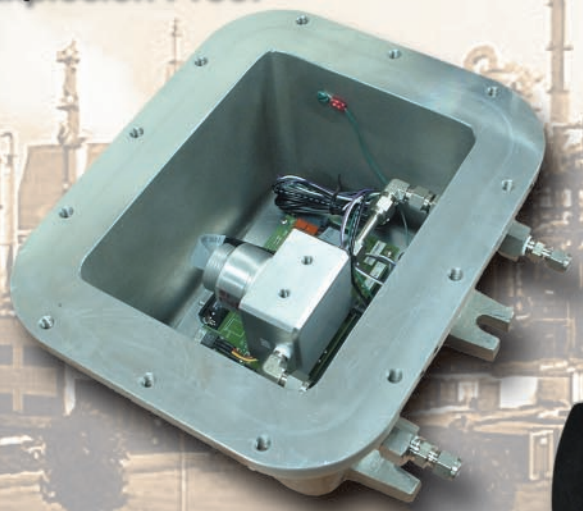
2200 SERIES
Hydrogen Specific Analyzers

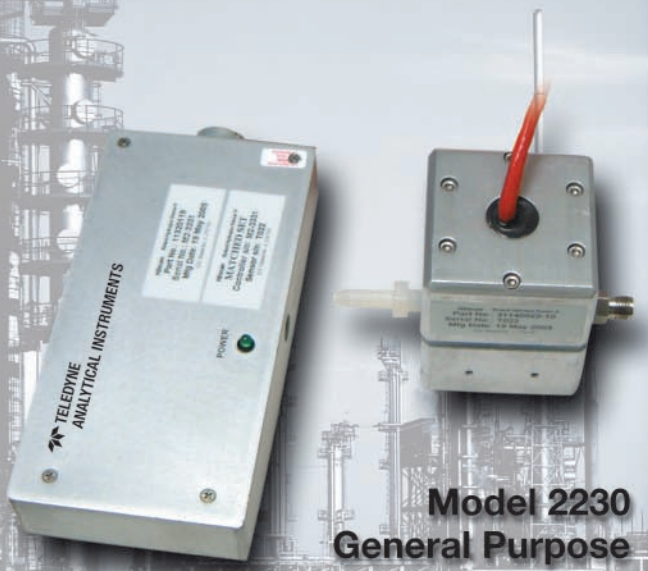
Model 2230
Explosion Proof



For today's conventional economy to tomorrow's hydrogen economy

Model 2240

Model 2220



Model 2230
General Purpose

Reliable monitoring of hydrogen gas is critical wherever it is produced, used, stored or transported. Teledyne's 2200 Series of hydrogen specific analyzers meets this crucial need. Through a state-of-the-art solution for detecting hydrogen, these instruments measure from trace levels for early warning of an impending, potentially hazardous leak, to 100% when qualifying hydrogen purity.

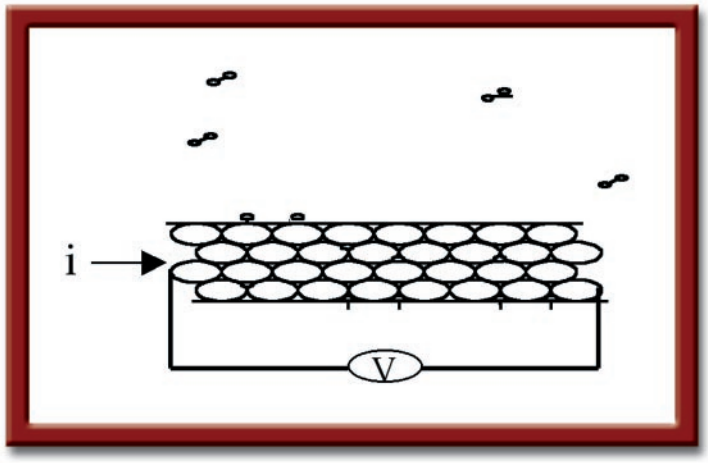
TELEDYNE ANALYTICAL INSTRUMENTS

Hydrogen Sensor Technology

The new Palladium-Nickel Thin Film based hydrogen sensor marks a significant leap in hydrogen specific sensing technology, and puts Teledyne at the forefront of analytical instrumentation companies in assisting the Hydrogen economy. The sensor is capable of monitoring hydrogen in a wide range from as low as 100 parts-per-million in air or inert background gases to 100%, making the sensor ideal for both hydrogen leak detection and hydrogen process monitoring. The technology operates on a partial pressure basis and has no cross sensitivity to any hydrocarbons.

Two versions of this palladium-nickel thin film technology are available for hydrogen monitoring. One is the use of thin film as a resistor for monitoring hydrogen from 0.5% to 100%. The second version is the use of the thin film as a FET for monitoring hydrogen from 100 parts-per-million levels to 1%.

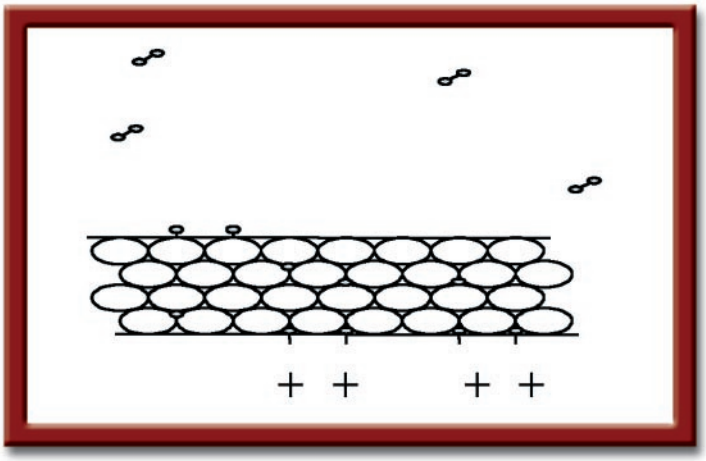
As the sample gas reaches the sensor surface, the palladium in the sensor catalyzes the breaking of the molecular bond of the hydrogen molecule, and the hydrogen atoms attach to sites (palladium atoms) on the surface of the palladium-nickel thin film. The hydrogen atoms then diffuse into the bulk of the thin film and reside in the interstitial sites in the metallic structure. This results in a resistance change proportional to the hydrogen concentration, and operates from 0.5% to 100% hydrogen.



Thin film as a resistor

These interstitial hydrogen atoms increase electron scattering and increase the electrical resistance of the thin film. One percent of hydrogen at atmospheric pressure will change the resistance by about one percent. This change is measured as a voltage change by the analyzer electronics and the voltage output is calibrated against hydrogen concentration. The resulting voltage versus concentration is a power law curve obeyed up to at least 31 atmospheres.

A CMOS heater FET and temperature sensing diode are manufactured on the silicon chip. The sensor electronics measure the voltage of the temperature sensing diode and precisely control this temperature to close tolerances through the heater FET. This temperature is chosen to be higher than ambient which provides control and prevents condensation of water in high humidity operations.



Thin film as an FET

The palladium-nickel thin film is also used to form the gate function of a FET on the above ASIC. The FET is configured to operate at a constant current as controlled by the gate voltage. The hydrogen molecule disassociates as described for the resistor, but the measurable changes would not take place at the interface between the thin film and its substrate. This substrate is a thin film insulator on doped silicon wafer. The bulk hydrogen in the thin film cannot penetrate the insulator and acts as a positive electronic charge at this interface.

This charge is viewed by the FET device as a dipole that changes the electric field. The external circuitry is designed to adjust the gate voltage to maintain a constant current. Thus, the gate voltage changes with hydrogen concentration. The mathematical form of this relationship is a logarithmic function and spans over a wide range of hydrogen concentration, over 1000 orders of magnitude, from less than 10 ppm to 1% (10,000 ppm) in air.

These two versions of the catalytic effect of palladium on hydrogen complement one another. The sensing ranges are complementary and a wide range hydrogen specific sensor is the result of this technology.

AIR SEPARATION

- Bulk gas purity monitoring
- Gas mixture blending
- Calibration gas blends

PETROCHEMICAL AND REFINERY

- H_2 purity monitoring in recycle gas streams
- H_2 reformer process
- HYCO Syngas monitoring
- UOP (CCR) N_2 header, lift gas H_2 / HC safety analysis

TURBINE GENERATORS

- Hydrogen purity analysis of purge cooling gas in the turbine generator housing to detect possible seal leaks

NUCLEAR POWER GENERATION

- Hydrogen monitoring in nuclear fuel storage facilities

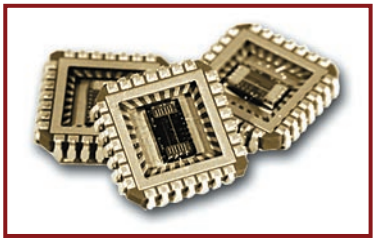
STEEL / HEAT TREATING

- Annealing furnace blanket gas monitoring
- Blast furnace monitoring

Model 2240
Portable Hydrogen Leak Detector

FEATURES AND BENEFITS

- Hydrogen specific sensing technology
- No interference from hydrocarbons
- Extremely fast response
- Dynamic range-ability
- Lightweight portable unit
- Wand extention for difficult to access potential leak locations
- Multiple packaging designs for process and leak detection purposes
- Easy to operate / no maintenance sensor design



Pd-Ni Thin Film Sensor

From handheld to on-line explosion proof configurations, we meet industry's various packaging and mounting needs

APPLICATIONS

- Semiconductor annealing furnace atmosphere monitoring
- Hydrogen cooled generator leak detection
- Nuclear waste monitoring
- Hydrogen degassing monitoring in battery storage facilities
- Power station off-gas monitoring
- Process hydrogen monitoring of recycle gas streams
- Hydrogen leak detection of fuel cell power generation devices
- Monitoring hydrogen generated via electrolysis
- Hydrogen Reformers and HYCO plants

SPECIFICATIONS – 2200 Series

Configuration	Model 2240 Portable Hydrogen Leak Detector	Model 2230 Explosion Proof Hydrogen Analyzer	Model 2220 Hydrogen Area Monitor / Leak Detector
Sensor	Palladium-nickel thin film sensor		
Range	0.5% to 100% Hydrogen in air or inert gas; contact factory for other background gases		
Accuracy	±2% of full scale (Call factory for Model 2240 accuracy specifications).		
Response time	Initial response under 2 seconds. T63 / T90 response is application and hydrogen concentration dependent.		
Power requirement	1.5A @ 12 VDC; 120 VAC rechargeable battery	12-24 VDC	12-24 VDC
Display	Local LCD	External digital meter, +24V, with 3.5 digit display	External digital meter, +24V, with 3.5 digit display
Output – analog	None	4-20 mADC Load: 750 Ohms (Max)	4-20 mADC Load: 750 Ohms (Max)
Output – digital	RS-232 serial interface (Sub D9), ASCII, 8 bit, 19200 baud, no parity, 1stop		
Sample flow rate through sampling	Not applicable	0.5-10 scfh	0.5-10 scfh when used with flow
Operating pressure	Not applicable	Positive pressure, about 3 psig	Positive pressure, about 3 psig when used with flow through sampling
Operating temp.	-10 to +50° C	0 to 40° C	0 to 40° C
Dimensions	Handheld module: 13.6" x 2.9" x 1.7" (L x W x D) 1.7 lb. weight	Explosion proof housing: Class I, Div 1, Groups B, C, D 9.3" x 11.3" x 6.5" (L x W x D) 20.0 lb. weight	Area monitor: 8.25" x 3.6" x 1.57" (L x W x D) 0.80 lb. weight

TELEDYNE ANALYTICAL INSTRUMENTS

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www.teledyne-ai.com

Warranty: Instrument is warranted for 1 year against defects in material or workmanship

NOTE: Specifications and features will vary with application. The above are established and validated during design, but are not to be construed as test criteria for every product. All specifications and features are subject to change without notice.

CERTIFIED
ISO 9001 : 2000

Accredited by the Council for Accreditation (RvA)

National Accreditation Program