Clamp – on Ultrasonic

Product family introduction
Principle of operation
Product review
Applications
Key product features
Clamp-On Ultrasonic Flowmeter Family

Ideal for providing highly accurate measurement of liquids and gases while minimizing installation time and maintenance expenses.

<table>
<thead>
<tr>
<th>Product family</th>
<th>FUS1010</th>
<th>FUP1010</th>
<th>FUE1010</th>
<th>FUT1010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle of operation</td>
<td>Standard</td>
<td>Portable</td>
<td>Energy</td>
<td>CT-Spool</td>
</tr>
</tbody>
</table>

| | FUG1010 | FUH1010 |
|----------------|---------|
| Gas | Hydrocarbon |

<table>
<thead>
<tr>
<th></th>
<th>FST020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Compact</td>
</tr>
</tbody>
</table>
Principles of operation

Zeromatic Path™
No need to shut flow or block line for Zero Setting
No Zero Drift
Automatic, continuous zero check.
Principles of operation
Principles of operation

- A transducer converts electrical energy into mechanical energy
- A transducer also converts mechanical energy into electrical energy
  - Piezoelectric Effect
- A transducer is both a transmitter and receiver

Frequency ($f$):
- Subsonic 0 to 20 Hz
- Audio 20 Hz to 20 kHz (human hearing)
- Ultrasonic >20 kHz
Principles of operation

Larger Flow Sample with Dual / Quadruple Beam

Dual WideBeam

Quadruple WideBeam
Principles of operation

Transit-Time Measure Variables

- Flow Velocity
- Sonic Velocity
- Signal Strength
- Liquid Aeration
- Temperature
## Principles of operation

### Pipe Configuration Menu

<table>
<thead>
<tr>
<th>Principle of operation</th>
<th>Fully Developed</th>
<th>Fully Developed flow, as would be expected for very long straight pipe runs or installation downstream of a flow condition or installation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product family</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application</td>
<td>1 Elbow</td>
<td>Single 90 degree Elbow upstream of transducer installation</td>
</tr>
<tr>
<td></td>
<td>Dbl Elbow -</td>
<td>Double out-of-plane Elbows upstream of transducer installation</td>
</tr>
<tr>
<td></td>
<td>Dbl Elbow +</td>
<td>Double in-plane Elbows upstream of transducer installation</td>
</tr>
<tr>
<td></td>
<td>Expander</td>
<td>Pipe expansion upstream of transducer installation</td>
</tr>
<tr>
<td></td>
<td>Reducer</td>
<td>Pipe reduction upstream of transducer installation</td>
</tr>
<tr>
<td></td>
<td>Header Inlet</td>
<td>Header or pipe manifold upstream of transducer installation</td>
</tr>
</tbody>
</table>
Principles of operation

Basic Clamp-on
System Components

Flow Display Computer

Transducer Cable Pair

Ultrasonic Clamp-on Transducers

Mounting Assembly

PIPE

Mounting Strap Kit

RTD Transducer and Mount

Spacer Bar

RTD Cable

Coupling Compound

Product family

Principle of operation

Product overview

Application

Key features

Flow seminar

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Principles of operation

Doppler

Doppler available in all units except FST020
Freq shift is effected by particle distributions and size
Principles of operation

Transit time & Doppler

Principle of operation

Product overview

Application

Key features
Principles of operation

Non-Intrusive (No Process Shutdown)
Low Installation Costs
Measure Pipes From 1/4” – 360”
No Pressure Drop or Energy Loss
Little to No Maintenance
No Moving Parts to Wear or Foul
Maintains Calibration
No Process Shutdown for Installation
No Need to Cut Pipes
Wide Turn-Down Ratio
Can measure non-conductive liquids
Product overview

Flow Display
Transmitters

Mount Hardware

Transducers

Accessories
Transducers

**Product family**

**Principle of operation**

**Product overview**

**Application**

**Key features**

**Universal**

Standard Accuracy

Selected by Pipe Diameter

**High Precision**

For Highest Accuracy

Selected by Wall Thickness

**ONLY FOR STEEL PIPES**
Transducers

Product family

Aerospace

Principle of operation

High Temp

Product overview

Doppler

Application

Key features
Advantages of solid couplant

- Maintenance Free
- Wide temperature range
- Clean installation without the use of grease
- Resistant to hydrocarbons, fuels, liquids, and environments
- Cost Savings - Yearly Maintenance not necessary

Signal Amplitude vs. Time

*Grease Couplant*
*Dry Couplant*
## Enclosure Styles

<table>
<thead>
<tr>
<th>Product family</th>
<th>General Enclosures</th>
<th>Portable Enclosures</th>
<th>Explosion Proof Enclosures</th>
<th>SITRANS F US Families</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle of operation</td>
<td>FST020-IP65 NEMA 4X</td>
<td>FUP1010 IP67 FUE1010 IP40 NEMA 1</td>
<td>FUS1010 IP65 NEMA 7 compact FUG1010 IP65 NEMA 7 compact FUH1010 IP65 NEMA 7 compact</td>
<td>1. SITRANS FST020 Basic</td>
</tr>
<tr>
<td>Product overview</td>
<td>Portable Enclosures</td>
<td>Explosion Proof Enclosures</td>
<td>SITRANS F US Families</td>
<td>2. SITRANS FUS1010 General Use</td>
</tr>
<tr>
<td>Application</td>
<td>FUS1010 IP65 NEMA 4X FUE1010 IP65 NEMA 4X FUH1010 IP65 NEMA 4X FUG1010 IP65 NEMA 4X</td>
<td>FUS1010 IP65 NEMA 7 Wall Mount FUG1010 IP66 NEMA 7 Wall Mount FUH1010 IP66 NEMA 7 Wall Mount</td>
<td>3. SITRANS FUP1010 Portable</td>
<td></td>
</tr>
<tr>
<td>Key features</td>
<td>FUS1010 IP65 NEMA 4X FUE1010 IP65 NEMA 4X FUH1010 IP65 NEMA 4X FUG1010 IP65 NEMA 4X</td>
<td>FUS1010 IP66 NEMA 7 Wall Mount FUG1010 IP66 NEMA 7 Wall Mount FUH1010 IP66 NEMA 7 Wall Mount</td>
<td>4. SITRANS FUE1010 Energy</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5. SITRANS FUH1010 Hydrocarbon</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>6. SITRANS FUG1010 Gas</td>
</tr>
</tbody>
</table>
## Common Benefits To All Families

- Easy installation; no need to cut pipe or stop flow
- No moving parts to foul or wear
- No pressure drop or energy loss
- Wide turn-down ratio
- Minimal maintenance; external transducers do not require periodic cleaning
- Choice of single channel or dual channel/dual path, with Doppler capability. (Excluding the FST020)
- Dual mode allows for Transit-time and Doppler operation at the same time on the same pipe. (Excluding the FST020)
- Dual path allows for two sets of transducers to be set up on one pipe and averaged for higher accuracy. (Excluding the FST020)
- Zeromatic Path automatically sets zero without stopping flow and reduces zero drift, even at low flow
Product Information

Common Functions To All Families

- Flow display computers have integral 33 button keypads & large (128 x 240 pixel) graphic displays visible up to 12 m (40 ft) away
- Compact flow display computer has a 2 x 16 alphanumeric LCD display
- Current, voltage, status alarm, frequency and RS232 outputs (see specification section for details)
- Optional current, voltage and temperature inputs (see specification section for details) (Excluding the FST020)
- Zeromatic Path dynamically sets zero w/o stopping the process
- Bidirectional flow operation
- 1 MByte data logger with both site and data logger storage
- MODBUS / Metasys N2 IP65 (NEMA 4X, WX)
- Detects reverse flow and empty pipe detection
- English, Spanish, German, Italian and French language options
Unique FUP1010 Functions
• Optional current, voltage and temperature inputs

Unique FUP1010 Benefits
• Battery power facilitates field use; the meter is easily transported from one installation to another – saving time for surveys, monitoring and temporary installations

• Weatherproof model can be used outdoors and left in place without concern for rain damage

• Weatherproof model’s rugged plastic case enables it to withstand rough treatment that would destroy most other meters
Portable Clamp-on Check Metering Kit

Product family

Principle of operation

Product overview

Application

Key features
Product Information

Unique FST020 Benefits
• Low cost
• Compact, integral design reduces installation cost

Unique FST020 Functions
• 2x16 integral alphanumeric display and 5 key keypad for installation menu and data display
• Assignable 4 ... 20 mA isolated loop-powered output
• TTL flow pulse rate output
• DB9 connector for PC communication
• Assignable open collector alarm output (40 V DC max)
• Internal calibration security switch
• Remote PC installation menu
Product Information

Unique FUE1010 Benefits
- Measures energy rate and total consumption with highest accuracy available
- Accurately measures at both low flow rates and low differential temperatures
- Choice of single or dual channel / dual path or dual mode operation:
- Dual channel operation reduces the cost for the system on a per channel measurement basis and permits measuring hot and chilled water lines at the same time

Unique FUE1010 Functions
- 4-wire 1000 Ω platinum RTD’s for supply and return temperature measurements are precision matched to within 0.01 °C (0.02 °F)
- Temperature is factory calibrated with built-in field calibrator
- Built-in energy/BTU mode
- Cooling load (kW/ton)
- Coefficient of performance (COP)
- Energy efficiency ratio (EER)
Software: Si-Ware

Si-Ware capabilities include:

- “Terminal mode” communication and downloading of specific data
- Programming and set-up of the meter
- Evaluation of meter operation and performance
- Troubleshooting performance issues
- Querying the meter and creating data reports
- “Flashing” new operating system software
- Generation and uploading of AGA-8 Tables
- Download and transfer of “live” site data
### Applications

<table>
<thead>
<tr>
<th>Product family</th>
<th>Wastewater</th>
<th>Water</th>
<th>Power</th>
<th>HVAC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Raw Sewage</strong></td>
<td><strong>Effluent</strong></td>
<td><strong>Raw water</strong></td>
<td><strong>Nuclear</strong></td>
<td><strong>Chillers</strong></td>
</tr>
<tr>
<td><strong>Sludges</strong></td>
<td><strong>Mixed liquor</strong></td>
<td><strong>Potable water</strong></td>
<td><strong>Fossil</strong></td>
<td><strong>Condensers</strong></td>
</tr>
<tr>
<td><strong>Chemicals</strong></td>
<td></td>
<td><strong>Chemicals</strong></td>
<td><strong>Hydroelectric</strong></td>
<td><strong>Hot and cold water systems</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gas</strong></td>
</tr>
<tr>
<td>Checkmetering &amp; Allocation</td>
</tr>
<tr>
<td>Flow Survey Verification</td>
</tr>
<tr>
<td>LAUF Gas Analysis</td>
</tr>
<tr>
<td>Production/ Storage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hydrocarbon Petroleum</strong></td>
</tr>
<tr>
<td>Interface Detection</td>
</tr>
<tr>
<td>Standard Volume</td>
</tr>
<tr>
<td>Ship Loading/Unloading</td>
</tr>
<tr>
<td>Process Control</td>
</tr>
<tr>
<td>Tank Measurement</td>
</tr>
</tbody>
</table>
Compatible Piping Materials

Product family
- COPPER
- COPPER NICKLE

Principle of operation
- HASTELLOY
- TITANIUM

Product overview
- ALUMINUM

Application
- TEFYLON

Key features
- STEEL
- DUCTILE IRON
- CAST IRON
- BLACK IRON
- PLASTIC (ABS, PVC, PE, ETC)
- FRP
- GLASS
- CERAMIC
- CEMENT LINED PIPES

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## Applications – partial liquid list

<table>
<thead>
<tr>
<th>Product family</th>
<th>Principle of operation</th>
<th>Application</th>
<th>Key features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acids</td>
<td>Acetone</td>
<td>Molasses</td>
<td>Milk</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Alcohol</td>
<td>Oils (Crudes, Motor, etc.)</td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>Ammonia</td>
<td>Paper Pulp</td>
<td></td>
</tr>
<tr>
<td>Asphalt</td>
<td>Asphalt</td>
<td>Paint</td>
<td></td>
</tr>
<tr>
<td>Beer</td>
<td>Beer</td>
<td>Peanut Butter</td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>Benzene</td>
<td>Phosphorous</td>
<td></td>
</tr>
<tr>
<td>Brine</td>
<td>Brine</td>
<td>Polymer</td>
<td></td>
</tr>
<tr>
<td>Butane</td>
<td>Butane</td>
<td>Process Condensate</td>
<td></td>
</tr>
<tr>
<td>Caustic</td>
<td>Caustic</td>
<td>Resins</td>
<td></td>
</tr>
<tr>
<td>Chlorine</td>
<td>Chlorine</td>
<td>Styrene</td>
<td></td>
</tr>
<tr>
<td>Deionized Water</td>
<td>Deionized Water</td>
<td>Sodium Hydroxide</td>
<td></td>
</tr>
<tr>
<td>Ethylene Glycol</td>
<td>Ethylene Glycol</td>
<td>Steam Condensate</td>
<td></td>
</tr>
<tr>
<td>Freon</td>
<td>Freon</td>
<td>Sulfuric Acid</td>
<td></td>
</tr>
<tr>
<td>Fruit Juices</td>
<td>Fruit Juices</td>
<td>Tetrahydrofuran</td>
<td></td>
</tr>
<tr>
<td>Hydraulic Oil</td>
<td>Hydraulic Oil</td>
<td>Toluene</td>
<td></td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>Hydrocarbons</td>
<td>Tomato Juice &amp; Paste</td>
<td></td>
</tr>
<tr>
<td>Gasolines</td>
<td>Gasolines</td>
<td>Water (All Types)</td>
<td></td>
</tr>
<tr>
<td>Latex</td>
<td>Latex</td>
<td>Wine</td>
<td></td>
</tr>
<tr>
<td>Lime &amp; Slurry</td>
<td>Lime &amp; Slurry</td>
<td>Xylene</td>
<td></td>
</tr>
<tr>
<td>Liquor (Black, White, etc..)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td>Milk</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Application Considerations

Pipe Condition

- Inside Diameter
- Clean pipe
- Inside Diameter
- Wall build-up
- Changes inside diameter
- Creates meter error

Transducer location

- Bubbles to top
- Sediment collects at bottom

Pipe Orientation

- Vertical up (Preferred)
- Horizontal (Good)
- Vertical down (Questionable)
Applications

Product family

Principle of operation

Product overview

Application

Key features

24” Jet Fuel Line Hong Kong

54” Penstock

16” Crude Oil, Lanzhou China

8” Natural Gas, Texas
### Applications

**Product family**

**Principle of operation**

**Product overview**

**Application**

<table>
<thead>
<tr>
<th>Liquid Hydrocarbons</th>
<th>Bi-directional gas meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable</td>
<td>Direct Burial</td>
</tr>
</tbody>
</table>

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Applications

Product family

Principle of operation

Product overview

Application

Key features

108” Penstock

Lift station

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Applications

Product family

Principle of operation

Product overview

Application

Key features

Air Handling Unit
or
Fan Coil Unit

Flow Measurement

Temperature Sensor (RTD)

FUE 1010
Energy Meter

DANFOSS
EFC3500

Temperature Sensor

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Clamp-on Ultrasonics

- Non-intrusive
- 1/4” – 360”
- Lower cost than a Mag for sizes >10 / 12”
- Lower installation costs
- 0.25 – 2% accuracy
- Application diagnostics
- Permanent and portable applications
- Data logger
- Liquids / gas
- Non-conductive liquids
- Single or Multiple channels
- Approvals FM/CSA Class I, Div I & II
- Submersible transducers and portable meter