

7866 Digital Thermal Conductivity Analyzer for Binary Gas Mixtures

Specification

Overview

The Honeywell 7866 Thermal Conductivity Analyzer is designed to provide a highly sensitive and accurate analysis of a binary (2-component) mixture of gases. The analyzer can also be calibrated to measure a single component of a multicomponent gas mixture, providing the background gases constitute a stable mixture (such as air), or have approximately the same thermal conductivity.

The 7866 analyzer uses the principles of thermal conductivity, to determine the concentration of a sample gas through the measurement of thermal losses from two highly stable, matched thermistor probes inserted in a stainless steel block

Features

- Easy to use prompts
- Security code protected
- Reliable solid state design
- High speed of response
- High sensitivity
- Excellent stability
- Low maintenance requirement
- Low installation costs through optional remote mounting capability of the sensing unit (transmitter)
- Explosion-proof housing on the sensing unit
- Signal transmission from the sensing unit up to 1000 feet over unshielded leadwires
- Panel-mounted 1/4 DIN control unit (receiver) with easy-to-read display
- Current output signal from the control unit representing measured PV
- Single or dual alarms
- A triple range analyzer for hydrogen-cooled generator applications is available

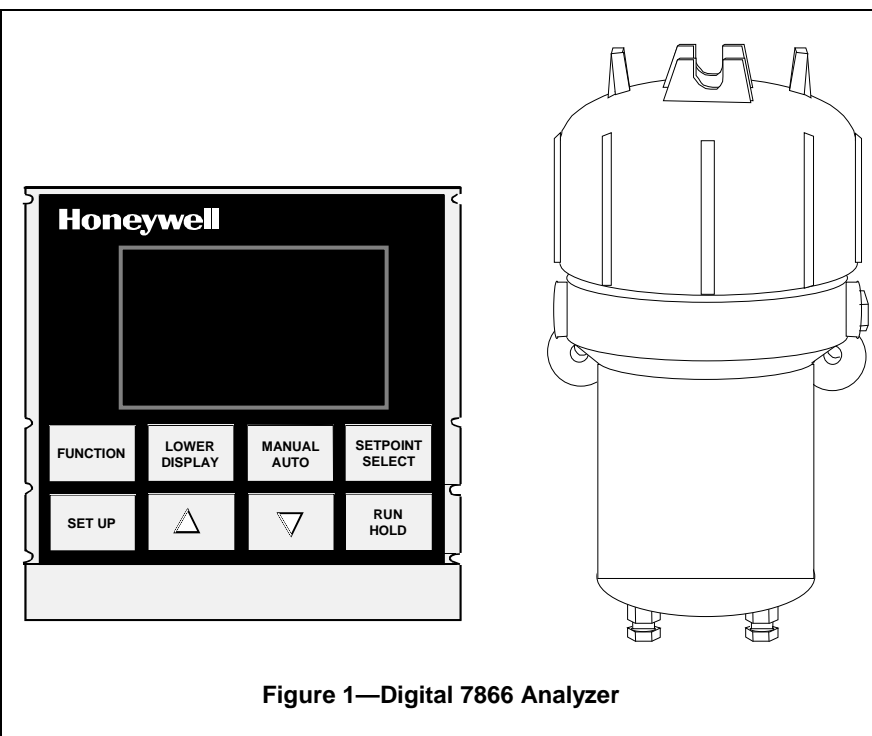


Figure 1—Digital 7866 Analyzer

- Triple range analyzer has available a second current output used to retransmit ranging data to optional indicator model (mutually exclusive with Alarm 2)
- Optional Modbus communications supports configuration and data acquisition

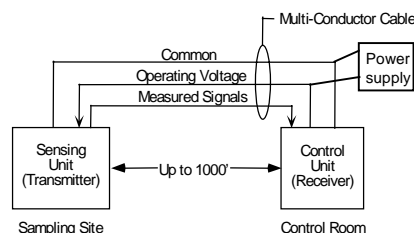
Description

The analyzer consists of three basic components: the sensing unit (transmitter), the control unit (receiver) and a power supply.

The sensing unit receives a continuous flow of the binary or multi-component gas mixture, measures the concentration of the sample gas and transmits an electrical signal to the control unit. The sensing unit is ruggedly constructed to meet most environmental conditions and is designed to be mounted up to 1,000 feet from the control unit with only a single multi-conductor non-shielded cable connecting the two, resulting in greater flexibility and lower installation costs.

The control unit receives the output signal from the sensing unit at the sampling site by way of the inter-connecting cable.

The control unit is designed for simplified panel-mounting either at the sampling site, if environmental conditions permit, or in a control room. The unit provides a current output signal to a remote device for monitoring or recording purposes.



The control unit is supplied with one or two alarms. When an alarm is detected, the specific relay de-energizes creating an open circuit that can activate an external annunciator or a relay to initiate a shutdown procedure for the process. When power is off the alarm relay is de-energized and the normally open contact is non-conducting (open).

An indicator model, which provides a continuous readout of the concentration of the gas under analysis, is available with the triple range 7866 analyzer. The indicator input is connected to the controller's current output. The indicator has no direct connection to the sensing unit.

Some common applications of the 7866 Thermal Conductivity Analyzer are:

- *Electric Power Industry Power Plants* – Accurate monitoring of hydrogen purity in hydrogen-cooled generators. The triple range analyzer also monitors carbon dioxide in air and carbon dioxide in hydrogen insuring safe execution of the purge cycles.
- *Chemical Industry* – Measurement of hydrogen in ammonia or nitrogen for dissociated ammonia applications. Also, measurement of hydrogen in oxygen, carbon dioxide, and methane.
- *Petroleum Industry* – Measurement of hydrogen in certain hydrocarbon streams.

Equipment

Sensing Unit – The 7866 Thermal Conductivity analyzer's sensor assembly is supplied with an explosion proof housing. The housing consists of a rugged cast aluminum construction that permits reliable operation under adverse ambient conditions.

The sensor assembly consists of two sections – the cell block assembly and the electronic assembly.

The cell block assembly is of stainless steel construction with two identical internal cells, the measuring cell and the reference cell. The highly stable thermistor is mounted in each cell. These matched thermistors form the active arms of a bridge circuit. The unbalanced current of the bridge provides the means of measuring the relative ability of the sample and reference gases to conduct the heat away from their respective thermistors to the cell wall, which is held at a constant temperature. The reference gas chamber, with inlet and outlet openings drilled into the chamber from the base, can be opened or sealed. All zero-based standard ranges and the 20 % to 50 % H₂ range have air-filled, sealed reference cells. For hydrogen ranges starting above 50 % as well as the 90-100 % oxygen range, a flowing reference is used. The measuring chamber is open to the continuous sample gas flow.

The cells in which the thermistors are mounted are dead-ended so the sample gas enters only by diffusion, minimizing the effect of sample flow variations. In addition, the entire cell-block assembly is maintained at a constant optimum temperature through two heaters and a control thermistor that are located in the cell block assembly.

The sensing unit's electronics assembly incorporates solid state electrical circuits. These circuits include:

- *Current Regulator* which supplies the constant current to the thermistor cell bridge circuit.
- *Proportional Action Temperature Controller* which maintains the entire cell block at a constant temperature.
- *Voltage to Current Converter/ Amplifier* whose current output is transmitted to the analyzer's Control Unit.

Control Unit – The control unit houses the remaining measuring circuits in an extruded aluminum 1/4 DIN standard case. In addition, the control unit contains the front-panel calibration adjustments for the analyzer system. This includes the zero and span adjustments.

Digital Display on the Control Unit – Provides a continuous readout of the concentration (0-100 %) of the gas under analysis.

Dual Alarms – Two alarms are available for high and low alarms. Each alarm can be individually set. An alarm hysteresis which sets the deactivation range for both alarms is also available. The alarms include numeric indication on the display, as well as, an external relay contact for external communication. The relay output can also service an external shutdown device.

Optional Modbus Communications – Allows the controller to be connected to a host computer via the Modbus protocol.

Upper Display - six characters

- Normal Operation - four digits dedicated to displaying the process variable
(Decimal place is selectable to either 1 or 2 places)
- Configuration Mode - displays parameter values or selection

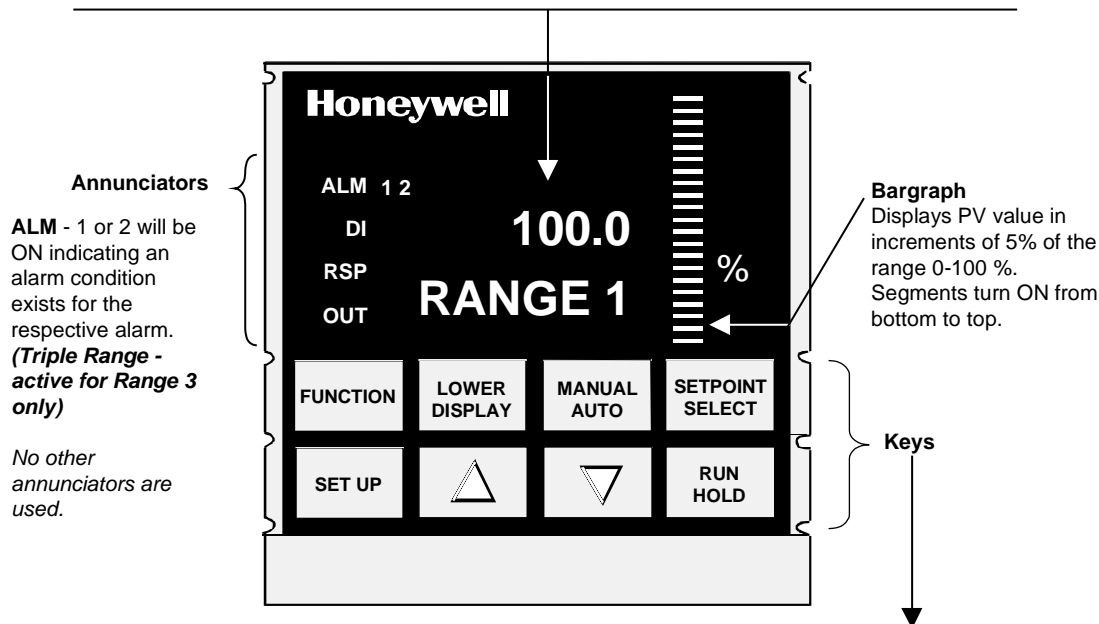
Lower Display - eight characters

- Normal Operation -

Single Range: displays RANGE1 or the gas prompt

Triple Range: displays either RANGE x (x = selected range 1, 2, 3) or the equivalent gas prompt

- Configuration Mode - displays the group or function prompt



SET UP	<ul style="list-style-type: none"> • Places the controller in the Configuration Set Up group select mode. Sequentially displays Set Up groups and allows the FUNCTION key to display individual functions in each Set Up group.
FUNCTION	<ul style="list-style-type: none"> • Used in conjunction with the SET UP key to select the individual functions of a selected Configuration Set Up group. • Pressing this key saves, into nonvolatile memory, any changes made to previous function value or selection. • Used during field calibration procedure.
▲	<ul style="list-style-type: none"> • <i>Configuration Mode:</i> Used to scroll through the parameter selections or to increase the selected parameter value. • Used during field calibration procedure.
▼	<ul style="list-style-type: none"> • <i>Configuration Mode:</i> Used to scroll through the parameter selections or to decrease the selected parameter value. • Used during field calibration procedure.
SETPOINT SELECT	<ul style="list-style-type: none"> • Triple Range: Normal Operation: Used to toggle what is shown in the lower display—either the Range being measured or its corresponding Gas. • Single Range: Unused key—KEY ERR message appears in lower display if key is pressed.
LOWER DISPLAY	<ul style="list-style-type: none"> • Triple Range: <ul style="list-style-type: none"> • <i>Normal Operation:</i> Used to scroll through the lower display selections: • If Range was selected (by pressing SETPOINT SELECT), selections are RANGE 1, RANGE 2, or RANGE 3. • If Gas was selected (by pressing SETPOINT SELECT), selections are CO2inAIR, H2in CO2, H2in AIR (corresponding to Range 1, Range 2, and Range 3 respectively). • Single Range: <ul style="list-style-type: none"> • Used to toggle between RANGE 1 and the Input Type [e.g., PC H2 (Percent Hydrogen)] during normal operation.
MANUAL AUTO RUN HOLD	<ul style="list-style-type: none"> • Unused keys • KEY ERR message will appear in lower display if one of these keys is pressed.

Figure 2—7866 Control Unit Operator Interface and Key Functions

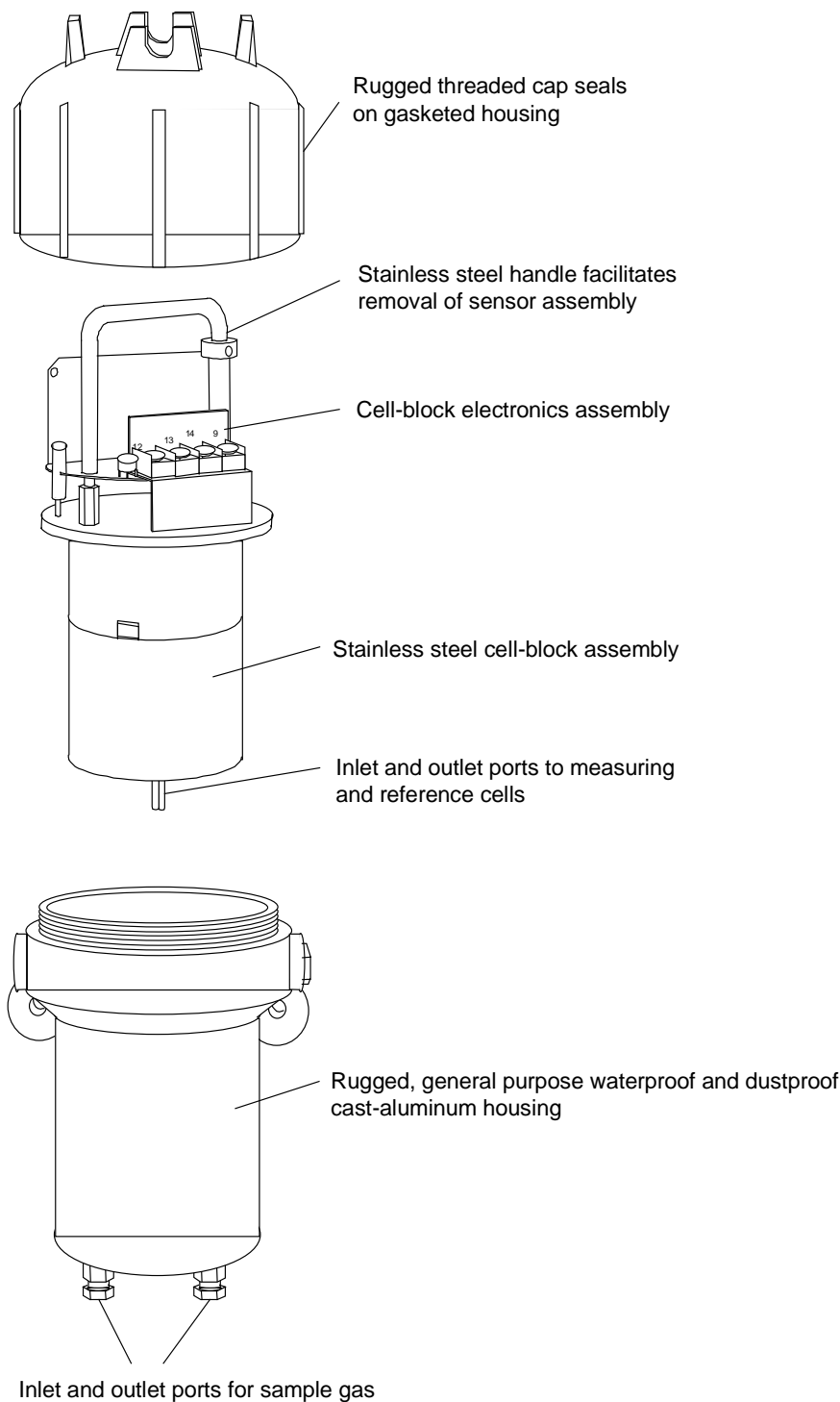


Figure 3—7866 Sensor Assembly

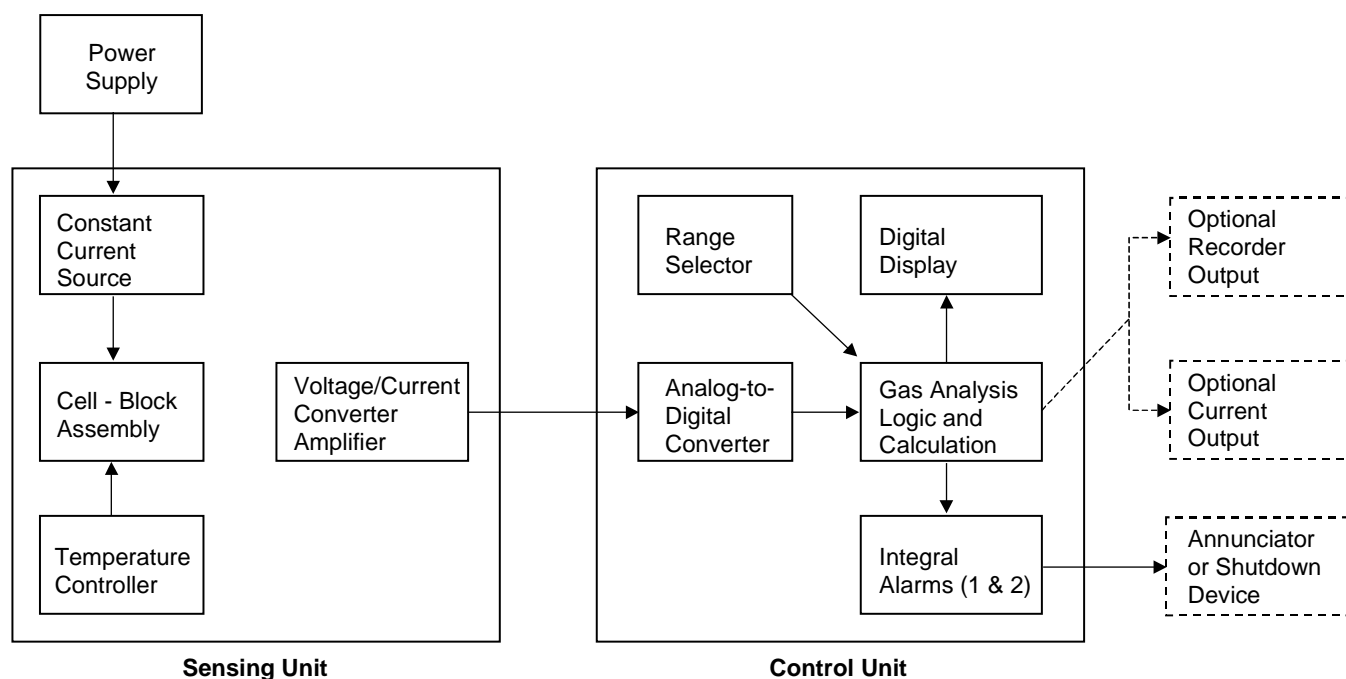


Figure 4 Block Diagram of 7866 Digital Thermal Conductivity Analyzer

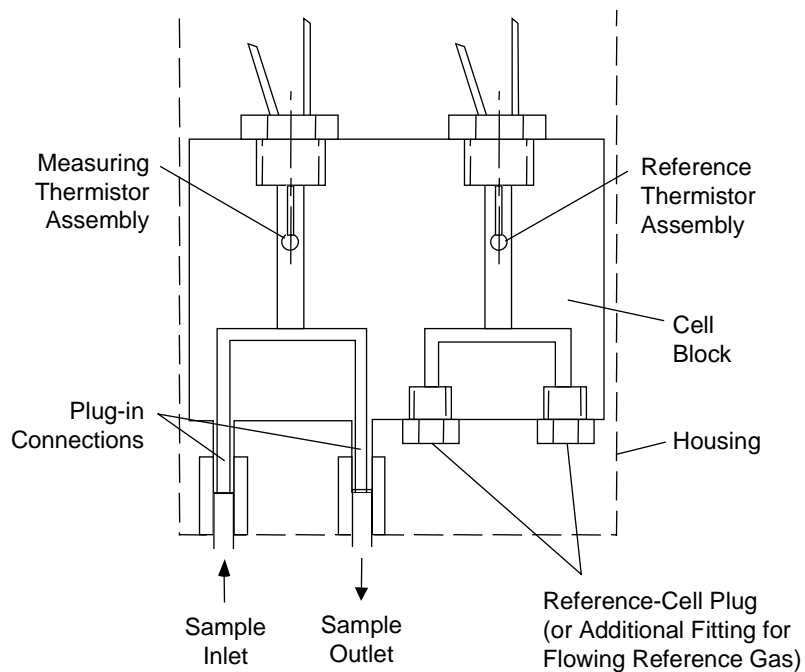


Figure 5—Cross-Section of 7866 Sensing Unit

Specifications

Performance	
Accuracy	± 2 % of span (output signal) at reference conditions for binary gas mixtures
Linearity	Within ± 2 % of span for most standard ranges. If linearity exceeds ± 2 % a correction curve is supplied with the analyzer.
Meter	<i>Accuracy:</i> ± 2 % of span <i>Digital Indication:</i> ± 0.1 %
Repeatability	Short term: ± 0.3 % of span
Reproducibility	24 hour: ± 1 % of span
Response Time	Maximum, for 4 cfh (2000 cc/min.) flow: For H ₂ ; initial, less than 1 second; 63 %: 13 seconds 90 %: 23 seconds 99 %: 40 seconds For CO ₂ ; Initial, less than 2 seconds; 63 %: 24 seconds 90 %: 45 seconds 99 %: 80 seconds
Maximum Drift	<i>Zero:</i> ± 2 % of span per week maximum <i>Span:</i> ± 2 % of span per week maximum
Ambient Temperature Influence	<i>At sensing unit:</i> Depends on range; typically less than 1 % F.S. over entire temperature range <i>At control unit:</i> ± 0.01% per °C (± 0.005 % of span per °F)
Atmospheric Pressure Influence	± 0.01 % of span per inch H ₂ O (± 0.05 % of span per mm Hg)
Sample Flow Rate Influence	Less than ± 0.5 % of span over flow range of 0.2 to 4 cfh (100 to 2000 cc/min)
Line Voltage Influence	Maximum 0.02 % of span for each 1 % change of line voltage
Operating	
Measuring Range	<i>Triple Range Analyzer</i> Three ranges—Range 1 measures CO ₂ in Air, Range 2 measures H ₂ in CO ₂ , and Range 3 measures H ₂ in Air <i>Single Range Analyzer</i> One range, as specified. For standard ranges, see Selection Guide Table in the Model Selection Guide.
Output Ranges	0-20 mA maximum load: 800 ohm 4-20 mA maximum load: 800 ohm
0/4-20 mA Output	<i>Triple Range Analyzer</i> <i>Range 1:</i> 0 to 100 % CO ₂ in Air <i>Range 2:</i> 0 to 100 % H ₂ in CO ₂ <i>Range 3:</i> 0 to 100 % H ₂ in Air <i>Single Range Analyzer</i> 0/4 mA at low range limit 20 mA at high range limit

Alarm Outputs	<p>One or two alarms are available; each uses an SPDT electromechanical relay.</p> <p>Alarm Relay Contacts Rating <i>Resistive Load:</i> 5 amps @ 24 Vdc or 120 Vac or 240 Vac <i>Inductive Load:</i> 50 VA</p>
Outputs	<p>One relay output for input sensor range control One or two additional relay outputs for Alarm 1 and Alarm 2 (when 2nd current output not required) One current output that represents value of PV of selected range. <i>Indicator model (available with Triple Range only):</i> 2nd current output (mutually exclusive with an alarm relay output)</p>
Sample Requirements	<p>Sample Flow: 0.2 to 4.2 cfh (100 cc/min to 2000 cc/min) Sample Pressure: 37 mm Hg (20" H₂O) minimum (with filter and flowmeter)</p>
Reference Gas Requirements	<p><i>Triple Range Analyzer</i> The triple range H₂ and CO₂ analyzer requires flowing air as the reference gas.</p> <p><i>Single Range Analyzer</i> None required, except for ranges 095000, 098000, 500006, 512000, and 516000; these require pure hydrogen reference gas flow, 0.02-0.2 cfh (10-100 cc/min).</p>
Ambient Requirements	<p><i>Relative Humidity:</i> 90 % maximum <i>Temperature Range:</i> -10 °C to +50 °C (14 °F to 122 °F) <i>Storage Temperature:</i> 70 °C maximum (158 °F)</p>
Power Requirements	<p><i>Control Unit only:</i> Universal supply 90 Vac to 264 Vac (consumption 18 VA maximum) or 24 Vac/dc (consumption 12 VA maximum); 50 Hz to 60 Hz</p>
Materials Contacting Sample Gas	<p>Sample contacts 316 stainless steel, Buna N, Teflon, glass and Viton</p>
Connections	<p><i>Sample inlet and outlet:</i> 1/4" OD tubing (compression fittings supplied) <i>Reference gas inlet and outlet:</i> 1/4" OD tubing (compression fittings supplied) <i>Electrical power inlet:</i> Opening for 1/2" conduit (control unit only) <i>Sensing unit power inlet (24 Vdc from control unit):</i> 1/2" NPT (female conduit)</p>
Communications (optional):	<p><i>Link Characteristics:</i> Two-wire multi-drop Modbus RTU protocol, 15 drops maximum or up to 31 drops for shorter link length <i>Distance:</i> 4000 feet maximum <i>Baud Rate:</i> 2400 baud, 4800 baud, 9600 baud, or 19.2K baud selectable <i>Data Format:</i> Floating point or integer <i>Parity:</i> Selectable odd or even</p>
Physical Specifications	<p>Sensing Unit: <i>Weight:</i> 8.5 kg (18-3/4 lb.) <i>Dimensions:</i> Approximately 150 mm x 150 mm x 325 mm (6 in. x 6 in. x 12-3/4 in.)</p> <p>Control Unit: <i>Weight:</i> 1.3 kg (3 lb.) <i>Dimensions:</i> <i>Bezel:</i> 96 mm H x 96 mm W (3.78" H x 3.78" W) <i>Case:</i> 92 mm H x 92 mm W x 192 mm D (3.62" H x 3.62" W x 7.55" D)</p>
Standards – Sensing Unit	<p>Designed to meet NEMA 7, Class I, Division 1, Groups A, B, C and D</p>

Standards – Control Unit	<p>This product is in conformity with the protection requirements of the following European Council Directives: 73/23/EEC, the Low Voltage Directive, and 89/336/EEC, the EMC Directive. Conformity of this product with any other “CE Mark” Directive(s) shall not be assumed.</p> <p><i>Product Classification:</i> Class I: Permanently connected, panel-mounted Industrial Control Equipment with protective earthing (grounding). (EN61010-1).</p> <p><i>Enclosure Rating:</i> Panel-mounted equipment, IP 00. This controller must be panel-mounted. Terminals must be enclosed within the panel. Front panel IP 65 (IEC 529).</p> <p><i>Installation Category (Overvoltage Category):</i> Category II: Energy-consuming equipment supplied from the fixed installation, local level appliances, and Industrial Control Equipment. (EN61010-1)</p> <p><i>Pollution Degree:</i> Pollution Degree 2: Normally non-conductive pollution with occasional conductivity caused by condensation. (Ref. IEC 664-1)</p> <p><i>EMC Classification:</i> Group 1, Class A, ISM Equipment (EN55011, emissions), Industrial Equipment (EN50082-2, immunity)</p> <p><i>Method of EMC Assessment:</i> Technical File (TF)</p> <p><i>Declaration of Conformity:</i> 51309602-000</p>
Miscellaneous	<p><i>Analyzer temperature:</i> Sensing unit thermostated at 50 °C (122 °F)</p>

Dimensions

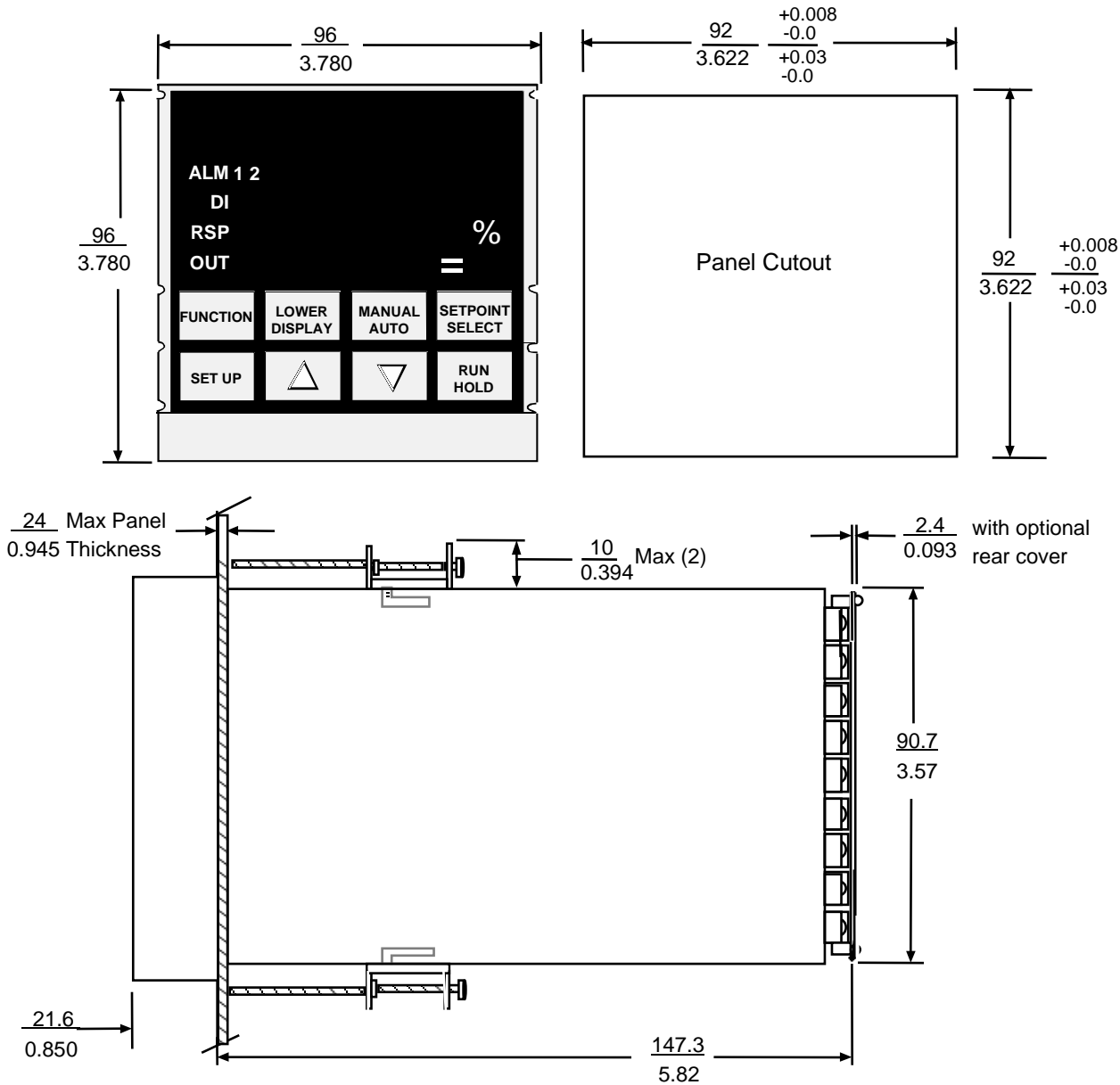


Figure 6—7866 Control Unit/Indicator Mounting Dimensions

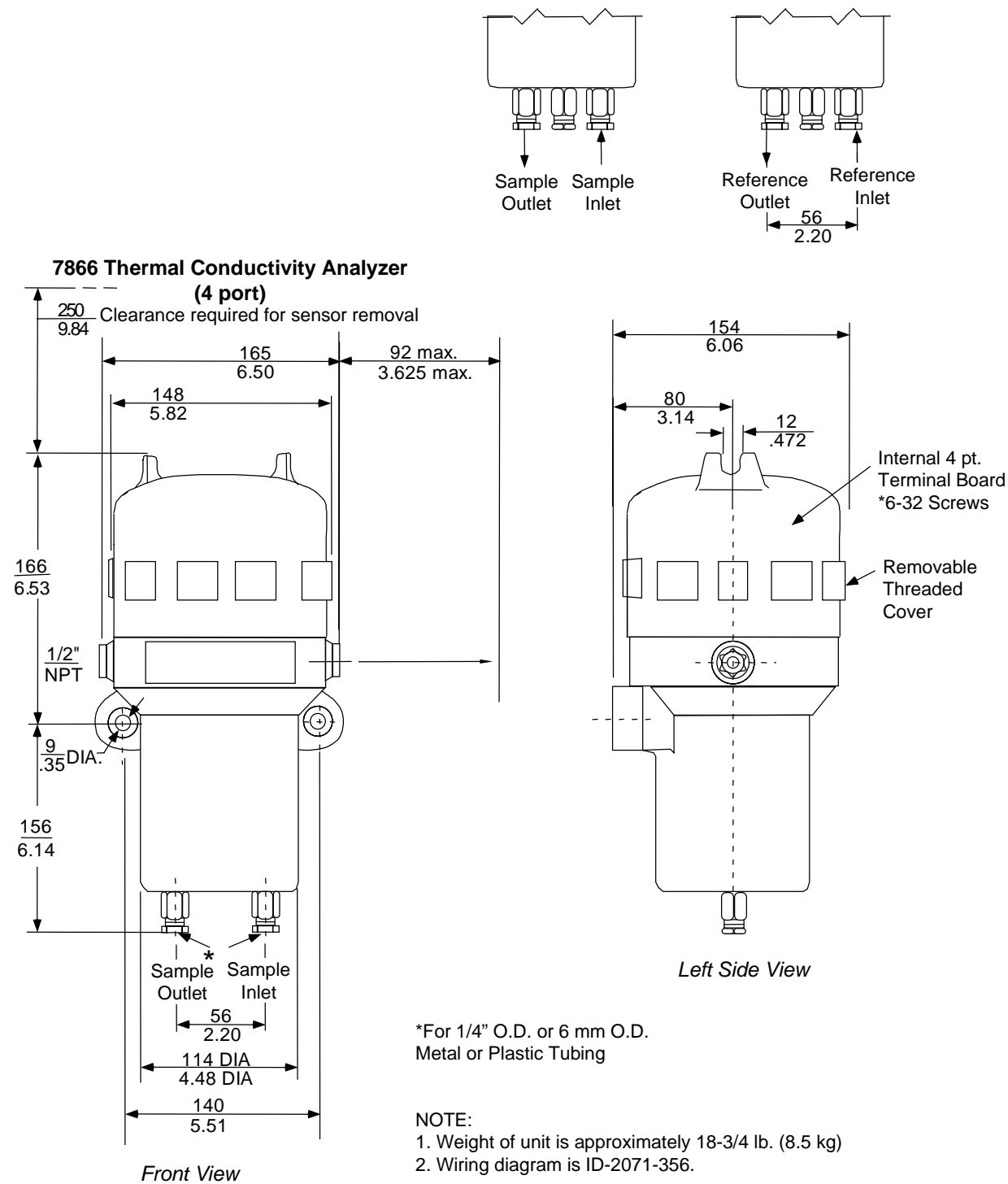


Figure 7—7866 Sensing Unit Mounting Dimensions

Model Selection Guides

Single Range Analyzer 51-52-16-78 Issue 1

Instructions

- Select the desired key number. The arrow to the right marks the selection available.
- Make one selection from Tables using the column below the proper arrow.
A dot (•) denotes unrestricted availability.

Key Number	I	II	III	IV	V	
	VI	VII	VIII			

KEY NUMBER	Description	Selection	Availability			
7866 Digital Thermal Conductivity Gas Analyzer consisting of:	a) 07866DS2 Sensor Assembly (includes housing)	07866DO2	↓			
	b) 07866DC2 Digital Control Unit	07866DC2		↓		
7866 Replacement Digital Control Unit <i>Only</i>		07866SS2			↓	
7866 Replacement Sensor Assembly - 2 Port (<i>Electronics Only</i>)		07866SS4				↓
7866 Replacement Sensor Assembly - 4 Port (<i>Electronics Only</i>)						

TABLE I - SENSOR POWER SUPPLY/LINE VOLTAGE

None	0		•	•	•
Input Voltage 105 - 125 VAC, 50 - 400 Hz.	2	•	•		
Input Voltage 210 - 250 VAC, 47 - 520 Hz.	4	•	•		

TABLE II - OUTPUT (PV RANGE)

None	0			•	•
0-20 mA	1	•	•		
4-20 mA	2	•	•		

TABLE III - COMMUNICATIONS

None	000	•	•	•	•
RS422/485/MODBUS	101	•	•		

TABLE IV - BACKGROUND GAS (Note: On replacement control unit chassis, selection must be same as selection on original unit)

Air, N ₂ , CO ₂ , or O ₂ where component being measured is % H ₂	1	j	j	j	j
Air, N ₂ , or O ₂ where component being measured is % CO ₂	2	k	k	k	
H ₂ where component being measured is % O ₂	4	l	l	l	
Air where component being measured is % He	5	m	m		m

		0	0	0	0
		7	7	7	7
		8	8	8	8
		6	6	6	6
		6	6	6	6
		D	D	S	S
		O	C	2	4
		2	2	2	4
TABLE V - RANGE (Note: On replacement control unit chassis, selection must be the same as selection on original unit)		Selection			
When measuring % H ₂ in Air, N ₂ , or O ₂ ; % H ₂ @:					
0-1	001000	c	•	•	
0-2	002000	c	•	•	
0-5	005000	c	•	•	
0-10	010000	c	•	•	
0-15	015000	c	•	•	
0-20	020000	c	•	•	
0-30	030000	c	•	•	
0-75	575000	c	•	•	
0-100	503000	c	•	c	
50-100	103000	h	•		•
80-100	080000	h	•		•
85-100	516000	h	•		•
90-100	506000	h	•		•
95-100	095000	h	•		•
98-100	098000	h	•		•
60-80	515000	c	•	•	
40-80	548000	c	•	•	
45-55	514000	c	•	•	
20-50	050000	c	•	•	
When measuring % CO ₂ in Air, N ₂ , or O ₂ ; % CO ₂ @:					
0-10	010000	c	•	•	
0-15	015000	c	•	•	
0-20	020000	c	•	•	
0-30	030000	c	•	•	
0-40	518000	c	•	•	
0-100	519000	c	•	•	
When measuring 0-100 % H ₂ in CO ₂	111000	c	•	•	
When measuring 70-100 % He in Air	510000	h	•		•
When measuring 95-100 % O ₂ in H ₂	090000	c	•	•	
Special application: 0-75% dissociated ammonia	075000	c	•	c	

Table VI - SENSOR UNIT

None	0		•		
Sealed Reference - 2 Port Explosion Proof	3	•		•	
Flowing Reference - 4 Port Explosion Proof	7	•			•

TABLE VII - FACTORY USE ONLY

Reservcd for Use by Fort Washington	0	•	•	•	•
-------------------------------------	---	---	---	---	---

			0	0	0	0
			7	7	7	7
			8	8	8	8
			6	6	6	6
			6	6	6	6
			D	D	S	S
			O	C	2	4
			2	2	2	4
TABLE VIII - OPTIONS		Selection				
None		000	•	•	•	•
Linen Tags: 15 characters max. On each of three lines: Specify legend. One mounted on control Unit. One on Sensing Unit		206	•	•	•	•
Stainless Steel Tag: 15 characters max. On each of three lines: Specify legend. One mounted on control Unit. One on Sensing Unit		208	•	•	•	•

ACCESSORY PARTS

Description	Part Number
Power Supply - Input Voltage 105-125VAC, 50-400 Hz	51450915-501
Power Supply - Input Voltage 210 -250VAC, 47-520 Hz	51450915-502
DIN Adaptor Plate	30755223-002

RESTRICTIONS

Restrictions Letter	Available Only With		Not Available With	
	Table	Selection	Table	Selection
c	VI	3		
h	VI	7		
j			V	090000, 510000, 518000, 519000
k	V	010000, 015000 20000, 030000 518000, 519000		
l	V	090000		
m	V	510000		

SELECTION GUIDE (Note 1)

Single % Range (no price adder)	Measurement Component	Background	Table IV Background Gas Code	Table V Range	Table VI Sensing Unit
0-1	% H ₂	Air or N ₂ or O ₂	1	001000	3
0-2				002000	
0-5				005000	
0-10				010000	
0-15				015000	
0-20				020000	
0-30				030000	
0-75				575000	↓
0-100				503000	3
50-100				103000	7
80-100				080000	7
85-100				516000	7
90-100				506000	7
95-100				095000	7
98-100				098000	7
60-80				515000	3
40-80				548000	3
45-55				514000	3
20-50				050000	3
0-10	% CO ₂	Air or N ₂ or O ₂	2	010000	3
0-15				015000	
0-20				020000	
0-30				030000	
0-40				518000	
0-100				519000	↓
0-100	% H ₂	CO ₂	1	111000	3
70-100	% He	Air	5	510000	7
95-100	% O ₂	H ₂	4	090000	3
0-75 dissociated ammonia	% H ₂	N ₂	1	075000	3
Triple Range: For hydrogen cooled generator applications, See GA-21 for pricing on 7866DHH2 and GA-3 for <i>Optional</i> 7872 Sampling System.					

NOTES:

1. This Selection Guide is included to assist in the model selection process for 7866 Digital Thermal Conductivity Gas Analyzers.

Triple Range Analyzer 51-52-16-79 Issue 1

Instructions

- Select the desired Key Number. The arrow to the right marks the selection available.
- Make one selection each from Table I using the column below the proper arrow.
- A dot (•) denotes unrestricted availability.

Key Number

_____ - ☐ I ☐ II ☐ III ☐ IV ☐ V ☐ VI

KEY NUMBER

Selection Availability

7866 Digital Thermal Conductivity Analyzer <i>for Hydrogen Cooled Generator Applications consisting of:</i>	07866DHH2	↓			
a) 07866DHS2 Sensor Assembly (includes housing)					
b) 07866 7866DHC2 Digital Control Unit					
7866 Replacement Digital Control Unit only (<i>for Hydrogen Cooled Generator Applications</i>)	07866DHC2		↓		
7866 Digital Remote Range Indicator	07866DRRI			↓	
7866 Replacement Sensor Assembly (electronics only)	07866HHSS				↓

TABLE I - SENSOR POWER SUPPLY/LINE VOLTAGE

None	0	•	•	•	•
Input Voltage 105 -125VAC, 50-400 Hz	2	•	•		
Input Voltage 210 -250VAC, 47-520 Hz	4	•	•		

TABLE II - OUTPUT (PV RANGE)

None	0	•	•	•	•
0-20 mA	1	•	•		
4-20 mA	2	•	•		

TABLE III - COMMUNICATIONS

None	000	•	•	•	•
RS422/485/MODBUS	101	•	•		

TABLE IV - INDICATOR USE

None	0	•	•	•	•
For Use Without 07866DRRI Indicator	1	•	•		
For Use With 07866DRRI Indicator	2	•	•		



TABLE V - Factory Use Only

	Selection	DHH2	DHC2	DRRI	HHSS
Reserved for Use by Fort Washington	000	•	•	•	•

TABLE VI - TAGGING

None	000	•	•	•	•
Linen Tags: 15 characters max. On each of three lines: Specify legend. One mounted on Control Unit; one on Sensing Unit.	206	•	•	•	•
Stainless Steel Tags: 15 characters max. On each of three lines: Specify legend. One mounted on Control Unit; one on Sensing Unit.	208	•	•	•	•

ACCESSORY PARTS

Description	Part Number
Power Supply - Input Voltage 105-125VAC, 50-400 Hz	51450915-501
Power Supply - Input Voltage 210 -250VAC, 47-520 Hz	51450915-502
DIN Adaptor Plate	30755223-002

For more information, contact Honeywell sales at (800) 343-0228.

WARRANTY/REMEDY

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Contact your local sales office for warranty information. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace without charge those items it finds defective. The foregoing is Buyer's sole remedy and is **in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose.** Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

Distributor :

Honeywell

Sensing and Control

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