Keynes Controls Ltd

VibWire-201

Product Training Video

Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

Keynes Controls Ltd

VibWire-201

Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

VibWire-201-Pro

Vibrating Wire Sensor Analyser, Logger and Display Unit

- Connecting the instrument to a PC
- Installing and running the device configuration software
- Scanning the instrument for Calibration Factors
- Windows Free Software
- Sample Manufacturer's Calibration Factors
- Select Thermistor Type
- Understanding the Sensor Linearisation Formula
- Storing new sensor types into the unit
- Download and Restore Projects

Running Time 5 Minutes

Software Features

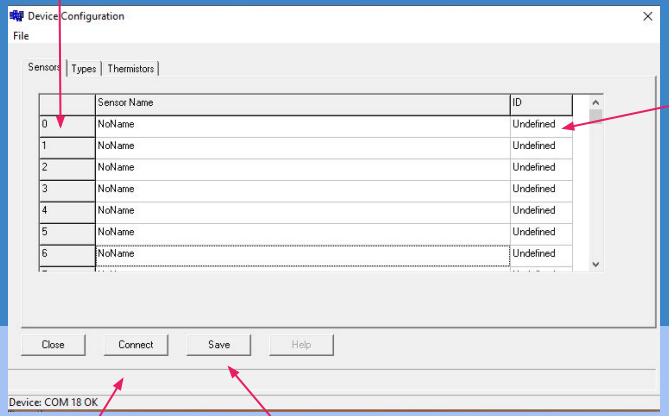
Sensor Number

The sensor number assigns the order in which a defined sensor will be scanned by the instrument. The instrument scans from starts from Sensor 0 and continues for all assigned sensors.

Sensor Types

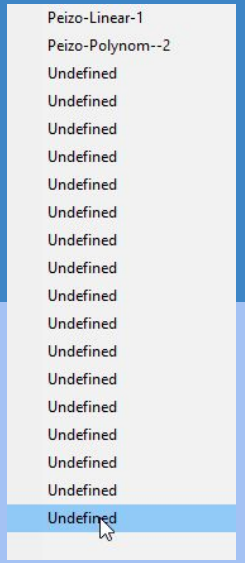
The User can preset the sensor type and process option. See Slides X a Y for further details. Useful when many sensors of the same type are to be used.

Sensor Number 0 .. 200



VW201Cal Sensor Setup Window

Defined Sensor Types



Connect Button

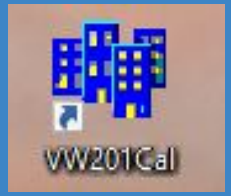
Press this button in order to download the current instrument configuration settings.

Save Button

Press this button in order to write the sensor details into the instrument.

Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

Initial Window



VW201Cal Desktop App

Connect a USB cable connects the VibWire-201 to a Windows PC

Activate the VW201Cal Software

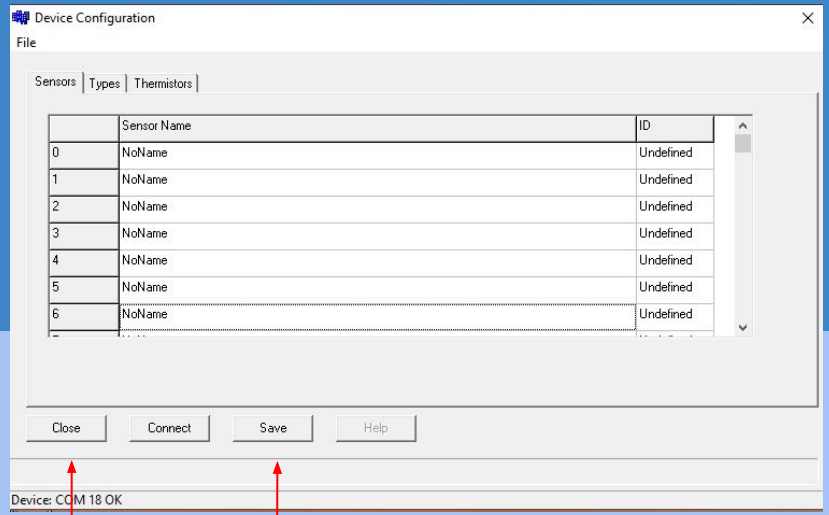
The Device Configuration will appear as shown opposite.

Press the "**Connect**" button to download and display the parameters stored inside the unit. This action also prepares the instrument to accept new parameters.

Default Screen

Once the VW201Cal software is installed and activated then the default screen will appear. Only when a VW201 has been connected to a PC can any previously stored settings be accessed and changed.

Device Configuration Window



Download and display sensor parameters from the VibWire-201

Store parameters into the VibWire-201

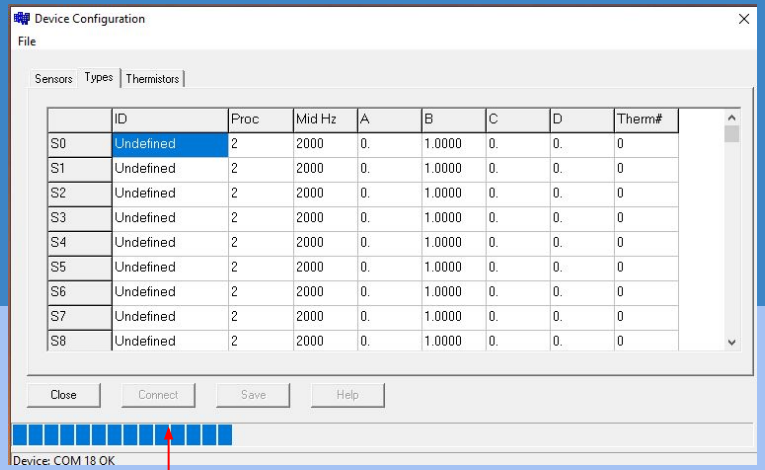
Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

Downloading the Instrument Configuration

Press the Connect Button

The blue status bar will appear as the Instrument configuration is downloaded

Any Pre-set Sensor Configurations will be displayed in the table,



Download Parameter Status Bar

Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

Sensor Scanning Operations

1. Connect the VibWire-201 to a Windows PC using the supplied USB Cable.
2. Activate the VW201Cal Software.
3. Download any Preset Sensor Calibration Factors and display the results in the VW201Cal software.
4. Assign all of the Vibrating Wire Sensor Calibration Factors into the instrument.

   Each sensor can be individually configured.

5. Assign the Sensor Name - Starting with **Sensor 0** and continuing until all the Sensors are configured, or updated.

   The instruments starting scanning at Sensor 0 then increments automatically to Sensor 1 etc …

6. Save the new Calibration Factors into the instrument,
7. Any recorded values are stored onto an SD Card inserted into the unit.

8. The results are stored in the order they are assigned to the device, Sensor 0 being the first column of data
9. with a separate column for each defined sensor. CSV files can be read into any spreadsheet including Google Docs,,,

Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

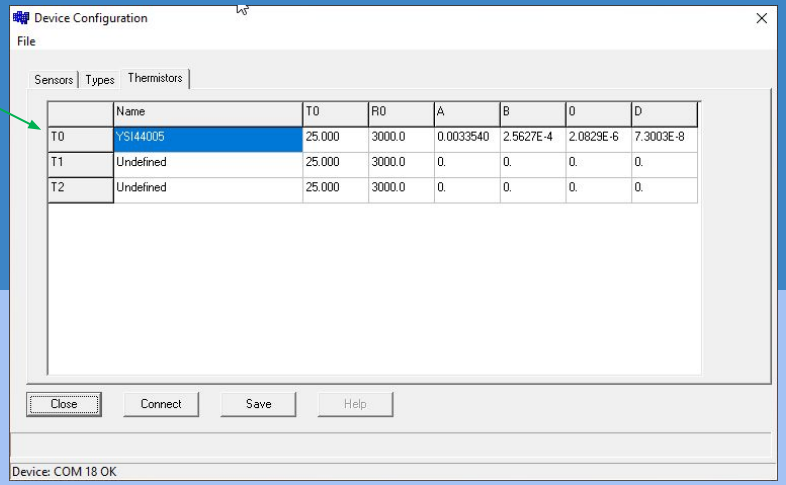
Temperature Sensor Configuration

T0 is the preset thermistor calibration parameters for the most popular temperature sensor built into many vibrating wire sensors.

T1 and **T2** are for User assigned calibration factors for the temperature sensors.

The calibration factors are taken from the temperature section of vibrating wire sensor manufacturers data sheet.

If no temperature sensor calibration factors are supplied then simply use the preset T0 type in the software. The results should be accurate.



Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

Temperature Sensor Configuration

Steinhart-Hart Thermistor Factors and Beta Value Calibration Factors

The most accurate temperature readings are carried out when the thermistor calibration factors are assigned for use with the Steinhart-Hart thermistor equation.

For this operation to be undertaken then you are looking for parameters such as
T0 = 25 Deg C R0 = 3 K Ohm and Parameters A, B, C and D on the sensor data sheet.

Beta Value

Some sensor manufacturer's do not supply the full temperature sensor calibration factors but use the simplified '**Beta' Factor**. This is can be used and set into the VW201Cal software.

The calibration factors will be shown similar to

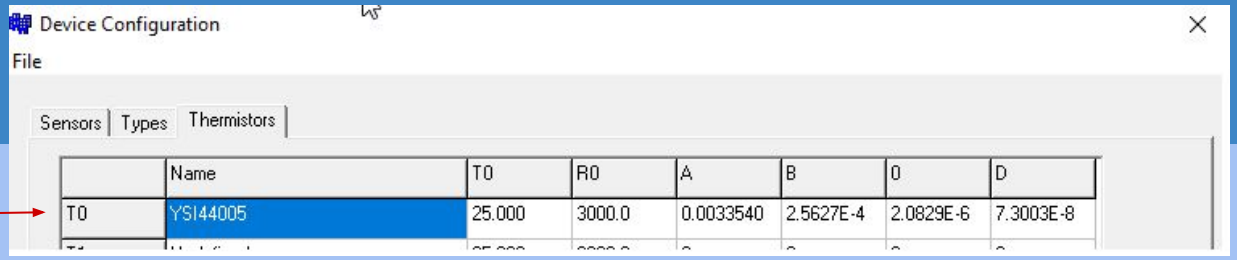
T0 = 25 Deg C R0 = 3 K Beta = 3461

The calibration factors for the software will be A = 0 B = 3461 C = 0 D = 0.
Only the 'B' factor is used.

Temperature Sensor Configuration

When there are no temperature setup factors assigned to a Calibration report then set the thermistor type to type **T0.** This is the default setting preset into the software for the most popular industry standard temperature built into many different vibrating wire sensors.

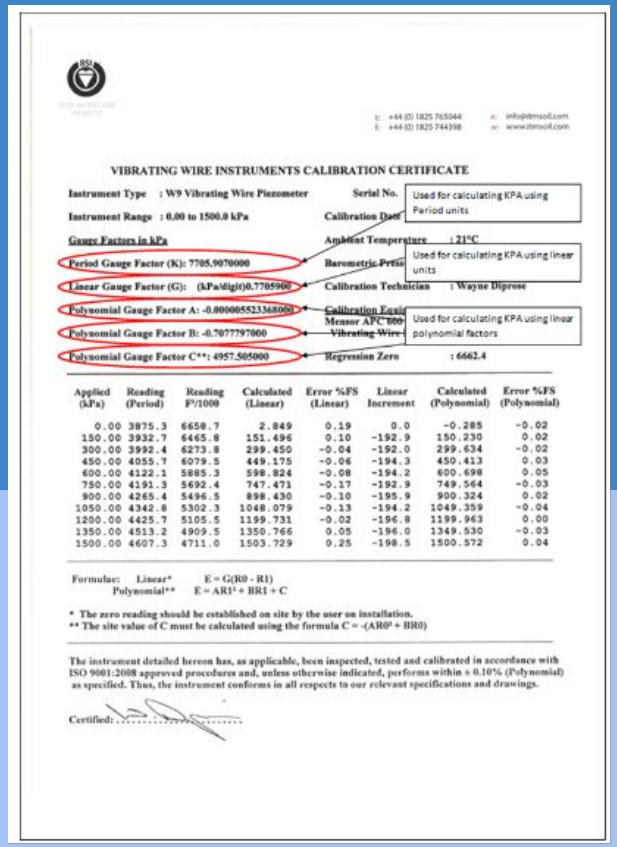
T0



Preset Thermistor Calibration Parameters

Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

Sample Calibration Data Sheet



VIBRATING WIRE INSTRUMENTS CALIBRATION CERTIFICATE

Instrument Type : W9 Vibrating Wire Piezometer
Serial No.
Instrument Range : 0.00 to 1500.0 kPa
Calibration Date
Gauge Factors in kPa
Ambient Temperature : 21°C
Period Gauge Factor (K): 7705.9070000
Barometric Pressure
Linear Gauge Factor (G): (kPa/digit)0.7705900
Calibration Technician : Wayne Diprose
Polynomial Gauge Factor A: -0.0000055233680[illegible]
Calibration Equipment
Mensor APC 600
Polynomial Gauge Factor B: -0.7077797000
Vibrating Wire
Polynomial Gauge Factor C**: 4957.505000
Regression Zero : 6662.4

Used for calculating KPA using Period units

Used for calculating KPA using linear units

Used for calculating KPA using linear polynomial factors

Applied (kPa)	Reading (Period)	Reading F²/1000	Calculated (Linear)	Error %FS (Linear)	Linear Increment	Calculated (Polynomial)	Error %FS (Polynomial)
0.00	3875.3	6658.7	2.849	0.19	0.0	-0.285	-0.02
150.00	3932.7	6465.8	151.496	0.10	-192.9	150.230	0.02
300.00	3992.4	6273.8	299.450	-0.04	-192.0	299.634	-0.02
450.00	4055.7	6079.5	449.175	-0.06	-194.3	450.413	0.03
600.00	4122.1	5885.3	598.824	-0.08	-194.2	600.698	0.05
750.00	4191.3	5692.4	747.471	-0.17	-192.9	749.564	-0.03
900.00	4265.4	5496.5	898.430	-0.10	-195.9	900.324	0.02
1050.00	4342.8	5302.3	1048.079	-0.13	-194.2	1049.359	-0.04
1200.00	4425.7	5105.5	1199.731	-0.02	-196.8	1199.963	0.00
1350.00	4513.2	4909.5	1350.766	0.05	-196.0	1349.530	-0.03
1500.00	4607.3	4711.0	1503.729	0.25	-198.5	1500.572	0.04

Formulae: Linear* E = G(R0 - R1)
Polynomial** E = AR1² + BR1 + C

* The zero reading should be established on site by the user on installation.
** The site value of C must be calculated using the formula C = -(AR0² + BR0)

The instrument detailed hereon has, as applicable, been inspected, tested and calibrated in accordance with ISO 9001:2008 approved procedures and, unless otherwise indicated, performs within ± 0.10% (Polynomial) as specified. Thus, the instrument conforms in all respects to our relevant specifications and drawings.

Certified: .....

The image opposite shows a sample calibration report for a Vibrating Wire Piezometer

This is a simple example of how to use the calibration report using the Linear Gauge Factor calibration parameters to determine the the sensor output in **SI Units of KPa**.
This time the calculation will use the Digits which is **Process 1**

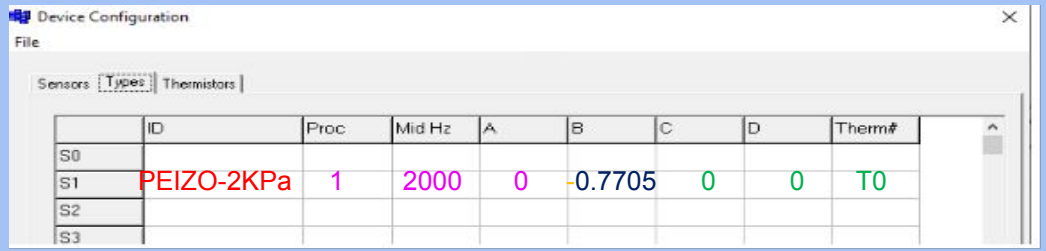
Note

The calibration parameters have been assigned to a Sensor ID Type "**PEIZO-2 10m KPa**"

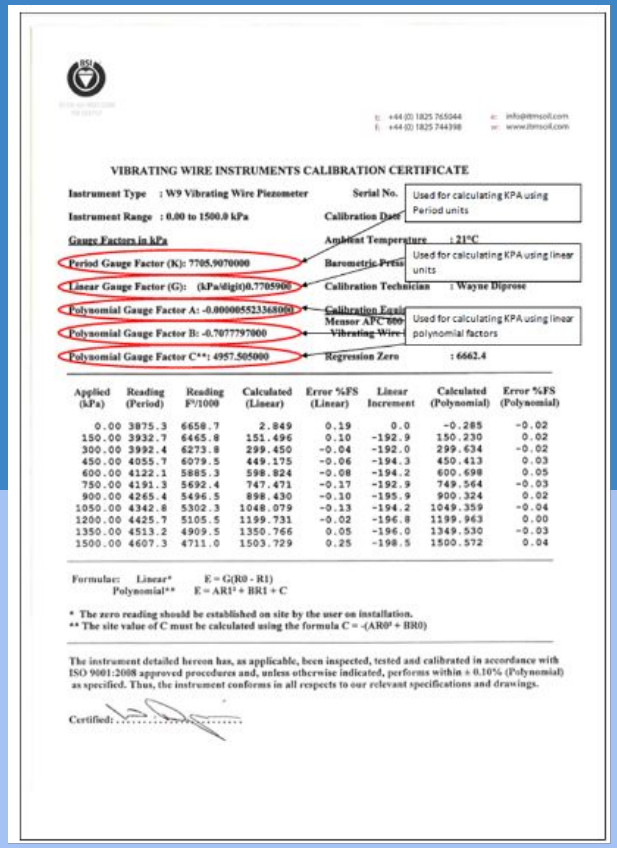
Process = 1 this ensures the VibWire-201 uses the **E = G**.(R1-R0) Formula

where **G = Linear Gauge Factor = 0.77059** as shown in the Calibration Report

R1 = Current Sensor Reading from the VibWire-201
R0 = Initial Condition Reading this is typically set to 0



Sample Calibration Data Sheet



VIBRATING WIRE INSTRUMENTS CALIBRATION CERTIFICATE

Instrument Type : W9 Vibrating Wire Piezometer
Instrument Range : 0.00 to 1500.0 kPa
Gauge Factors in kPa
Period Gauge Factor (K): 7705.9070000
Linear Gauge Factor (G): (kPa/digit)0.7705900
Polynomial Gauge Factor A: -0.0000055233680[illegible]
Polynomial Gauge Factor B: -0.7077797000
Polynomial Gauge Factor C**: 4957.505000

Serial No.
Calibration Date
Ambient Temperature : 21°C
Barometric Pressure
Calibration Technician : Wayne Diprose
Calibration Equipment
Mensor APC 600 Vibrating Wire
Regression Zero : 6662.4

Used for calculating KPA using Period units

Used for calculating KPA using linear units

Used for calculating KPA using linear polynomial factors

Applied (kPa)	Reading (Period)	Reading F²/1000	Calculated (Linear)	Error %FS (Linear)	Linear Increment	Calculated (Polynomial)	Error %FS (Polynomial)
0.00	3875.3	6658.7	2.849	0.19	0.0	-0.285	-0.02
150.00	3932.7	6465.8	151.496	0.10	-192.9	150.230	0.02
300.00	3992.4	6273.8	299.450	-0.04	-192.0	299.634	-0.02
450.00	4055.7	6079.5	449.175	-0.06	-194.3	450.413	0.03
600.00	4122.1	5885.3	598.824	-0.08	-194.2	600.698	0.05
750.00	4191.3	5692.4	747.471	-0.17	-192.9	749.564	-0.03
900.00	4265.4	5496.5	898.430	-0.10	-195.9	900.324	0.02
1050.00	4342.8	5302.3	1048.079	-0.13	-194.2	1049.359	-0.04
1200.00	4425.7	5105.5	1199.731	-0.02	-196.8	1199.963	0.00
1350.00	4513.2	4909.5	1350.766	0.05	-196.0	1349.530	-0.03
1500.00	4607.3	4711.0	1503.729	0.25	-198.5	1500.572	0.04

Formulae: Linear* E = G(R0 - R1)
Polynomial** E = AR1² + BR1 + C

* The zero reading should be established on site by the user on installation.
** The site value of C must be calculated using the formula C = -(AR0² + BR0)

The instrument detailed hereon has, as applicable, been inspected, tested and calibrated in accordance with ISO 9001:2008 approved procedures and, unless otherwise indicated, performs within ± 0.10% (Polynomial) as specified. Thus, the instrument conforms in all respects to our relevant specifications and drawings.

Certified: .....

Using **Natural Units = $A(R1)^2 + B(R1) + C + K(T1-T0) - (S1-S0)$** **(Equation 1)**

This is a simple example of how to use the calibration report using the Polynomial calibration parameters to determine the the sensor output in **SI Units of KPa**.

This time the calculation will use **Process 2** **(Polynomial Calculation)**

A = **-5.523E-6** B = **-7.078E-1** **C = 4957.50** Values taken from the sample data sheet

The calibration parameters have been assigned to a Sensor ID Type "**Peizo-Polynom-2**"

Calibration Parameters

Device Configuration

File

Sensors | Types | Thermistors

	ID	Proc	Mid Hz	A	B	C	D	Therm#
S0								
S1								
S2	Piezo-Polynom-2	2	2000	-5.523E-6	-7.078E-1	4957.50		T0
S3								

Default Thermistor Type

Sensor ID

Sample Calibration Data Sheet

Further Information

when the initial conditions are known then it is possible to expand on the use linear formula

Process = 1 this ensures the VibWire-201 uses the E = G.(R1-R0) Formula

E = G.R1 - G.R0 where G.R0 is a constant value and is used as an Offset

It is possible to use the

where **G = Linear Gauge Factor = 0.77059** as shown in the Calibration Report

R1 = Current Sensor Reading from the VibWire-201
R0 = Initial Condition Reading and this is typically set

Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

Sample Calibration Data Sheet

The VibWire-201-Pro uses:

Calibration equation. **Natural Units = $A(R1)^2 + B(R1) + C + K(T1-T0) - (S1-S0)$** **(Equation 1)**

and this is expanded to: **= $C(R1-R0)^2 + B(R1-R0) + A + K(T1-T0) - (S1-S0)$** **(Equation 2)**

when initial conditions in the measurements are involved.*where S0 = Initial Condition (SI unit) S1 = Current reading*
T0 = Initial temperature (Deg C) T1 = Current temperature

The additional terms used in equation 2 only change the constant parameter (A) and are not often used.

Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

Selecting Hz, Digits or Engineering Units

In order to set the instrument to use the correct calculation type for the frequency component of a vibrating wire sensor then it has to be told what to do.

The VibWire-201 supports only 3 separate process options for all of its sensor operation

Process Option = 0

All calculations are based on using the raw sensor value in Hz

Typically only the Offset and Scale Parameters only.

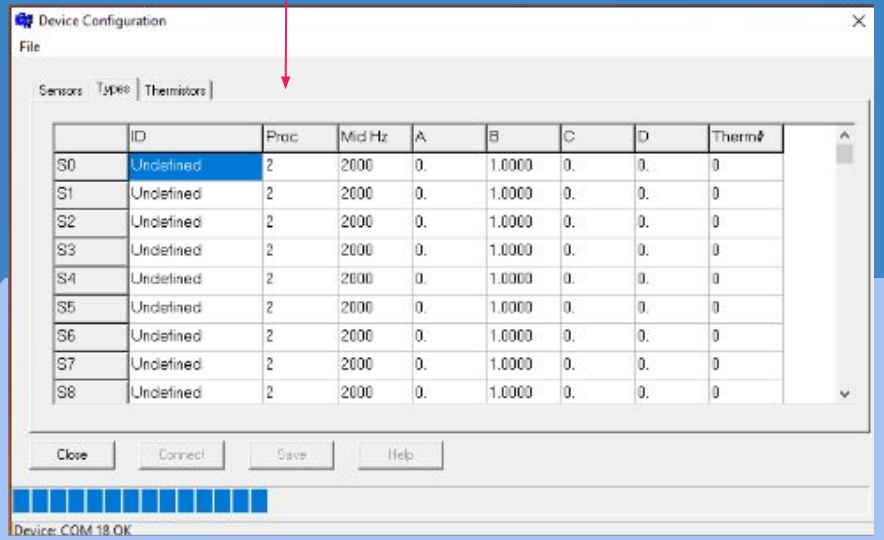
Yout = **Raw Signa (Hz)l x Scale + Offset**
Only parameters A and B are required C and D are not used and set to 0

Process Option = 1

This option uses the calculation **Digits = Frequency ^{2} / 1000** **(Hz^2)** 1000

Process Option Tab

0 - Hz 1 = Digits 2 = SI Units



Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

Sensor Polynomial Coefficients

The VibWire-201-Pro uses the industry standard equation often quoted on sensor calibration reportes to convert sensor frequency in Hz, to natural units.

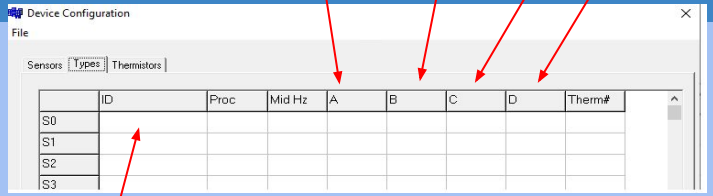
Second Order (Squared) Term Linear Term Constant

Calibration equation. **Natural (SI) Units = $A(R1)^2 + B(R1) + C + D(T1-T0) - (S1-S0)$** **(Equation 1)**

Initial Conditions

Temperature Compensation

Note, Take care when entering the sensor calibration coefficients that the second order (Squared) term is entered as **A**, the linear term is **B** etc ..



Sensor Type Table VW201Cal Software

Sensor Identifier Name

Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

Sensor Polynomial Coefficients

$$\text{Natural (SI) Units} = A(R1)^2 + B(R1) + C + D(T1-T0) - (S1-S0) \qquad \text{(Equation 1)}$$

Nearly all vibrating wire sensor manufacturer's use the above equation, or variations to determine the Natural (SI) value from a measured sensor frequency reading.

Occasionally some sensor manufacturers rearrange the above formula shown on the calibration reports to look something like

$$\text{Natural (SI) Units} = D(R1)^2 + C(R1) + B + A(T1-T0) - (S1-S0)$$

This just a rearrangement of the terms but care has to be taken to ensure the coefficients are set into the correct order for storage into the VibWire-201.

Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

Sensor Polynomial Coefficients

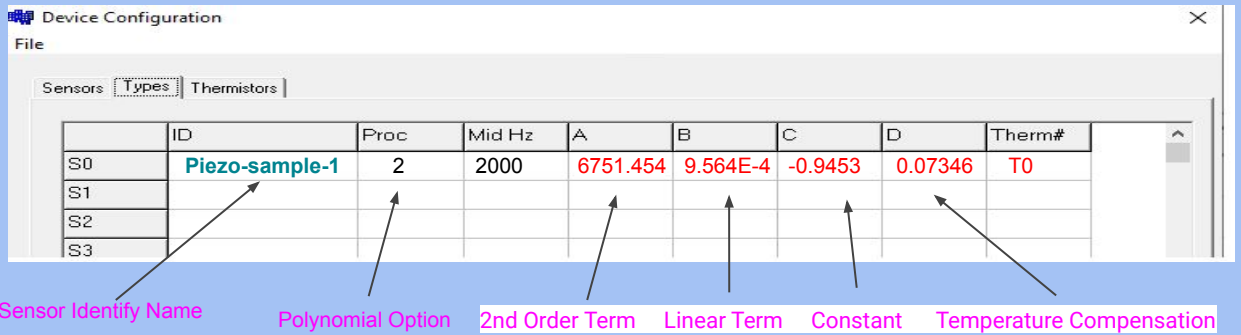
Natural (SI) Units = $A(R1)^2 + B(R1) + C + D(T1-T0) - (S1-S0)$ used by the instrument

Worked Example 1 - This example below shows the calibration factors have been swapped around by the sensor manufacturer, This is a common practice between the different manufacturers and care should be taken to watch out for this change. The calibration equation has been given as

Pressure $H^20mm = D(R1)^2 + C(R1) + B + A(T)$

where **D** = 6751.454 C = 9.564E-4 B = -0.9453 A = 0.07346 (Parameters are random and for example only)

2nd Order Term | Linear Term | Constant | Temperature Compensation



Take care to assign the polynomial coefficients to the correct cell.

Sensor Groups and Types

Once all of the sensors to be scanned have been defined and stored into the instrument then it is an easy operation to assign the scanning operations.

Repeat for all Sensors that are to be Scanned

Assign Sensor Identifier - Keynes suggests that an identifier string clearly shows sensor location and type

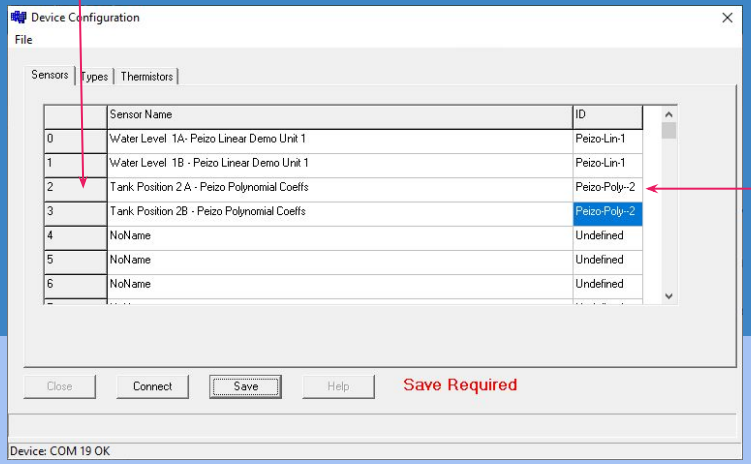
Assign the Sensor Type - A pull down list shows all the defined sensor types that can be used.

Store the configuration into the instrument by pressing the “Save” button.

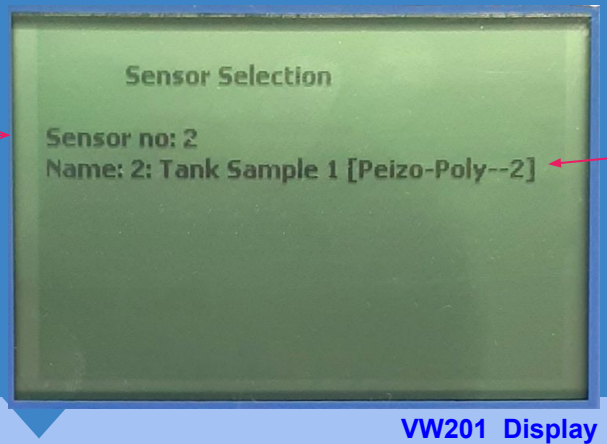
Tel: 0044 118 327 6067
E-mail: sales@keynes-controls.com

Sensor Groups and Types

Sensor No: 2

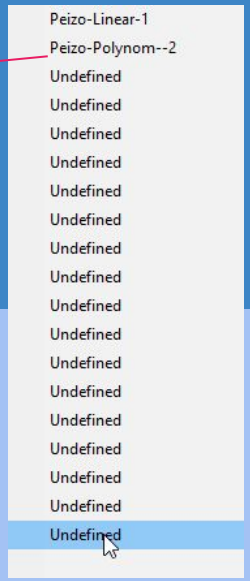


VW201Cal Sensor Setup Window



VW201 Display

Defined Sensor Types

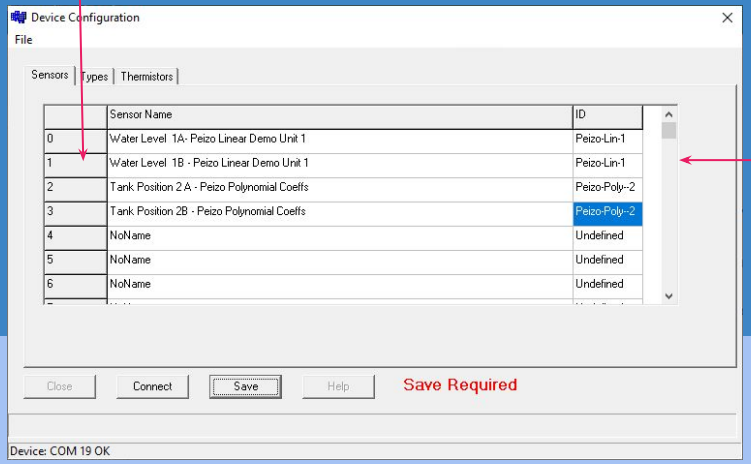


The images above show how the Configuration settings used in the VW201Cal software appear on the instrument display.

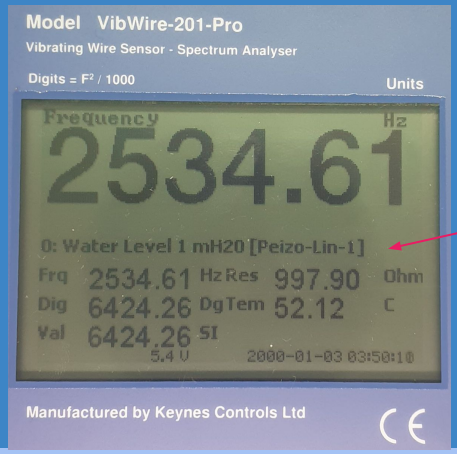
The details for Sensor Type **Peizo-Poly-2** can be seen on slide 10

Sensor Groups and Types

Sensor No: 1

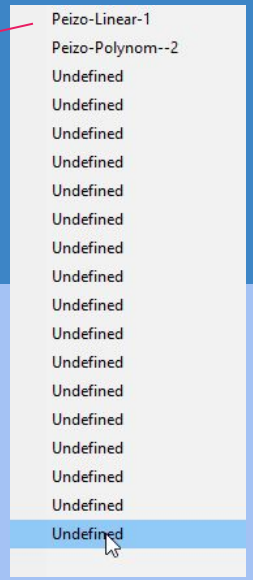


VW201Cal Sensor Setup Window



VW201 Display

Defined Sensor Types



The images above show how the Configuration settings used in the VW201Cal software appear on the instrument display.

The details for Sensor Type **Peizo-Linear-1** can be seen on slide 10