

ViscoTron In-Line Viscometers



Your process viscosity measurement solution

- ④ Next generation transducers employing our proven operating principle
- ④ High speed frequency analysis for stable measurement
- ④ Viscosity, temperature and frequency measurement
- ④ Cable length independent factory calibration
- ④ Factory independent customer calibration
- ④ Rugged and maintenance free
- ④ Proven in many applications

Viscotronics Co., Ltd.

Company History

Viscotronics started out as Marimex Industries Corp., which was founded in Canada in 1984 selling and supporting a wide variety of analytical process instruments. By 1993 Marimex was concentrating its efforts on torsional motion process viscometers.

With many successful installations in chemical, petrochemical, pharmaceutical and food applications, we have proven to be a reliable partner to our customers. More than 30 years of experience with process viscosity applications help us to analyze difficult and demanding applications. Together with our customers we determine the measurement requirement and provide a solution for the application. The selected instrument configuration will provide quick results for a project.

If process parameters change, we are ready to support our customers by re-evaluating the application based on the new parameters. This enables current installations to be optimized.

Continually changing requirements are used as an opportunity to improve existing instrumentation. Whilst development is a continuously ongoing process, significant enhancements have been made in the past few years for transducers and transmitters.

Incorporating modern manufacturing methods which include Laser welding of the sensor, required finding new suppliers and add our own manufacturing capabilities. This resulted in separation from previous business relationships and the forming of Viscotronics Co., Ltd.

ViscoTron systems incorporate recent customer demands like longer non-active extensions and high temperature capability without air cooling, which significantly reduces operating costs. The recent

introduction of our flow through viscometers expands the capabilities by eliminating the need of sampling cells for small pipes. Flow through viscometers are available with tube diameters from 6 to 25 mm.



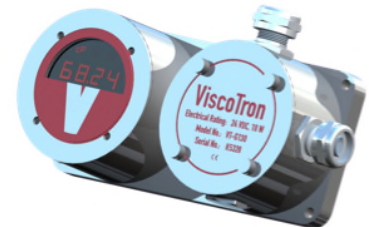
Transmitter timeline



1997



2003



2011



2013/14



2018

Operating Principle

ViscoTron process viscometers measure the viscosity of liquids continually and precisely in-line. ViscoTron sensors have virtually no moving parts and are maintenance free.

Torsional oscillation viscometers are surface loading devices. These devices measure the viscosity at the interface between the liquid and the solid surface.

Drive shaft and compliant sheath welded to sensor

The sensor bulb twists back and forth at the natural resonance of the sensor.

The drive shaft is welded to the sensor and moves the sensor resulting in a micron size motion at the sensor surface. The compliant sheath, which is also welded to the sensor and an opposing static plane, acts as a spring for the resonance. This completely welded construction hermetically seals the internal mechanism from the process and provides high integrity for the sensor. The vibration on the sensor surface can barely be felt.

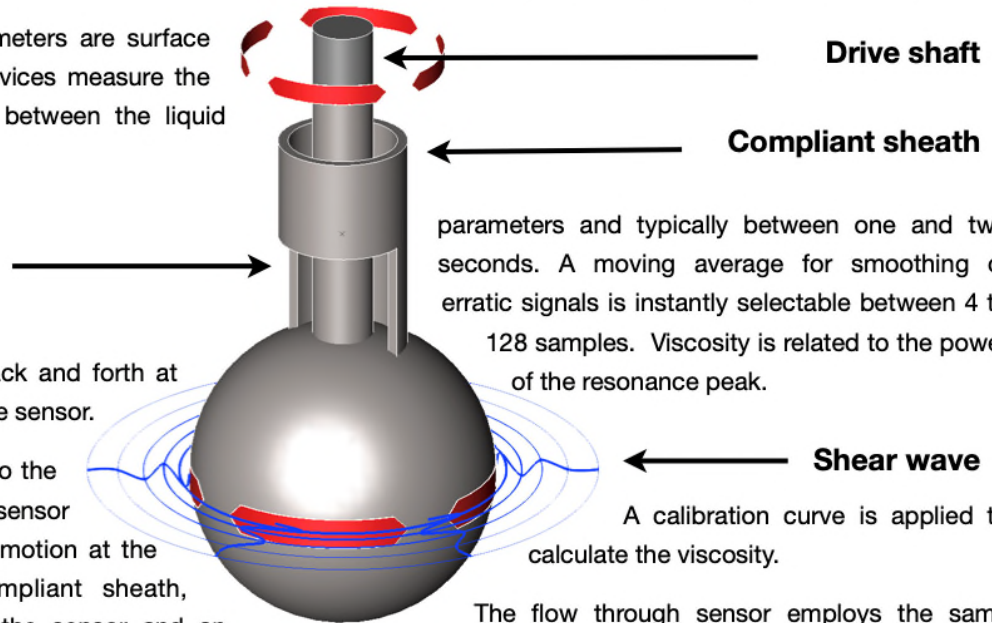
ViscoTron sensors and transmitters induce a natural resonance response into the sensor bulb or tube. The resonant frequency response is intelligently analyzed.

The analysis time cycle is dependent on required

parameters and typically between one and two seconds. A moving average for smoothing of erratic signals is instantly selectable between 4 to 128 samples. Viscosity is related to the power of the resonance peak.

A calibration curve is applied to calculate the viscosity.

The flow through sensor employs the same operating principle, however the tube is being twisted back and forth to generate an internal shear wave. The tube itself acts as a spring and the construction and mounting provide the static plane the sensor vibrates against.



Technology

The VT-IRFTi and VT-IRFTx transmitters use Fast Fourier Transform technology, which was costly to implement only a few years ago. Today's micro processors allow the induced resonance to be continuously analyzed and external influences to be identified at the same time. If interference from external influence is below configured parameters, the viscosity is updated.

Measuring the power at the resonance frequency provides the information of the viscosity. This information is applied to a calibration curve to calculate the viscosity.

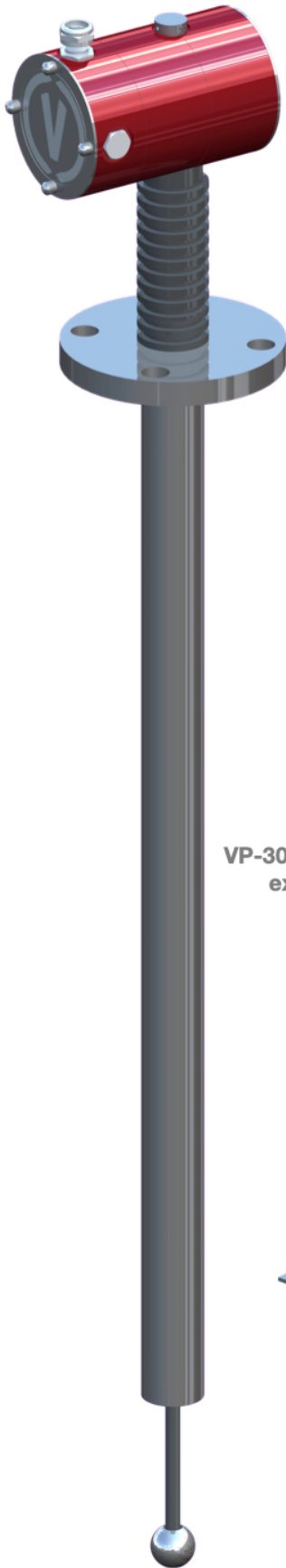
Measurements taken during occasional short interferences like mechanical vibration are identified

and disregarded for measurement. More severe and continuous interference will result in an alarm condition.

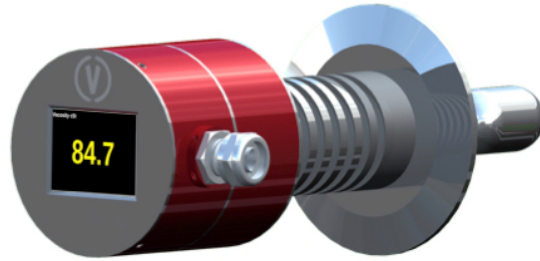
Identifying continuous interferences is made easy with an available service mode. In service mode interference is allocated to the analyzed spectrum, which shows the problem in an animated fashion.

Traditional servo driven analog transmitters may still be relevant. Those instances may include maintenance, thus we are still offering the VT-G144 at the current time.

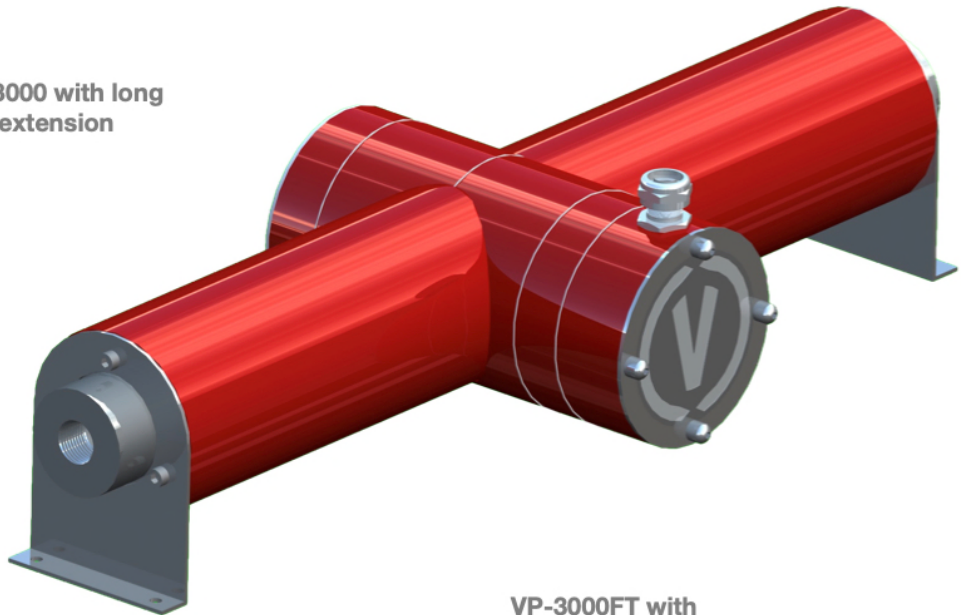
ViscoTron Transducers



VP-3000 with long extension



VP-1000 with Sanitary Flange and internal transmitter



VP-3000FT with 1" Female NPT fitting

The ViscoTron sensor series VP-1000 has been developed employing experience gained over more than 30 years of applying, developing and manufacturing torsional motion viscometers.

Laser welded construction and innovative assembly allows the series VP-1000 sensors to be manufactured to exacting standards and competitive prices. Laser welding also eliminates extra processing steps, which are required when using traditional welding methods, thus providing a stable measurement.

The series VP-1000 is available in versions to measure low, medium, high or extra high viscosities. Sensors can be constructed for pressures up to 5 MPa (725 psi) and temperatures up to 250°C (480°F). Factory calibration with Newtonian fluids over multiple decades is optional. The sensor can also be customer calibrated using the VT-IRFT transmitters.

The viscometer torsionally displaces the sensor bulb. The drag on the twisting motion is a measure of the

viscosity. Speed, direction and turbulence of flow have no influence on the measurement.

The resonant frequency is dependent on the mechanical construction of the sensors and typically between 400 and 600 Hz. The microscopic motion and low shear rate provides excellent sensitivity and resolution for newtonian and non-newtonian fluids.

Air cooling of the sensor housing is not required. Eliminating air cooling lowers operating cost and eliminates temperature variations at the sensor bulb, which can result from air cooling inside the housing. An optional temperature probe placed close to the sensor is field serviceable. Alternatively a temperature probe can be placed directly inside the sensor.

ViscoTron series VP-1000 sensors are also available in intrinsically safe versions, they can be used in classified hazardous areas.

Description	VP-1000L	VP-1000M	VP-1000H	VP-1000X
Measurement range (mPa·s x g/cm ³)	0.0 to 1,000	0.0 to 10,000	0 to 100,000	0 to 1,000,000
The measurement and calibration ranges indicated above are a guide only, the final range capability is dependent on pressure requirements, sensor dimensions and other design factors				
Calibration	Factory calibration with Newtonian fluids is available for 1, 2 or 3 decades within the measurement range. Thus the calibrated range can be matched to the customer requirements			
Sensor length	80 to 140 mm, dependent on range and installation requirements			
Maximum process temperatures with external transmitter	LTE	< 85°C / 185°F		no riser
	MTE	< 175°C / 350°F		85 mm riser
	STE	< 250°C / 480°F		125 mm riser
Maximum process temperatures with internal transmitter	LTI	< 100°C / 210°F		85 mm riser
	MTI	<150°C / 300°F		125 mm riser
Resonant frequency	Typically 400 to 600 Hz (dependent on design)			
Shear rate	Typically between 2,500 and 3,800 sec ⁻¹ (dependent on design)			
Repeatability	0.5% or ±1 digit			
Accuracy	1% or ±1 digit, whichever is greater (factory calibrated with NIST standards)			

For complete specifications and model number selection request the VP-1000x specification sheet

The ViscoTron sensor series VP-3000 has been developed employing experience gained over more than 30 years of applying, developing and manufacturing torsional motion viscometers.

Laser welded construction and innovative assembly allows the series VP-3000 sensors to be manufactured to exacting standards and competitive prices. Laser welding also eliminates extra processing steps, which are required when using traditional welding methods, thus providing a stable measurement.

The series VP-3000 sensors can be manufactured to match customer application requirements by using long lengths and different shapes for an extension.

The series VP-3000 is available in versions to measure very low, low, medium, high or extra high viscosities. Sensors can be constructed for pressures up to 50 MPa (7,250 psi) and temperatures up to 450°C (840°F). Factory calibration with Newtonian fluids over multiple decades is optional. The sensor can also be customer calibrated using the VT-IRFT transmitters.

The systems are adaptable to changing customer needs, without having to re-construct the sensor. The sensors are gravity independent and can be mounted in any direction. Speed, direction and turbulence of flow have no influence on the measurement.

The viscometer torsionally displaces the sensor bulb. The twisting motion at the natural resonance of the sensor creates a shear wave. The drag of the fluid on the sensor surface is a measure of the viscosity.

The resonant frequency is dependent on the mechanical construction of the sensor and typically between 200 and 400 Hz. The microscopic motion and low shear rate provides excellent sensitivity and resolution for newtonian and non-newtonian fluids.

The resonant frequency and hence shear rate can be manipulated at the factory to be the same for multiple sensors.

ViscoTron series VP-3000 sensors are also available in intrinsically safe versions, they can be used in classified hazardous areas.

Description	VP-3000LL	VP-3000L	VP-3000M	VP-3000H	VP-3000X
Viscosity range (mPa·s x g/cm ³)	0.00 to 500	0.00 to 2,500	0.0 to 25,000	0 to 250,000	0 to 5,000,000
The measurement ranges indicated above are a guide only, the final range capability is dependent on pressure requirements, sensor dimensions and other design factors.					
Calibration	Factory calibration with Newtonian fluids is available for 1, 2 or 3 decades within the measurement range. Thus the calibrated range can be matched to the customer requirements				
Sensor length	120 to 190 mm, dependent on range and installation requirements				
Maximum process temperatures with external transmitter	MTE	< 175°C / 350°F		65 mm riser	
	STE	< 350°C / 660°F		125 mm riser	
	HTE	< 450°C / 840°F		225 mm riser	
Maximum process temperatures with internal transmitter	LTI	< 100°C / 210°F		65 mm riser	
	STI	<175°C / 350°F		125 mm riser	
	HTI	< 350°C / 660°F		225 mm riser	
Resonant frequency	Typically 250 to 400 Hz (dependent on design)				
Shear rate	Typically between 1,500 and 2,500 sec ⁻¹ (dependent on design)				
Repeatability	0.5% or ±1 digit				
Accuracy	1% or ±1 digit, whichever is greater (factory calibrated with NIST standards)				

For complete specifications and model number selection request the VP-3000 specification sheet

The VP-3000FT series of flow through viscosity sensors has been developed employing experience gained over many years with our process viscometers. Using the same torsional vibration principle, the flow through transducer is capable of measuring viscosities accurately over a very wide range in real time.

The sensor has a straight through flow path. There are no bends or restrictions and therefore can be easily cleaned with foam pigs commonly used in some applications, should this be required. The straight flow through tube makes the sensor rugged and virtually maintenance free.

Laser welded construction and innovative assembly allows the series VP-3000FT sensors to be manufactured to exacting standards at competitive prices. Laser welding also eliminates extra processing steps, which are required when using traditional welding methods, thus providing a stable measurement.

The series VP-3000FT is available in versions to measure very low, low, medium and high viscosities. Sensors can be constructed for pressures up to 10 MPa (1,440 psi) and temperatures up to 175°C (350°F).

The viscometer creates a shear wave by torsionally resonating the tube. The drag of the fluid on the twisting motion is a measure of the viscosity. Factory calibration with Newtonian fluids over multiple decades is optional. The sensor can also be customer calibrated using the VT-IRFT transmitters.

The resonant frequency is dependent on the mechanical construction of the sensor and typically between 200 and 600 Hz. The microscopic motion and low shear rate provides excellent sensitivity and resolution for newtonian and non-newtonian fluids.

For fluids which easily adhere to walls, low friction coatings for the flow through tube are available as an option. Additionally the housing can be heated or cooled with a fluid or electrical heating tape. A RTD is optionally provided to measure the internal housing temperature.

Description	VP-3000FTLL	VP-3000FTL	VP-3000FTM
Measurement range (mPa·s x g/cm ³)	0.00 to 500	0.0 to 2,500	0 to 25,000
The measurement ranges indicated above are a guide only, the final range capability is dependent on pressure requirements, sensor dimensions and other design factors			
Calibration	Factory calibration with Newtonian fluids is available for 1, 2 or 3 decades within the measurement range. Thus the calibrated range can be matched to the customer requirements		
Sensor dimensions	Diameter varies dependent on range, pressure requirements and process connections, typical length between 500 and 1,000 mm.		
Maximum process temperature with external transmitter	LTE STE	< 130°C / 265°F <175°C / 350°F	
Maximum process temperature with internal transmitter	LTI	< 50°C / 120°F	
Resonant frequency Shear rate	200 to 600 Hz (dependent on range and design requirements) Typically between 1,250 to 3,800 sec ⁻¹ (dependent on range and design requirements)		
Reproducibility	0.5% or ±1 digit, whichever is greater		
Accuracy	1% or ±1 digit (factory calibrated with NIST standards)		

For complete specifications and model number selection request the VP-3000FT specification sheet

VT-IRFT transmitters are continuously performing in-line sensor diagnostics to identify sensor health and other influences. During each measurement cycle a green and a red LED indicate, if the sensor is working normally or is potentially effected by mechanical or electrical interferences.

Continuous analysis of the measurement frequency and surrounding spectrum allows external influences to be identified during each measurement cycle. If interference from mechanical or electrical sources is excessive, the viscosity measurement is rejected. Once interference is below selected parameters, the viscosity is updated. Severe and continuous vibrations and interferences will result in an alarm condition.

VT-IRFTi transmitters with or without display can be integrated into ViscoTron transducers to form a single unit.

VT-IRFT transmitters can be mounted a long distance away from the sensor, a cable resistance of up to 10 Ω is acceptable - 200 meters with AWG 22, 475 meters with AWG 18 and 1,200 meters with AWG 14. The transmitters are small enough to be mounted inside an ex-proof enclosure and thus can be mounted in a hazardous area.

ViscoTron VT-IRFT transmitters allow cable length changes in the field. Cable length changes do not have any influence on factory calibration, they are eliminated during start-up operations.

VT-IRFT transmitters can be configured using the touch panel or a command line interface via the USB connection. An optional RS485 Modbus interface provides data transfer capabilities.

Item	Description
Technology	<ul style="list-style-type: none"> • Open loop induced resonance using FFT analysis for fast viscosity measurement • Selectable averaging of 4, 8, 16, 24, 32, 64 and 128 samples is instantly available • Identification and automatic rejection of external mechanical vibrations • Zero procedure algorithm eliminates cable length influences • Continuous in-line diagnostics and analysis identifies sensor performance • Optionally one PT1000 or PT100 temperature input using 2, 3 or 4 wires • Compatible with ViscoTron and other 3rd party torsionally vibrating sensors
Measured parameters	<ul style="list-style-type: none"> • Viscosity • Resonant frequency of sensor • Process temperature optional (0.1°C)
Display	<ul style="list-style-type: none"> • 320 x 240 pixels 2.4" graphical TFT with touch panel for display of viscosity, temperature, resonance and vibration analysis
Configuration and calibration	<ul style="list-style-type: none"> • Complete user parameter configuration and calibration using the touch panel • Factory calibration - 3 models are available dependent on number of calibration points <ul style="list-style-type: none"> • Hybrid Spline, Cubic Spline and Linear Spline • One user calibration is available completely independent of factory calibration • Visual confirmation of the linearization is provided via the touch panel

For complete specifications and model number selection request the VT-IRFTi specification sheet



IRFTi transmitter in wall mount enclosure

VT-IRFT transmitters are continuously performing in-line sensor diagnostics and identify other external influences. During each measurement cycle a green and a red LED indicate, if the sensor is working normally or is potentially effected by mechanical or electrical interferences.

Continuous analysis of the measurement frequency and the surrounding spectrum allows external influences to be identified. If interference from mechanical or electrical sources exceeds configurable parameters, the viscosity measurement is rejected. Once interference is below configured parameters, the viscosity is updated. Severe and continuous vibrations and interferences will result in an alarm condition.

VT-IRFT transmitters can be mounted a long distance away from the sensor, a cable resistance of up to 10 Ω is

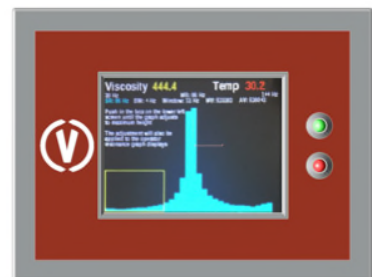
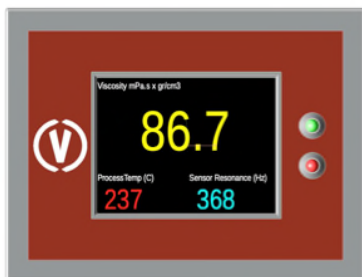
acceptable - 200 meters with AWG 22, 475 meters with AWG 18 and 1,200 meters with AWG 14. The transmitter is small enough to be mounted inside an ex-proof enclosure and thus can be mounted in a hazardous area.

VT-IRFT transmitters can be configured and calibrated in the field using only the touch panel menu. Up to two factory calibration curves can be implemented and three independent user calibration curves are available for field calibration.

A USB port provides command line support and data streaming. ModBus protocol function 3 has been implemented for an optional RS485 interface.

Item	Description
Technology	<ul style="list-style-type: none"> • Open loop induced resonance FFT analysis for fast viscosity measurement <ul style="list-style-type: none"> • Cycle times are between 1 and 2 seconds dependent on sensor configuration and range. • Selectable averaging of 4, 8, 16, 24, 32, 64 and 128 samples is instantly available • Identification and rejection of external mechanical vibrations • Zero procedure algorithm eliminates cable length influences • Continuous in-line diagnostics and analysis identifies sensor performance • Optionally up to two PT100 temperature inputs using 3 or 4 wires • Compatible with ViscoTron and other 3rd party torsionally vibrating sensors • RTC real time clock with battery backup
Measured parameters	<ul style="list-style-type: none"> • Viscosity • Resonant frequency of sensor • Optionally up to two temperatures
Display	<ul style="list-style-type: none"> • 320 x 240 pixels 3.2" graphical TFT with touch panel for display of viscosity, temperature, resonance and vibration analysis
Calibration & Configuration	<ul style="list-style-type: none"> • Parameter configuration via touch panel. Touch panel functions can be selectively disabled • Parameter configuration using a command line interface via USB, RS485 or Bluetooth • Factory calibration - 3 models are available dependent on number of calibration points <ul style="list-style-type: none"> • Hybrid Spline, Cubic Spline and Linear Spline • One user calibration is available completely independent of factory calibration • Visual confirmation of the linearization is provided via the touch panel

For complete specifications and model number selection request the VT-IRFTx specification sheet



..... measurement mode calibration mode analysis mode

IRFTx transmitter in panel mount enclosure

ViscoTron VT-G144-LED transmitters use digital technology to directly drive ViscoTron or other torsionally oscillating viscometers. A powerful microprocessor enables the use of an algorithm providing accurate frequency control. This feed forward control technology mitigates influence from external mechanical vibrations at the source instead of masking them later with a filter.

ViscoTron VT-G144-LED transmitters allow cable length changes in the field. Cable length changes do not have any influence on factory calibration, they are eliminated during start-up operations.

VT-G144-LED transmitters are capable of performing in-line transducer diagnostics and transferring data via RS485 to a computer. Current sensor performance can be compared to

factory data. Comparing the stored data to factory data, mechanical integrity of the sensor can be verified.

VT-G144-LED transmitters are compatible with ViscoTron transducers as well as other torsionally oscillating viscosity sensors. VT-G144-LED transmitters can be integrated into VP transducers to form a single unit.

VT-G144-LED transmitters can be mounted up to 1000 meters away from a sensor. If a sensor is located in a hazardous area, safety barriers are used to achieve hazardous area approvals. See the sensor specifications for available approval ratings.

Item	Description
Technology	<ul style="list-style-type: none"> • Direct digital drive of the viscometer sensor with feed forward control • External vibrations are not looped back to the frequency drive • Zero procedure algorithm eliminates cable length influences • Compatible with ViscoTron, ViscoScope and other torsionally vibrating sensors
Measured parameters	<ul style="list-style-type: none"> • Viscosity • Process temperature (0.1°C) • Resonant frequency of sensor
Display	<ul style="list-style-type: none"> • 4 digit floating point 10 mm high LED display, configurable display cycle • Identification of displayed parameters via backlit indicators
Calibration and configuration	<ul style="list-style-type: none"> • 4 push buttons below the LED display for parameter configurations • Buttons are hidden and only accessible after removal of the cover • Some parameters configurable via ViscoTools software only (included) • Factory calibration can be provided for two independent linearization models and up to 10 calibration points

For complete specifications and model number selection request the VT-G144 data sheet

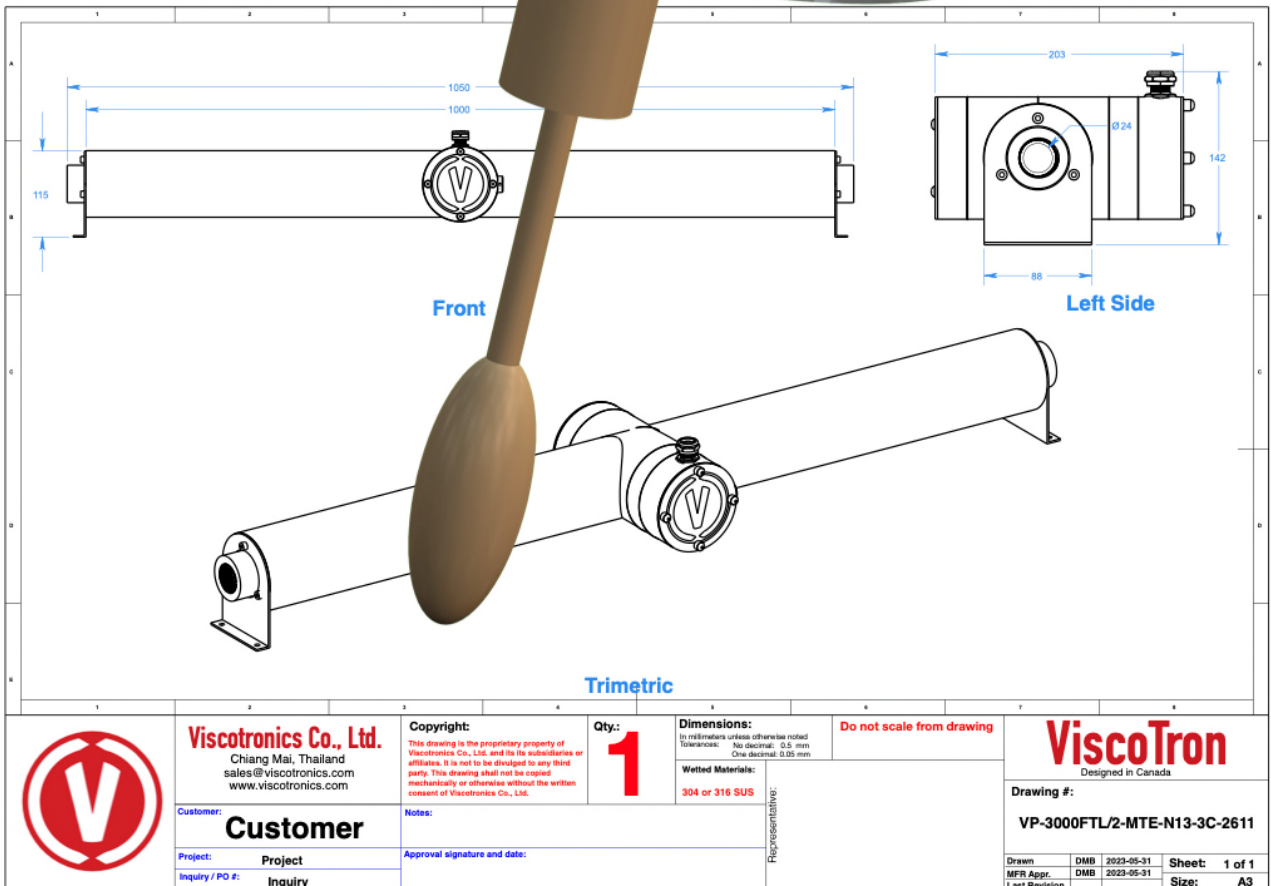
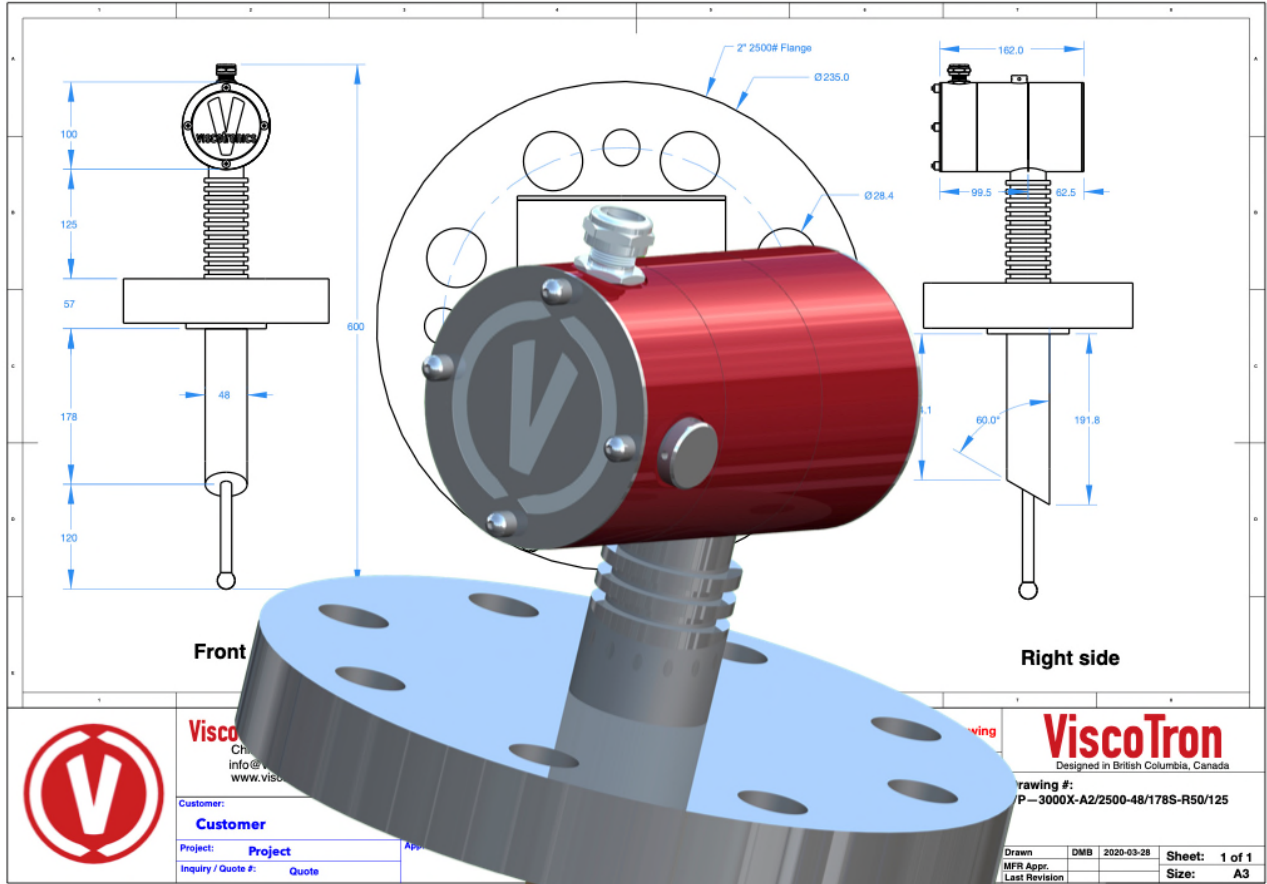


ViscoTron VT-G144-LED in DIN rail / wall mount enclosure




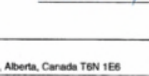
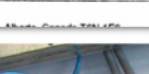


ViscoTron VT-G144-LED in Panel Mount enclosure

Example Drawings



Approval and Application Examples

 <h3>IECEx Certificate of Conformity</h3> <p>INTERNATIONAL ELECTROTECHNICAL COMMISSION IEC Certification Scheme for Explosive Atmospheres <small>for rules and details of the IECEx Scheme visit www.iecex.com</small></p>	
 <h4>IECEx TEST REPORT COVER</h4>	
ExTR Reference Number	CA/CSA/ExTR13.0025/00
ExTR Free Reference Number	CA/CSA/2013/TR2617216
Compiled by + signature (ExTL)	Nicholas Cameron 
Reviewed by + signature (ExTL)	Andrew Redeker 
Approved by + signature (ExCB)	Dorin Stochilou 
Date of issue	August 8, 2013
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Address	1707 94 Street, Edmonton, Alberta, Canada T6N 1E6
Ex Certification Body (ExCB)	CSA Group
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< IECEx Approval for VP series transducers



^ Continuous polymer production @ 280 C, no air cooling required

< Crude oil compliance monitoring

- Polymers**
- Batch Resins**
- Silicone Emulsions**
- Crude Oil Blending**
- Black Liquor**
- Ceramics**

- Additives**
- Slurries**
- Coatings**
- Spray Driers**
- Food Industry**
- Creams**
- Cheese**
- Milk Powder**



Continuous polymer production

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