



**TELEDYNE INSTRUMENTS**  
*Monitor Labs*  
A Teledyne Technologies Company

# ULTRAFLOW 150



ULTRASONIC GAS FLOW AND TEMPERATURE MONITOR

**Ultraflow 150's** state-of-the-art signal processing and innovative modularity offers customers incomparable performance, accuracy, flexibility and a maintenance-free solution amongst all flow technologies.

**Innovative, non-contacting technique greatly reduces maintenance**



The Ultraflow 150 is a patented advance in continuous flow measurement systems for small and large stacks and ducts. Transducers are non-intrusively mounted in Teflon housing and are protected from flue gas and particulate with continuous purge air. This non-contacting method mitigates maintenance and ensures long term operation unlike intrusive pitot, thermal systems, optical scintillation and reflective ultrasonic technology.

**Velocity measurement independent of temperature, pressure and density of flue gas**

The system measures the transit times  $t_1$  and  $t_2$  of the tone bursts between the pair of transducers with a 50 nanosecond transit time resolution. The equation for determining velocity is:

$$F_v = [L/(2\cos\theta)][(t_2-t_1)/t_2t_1]$$

Where L is the pathlength and  $\theta$  is the angle between the line-of-sight of the transducers and the nominal flow direction. The flue gas composition has no influence on the calculation of velocity and therefore knowing only the geometry and transit times are sufficient to calculate the velocity.

**Line average response is exceptionally accurate...long term drift  $\pm 1\%$**

The Ultraflow 150 integrates the infinitesimal velocity vectors along the transducer path to calculate velocity as well as temperature. A normal sampling cycle consists of many measurements in each direction over a time period that can be as short as 5 seconds.

Resolution is better than  $\pm 0.3\text{ft}/\text{sec}$ . Long term drift is  $\pm 1\%$  over the life of the instrument. A barometric pressure transducer option is available to correct back to SCFM.

**Temperature Measurements**

The equations for determining temperature are :

$$Cs = (L/2)[(t_2+t_1)/t_2t_1]$$
$$T = r Cs^2$$

Where Cs is the speed of sound and "r" is a correction factor that relates the speed of sound to a specific gas composition.

**Dynamic calibration checks verify all system components**



Ultraflow 150 meets all 40CFR75 requirements, NOX budget rules and new RATA standards. Calibration checks are conducted once per day or on command to fully test the signal transmission, reception, processing display and output; i.e., a full system integrity test not available via competing technologies. The flow characterization curve is also tested under this protocol. No adjustments are ever made to the zero and span since the monitor is drift free. Calibrations can be initiated manually, automatically, by a digital input or via the front panel command.

**Digital signal processing provides greater accuracy, quicker response time and excellent resolution**

Ultraflow 150 utilizes a Field Programmable Gate Array (FPGA) to determine the time of flight based on a proprietary peak finding algorithm. Our peak finding algorithm enables response times of down to 5 seconds; making the 150 ideal for hazardous waste combustors and process applications.

**Easy to use Enhanced Remote Panel**

The remote display features easy-to-use menu structures that make configuration of the flow monitor simple and easy without the need of a laptop. I/O includes four analog outputs, eight digital inputs, eight contact outputs, RS232, 422, 485 or LONWORKS® network communication. A large LCD display makes viewing easy throughout a control room.

**Heavy duty components are easy to install**



The Ultraflow 150 has simplified placement requirements, using customer-installed, 3½" I.D., schedule 40 pipe as mounting ports. (For other pipe sizes, consult factory). Teledyne Monitor Labs provides all system components. Materials of construction for the Transducer Interface Enclosure and j-boxes are stainless steel. Transducer assemblies are aluminum protected by acid resistant epoxy paint.

**"X" Pattern configuration eliminates a second platform**

In many cases, due to the 150's improved resolution, low angles of installation (typ. 5ft. vertical offsets from a single platform) are possible. In some demanding applications, an "X"- pattern may be required.

The Ultraflow 150 has the capability of measuring flow through either a single or dual set of transducers. A dual set of transducers is typically referred to as our "X" Pattern. An "X" Pattern eliminates any adverse affects due to applications that exhibit a pitch flow; enables nearly 100% availability and may institute redundancy.

## Transducer Interface Enclosure (TIE)

Electrical signals corresponding to acoustic transmit and receive signals are conveyed via cables between the transducers and the TIE. The TIE houses preamp /driver boards that amplify receive signals and transmit pulses. A signal processing board containing an FPGA controls timing, data collection, filtering, boxcar integration and other functions. A microprocessor board evaluates the box car data and determines time of flight, flow velocity, volume, speed of sound, temperature and signal to noise ratio. All these data values may be viewed via the Enhanced Remote Panel or the optional Local User Interface (LUI).

## Purge Air System

The transducer assemblies are normally kept dry and clean by purge air. Depending on the application, the optimal installation may consist of dual blowers (a separate purge blower for each side of the stack), a single blower configuration with flow splitter to reliably send equal amounts of purge air to each side of the stack, or no blowers at all where a reliable negative-draft process is present. A no blower system has an in-line filter to clean up the ambient air. When blowers are used, the normal purge system consists of blowers, hoses, air filters, mounting plates and a protective weather cover. Teledyne Monitor Labs Engineering will recommend the optimum configuration for each application.

## Transducer Assemblies

Each of the two transducers alternately acts as transmitter and receiver. The purge nozzles are constructed of acid-resistant Teflon with stainless steel or Hastelloy hardware for easy cleaning and a long service life. Each transducer assembly is made of lightweight aluminum stock and can be easily extracted from its mounting port by disengaging four draw latches.



## Enhanced Remote Panel

Uses a large, back-lit, LCD graphics display with English-language menu-driven screens, providing ready access to all information needed for full use of the system. In addition, the user can graph up to the most recent 100 values of a selected parameter, such as:

- Volumetric Flow and Temperature
- Calibration Values

The keypad, a rugged 20-button ensemble inlaid under a tough, hard coated, scratch and chemical-resistant coating, can be used to:

- Display Volumetric Flow, Velocity and Temperature
- Identify the Cause of Alarm or Malfunction
- Configure the Analog Outputs
- Edit Parameters such as Path Length
- Set Alarm Values for High or Low Volumetric Flow or Temperature and Out of Cal measurements
- View New Signal-to-Noise Diagnostics
- Load Linearization Curves for Correlation to Method 2
- View Flow Data Pre and Post Linearization

Standard with the Enhanced Remote Panel is a security keylock for protection of important calibration parameters. System elements communicate over a single twisted pair (FTT) using LONWORKS® communication protocol. Bright LED indicator lights are used to indicate faults and alarms. The four optically-isolated analog outputs, normally packaged within the Enhanced Remote Panel, can also be offered in a separate housing for convenient installation.

## Ethernet Interface

The Ultraflow 150 Enhanced Remote Panel now features a 10/100 BaseT Ethernet interface as standard equipment. This capability provides a multilevel password protected user interface to TCP/IP networks such as LAN's or the Internet. Client side user interface access is via standard web browsers. Simultaneous Modbus TCP access to instrument parameters and emission data is also supported.

# Specifications



## Training

An Operation and Maintenance Manual is provided with the ULTRAFLOW 150. In addition, periodic hands-on training classes are conducted at the Teledyne Monitor Labs facility. Training classes may also be scheduled at the customer's site.



## Warranty

The ULTRAFLOW 150 is covered by Teledyne Monitor Labs Commercial Performance Warranty provided certain conditions are met. Consult the factory for details.



## Maintenance and Support Services

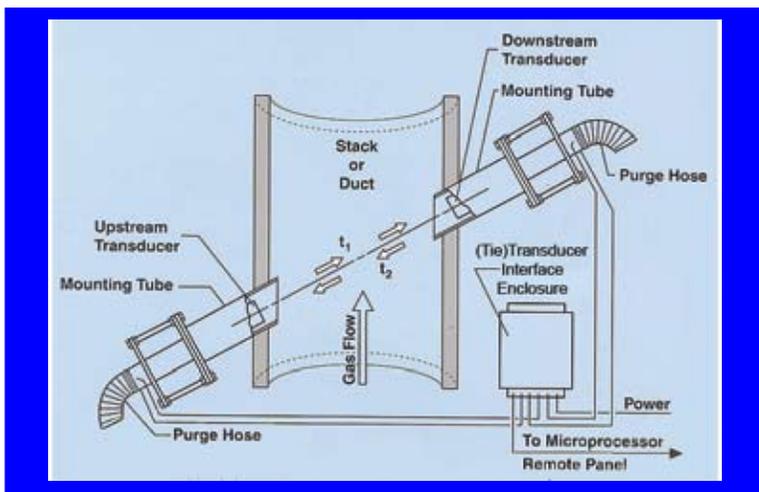
Consult the factory for details on Teledyne Monitor Labs complete line of Service and Maintenance Programs, in addition to a user support line available on a 24-hour basis.

<b>Flow Measurement:</b>	<b>Range:</b>	0-200ft/sec (0-61m/sec)
	<b>Resolution:</b>	0-0.1ft/sec (0.03m/sec)
	<b>Long-Term Repeatability:</b>	+/-0.3ft/sec (+/-0.1m/sec)
	<b>Relative Accuracy:</b> (VS. EPA Test Method 2)	Site dependent, see Commercial Performance Warranty. Typically <5% above 10/ft/sec
	<b>Response Time:</b>	As low as 5 sec (adjustable)
<b>Initial Calibration:</b>	Factory calibration based on duct geometry plus flow data. Available for site specific calibration against pitot tube traverses.	
<b>Drift:</b>	+/- 1% reading over full range of rated ambient temperature and line voltage.	
<b>Media Conditions:</b>	<b>Temperature:</b>	-40° to 650F (-40° to +343°C) depending on stack size and flow speed. Consult factory.
	<b>Pressure:</b>	-30 to 20 inches of H <sub>2</sub> O
	<b>Moisture:</b>	Dry to saturated, including condensed water
	<b>Particulate:</b>	<=3000 mg/m <sup>3</sup>
<b>Duct Size:</b>	<b>Diameter:</b>	From 3 - 45 Ft. (0.9 - 14M) Dia.
<b>Temperature Calculations:</b>	<b>Accuracy:</b>	+/- 3°F (1.7°C) for most reasonably stable combustion applications
	<b>Display Resolution:</b>	<= 0.1° (C or F)
<b>Power:</b>	<b>TIE:</b>	85-245VAC, 47-63Hz, Single Phase, 40 VA Maximum Fuses Power Supply Board: 1.25 Amp Time Delay, 250V, TR5
	<b>Enhanced Remote Panel:</b>	85-245 VAC, 47-63Hz, Single Phase, 30 VA Maximum Fuses 2 Amp Time Delay, 250V, 5x20mm
	<b>Single Purge System:</b>	50Hz Single Phase: 115VAC, 14.6A; 230VAC, 7.3A 60 Hz Single Phase: 115VAC, 16.6A; 230VAC, 8.3A
	<b>Dual Purge System:</b>	Two circuits, each 115VAC/230VAC, 60/50Hz, Single Phase, 414 VA Maximum
<b>Environment:</b>	<b>Ambient Temp. Limits:</b>	TIE: -40° to +140°F (-40° to 66° C) Enhanced Remote Panel: +32°F to 104°F (0 to +40°C) Single Purge System: -40° to +140°F (-40° to +60°C) Dual Purge System: -40° to +140°F (-40° to +60°C)
	<b>Relative Humidity:</b>	TIE: 5% to 100% humidity, condensing Enhanced Remote Panel: 0 to 95% non-condensing Single Purge System: 5% to 100% humidity, condensing Dual Purge System: 5% to 100% humidity, condensing
<b>Mounting:</b>	<b>Process Connection:</b>	Mounting plates furnished for welding to 3½" Sch. 40 pipe (supplied by customer) with squeeze rings, seals and stainless steel hardware provided. For other pipe sizes, consult factory.
<b>TIE:</b>	<b>Output:</b>	RS-232C or LONWORKS® network protocol
<b>Enhanced Remote Panel:</b>	<b>Display Type:</b>	Graphics mode liquid crystal with LED backlight
	<b>Display Resolution:</b>	240 x 128
	<b>Indicating LED's:</b>	Fault, Alarm, Power
	<b>User Input Controls:</b>	20-key keypad, security keyswitch
	<b>Diagnostics:</b>	Numerical and English descriptive diagnostic codes
	<b>Security:</b>	Both security code and key switch
	<b>Alarms &amp; Faults:</b>	Cal out of tolerance, malfunction, purge fail
<b>Multi I/O Board Characteristics:</b>	<b>Analog Outputs:</b>	Four outputs, 4-20mA current type: Isolation: optical and capacitive barriers: channel to channel, channel to circuit common and earth
	<b>Digital Inputs:</b>	Eight Inputs, Modes: Isolated (5 VDC-24 VDC user supplied) and Non-isolated (dry contact)
	<b>Relay Outputs:</b>	Eight Outputs, N.O. or N.C. (Single Pole Single Throw, Normally Open or Normally Closed [jumper selectable])
<b>Direct Interface Configuration Characteristics:</b>	<b>Analog Outputs:</b>	Number: 2 Output Type: 4-20mA with live 4mA zero, or 0-20mA w/o live zero Isolation Type: Optical & capacitive barriers; channel to channel, channel to circuit common and earth
	<b>Digital Inputs:</b>	Number: 2 Modes: Isolated (5 VDC-24 VDC user supplied) and Non-isolated (dry contact)
	<b>Relay Outputs:</b>	Number & Type: 2 SPST, N.O. or N.C. (Single Pole Single Throw, Normally Open or Normally Closed [jumper selectable]).

# The Ultraflow 150

A state-of-the-art advance in flow and temperature measurement of stacks and ducts

- Ultra-low drift operation
- Full system integrity calibration checks
- Low mounting angle rejects pitch flow effects
- Non-intrusive, non-contacting technique
- Flow measurement independent of flue gas composition, pressure and temperature
- Measurement technique rejects cyclonic flow



The Ultraflow Model 150 is a non-contacting gas flow and temperature monitor. The system measures the transit time of a tone burst through the gas stream to determine both flow and temperature. Transducer assemblies are usually mounted opposite each other at an angle on each side of the stack or duct with one transducer upstream from the other. In locations where a second access platform is cost prohibitive, a shallower angle, resulting in upstream/downstream transducer offsets as small as 4 feet may be used. If the reduced transducer offset results in pitch-angle errors, a dual set of transducer assemblies (four) can be installed. This "X" Pattern provides an average flow measurement directly up the stack and has the potential added benefit of multiple certifications of both transducer assembly sets. This ensures nearly 100% uptime.

The system accurately measures the time required for the tone bursts to traverse the gas stream in each direction. The flow velocity is directly related to the difference in propagation time,  $t_1$  and  $t_2$  of the tone bursts with and against the gas flow. Based on the cross-sectional area of the stack or duct, the flow velocity is converted to volumetric flow. This flow measurement is independent of the temperature, density, viscosity and particulate or condensate concentration.

**EPA's stringent 7.5% RATA requirement and flow-to-load ratio checks established the need for accurate and repeatable flow measurement. Teledyne Monitor Lab's Ultraflow achieves this consistent accuracy.**

*40 CFR Part 75 and the N0x Budget Rule requires reporting SOx and N0x mass emissions in pounds per hour and establishes an open market trading system for emissions allowances. To meet these requirements most electric utilities and other industries have installed Ultraflow's to provide a necessary accurate flow measurement.*

*Older differential pressure or thermal methods place one or more sensing elements inside the stack in direct contact with the flue gas. These devices are then subject to erosion, corrosion, plugging or fouling. Verification of the total system integrity and performance under these conditions must include visual inspection of the sensing element.*

*Newer optical scintillation technologies cannot easily handle high flow rates, cyclonic flow, low dust conditions and are prone to excessive maintenance due to inability to handle and use purge air.*

*Competing ultrasonic technologies lack the integral design of the Ultraflow and therefore have not performed in many applications as expected. Low signal power and non-purged systems have verified that certain designs lack the accurate and reliable results of the Ultraflow.*

*With the Ultraflow's new quad-probe handling capability, improved resolution and faster response time, the monitor is ideally suited for both small and large stacks and less than ideal locations. The quad probe design rejects all pitch angle flow while signal processing improvements enable quicker response time and better accuracy.*

*The Teledyne Monitor Labs Ultraflow 150 makes a drift-free measurement across the center of the stack and calculates an average reading without contacting the gas stream. In addition, the sensing elements are protected from corrosive stack gases by the use of purge air.*

# Teledyne Monitor Labs, Inc.

*Leading the way in Emissions Monitoring*

Throughout its history, Teledyne Monitor Labs has developed and patented breakthrough advances in emission monitoring technology. Teledyne Monitor Lab's drift-free Ultraflow Volumetric Flow Monitor was the first to perform across-the-stack zero span calibration checks. Now, Teledyne Monitor Labs has advanced the technology to include quad-sets of transducers to handle unique application issues eliminating the need for additional platforms and to improve response time for process control applications. The Ultraflow's modular design enables site specific configurations, thus giving users unique control over their application needs. These advanced products-along with aggressive, ongoing development programs-make Teledyne Monitor Labs a leader in the emissions monitoring instrumentation market.

***U.S. Patent 4,630,482***  
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