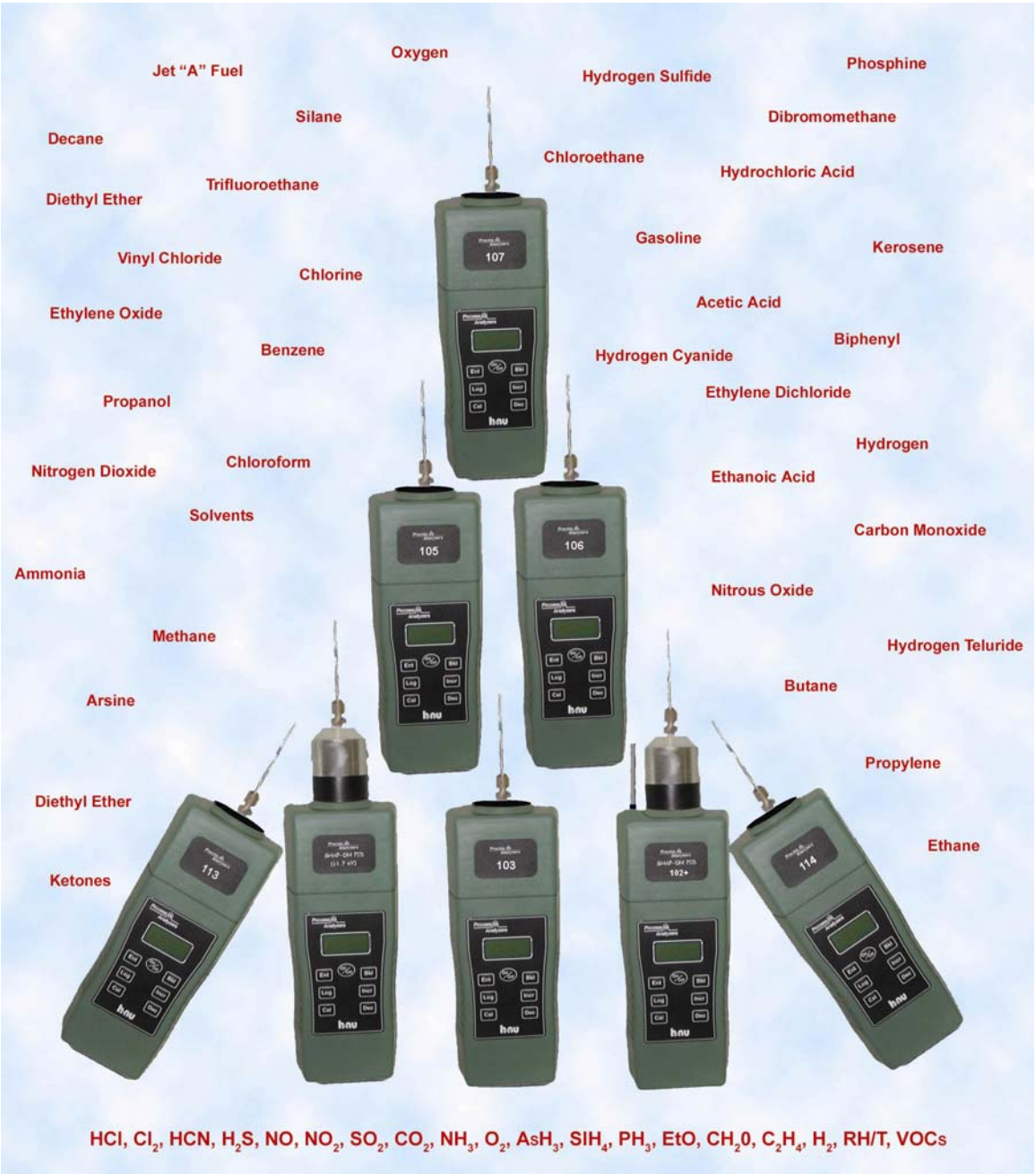

Suite of portable instruments from PID Analyzers – HNU Technology

HNU Portable Analyzer Technology & Specifications

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HNU Portable Analyzer Technology & Specifications

1. INTRODUCTION

HNU introduced the first commercial photoionization based instrumentation. More than 35,000 of the portable and\ laboratory PIDs have been sold throughout the world. Many United States Environmental Protection Agency and Occupational Safety & Health Administration (OSHA) methods have been published in the Federal Register.

This range of products encompasses more than 30 sensors based on the following technologies:

PID
TCD
CG
EC
IR
Capacitance

We are constantly adding to the number of sensors and technologies available for our Smart Docking Unit. We want to provide our customers with the widest range of technologies and sensors available for portable Analyzers.

The amplifier board in the Head has the electronics for 5 sensors. A sensor mounting board snaps directly into the amplifier board. The sensors can be easily interchanged. The amperometric electrochemical sensors have special circuitry in place when the power is turned off. This provides fast responding sensors with an instantaneous response.

In the following sections, we describe our Smart Docking Units, Heads technology, specifications and applications. We have divided the Analyzers & specs into two types plus common features:

a. PID type
b. Sensors type

This range of Analyzers provides a wide variety of sensors that allow the customer to choose the best Analyzer for their applications. In addition, the customer will be able to expand or change the capability of the Analyzer in the future.

Analyzer Selection

What do you want to measure with your Analyzer?

VOCs	Model #
% LEL	106, 105, 102+
%	105
ppm	102, 102+,103, 113- CG (to 50 ppm)
ppb	102+ ppb,103
Indoor air-ppb	102+ ppb,103

Confined Space	Model #
LEL, O_2, CO	106, 105, 102+

Stack Gases	Model #
SO_2, NO, CO, O_2	107

Oxygen	Model #
O_2 %	113, 102+
O_2 ppm/ppb	113
Headspace	113

CO_2	Model #
CO_2 IR ppm or %	114
CO_2 EC ppm or %	113, 102+

Leak detection	Model #
Ppm to 3,000	102, 102+
Ppm to %	105, 102+ with TCD

EPA Method 21	Model #
Ppm to 30,000	102, 102+ with dilution probe

Toxic gases	Model #
ppm –SO_2, HCN, HCl, NO…	113, 102+

Vapor well HC's	Model #
ppm –gasoline, diesel	102, 102+

2. SMART DOCKING MODULE WITH SNAP-ON HEADS

Snap On PID Head -

There are three easy to interchange Snap-On Heads with 9.5, 10.6 or 11.7 lamps. Just snap on to the Docking Module. The Smart Docking Module will automatically recognize the type of Head. It will also remember the previous calibration for that head. Thus, these heads can be interchanged without the need for recalibration. A PID only Snap-On head is available for the 102 while a PID plus1-3 other sensors is available for the 102+.

Figure 1. 102 Snap On Head
Exterior View

Figure 2. 102 Snap on Head
Internal View

Snap-On Sensor Head

The Snap-On Sensor head has 4 positions for plug-in sensors:

a. Position #1- Wheatstone bridge for CG or TCD or IR sensor-Position
b. Position #2 & 3 amperometric electrochemical sensors
c. Position # 4 amperometric or potentiometric EC sensors

The bridge setup is different for each of the sensors in (a) above. One could have a head with a CG and another with a TCD plus three electrochemical sensors. When these are interchanged, the Smart Docking Unit will remember the calibrations.

Many portable instruments are used infrequently. This doesn't minimize the importance of these analyzers. They can be used for safety, industrial hygiene, and stack or process analysis. The Snap On Heads allow an inexpensive solution to a multipurpose Analyzer.

3. DESCRIPTION OF SENSOR TECHNOLOGY

PID, TCD, CG, IR, EC, RH

Photoionization (PID) -
The process occurs when a molecule absorbs light of sufficient energy to ionize a molecule see below:

$$RH + h\nu = RH+ + e-$$

in which RH is a molecule of gas
$h\nu$ is a photon with an energy greater than or equal to the ionization potential of the molecule RH.

The ultraviolet lamp generates photons that ionize the molecule RH (above) and generates positive ions. An accelerator electrode (positively biased) pushes the ions; to the collector electrode where the current generated (proportional to concentration) is amplified and displayed on the digital meter. The PID can be used for VOC measurements on ppm 0.1-3,000 ppm or ppb (optional) 1-20,000 ppb ranges.

Thermal Conductivity (TCD) -
The Thermal Conductivity Detector (TCD) measures the difference (change in resistance) in cooling between the sample and a sealed reference through a Wheatstone Bridge circuit that detects small changes in resistance. This difference in the signal between the measurement and reference sensors is amplified and the output is displayed on the digital meter after processing. The range for the TCD can be 0-100% LEL or 0-100 % v/v. The detection limit on the LEL range is approximately 150 ppm. The span of the gas (range) can be reprogrammed in the Meter to use the Analyzer for measurements in different areas. The software for the TCD has response factors for >20 compounds.

Combustible Gas (CG) -
The Combustible Gas Sensor (CG) measures the difference (change in resistance) in temperature between a heated catalytic element and a heated element without a catalyst (reference) through a Wheatstone Bridge circuit that detects small changes in resistance. This difference in the signal between the measurement and reference sensors is amplified and the output is displayed on the digital meter after processing. The range for the CG sensor is 0-100% LEL. The detection limit on the LEL range is approximately 50 ppm. The span of the gas (range) can be reprogrammed in the Meter to use the Analyzer for measurements in different areas.

IR

The technique for measuring the concentration depends upon the Lambert Beer Law:

$I = I_o e^{-kx}$

Where- I is the measured intensity
I_o is the incident intensity k is the absorption coefficient
x is the pathlength

This dual beam sensor consists of a pulsed IR source, a fixed path length cell, a measurement filter, a reference filter and an IR detector (thermopile). Infrared radiation in the 4 to 5 micron region is absorbed by carbon dioxide and converted into molecular vibration energy. This absorption is associated with the C-O stretching, or bending frequencies. Infrared absorption spectra are due to transitions between vibrational - rotational levels.

Electrochemical (EC) -

Two and three electrode systems are used for the electrochemical sensors. Sensor technology includes potentiometric (CO_2, NH_3), fuel cell (O_2) and amperometric (SO_2, H_2S, ...) where the sample is oxidized or reduced. Sensors are chosen to maximize performance and lifetime. The sensors can be easily interchanged via the plug-in sensor board and embedded software. Some of the reactions involved include the following:

	$CO + H_2O \rightarrow CO_2 + 2H^+ + 2e^-$
Hydrogen Sulphide (H_2S) :	$H_2S + 4H_2O \rightarrow H_2SO_4 + 8H^+ + 8e^-$
Sulphur Dioxide (SO_2) :	$SO_2 + 2H_2O \rightarrow H_2SO_4 + 2H^+ + 2e^-$
Nitric Oxide (NO) :	$NO + 2H_2O \rightarrow HNO_3 + 3H^+ + 3e^-$
Nitrogen Dioxide (NO_2) :	$NO_2 + 2H^+ + 2e^- \rightarrow NO + H_2O$
Hydrogen (H_2) :	$H_2 \rightarrow 2H^+ + 2e^-$
Chlorine (Cl_2) :	$Cl_2 + 2H^+ + 2e^- \rightarrow 2HCl$
Hydrogen Cyanide (HCN) :	$2HCN + Au \rightarrow HAu(CN)_2 + H^+ + e^-$
Ethylene Oxide (C_2H_4O) :	$C_2H_4O + 2H_2O \rightarrow C_2H_4O_3 + 4H^+ + 4e^-$
Ammonia (NH_3) :	$12NH_3 + I_2 + 6H_2O \rightarrow 2IO_3^- + 12NH_4^+ + 10e^-$

RH/T

The relative humidity (RH) sensor uses a thermoset polymer with three layer capacitance construction. The electrodes are platinum with on-chip signal conditioning. Water vapor in the active capacitor's dielectric layer equilibrates with the surrounding gas and produces a voltage that is proportional to the RH. The porous platinum layer shields the dielectric response from external influences while the protective polymer over layer provides mechanical protection for the platinum layer from contaminants such as dirt, dust and oils.

The temperature sensor is a platinum resistance temperature device that is incorporated into the RH sensor package.

4. SENSOR SPECIFICATIONS

	Det. Limit	Response Time	Interferences	
PID				
9.5 eV	0.1 – 3,000	0.1	1s	NA
10.6 eV	0.1 – 3,000	0.1	1s	NA
10.6 – ppb	1-20,000 ppb	1 ppb	5s	
11.7 eV	0.1 – 3,000	0.1	1s	NA
Infrared				
LEL CH4	0-100%	1%	20s	NA
CO2	0-2%	0.04%	20s	NA
TCD				
Organic & Inorganic	0-100% v/v	1%	20s	NA
CG				
Organics- LEL	0-100%	1%	20s	NA
RH/Temperature				
RH	0-100%	0.1%	50s	NA
Temperature	0-60°C	0.1°C	20s	NA
Electrochemical				
Ammonia	0-50	0.01	30 sec.	acid gases
Carbon Dioxide	0-1,000/0-10%	ppm	90 sec.	other acid gases
Carbon Monoxide	0-500/1000	0.5	10 sec.	C2H4
Carbon Monoxide-SG	0-1,000	1	15 sec	H_2, C_2H_4
Chlorine	0-10	0.01	30 sec.	——
Ethylene	0-20	0,01	45 sec	alcohols, other org.
Ethylene Oxide	0-20	0.01	1 min.	alcohols, org., CO
Formaldehyde	0-20	0.01	5 sec.	alcohols, CO
Hydrogen	0-1000	2	45 sec.	CO, C2H4
Hydrogen Cyanide	0-50	0.01	50 sec.	C2H4, H2S, SO2
Hydrogen Chloride	0-100	0.01	1.5 min.	SO_2 ,H_2S----
Hydrogen Sulfide	0-100	0.01	20 sec.	——
Hydrogen SulfideSG	0-5,000	1	15 sec.	—— with filter
Nitric oxide	0-50	0.01	10 sec.	NO2
Nitric oxide-SG	0-1,000	1	10 sec.	——— with filter
Nitrogen dioxide	0-10	0.01	15 sec.	Cl2, H2S
Nitrogen Dioxide-SG	0-200	0.1	15 sec.	H_2S
Oxygen	0-30%	0.1%	15 sec.	——
Oxygen-SG**	0-30 %	0.1%	8 sec.	uses H^+ electrolyte
Ozone	0-5 ppm	0,002	75 sec	____
Phosphine	0-5	0.05	40 sec.	SiH4, GeH4, B2H6
Sulfur dioxide	0-5	0.01	20 sec.	NO2
Sulfur Dioxide-SG	0-5000	1	20 sec.	NO_2 filter
Silane	0-5	0.05	30 sec.	AsH3, GeH4, PH3

There are more than 30 different sensors available for these Analyzers.
SG= stack gas sensor

5.0 PID BASED ANALYZERS- 102, 102+ 103

SPECIFICATIONS-

· Size: 10.0" L x 3" W x 2.25"D
· Weight: 1.9 pounds
· Display: 2 line x 16 character LCD display with backlighting
· Analog to Digital Converter: 16 bit
· Precision: +/- 1% with 10 ppm standard
· Accuracy: 97-98 % at 10 ppm
· Analog (Sensor)Input channels:
  102: 1
  102+: 4
  103 : 4
· Linear to 3,000 ppm
· ppm range- 0.1 to 3,000 ppm- Models 102, 102+ 103
· ppb range- 1-20,000 ppb 102+ (optional), 103
· Fast response 1 sec to 90%
· Battery: nickel methal hydride rechargeable
· Battery life- 8-10 hours
· Low battery indicator & automatic shutdown
· Datalogging for 7,000 points
· RS232 output
· 0-1 VSC output- programmable

FEATURES

· Single unit construction
· Easy to use even for unskilled personnel
· Simple 5 button operation
· No keyboard· Easy to use even for unskilled operators
· Library of sensitivities built in for > 250 compounds
· Use “Resp as” to setup for direct reading
· Calibrate with isobutylene or other gases
· Alphanumeric display for compound, detector, alarm, range, & logging
· Bright LED digital display for readability/backlighting selectable
· Duraclean TM PID
· Auto electronic zero in Cal, background zero
· Simple pushbutton sensitivity control
· Reliability

The basic simplicity, durable construction and design of the Model 102 has resulted in the elimination of problem areas associated with many other measurement techniques in portable analyzers.

PID ANALYZERS
PID Analyzers, LLC

APPLICATIONS

Non-specific- Responds to VOC's & inorganic species (NH3, H2S, PH3, AsH3, etc.)
Headspace- VOCs in soil or water- special headspace method in software
Quality control- residual monomer in resins, residual solvents in paper or food, testing gas masks, residual gases in cylinders
Emergency response- spills from trucks & trains
First responders
Arson investigations- find trace accelerants
Confined space entry- health & safety
EPA Method 21
Fugitive emissions- leak detection
Leaking Underground Storage Tanks
Building security
Indoor Air Pollution

6.0 TCD, CG, IR, EC BASED ANALYZERS- 107, 108,113, 114,115

SPECIFICATIONS-

· Size: 8.0" L x 3" W x 2.25"D
· Weight: 1.6 pounds
· Display: 2 line x 16 character LCD display with backlighting
· Analog to Digital Converter: 16 bit
· Precision: +/- 1-2% with 10 ppm standard
· Accuracy: 95 % at 10 ppm or 10% LEL
· Analog (Sensor)Input channels:
    105: 1-4
    106: 4
    107: 1-4
    113: 1-4
    114: 1-4
· Linearity: see specs for sensors
· ppm range- 0.1 to 3,000 ppm- Models 102, 102+ 103
· Fast response- see specs for sensors
· Battery: nickel methal hydride rechargeable
· Battery life- 10-30 hours
· Low battery indicator & automatic shutdown
· Datalogging for 7,000 points
· RS232 output
· 0-1 VSC output- programmable

FEATURES

· Single unit construction
· Easy to use even for unskilled personnel
· Simple 5 button operation
· No keyboard· Easy to use even for unskilled operators
· Library of sensitivities built in for each sensor: TCD, CG, EC
· Use “Resp as” to setup for direct reading
· Calibrate with other gases
· Alphanumeric display for compound, detector, alarm, range, & logging
· Bright LED digital display for readability/backlighting selectable
· Duraclean TM PID
· Zero & Span in Cal for 2 point calibration, background zero
· Simple pushbutton sensitivity control
· Reliability

The basic simplicity, durable construction and design of the Model 102 has resulted in the elimination of problem areas associated with many other measurement techniques in portable analyzers.

APPLICATIONS

EC

Safety Monitoring
Industrial Hygiene
% O_2
ppm O_2
ppb O_2
Quality control
Headspace
Stack Gas Analysis
Combustion performance- LEL/CO, LEL/O_2
Inexpensive Backup Analyzer

CG

Confined Space- CG (LEL)/O_2/CO/H_2S
Confined Space- CG (LEL)/O_2/NH_2/CH_2O
Confined Space- CG (LEL)/O_2/NH_2/C_2H_2
Leak Detection- CG
Combustion leaks- CG/CO (stack gas sensor) or CG/O2 (stack gas sensor)

TCD

Confined Space- TCD (LEL)/O_2/CO/H_2S
Leak Detection- TCD (organics), He, H_2
Combustion leaks- LEL/CO
Composition- of natural gas
Combustion performance- LEL/CO, LEL/O_2

IR

Safety
Industrial Hygiene
Stacks
CO_2 in ambient air
CO_2 in process streams

7.0 CONTROLS & DATALOGGING

CONTROLS

On/Off- Battery power
Incr-Function ON, scrolling menu up,increase number
Decr-Function OFF, scrolling menudown, decrease number
Bkl-Turns backlight on/off
Menus
LOG

Log Manual-
Set site #, and manually log each pt.
Auto- Set ave. time (sec) and samples/hr. to Autolog Site # 1-7000
Setup- Setup Auto; Ave. time sec., samples/hour Exit- Return to Run

CAL

Cal- Performs Autozero, set cal value, calibration
Bkg Zero- used to zero out background- can be shut off by turning off the 102 then turning it back on
Cal Gas- Select name of cal gas
Resp as- Once the 102 is calibrated-change to direct reading on any of > 250 compounds Alarm-
Alarm-Turn on/Off Alarm audible alarm
Exit- Return to Run mode

DATA LOGGING

Datalogging
The portable analyzers have manual or automatic data logging capability for up to 7,000 points for 1-4 components. The software for data logging is included with the Model 102. IT uses Grapher Software for downloading the information for the102. The Analyzer will automatically time and date stamp the data. To check the time see the Model 102+ Instruction Manual. A typical Auto data logging format is shown below:102 Data:

	Date	Time		ppm
SP6	6/12/2002	15:02:27	7	1.7496
SP6	6/12/2002	15:03:27	7	1.6497
SP6	6/12/2002	15:04:27	7	1.6498
SP6	6/12/2002	15:05:27	7	1.6499
SP6	6/12/2002	15:06:27	7	1.6500
SP6	6/12/2002	15:07:27	7	1.6400

End Of Log Data

This data can be saved directly into Excel as a csv file.