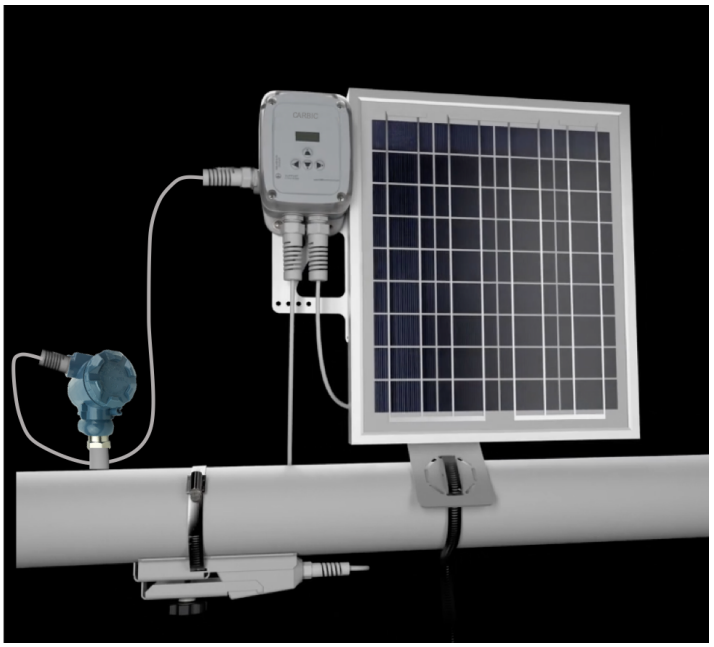
CARBIC

TriSense System™

Satellite connected non-intrusive ***FLOW METERS with INTEGRATED PRESSURE and TEMPERATURE SENSORS*** *that use ultrasonic principles and a proprietary Artificial Intelligence Architecture.*



APPLICATIONS & BENEFITS

The *Carbic TriSense System* gives the power to measure and monitor fluid movement for an entire oilfield - all from any internet connected device. Example uses:

- Measure any oilfield fluid - raw streams, oil, wastewater, etc.
- Monitor, measure and improve well production
- Reduce well downtime
- Track facility performance
- Improve equipment performance

FEATURES

TriSense sensors install easily, require no maintenance, and automatically send data to Carbic servers and software where it is accessible via any internet connected device:

- Instant installation that only requires a screwdriver
- Retains accuracy with wide variety of fluids and pipe sizes
- Integrated pipe-wall temperature sensor
- Advanced satellite telemetry built in
- Ultra efficient battery
- Intrinsically safe & non-incendive

DESCRIPTION & COMPONENTS

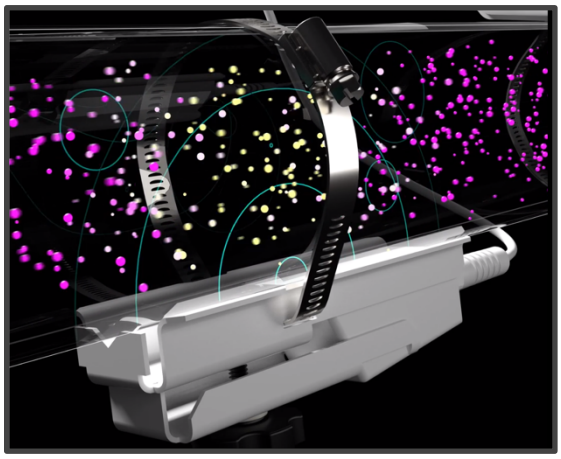
The TriSense system combines a sonic-based flow meter, temperature and pressure sensor, with a communications module to allow oil and gas operators to measure and transmit critical information from remote locations. There are four physical components to this system: (1) main CPU module with battery and data transmitter, (2) ultrasonic transducer with embedded pipe wall temperature sensor, (3) pressure sensor, and (4) solar panel to provide power.

TriSense gives operators the tools to understand exactly what is happening with flow streams from any well or pipe by tracking data on any pipe-contained fluid movement with unprecedented ease, accuracy, and flexibility.

As with all Carbic products, no additional equipment or expertise is needed to start bringing your oil field online. TriSense installs with zero pipe intrusion, and zero external power. Telemetry or SCADA systems are also not needed. This is made possible by a number of breakthroughs and innovations pioneered by Carbic.

TECHNOLOGY INVOLVED

The primary mechanism for reading activity in the pipe is through the ultrasonic acoustic waves sent and received by the transducer. These waves are powerfully transmitted through the pipe wall, any scaling or paraffin buildup, and reflect off of the many bubbles, gas or solids present in the flowstream.



The proprietary onboard processor performs a spectral frequency analysis of the waves to calculate a flow profile. From the profile of these sound waves, a mix of on-board and cloud-based algorithms compute a fluid velocity in the pipe.

Unlike most sonic-based metering systems that require significant amounts of external power, TriSense uses algorithms to intelligently and dynamically manage its power system. This system allows the sensor to automatically manage its own power usage and supply merely with a solar panel the size of a tablet. And as with all Carbic sensors, the TriSense series sensors collect relevant data throughout the operation and send it to cloud based software via satellite.

ADDITIONAL OPTIONS

- TriSense comes bundled with access to Carbic software (demo link) that will automatically deliver daily reports and customizable alarms to notify recipients when a flow stream may be behaving unusually (failures, blockages, etc)

- The CPU module in TriSense has the capability to read and transmit data from any piece of equipment with a HART or modbus output protocol
- TriSense can be paired with VoluSense tank monitoring solutions to allow operators to monitor their entire field from a computer in the office

TECHNICAL SPECIFICATIONS	
FLOW ACCURACY	
Measurement type	Proprietary hybrid ultrasonic based frequency-shift and transit-time algorithmic evaluation
Repeatability	0.5% ± 0.25%**
Calibration Process	Provide to Carbic an approximate figure of the average flowrate of the target flow stream, the system then requires 36 hours to accumulate data
Post-calibration accuracy	5% ± 1%**
Measurement parameters	Velocity, volumetric, totalized flow, pressure, and pipe wall temperature
Fluid types	Fluids with particulates or bubbles of 100 microns or larger and minimum concentrations of 75 ppm
Flow rate range	0.02 to 25 m/sec **
PIPE WALL TEMPERATURE ACCURACY	
Repeatability	± 0.2% FS
Post-calibration accuracy	± 2^{0}C
PRESSURE ACCURACY	
Repeatability	± 1.0% FS
TELEMETRY & COMMUNICATION	
Type	Terrestrial: 3G, 2.5G Satellite: LEO Global Network
Direction	Uplink and downlink (down accessible only by Carbic personnel)
Latency	~30s
Transmission Frequency	~24 - 100/day standard
External Power requirements	None (all supplied by included solar panel)
Local Inputs	4-20mA, HART, Modbus/RS485
Local Outputs	HART, Modbus/RS485
ELECTRICAL SPECIFICATION	
Battery size	10,400 mAh
Expected operating time (without power)	200 hours
Solar panel peak power	12 watts
Solar panel peak voltage	19.0 V
Safety mechanism	Intrinsically safe barrier
Transducer cable	20 ft (6m), shielded coaxial pair
Total Number of cable inlets	2

MECHANICAL SPECIFICATIONS	
Components	CPU enclosure, solar panel, transducer, cabling, mounting-clamps
Pipe size range	1-1/2" to 180" (38 mm to 4.5 m) ID
Pipe material requirements	Carbon steel, HDPE, stainless steel, ductile iron, copper, FRP, or any other that sufficiently conducts sound
Contact temp range	-2°F to 212°F (-19°C to 100°C)
Operating ambient temp range	-4°F to 140°F (-20°C to 60°C)
Mounting style (CPU)	Clamp-on
Dimensions (CPU)	193.80 x 117.60 x 78.49 mm (7.63 x 4.63 x 3.09 in.)
Mounting style (Solar Panel)	Clamp-on
Dimensions (Solar Panel)	357 x 302 x 30 mm (14.06 x 11.89 x 1.18 in)
Mounting style (Transducer)	Clamp-on
Dimensions (Transducer)	85 x 35 x 38mm (3.375 x 1.375 x 1.5 in)
Aggregate weight	14.2 lbs
Enclosure materials	Polycarbonate Resin (UV Stabilized & Flame Retardant)
Enclosure Ratings	Flame Rating: UL94V-0 NEMA Rating: 1, 2, 4, 4X, 6, 6P, 12, 13 IP Rating: IP65, IP66, IP67, IP68
Couplant	High temperature resistant hydrophobic gel
Module Rating specification	Class I, Division 2, Group D T3C with Class 1, Division 1 port (ISA 12.12.01-2015 / CSA C22.02 No. 213-15 / UL913)
Sensor Rating specification	Pressure: Class 1, Division 1, Groups A,B,C,D, T3C (UL 1203) Sonic transducer: Class I, Division 1, Group D T3C Embedded temperature sensor: Class I, Division 1, Group D T3C

*** accuracy,repeatability and minimum and maximum flow rate range are based on field proving test conditions however they may vary depending on significant changes on fluid characteristics. To avoid discrepancies, customers should upload in the Carbic dashboard the re-calibration data.*

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