45	54	225	M10 P1.0
	HEC-45254M	25・45	30 or less	6600	1.0	50	45	88	385	M10 P1.0
	HEC-60282	28	35 or less	3300	1.0	50	60	68	410	M10 P1.0
$(Bi,Na)TiO_3$ type Lead-free Piezoceramics	HEC-45282Z	28	75±25	1300	1.0	50	45	80	395	M10 P1.0
	HEC-45284Z	28	40±20	3300	1.0	50	45	85	405	M10 P1.0
	HEC-45382Z	38.5	70±25	1300	1.0	50	45	60	270	M10 P1.0

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※1 Reference power value
(Measurement condition : Room temperature 25±3℃)

◆Thickness vs torque

Thickness (mm)	Installation torque (N・m) ※2
1.0 to 1.5	5
1.6 to 2.0	8
2.1 to 3.0	10

※2 Standard value

BLT for process machinery

By the original structure design of transducer, high electroacoustic conversion efficiency, low mechanical vibration loss and less heat generation can be achieved.

Model	Frequency (kHz)	Admittance (mS)	Static capacity (pF)	Measurement voltage (Vrms)	Max. input power (W) ※1	Dimension (mm)	Length (mm)	Mass (g)	Joint screw size	Transmission installation torque (N・m) ※2
HEC-1340P4BF	40	15	2000	5	20	13	65	30	M6 P0.75	7
HEC-1540P2BF	40	10	850	10	30	15	67	40	M6 P0.75	7
HEC-1560P4B	60	40	2000	5	50	15	39	30	M5 P0.5	5
HEC-2528P2BF	28	25	2300	10	150	25	88	165	M8 P1.0	15
HEC-2528P4B	28	40	4300	10	300	25	89	180	M10 P1.0	20
HEC-2528P4BX	28	40	4300	10	350	25	89	180	M10 P1.0	20
HEC-3020P2B	20	20	2900	10	200	30	130	310	M10 P1.0	20
HEC-3028P2BF	28	20	3000	10	200	30	90	225	M10 P1.0	20
HEC-3028P4B	28	45	5750	10	400	30	88	280	M10 P1.0	20
HEC-3028P4BX	28	45	5750	10	450	30	88	280	M10 P1.0	20
HEC-3039P4B	39	200	7600	1	300	30	60	115	M10 P1.0	20
HEC-4020P4B	20	100	8400	10	500	40	125	570	M16 P1.0	70
HEC-4020P4BX	20	100	8400	10	600	40	125	570	M16 P1.0	70
HEC-4027P4B	27	150	10000	10	500	40	90	445	M16 P1.0	70
HEC-4028P4BH	28	150	10000	10	500	40	90	435	M10 P1.0	20
HEC-5020P4B	20	200	15500	10	700	50	127	925	M18 P1.5	80
HEC-5020P4BX	20	200	15500	10	850	50	127	925	M18 P1.5	80
HEC-5020P6B	20	250	23000	10	1000	50	124	980	M18 P1.5	80
HEC-6015P4B	15	150	10500	10	1500	60	161	1800	M20 P1.5	100
HEC-6015P4BX	15	150	10500	10	1800	60	161	1800	M20 P1.5	100
HEC-7015P4B	15	250	20000	10	2000	70	164	2590	M24 P1.5	110
HEC-5020P4BW ※3	20	260	12900	10	900	50	127	973	M18 P1.5	80
HEC-5020P6BW ※3	20	360	19200	10	1200	50	124	1020	M18 P1.5	80
HEC-5020P6BXW ※3	20	360	19200	10	1400	50	124	1020	M18 P1.5	80

(Measurement condition : Room temperature 25±3℃)

※1 Reference power value ※2 Standard value ※3 High power type

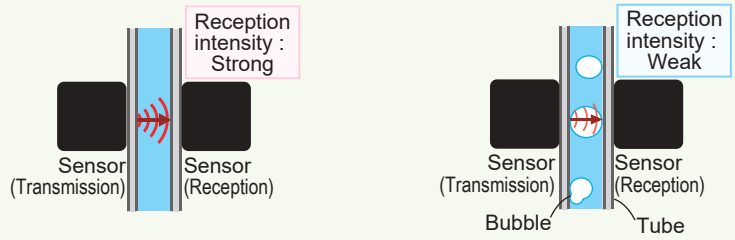
※These are make-to-order products. The Lead time should be inquired.
※Please contact us for the customization.

Ultrasonic sensor

Bubble detection sensor

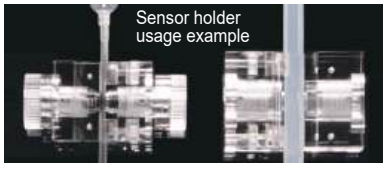
Basically ultrasound travels well in liquid. However, when a liquid includes suspended bubbles, ultrasound is deflected by them and shows quick attenuation.
Using this relation, ultrasonic bubble detection sensor measures bubbles.
Detectable bubble size is 1μℓ or more depending on the setting and transmission methods of sensor.

Image diagram

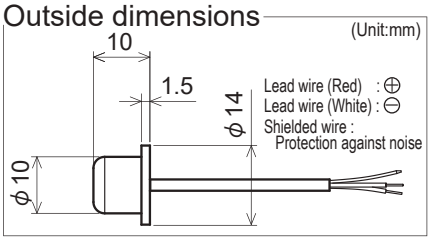


〈 Tube diameter : φ3～φ7mm 〉※1

Reception intensity becomes strong if ultrasonic propagation efficiency is high.
[Propagation efficiency＝Reception intensity]



Outside dimensions (Unit:mm)



Model	HKS0620	HKS0630	HKS0630Z
Frequency	2MHz	3MHz	3MHz
T/R sensitivity ※2	−23dB or more	−25dB or more	−32dB or more
Electrostatic capacity	400pF	550pF	320pF
Input voltage	10Vrms		10Vrms
Insulated resistance (50VDC)	500MΩ or more		500MΩ or more
Operating ambient temperature	5℃ to 45℃		5℃ to 45℃
Storage temperature	−10℃ to 55℃		−10℃ to 55℃
Housing material	m-PPE		m-PPE
Lead wire	AWG30		AWG30

(Measurement condition : Room temperature 25±3℃)

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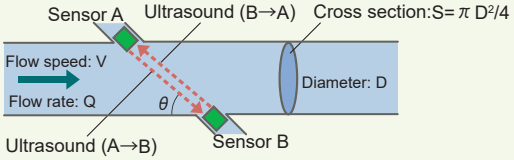
※1 Applicable tube size. Please inquire of us for details.
※2 Soft PVC tube (φ4.3−φ3.3) with water, Distance between T and R sensors : 2mm
T/R sensitivity=20log(Voltage received by reception sensor/Voltage transmitted by transmission sensor)

●Please contact us for the customization.

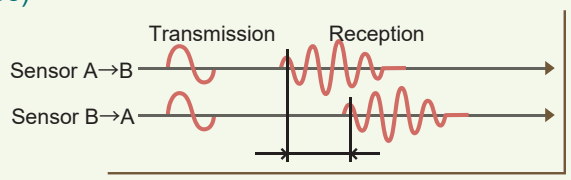
Sensor for Flow meter

Using ultrasonic waves, the flowmeter measures fluid velocity and calculates the flow rate.

Principle of ultrasonic flow meter (transit time difference type)



Transit time of forward direction (Sensor A→B) : $T_{AB}=L/(C+V\cos\theta)$
Transit time of opposite direction (Sensor B→A) : $T_{BA}=L/(C-V\cos\theta)$
$V=(L/2\cos\theta)\cdot(1/T_{AB}-1/T_{BA})$
$Q=(\pi D^2/4)\cdot V$



Ultrasound is propagated from both upstream and downstream, flow speed is determined from the transit time difference generated by flow.

Flow rate range (m³/h) ※3	Measurement tube size ※3	Frequency	Max. operating pressure	Wetted surface	Operation Temperature	Storage Temperature
10 to 300	50A to 250A	1MHz	1.0MPa	SUS316	0 to 80℃	−20 to 80℃
5 to 150	50A to 100A	3MHz				

(Measurement condition : Room temperature 25±3℃) ※3 Reference value

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Efforts to realize lead-free piezoelectric ceramics products

Laws and regulations restricting hazardous substances are enacted under the leadership of the European Union concerning environmental issues, regulations such as WEEE Directive (The Waste Electrical and Electronic Equipment Directive), RoHS Directive (Restriction on Hazardous Substances Directive), and ELV Directive (End of Life Vehicle Directive).
For PZT type piezoelectric ceramics widely used for various applications, is expected to be limited more strictly concerning the environment. Therefore, it is necessary to develop a lead-free piezoelectric material which the piezoelectric characteristics and physical properties are equivalent to PZT materials.

It is expected that terms of use of lead included in piezoceramic materials become severe. Meanwhile, we succeeded in the development of a practical lead-free piezoceramics.

The acquired patent lead-free piezoceramics which is three component complex perovskite based on $(Bi,Na)TiO_3$ and KNN have a practical use characteristic and a physics constant which are equivalent to PZT ceramics.

Notes on Usage

Products and specifications described in this catalogue are subject to change or discontinuation without notice due to improvements.

The delivery specifications should always be requested to check the details before use.

The performance and quality of each product are guaranteed to the limits stated in this catalogue, however, evaluation and confirmation of factors such as suitability of piezoelectric ceramic materials, mounting methods, and drive methods for the products are required in their actual mounted state prior to use, according to customer requirements.

Failure to use products in accordance with the specifications (including performance, ratings, and usage range) indicated in this catalogue may result in physical injury, fire, or social loss.

If you have any questions regarding usage, please feel free to contact Honda Electronics.

The products described in this catalogue are intended for use with standard equipment.

Customers considering use with equipment or systems requiring exceptionally high reliability and safety should confirm the suitability of products prior to their use.

Please note that Honda Electronics accepts no responsibility for any problems related to the intellectual property of third parties resulting from the use of these products, except for issues directly related to Honda Electronics' product construction and manufacturing processes.

The information in this catalog is current as of February 28, 2025.

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Registered company for ISO9001/ISO14001

-Contact-

Printed in Japan February 28, 2025 Ver.5