

300/400 UNITS - MODULAR CONFIGURATION



1160 US ROUTE 50

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300/400 UNITS - MODULAR CONFIGURATION TRITIUM MONITORS

ESSENTIAL CHARACTERISTICS, FEATURES AND OPTIONS

These are line powered tritium monitors for continuous unattended operation. They can be configured to serve a variety of purposes, including environmental surveillance in rooms, stacks or power plants, as well as glove boxes and process piping in tritium handling facilities.

FOREWORD

The 300/400 series tritium monitors are a family of instruments that share a common basic ionization chamber and electronics design philosophy.

Any specific model, to suit different applications, can be configured from a large selection of options.

All line powered tritium monitors for installation are grouped into the 300 and 400 series of instruments, and are categorized into four basic according to whether they use single or dual ionization chambers, or if automatic range switching for wide range of measurement has been incorporated.

Complexity, hence cost, is related to the number and nature of the associated ionization chambers, and the number of measurement ranges over which the instrument will function.

MODEL 311 (SINGLE CHAMBER, SINGLE RANGE)

Highest sensitivity of $1 \mu\text{Ci}/\text{m}^3$, with single ionization chambers from 10 cc to 2 liters. Four decade measurement range, with general application for glove box monitoring, process monitoring, chromatography and similar applications.

HIGHER SENSITIVITY

Increased sensitivity to $0.1 \mu\text{Ci}/\text{m}^3$ is attained through ionization chambers with larger volumes .



MODELS AVAILABLE: (but not limited to)

311 series	single range, with single ionization chamber
321 series	single range, with dual ionization chamber
411 series	multi-range, with single ionization chamber
421 series	multi-range, with dual ionization chamber



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**MODEL 411
(SINGLE CHAMBER, MULTIRANGE)**

Multirange version of Model 311, for wider measurement ranges up to 7 decades.

TRITIUM SPECIFIC IONIZATION CHAMBER RESPONSE

Monitors made to respond only to tritium, or tritium oxide, even in the presence of competing radioactive airborne agents. The 321 and 421 series instruments use balanced ionization chambers, which, together with specialized sample preparation systems are immune to competing radiogases, responding only to tritium or its oxide.

SENSITIVITY

Depending on chamber size, 300/400 tritium monitors will measure tritium from 10^{-7} $\mu\text{Ci/cc}$ to pure tritium.

SENSITIVITY AND RANGE OF MEASUREMENT, 300 SERIES

Single range monitors, the 300 series instruments, can be configured to measure over 3 to 5 decades selected anywhere between 10^{-7} $\mu\text{Ci/cc}$ to pure tritium.

SENSITIVITY AND RANGE OF MEASUREMENT, 400 SERIES

Multi-range monitors, the 400 series instruments, will measure over much wider ranges, covering up to as much as seven decades of displayed measurement.

A wide range of measurement places extreme demands on ionization chamber design with regard to contamination effects of tritium oxide. Proper design ensures linearity over the full range and minimum offset at the low end of the measurement range. Wider measurement ranges, such as 7 decades may use switched ionization chambers, using one ionization chamber only for low signal levels, and a second chamber only for high values.

There are special designs for ionization chambers which resist plate out.

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**KEY PERFORMANCE CHARACTERISTICS
OF OTC TRITIUM MONITORS**

OTC devotes a very significant portion of its budget to ongoing research and development to continuously improve instrument performance, to reduce costs, and improve the quality and maintainability.



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GAMMA RESPONSE

The 311 and 411 series of tritium monitors employ single ionization chambers, which respond not only to tritium but will also respond to external gamma and X ray fields. Typically, a flux of 1 mR/hr will produce instrument response equivalent to about 90 $\mu\text{Ci}/\text{m}^3$. Lead shielding can be supplied to mitigate gamma sensitivity.

In contrast, the 321 and 421 series of tritium monitors feature dual ionization chambers, the two chambers being of identical geometry and are used to cancel gamma response. Instruments with four ionization chambers are specified for optimum gamma suppression under challenging field gradient and energy conditions.

MEASUREMENT DISPLAY

All fixed 300/400 series instruments use 3/4, 4/4, even 3% or 5 full displays. Selection depends on the range and units of measure each particular application.

STABILITY AND NOISE LEVEL

The measurement sensitivity is specified in terms of stability and noise level under fully operational conditions, and not just to the electronic system performance alone.

For example, an instrument designed to measure to one micro Curie per cubic meter will exhibit a noise level and stability of better than 1 $\mu\text{Ci}/\text{m}^3$ for one standard deviation. Normally, the stability of the electronic circuitry itself is better by an order of magnitude.

OTC tritium monitors feature long term zero stability under all environmental conditions.

OTC pioneered proprietary methods to eliminate tritium monitor sensitivity to environmental effects including the disintegration of ambient radon, and of natural terrestrial and cosmic radiation.

SPAN ACCURACY AND LINEARITY

All OTC tritium monitors are calibrated to high levels of accuracy. OTC tritium monitors can be factory adjusted to a precision of as high as 5% in terms of equivalent electrical signal, or better than 15% when using certified tritium gas.

Measurement errors at low signal levels arise from tritium plate out, foreign radioactive material such as radon or cosmic radiation. At high levels, measurement errors are attributed to recombination effects which can be eliminated, or greatly mitigated by careful ionization chamber design.



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FEATURES

RESPONSE RATE

The measurement signal level and the rate (time constant) are inherently interrelated. High measurement levels demand fast response, whereas low measurement levels demand long time constants, in order to smooth out noise and to provide a stable display. To accommodate this contradictory requirement, three distinct time constants have been incorporated into the instruments.

3 second for measurement above 1000 mCi/m³

5 to 10 second time constant for measurement of 80 - 1000 mCi/m³

20 seconds or more for measurement below 80 mCi/m³

Time constants usually switch automatically, although manual switching as well as different break points can be incorporated as requested.

COMMON FEATURES

All 300 and 400 series instruments are equipped with a number of basic common features.

ICI/ICR Internal/Remote Ionization Chambers

The ionization chambers are normally furnished as separately or remote mounted, CODE ICR. Upon special request, chambers can be mounted inside the main electronics cabinet, use CODE ICR.

Measurement, Ranges and Sensitivity

A configuration with dual 8 liter chambers features a 0.1 $\mu\text{Ci}/\text{m}^3$ (1 s.d.) sensitivity.

Alarms, Measurement

Single or two independent alarms with visual and acoustic signals. Front panel mounted potentiometers are used to adjust the level set point. 400 series multiranging instruments are further equipped with range selector switches so that alarm setting can be made over the entire range of measurement.



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OPTIONS

Digital Displays

A variety of digital displays are available.

DD3.5	3 ¹ / ₄ Digit Display, max reading is 1999
DD3.75	3% Digit Display, max reading is 3999
DD4	4 Digit Display, Programmable, max reading is 9999
DD4.5	4 ¹ / ₄ Digit Display, max reading is 19999
DD5	5 Digit Display, Programmable, max reading is 99999

Use CODE DDxx depending on the number of digits required.

300 series single range instruments are typically equipped with 4/4 digit panel meters, and with 5 decade analog logarithmic output signals.

400 series employ moving decimal points on the panel meter and may include additional range indicating lights to identify the measurement decade in operation. Logarithmic analog outputs for 400 series instruments have scales of up to seven decades. Range switching is automatic and is not visible to the instrument operator.

Electrical Interfaces

All 300 and 400 series instruments have rear panel connections suitable for remote display, control or computer interface.

These include, as a minimum,

- Analog signal (0 - 10 V)
- Alarm functions, including remote acknowledge
- Supply voltage
- Range information (400 series)

ELECTRONIC AND PNEUMATIC OPTIONS

The standard 300/400 series instruments can be furnished with a variety of electronic options. A master "mother" board has room for several discretionary "plug-in" cards whose output interface connections protrude through the rear of the cabinet. OTC offers a number of standards as well as custom designed interface cards.

APS Alpha Pulse Suppression

Noise free measurements of airborne tritium is only possible by suppressing response to alpha decay due to environmental radon. With circuitry which inhibits instrument response to radon and large cosmic ray pulses, measurement sensitivities as low as 0.1 $\mu\text{Ci}/\text{m}^3$ can be attained.



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OPTIONS

LOG Logarithmic Converters

Circuits to convert instrument output signals to a logarithmic form for the purpose of logarithmic meter displays or for chart recorders with logarithmic scales. Useful for signal compression when used with 4-20 ma or digital interfaces.

TZ Totalizer

An 8 digit LCD display for time integrated activity rate of tritium. Very useful for the determination of inventory passage through stacks or hoods. A battery ensures retention of data during periods of line power loss.

PFA Pump and Flowmeter Assembly

A complete assembly consisting of HEPA filter, pump and adjustable flowmeter.

SFM System Failure Monitor

This supervisory circuit detects and signals failure of all d.c. power supplies, and verifies the integrity of the ionization chamber/electrometer.

FFA Low Flow Failure Alarm

Loss of flow sample stream switches are available on request.



CR Chart Recorder

An electronic chart recorder can be linked with the instrument to store data. The recorder has color LCD touch screen, removable memory card and RS-232 output.

ALX Customer selected Alarm Output Configuration

Special alarm configurations are available to fit into all 300/400 series instruments. Consult the factory for available options.

GP Gold Plated Measurement Chamber

Gold Plating of Measurement Chamber to Help Reduce Plate-Out

MP Mirror Polished Measurement Chamber

Mirror Polishing of Measurement Chamber to Help Reduce Plate-Out

RDU Remote Display Unit

Such options are designed to suit particular customer requirements and can include a variety of annunciators, visual and acoustic. Consult the factory for details.



RS-232/RS-485/Ethernet Computer Interfaces

All conventional computer interfaces are available on plug in cards.

HTL Helium Leak Test Certificate

Certification that the ionization chambers have passed leak tests performed with a helium mass spectrometer.

CALR Calibration Resistors

Ultra high meg ohm resistors, certified to about 2% precision for use for electrical calibration (or verification) of the tritium monitors response.

CALG Calibration Gas

NIST traceable tritium gas calibrators. Gas is contained in a "lecture" bottle, the calibrator is supplied with all necessary components, including the regulator, gages, and valves.



E-I Voltage To Current Converter

The 0 to 10 volt measurement signal can be converted to a standard 4 to 20 ma current signal.

400 series (multiranging) instruments can be equipped with a 4 to 20 ma signal which covers the entire range of operations.

Although not absolutely required, for better measurement resolution it is suggested that the 4 to 20 ma converter be preceded by a logarithmic conversion.

