Piezocon Gas Concentration Sensor

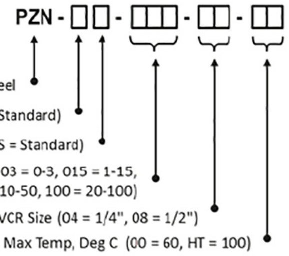
The Industry Standard for Reproducible Vapor Delivery Control

- The only gas concentration sensor to enable both monitoring and control of mass transfer of the precursor in real time
- Optimized for High Volume Manufacturing, with little to no user intervention and no periodic maintenance or calibration required
- Provides improved process reproducibility and increased yield by tightly controlling the delivery of process gases and precursor chemical vapors
- Lowers cost-of-operation by allowing more efficient use of precursor chemicals, extending the use of precursor sources and reducing waste
- Easier tool-to-tool matching with quantitative information directly meaningful to both equipment and process engineers
- Comprehensive diagnostic capabilities enable higher tool productivity
- Available options cover a broad range of operating pressures, temperatures and flow rates
- IECEx (TUR 21.0008X), KCs (21-AV4BO-0141X), and CE certifications

Standard Piezocon Gas Concentration Sensor

- Built using Veeco's industry-leading and production-proven Piezocon technology
- Optimized for use in high-volume manufacturing [HVM] applications where operating temperature is less than 100 Deg C and operating pressure is greater than 250 Torr
- Ideal for high-volume EPI and MOCVD applications
- Operates in either monitor or control mode, providing real-time feedback and control of gas or vapor concentration and flux delivery

Selection Guide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Piezocon Sensor, 316L Stainless Steel
Sensor Type (S = Standard)
Finish (S = Standard)
Flow Rate, LPM (003 = 0-3, 015 = 1-15, 050 = 10-50, 100 = 20-100)
VCR Size (04 = 1/4", 08 = 1/2")
Max Temp, Deg C (00 = 60, HT = 100)

Specifications

	Standard Sensor
Range of Concentration (Binary Mixture Only)	0 - 100%
Maximum Operating Pressure	8,000 Torr
Minimum Operating Pressure	250 Torr
Range of Flow Rates	0 - 3 LPM; 1 - 15 LPM; 10 - 50 LPM; 20 - 100 LPM
Temperature Range (Sensor)	0 - 60 Deg C; 60 - 100 Deg C
Temperature Range (Controller)	0 - 40 Deg C
Pressure Connections	Male VCR: 1/4", 1/2"
Leakage to Atmosphere	< 1x10 -9 atm cc/sec He
VCR Face-to-Face Dimension	124mm (4.88")
Weight (Sensor)	1.3 Kg (2.866 lbs)
Weight (Controller)	1-Channel Controller: 1.0 Kg (2.204 lbs) 4-Channel Controller: 2.8 KG (6.172 lbs)
Sensor Wetted Materials	316L Stainless Steel; Kapton; Inconel
Complete User Interface Software (Controller)	Monitor Status & Error Codes, Concentration, MFC Flow, Temperature
Communications Interface Options (Controller)	None; Devicenet; Profibus; RS-232; Modbus/TCP; Modbus/RTU; FabComms; Ethercat
Power Supply Options (Controller)	100 - 240 VAC, 50 - 60 Hz, 30 VA (internal); 24VDC External (3-wire interface provided for user to connect to their own external 24VDC power);

Typical Measurements for Standard Sensors

Precursor Chemical	Typical Process	Concentration % Qp/Qtotal *	Accuracy % Qp/Qtotal *	Repeatability % Qp/Qtotal *	Matching %
Diborane, B_2H_6	EPI	1	0.0285	0.0038	0.0228
Germane, GeH_4	EPI	1	0.0111	0.0015	0.0090
Phosphine PH_3	EPI	1	0.0239	0.0032	0.0192
Trichlorosilane, TCS [@ 18C, 30 psia]	EPI	1	0.0066	0.0009	0.0054

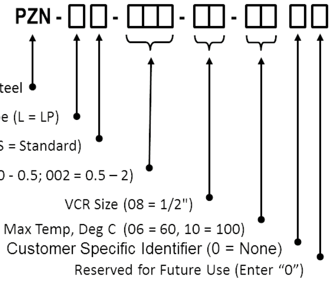
Example precursors in H2 carrier gas, 1,000 Torr, 25C [except as noted above]

* Qp = Precursor Volumetric Flow, Qtotal = Total Volumetric Flow

Low Pressure [LP] Piezocon Gas Concentration Sensor

- Built using Veeco's industry-leading and production-proven Piezocon technology
- Optimized for use in high-volume manufacturing [HVM] applications where operating temperature is less than 100 Deg C and operating pressure between 50 and 250 Torr
- Ideal for applications requiring low pressure and higher temperature, such as CVD and ALD
- Operates in either monitor or control mode, providing real-time feedback and control of gas or vapor concentration and flux delivery

Selection Guide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Piezocon Sensor, 316L Stainless Steel
Sensor Type (L = LP)
Finish (S = Standard)
Flow Rate, LPM (001 = 0 - 0.5; 002 = 0.5 – 2)
VCR Size (08 = 1/2")
Max Temp, Deg C (06 = 60, 10 = 100)
Customer Specific Identifier (0 = None)
Reserved for Future Use (Enter "0")

Specifications

	Low Pressure Sensor
Range of Concentration (Binary Mixture Only)	0 - 100%
Maximum Operating Pressure	250 Torr
Minimum Operating Pressure	50 Torr
Range of Flow Rates	0 - 1LPM; 0.5 - 3 LPM
Temperature Range (Sensor)	0 - 60 Deg C; 60 - 100 Deg C
Temperature Range (Controller)	0 - 40 Deg C
Pressure Connections	Male VCR: 1/2"
Leakage to Atmosphere	< 1x10 -9 atm cc/sec He
VCR Face-to-Face Dimension	124mm (4.88")
Weight (Sensor)	1.3 Kg (2.866 lbs)
Weight (Controller)	1-Channel Controller: 1.0 Kg (2.204 lbs) 4-Channel Controller: 2.8 KG (6.172 lbs)
Sensor Wetted Materials	316L Stainless Steel; Kapton; Viton
Complete User Interface Software (Controller)	Monitor Status & Error Codes, Concentration, MFC Flow, Temperature
Communications Interface Options (Controller)	None; Devicenet; Profibus; RS-232; Modbus/TCP; Modbus/RTU; FabComms; Ethercat
Power Supply Options (Controller)	100 - 240 VAC, 50 - 60 Hz, 30 VA (internal); 24VDC External (3-wire interface provided for user to connect to their own external 24VDC power);

Typical Measurements for Low-Pressure Sensors

Precursor Chemical	Typical Process	Concentration % Qp/Qtotal *	Accuracy % Qp/Qtotal *	Repeatability % Qp/Qtotal *	Matching %
Pentakis-dimethylamnotantalum, PDMAT[@ 80C, 50 torr]	ALD	0.8	0.0106	0.0014	0.0840
Tungsten Hexacarbonyl, $W[CO]_6$ [@80C, 50 torr]	ALD	5.02	0.0194	0.0026	0.0156
Titanium Tetrachloride, $TiCl_4$ [@20C, 100 torr]	ALD	9.6	0.0352	0.0046	0.0276
Trimethyl Phosphite, TMPi [@ 20C, 100 torr]	ALD	20.7	0.0602	0.0080	0.0048

Example precursors in Ar carrier gas

* Qp = Precursor Volumetric Flow, Qtotal = Total Volumetric Flow

Piezocon Gas Concentration Sensor

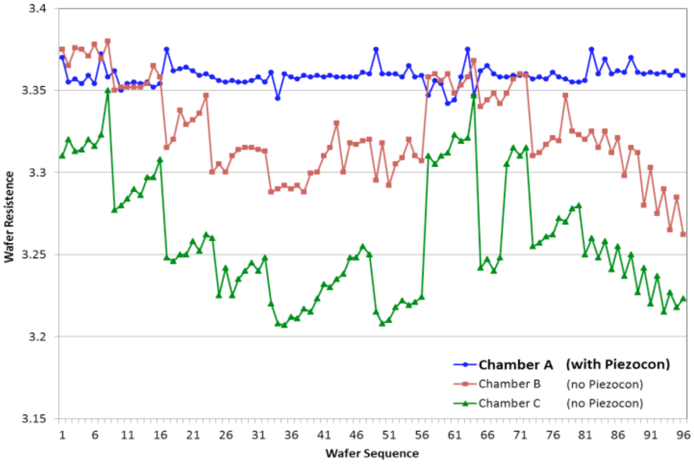
The Piezocon® Gas Concentration Sensor has become a standard within the semiconductor equipment industry for accurate monitoring and reproducible delivery control of chemical precursor vapors and of dopant gases to CVD, ALD and MOCVD process tools.

With over 7,000 installations worldwide, the Piezocon system is widely used by silicon, LED and compound semiconductor wafer and device manufacturers due to its unique ability to provide highly accurate and reproducible gas & vapor delivery monitoring. It also ensures improved process control, and can be used with a broad range of gas:gas or vapor:gas mixtures for many diverse applications.

Improves Process Reproducibility

Growth Rate Control with Piezocon Sensor Installed on Chamber A Only

(MFC flow rates for Chambers B and C were manually readjusted after each run, based on measured thickness data)



Ver 3.90.02
SN 13000
FIRMWARE 3.05.13
SAMPLING RATE 4.00
LOG FILE X:\ENGINEERING_PROJECTS\17 Pz G

SEC/SCREEN 600
Y-AXIS LOW 0.00
Y-AXIS HIGH 0.01

	SENSOR ID	MODE	GAS	CARRIER	TIME (usec)	TEMP (C)	VOLT SETPT	VOLT SOURCE	CORRECTED SETPT (V)	CARRIER (V)	RATIO (%)	QGAS/QMIX	
CHAMBER 1	13910	1K	TCS	H2	35.0290	24.295	0.497	0.498	0.505	0.506	20.60	0.172100	23.33
CHAMBER 2	NONE	1K	N2	N2									25.00
CHAMBER 3	NONE	1K	N2	N2									26.00
CHAMBER 4	NONE	1K	N2	N2									27.00

Lowers Cost-of-Operation

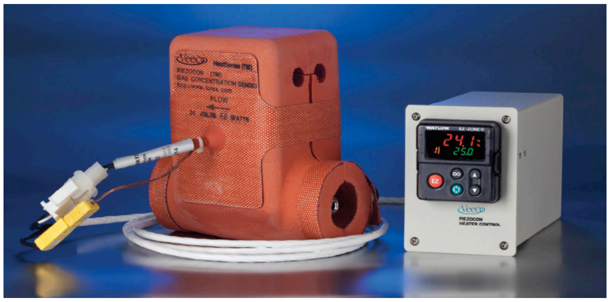
The Piezocon system lowers the tool's cost-of-operation by extending the use of precursor cylinder, bubbler or sublimater sources. Fewer vessel changes mean higher ROI and more capacity without adding more processing tools.

Easier Tool-to-Tool Matching

Tool-to-tool matching is facilitated by the Piezocon system's ability to provide relevant quantitative information on the ratio of precursor vapor to carrier gas concentration; and precursor delivery rate (g/min or mole/min) to the process chamber.

Comprehensive Diagnostic Capabilities

The Piezocon system generates log data files with information such as vapor carrier gas concentration, precursor delivery rate, and MFC set-point, allowing optimization of the delivery system and identification of any malfunction, such as issues with the bubbler temperature or pressure, MFCs, pressure controllers, etc.



Piezocon Heater Jacket and Heater Controller

Piezocon Single Sensor Controller

Piezocon Multi-Sensor Controller

**Find out more at www.veeco.com
or call 1.888.24.VEECO**

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