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NON-DISPERSIVE INFRARED ANALYZER MODULE



748417-A

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The information contained in this document is subject to change without notice.

This manual is based on the production version of the Non-Dispersive Infrared Analyzer Module. Hardware and/or software changes may have occurred since this printing.

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Manual Part Number 748417-A
August 1999
Printed in U.S.A.

Rosemount Analytical Inc.
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Anaheim, California 92807-1802

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PURPOSE/SAFETY SUMMARY

The purpose of this manual is to provide information concerning the components, functions, installation and maintenance of this particular NGA 2000 module.

Some sections may describe equipment not used in your configuration. The user should become thoroughly familiar with the operation of this module before operating it. Read this instruction manual completely.



To avoid explosion, loss of life, personal injury and damage to this equipment and on-site property, all personnel authorized to install, operate and service this equipment should be thoroughly familiar with and strictly follow the instructions in this manual. Save these instructions.

If this equipment is used in a manner not specified in these instructions, protective systems may be impaired.

DANGER is used to indicate the presence of a hazard which will cause severe personal injury, death, or substantial property damage if the warning is ignored.

WARNING is used to indicate the presence of a hazard which can cause severe personal injury, death, or substantial property damage if the warning is ignored.

CAUTION is used to indicate the presence of a hazard which will or can cause minor personal injury or property damage if the warning is ignored.

NOTE is used to indicate installation, operation or maintenance information which is important but not hazard-related.



WARNING: ELECTRICAL SHOCK HAZARD

Operate this equipment only when covers are secured. Servicing requires access to live parts which can cause death or serious injury. Refer servicing to qualified personnel. For safety and proper performance, this module must be connected to a properly grounded three-wire source of electrical power.

WARNING: POSSIBLE EXPLOSION HAZARD



This equipment is not designed for and should not be used in the analysis of flammable samples. Use of this equipment in this way could result in explosion and death.

Ensure that all gas connectors are made as labeled and are leak free. Improper gas connections could result in explosion or death.

WARNING: OVER-VOLTAGE SPIKING



If this Analyzer Module is used with a non-Rosemount Analytical power supply, adding Rosemount Analytical PN 903341 Current Protector in series with the 24V positive power line will prevent over-voltage spiking and resultant fuse blowing when powering up the instrument.

CAUTION: PRESSURIZED GAS



This module requires periodic calibration with a known standard gas. See General Precautions for Handling and Storing High Pressure Gas Cylinders at the rear of this manual.

CAUTION: HAND INJURY HAZARD



Dropping the front panel of the Platform while hand or fingers are inside either case handle can cause serious injury.

CAUTION: PARTS INTEGRITY



Tampering with or unauthorized substitution of components may adversely affect safety of this product. Use only factory approved components for repair.

CAUTION: OVERBALANCE HAZARD



This Analyzer Module may tip instrument over if it is pulled out too far and the Platform is not properly supported.

NOTE

Apply leak test liquid to cell or detectors only as a last resort.

GLOSSARY

Analyzer Module

The module that contains all sensor/detector components for development of a Primary Variable signal; includes all signal conditioning and temperature control circuitry.

Backplane

The interconnect circuit board which the Controller Board, Power Supply, Analyzer Module power and network cables, I/O Modules and Expansion Modules plug into.

Control Module

The Operator Interface plus the Controller Board.

Controller Board

The computer board that serves as the Network Manager and operates the Display and Keypad.

Distribution Assembly

The Backplane and the card cages that hold I/O and Expansion Modules.

Expansion Module

A circuit board that plugs into the Backplane from the front of the Platform and performs special features not related to I/O functions.

I/O Module

A circuit board that plugs into the Backplane from the rear of the Platform. Has a connector terminal for communication with external data acquisition devices and provides an input/output function.

Operator Interface

The Display and Keyboard.

Platform

Any workable collection of the following: Controller Board, Power Supply, Distribution Assembly, Enclosure and Operator Interface.

Power Supply

Any of a variety of components that provides conditioned power to other NGA 2000 components, from the Power Supply Board that plugs into the front of the Backplane in a stand-alone instrument to several larger ones that can power larger collections of modules and components.

Primary Variable

The measured species concentration value from an Analyzer Module.

Secondary Variable

Data placed on the network by a module regarding current status, e.g., sample flow, source voltage and other diagnostic information.

Softkeys

The five function keys located below the front panel display; they assume the function displayed directly above each on the display, a function dictated by software.

System

Any collection of Analyzer Module(s), Platform(s), I/O Module(s) and Expansion Module(s).

SPECIFICATIONS - GENERAL

MEASUREMENT SPECIES:	Heteroatomic gases such as ammonia (NH_3), carbon dioxide (CO_2), carbon monoxide (CO), carbon monoxide + carbon dioxide ethylene (C_2H_4), hexane (C_6H_{14}), methane (CH_4), nitric oxide (NO) and sulfur dioxide (SO_2)
RANGES:	10 ppm fullscale to 100% fullscale (application-dependent); 4 fullscale selections, including suppressed zero ranges
REPEATABILITY:	±1% of fullscale (at constant temperature)
MINIMUM DETECTABLE LEVEL:	0.1% CO_2 (at 1 atm. sample pressure; application dependent)
NOISE:	<1% of fullscale, peak-to-peak
LINEARITY:	±1% of fullscale with 4th order polynomial
RESPONSE TIME:	.05 to 30 seconds (selectable) for 0 to 90% of fullscale
DRIFT (ZERO AND SPAN):	<±1% of fullscale/24 hours at constant temperature (application dependent); <±2% of fullscale/week at constant temperature (application dependent)
EFFECT OF TEMPERATURE:	<±1% of fullscale over any 10°C interval for rate of change no greater than 10°C per hour (application dependent)
ENVIRONMENT:	Location - Class B controlled, indoor, non-hazardous
AMBIENT TEMPERATURE:	0 to 45°C (32 to 113°F)
EFFECT OF FLOW:	<1% of range when sample flow rate is changed by ≤250 ml/min. (No effect if flow rate is between 0 and 500 ml/min.)
POWER REQUIREMENTS:	24 VDC ±5%, 100 W max.; ripple and noise: <100 mV peak-to-peak; line and load regulations: <±1%

SPECIFICATIONS - SAMPLE

TEMPERATURE:	Non-flammable;: 0°C to 55°C (32°F to 138°F)
FLOW RATE:	500 to 1400 ml/min.
PRESSURE:	Maximum 690 hPa-gauge (10 psig), higher pressure in pressurized cell applications
PARTICULATES:	filtered to <2 microns
DEWPOINT:	<40°C (104°F), no entrained liquid
MATERIALS IN CONTACT WITH SAMPLE:	Gold plated Pyrex, sapphire, quartz, Irtran, FEP Teflon, Viton-A, 316 stainless steel

SPECIFICATIONS - PHYSICAL

CASE CLASSIFICATION:	General purpose for installation in weather-protected areas
DIMENSIONS:	See Outline and Mounting Dimensions, Figure 2-3
WEIGHT:	Standard: 11 kg (24.2 lbs.); extended: 12.5 kg (27.5 lbs.)
MOUNTING:	Inside a Platform or custom-installed in a panel
MAXIMUM LENGTH OF LON CABLE:	1600 m (1 mile) between Analyzer Module and Platform

See the Preface Section of the Platform manual for specifications regarding Platform related components.

CUSTOMER SERVICE, TECHNICAL ASSISTANCE AND FIELD SERVICE

For order administration, replacement Parts, application assistance, on-site or factory repair, service or maintenance contract information, contact:

Rosemount Analytical Inc.
Process Analytical Division
Customer Service Center
1-800-433-6076

RETURNING PARTS TO THE FACTORY

Before returning parts, contact the Customer Service Center and request a Returned Materials Authorization (RMA) number. Please have the following information when you call: *Model Number, Serial Number, and Purchase Order Number or Sales Order Number.*

Prior authorization by the factory must be obtained before returned materials will be accepted. Unauthorized returns will be returned to the sender, freight collect.

When returning any product or component that has been exposed to a toxic, corrosive or other hazardous material or used in such a hazardous environment, the user must attach an appropriate Material Safety Data Sheet (M.S.D.S.) or a written certification that the material has been decontaminated, disinfected and/or detoxified.

Return to:

Rosemount Analytical Inc.
4125 East La Palma Avenue
Anaheim, California 92807-1802

TRAINING

A comprehensive Factory Training Program of operator and service classes is available. For a copy of the *Current Operator and Service Training Schedule* contact the Technical Services Department at:

Rosemount Analytical Inc.
Phone: 1-714-986-7600
FAX: 1-714-577-8006

DOCUMENTATION

The following Non-Dispersive Infrared Analyzer Module instruction materials are available. Contact Customer Service or the local representative to order.

748417 Instruction Manual (this document)

COMPLIANCES

This product may carry approvals from several certifying agencies, including Factory Mutual and the Canadian Standards Association (which is also an OSHA accredited, Nationally Recognized Testing Laboratory), for use in non-hazardous, indoor locations

FM APPROVED

97-C219

Rosemount Analytical Inc. has satisfied all obligations from the European Legislation to harmonize the product requirements in Europe.

CE

This product complies with the standard level of NAMUR EMC. Recommendation (May 1993).

NAMUR

This product satisfies all obligations of all relevant standards of the EMC framework in Australia and New Zealand.

N96

1.1 OVERVIEW

This manual describes the Non-Dispersive Infrared (NDIR) Analyzer Module of Rosemount Analytical's NGA 200 Series of gas analysis components.

The NDIR Analyzer Module is designed to continuously determine the concentration of oxygen in a flowing gaseous mixture. The concentration is expressed in one of three fashions:

- parts-per-million
- percent of composition
- percent of fullscale

The user can obtain an output that is linear with concentration by initiating a linearizer, which is based on a fourth-order polynomial. The linearizer is incorporated in the Analyzer Module's electronic circuitry and is adjustable through interconnection with the network.

The entire Analyzer Module is designed as a slide-in module (if configured in stand-alone instrument fashion), removable from the front of the Platform, with gas connections made from the rear. All electronics relative to sample detection and conditioning are included in this module.

1.2 TYPICAL APPLICATIONS

The NDIR Analyzer Module is designed to cover a wide range of process, stack and automotive applications. Typical measurements include:

Chemical and Petroleum

- Carbon dioxide: Manufacture of ethylene oxide, phthalic anhydride and ammonia; nitrogen generation; and producer gas monitoring
- Carbon Monoxide: Stack monitoring
- Methane: Ammonia manufacture
- Acetylene: Manufacture of acetylene, acrylonitrile, and vinyl chloride
- Sulfur Dioxide: Sulfuric acid stack gas

Food and Agriculture

- Carbon Dioxide and Water Vapor: Blanketing of perishables, fermentation processes, photosynthesis studies, personnel protection

Aerospace and Oceanography

- Carbon Dioxide, Carbon Monoxide, and Water Vapor: Diving and space chambers

Metals and Ceramics

- Carbon Dioxide: Monitoring of producer gas, steel converting, manufacture of cement, soaking pit, heat treating
- Carbon Monoxide: Inert gas generation, producer gas monitoring, rotary kiln roasting, tin plate annealing, steel converting, aluminum power processing, porcelain kilns, tunnels
- Water Vapor: Heat treating, hydrogen brazing, nickel and chrome plating
- Sulfur Dioxide: Flash smelting
- Ammonia: Ammonia dissociation

1.3 THEORY OF TECHNOLOGY

Inside of the Analyzer Module, two equal-energy infrared beams are directed through two parallel optical cells, a flow-through sample cell and a reference cell. The reference cell may be sealed or may contain a continuously flowing reference gas. (See Figure 1-1.)

The infrared radiation is interrupted by a chopper at a frequency of 5 Hz.

During analysis, a portion of the infrared radiation is absorbed by the component of interest in the sample. The quantity of infrared radiation that is absorbed is proportional to the component concentration.

The detector is a "gas microphone" based on the Luft principle. The detector is generally filled with the same gas being analyzed. The infrared energy is therefore absorbed at the same wavelengths in the detector as that in the sample cell, making the detector specific for the analyzed component. The detector converts the difference in energy between sample and reference cells to a capacitance change. This change, which is proportional to component concentration, is processed and expressed as the primary variable on the network.

Other modules comprising the NGA 2000 unit then use this variable for a variety of purposes (e.g., expressing the gas concentration on the Front Panel Display or sending it to external data acquisition devices).

For a general understanding of the electrical interconnections in the NDIR Analyzer Module, see Figure 2-4.

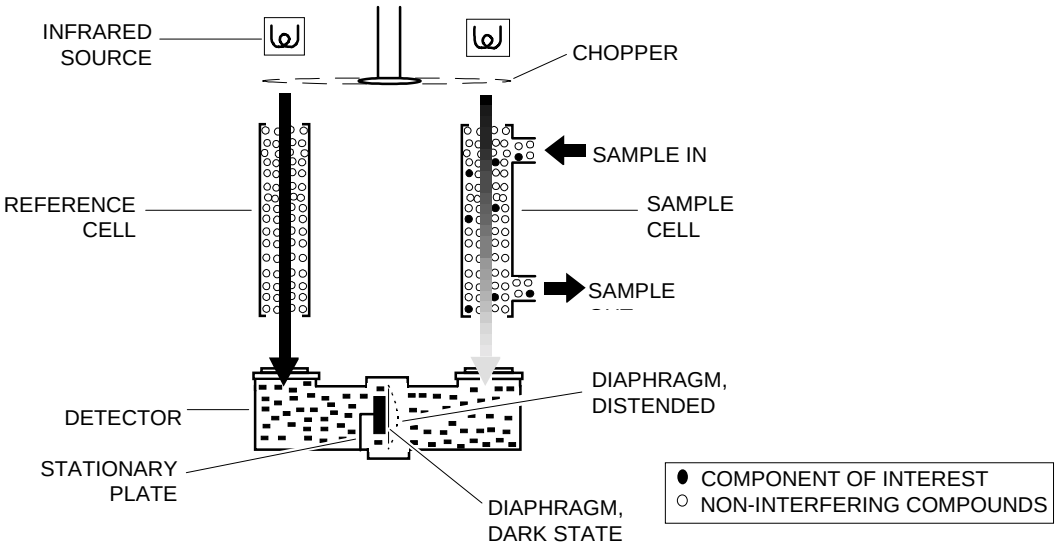


FIGURE 1-1. NDIR TECHNOLOGY

1.4 SAMPLE REQUIREMENTS

Maximum allowable sample pressure is 690 hPa-gauge (10 psig) for a standard configuration NDIR that has a flow restrictor which sets the flow at between 0.5 L/min. to 1 L/min. Special high pressure cells (up to 10,350 hPa-gauge, 150 psig) are available. Sample temperature range is 0°C to 55°C, and maximum dewpoint is 40°C. The sample must be filtered to exclude particulates larger than 2 microns in size. Consult factory for special configurations with specifications outside of those listed above.

1.5 PURGE KITS

A purge kit for the motor source or motor source/flowing reference cell accompanies some NDIR modules. The purpose of these kits is to improve performance and accuracy through the reduction of ambient CO_2 interference. ***They do not provide protection from explosion hazard.*** The purge gas vents into the case, which has no outlet fitting for these types of purge gases.

1.6 FEATURES

Among the features available in the NDIR Analyzer Module are:

- Pressure compensation for barometric fluctuations (optional)
- Flow sensing

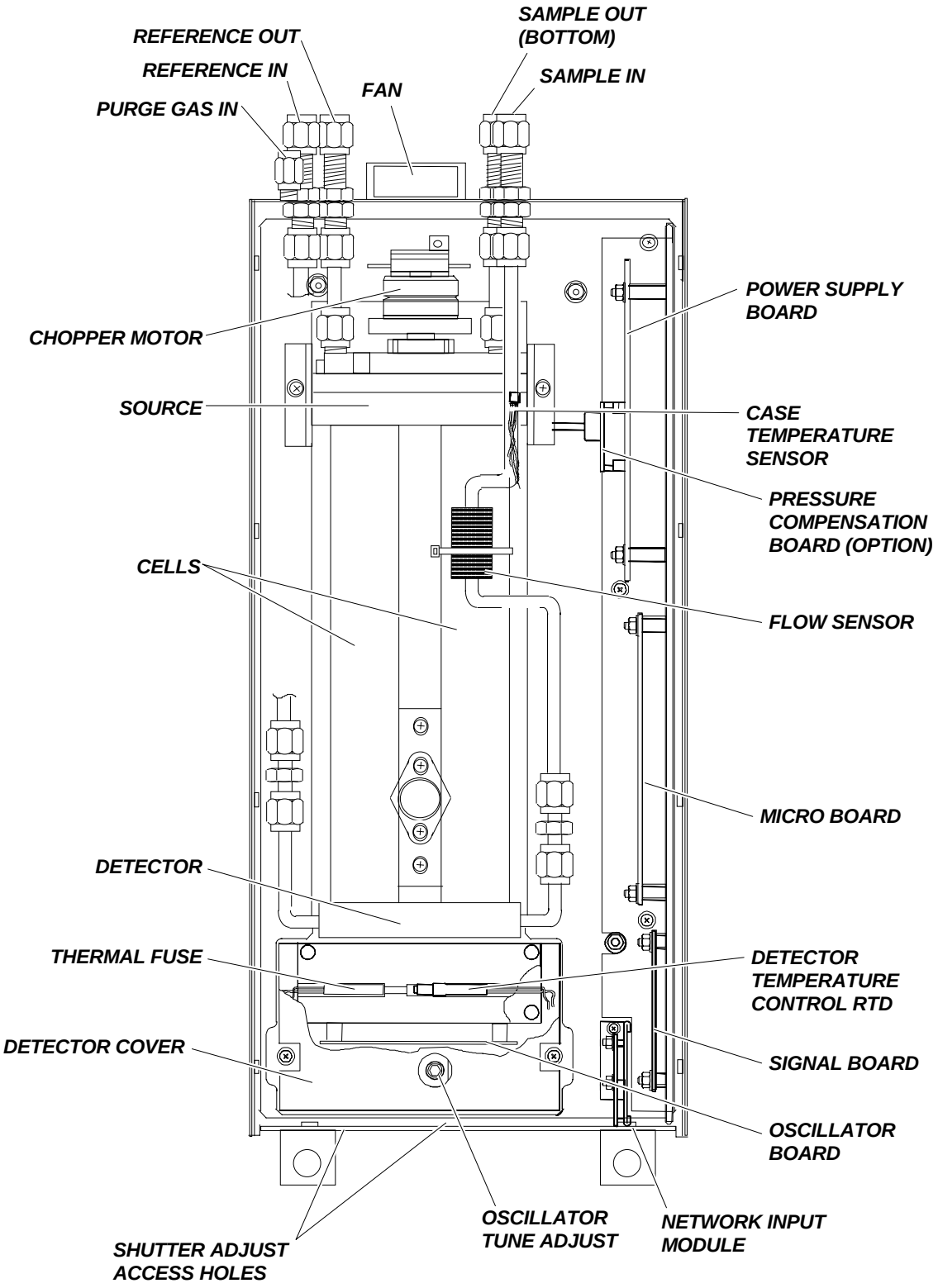


FIGURE 1-2. NGA 2000 NDIR ANALYZER MODULE (TYPICAL - ACTUAL CONFIGURATION MAY VARY)

NOTES

2.1 UNPACKING

If the NDIR Analyzer Module is received as a separate unit, carefully examine the shipping carton and contents for signs of damage. Immediately notify the shipping carrier if the carton or contents is damaged. Retain the carton and packing material until all components associated with the Analyzer Module are operational.

2.2 ASSEMBLY

If the NDIR Analyzer Module requires assembly with other components (e.g., the Platform and associated I/O Modules), do so at this time. Following the guides on the bottom left and bottom center of the Platform, carefully slide the Analyzer Module halfway into place.

CAUTION: HAND INJURY HAZARD

Do not place hands or fingers in the Platform front handles when front panel is open. Dropping the front panel of the Platform while hand or fingers are inside either handle can cause serious injury.

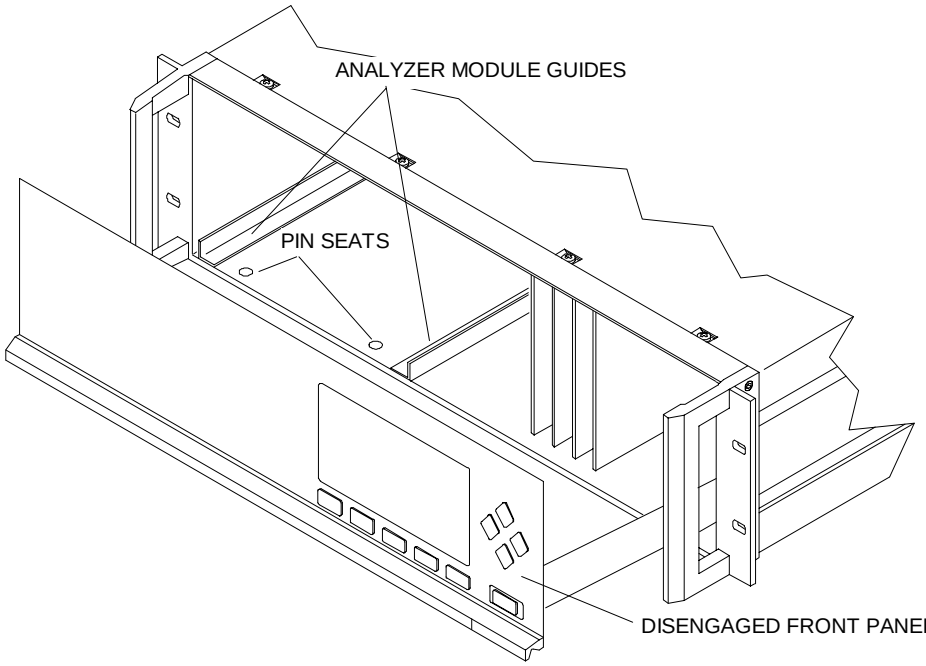


FIGURE 2-1. ANALYZER MODULE INSTALLATION INTO INSTRUMENT PLATFORM

Lift the spring-loaded pins on the front of the Analyzer Module, and carefully slide it the rest of the distance. Secure the module in position by releasing the pins, which seat in the available holes in the bottom of the case (see Figure 2-1). If the module and Platform are difficult to assemble, remove the module, ensure the top cover of the module is firmly seated on the hold-down screws, and repeat the assembly procedure.

Install I/O Module(s) according to guidelines in the I/O manual. After startup and calibration have been performed, secure the front panel with the six screws provided.

2.3 LOCATION

Install the NDIR Analyzer Module in a clean, non-hazardous, weather protected, vibration free location free from extreme temperature variations. For best results, install the instrument near the sample stream to minimize sample transport time. Operating ambient temperature is 0°C to 45°C (32°F to 113°F). Sample dewpoint is 40°C or less.

NOTE

Unrestricted air flow in the rear of the Analyzer Module is critical to its performance and reliability.

CELL LENGTH		CELL VOLUME CC	TOTAL VOLUME CC	TIME FOR 2 VOLUMES @ 2 SCFH (1L/MIN)
mm	inch	without inlet tube	cell with inlet tube	at 750 mm Hg
3	0.118	0.85	12	2 sec.
4	0.157	1.14	12	2 sec.
8	0.315	2.28	13	2 sec.
16	0.630	3.56	16	2 sec.
32	1.25	9.12	20	2 sec.
64	2.52	18.24	25	3 sec.
128	4.03	35.48	44	3 sec.
232	9.13	65.12	73	6 sec.
343	13.50	97.76	105	13 sec.
381	15.00	108.60	116	14 sec.

TABLE 2-1. CELL PURGING TIMES AT ATMOSPHERIC SAMPLE PRESSURE

2.4 GASES

2.4.1 SPECIFICATIONS

Calibration Gases

All applications require a zero standard gas to set the zero point on the display and external data acquisition devices. if the factory provided Calibration and Data Sheet (in the rear of the manual) specifies a background gas, use this as a zero gas. If a background gas is not specified, use dry nitrogen.

Span gas should be between 75% and 100% of fullscale span. Flowing reference (if used) should be dry nitrogen.

Flow Rate

Recommended sample flow rate is 1 to 2 SCFH (500 TO 1000 cc/min). A lower flow rate will not affect readings but may result in an undesirable time lag. Excessive flow can produce increases cell pressurization and reading error.

At higher cell pressures, the nonlinearity of the calibration curve increases. Therefore, the calibration curve should be redrawn for higher flow rates. Also, the effect of increased cell pressurization can be negated if the same flow rate is used for sample, zero and span gases. But, if flow is high enough to cause elevated pressure, careful control (tighter tolerance) of flow rate is required to avoid errors.

If low is kept at or below 2 SCFH (1 L/min), sample and instrument temperatures reach equilibrium regardless of stream temperature (within specifications; 0 to 55°C). At extremely high flow rates, this may not be true, although no such effect has been noted up to 18 SCFH (9 L/min).

See Table 2-1 for cell purging times at atmospheric sample pressure.

Sample Pressure/Filtration

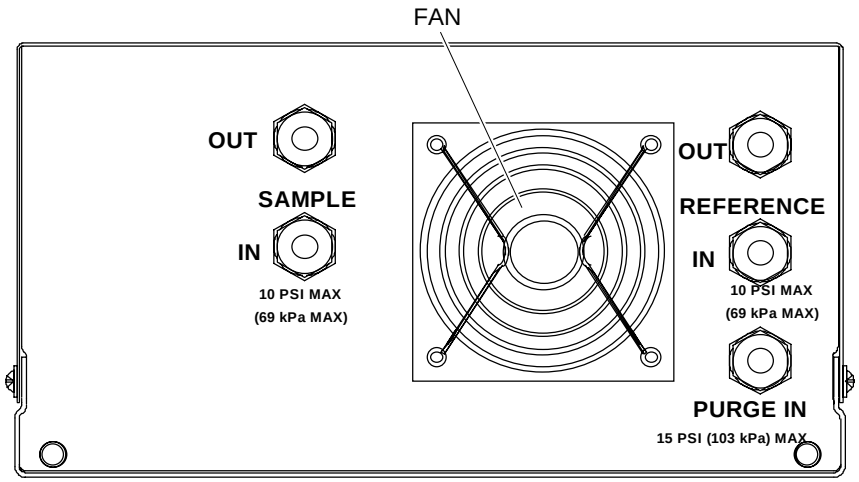
Sample should be introduced to the Analyzer Module at a maximum 690 hPa-gauge (10 psig). Pressurized applications are available, which require pressurized cells and careful control of flow rates, consult factory for these applications. Sample should be filtered for particulates down to two microns.

Leak Test

The Analyzer Module is completely tested at the factory for gas leakage. The user is responsible for testing for leakage only at the inlet and outlet fittings on the rear panel. The user is also responsible for internal leak testing periodically and if any internal pneumatic components are adjusted or replaced (with a test procedure chosen by the user).

2.4.2 CONNECTIONS

(See Figure 2-2) Connect inlet and outlet lines for sample/zero/span and flowing reference (if applicable) to appropriately labeled fittings on the rear panel. All four connections are 1/4 inch ferrule-type compression fittings.



Note: Reference and purge gas connections are applicable only to certain applications.

FIGURE 2-2. NDIR BACK PANEL

2.5 ELECTRICAL CONNECTIONS

NOTE

Electrical connections must be in compliance with National Electrical Code (ANSI/NFPA 70) and/or any applicable national or electrical codes.

Two electrical connections are required on the Analyzer Module; POWER and NETWORK. See Figure 2-3. On the Analyzer Module, two NETWORK connections are available, either of which is appropriate for : 1) interconnection with Backplane of the Platform (see Platform instruction manual) or 2) "daisy chaining" with other NGA 2000 components.

Connect Analyzer Module POWER 24 VDC power source, either the Platform or external power source.

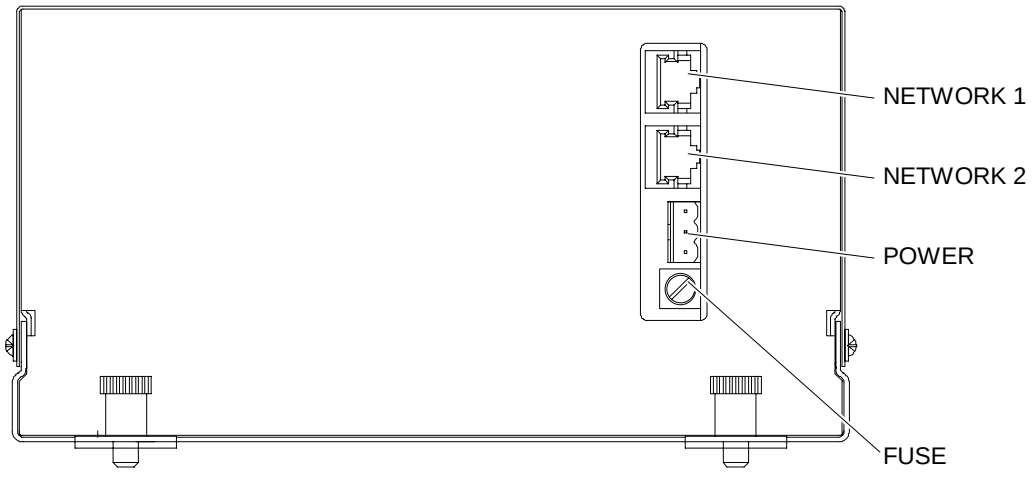


FIGURE 2-3. NDIR FRONT PANEL ELECTRICAL CONNECTIONS

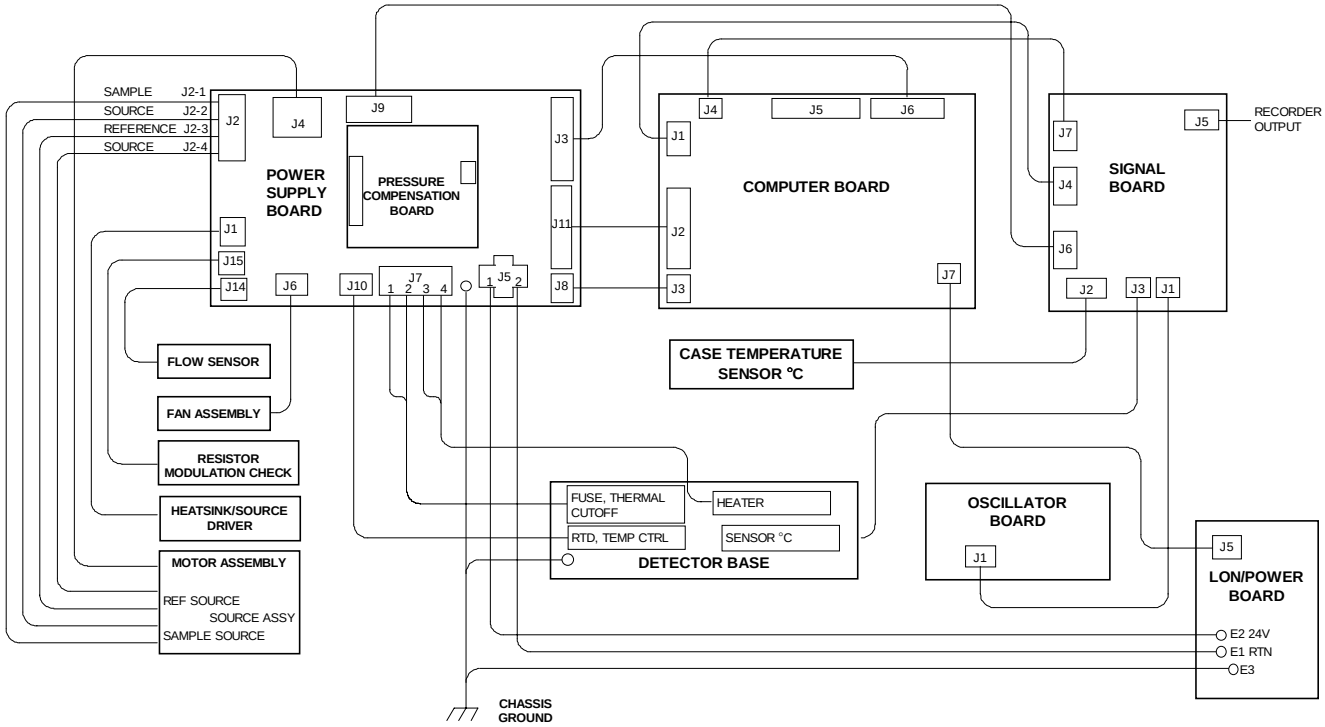
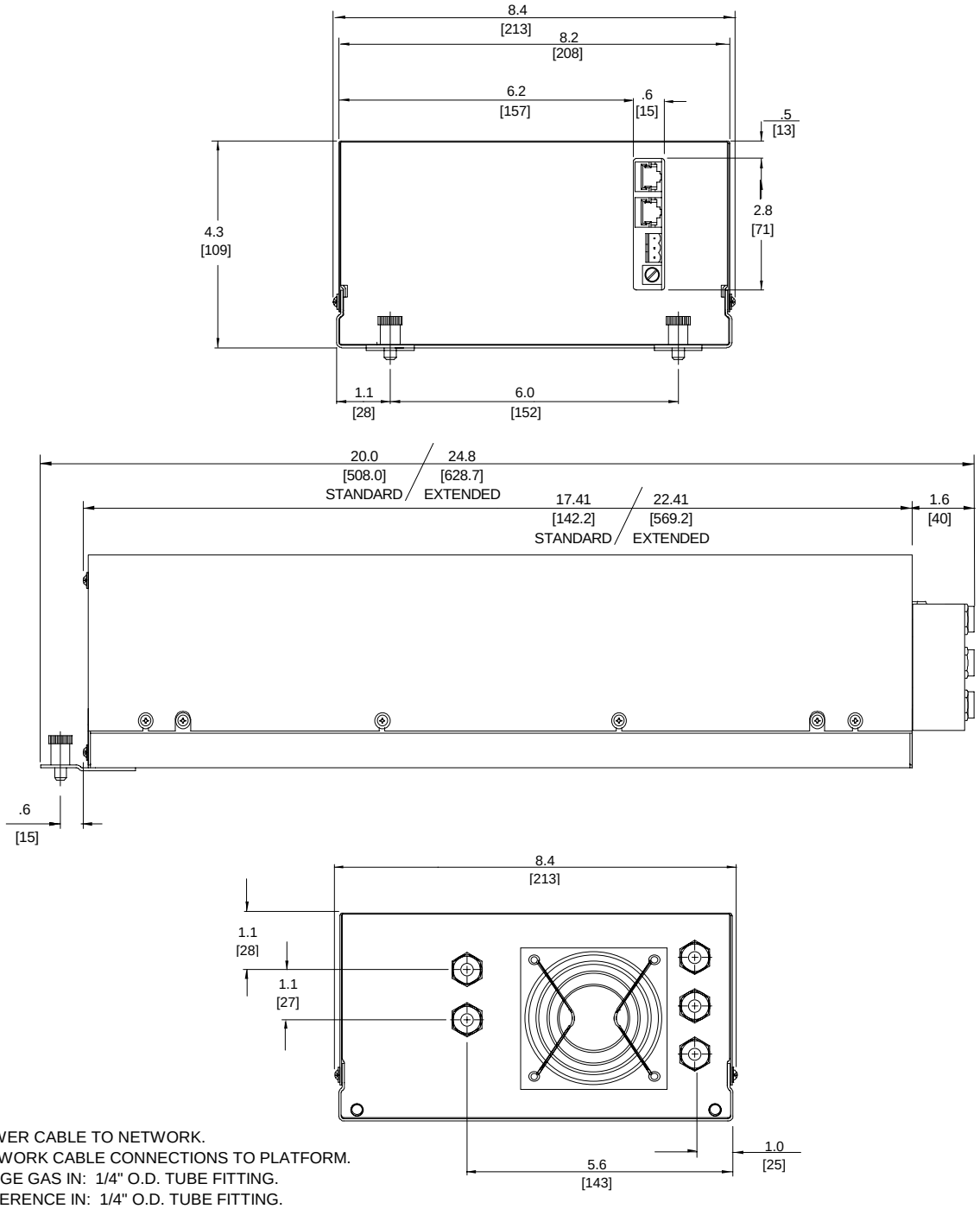


FIGURE 2-4. NDIR WIRING DIAGRAM



G. POWER CABLE TO NETWORK.
F. NETWORK CABLE CONNECTIONS TO PLATFORM.
E. PURGE GAS IN: 1/4" O.D. TUBE FITTING.
D. REFERENCE IN: 1/4" O.D. TUBE FITTING.
C. REFERENCE OUT: 1/4" O.D. TUBE FITTING.
B. SAMPLE OUT: 1/4" O.D. TUBE FITTING.
A. SAMPLE IN: 1/4" O.D. TUBE FITTING.

5. MODULE TO BE INSTALLED WITHIN ±15° OF HORIZONTAL.
4. POWER REQUIREMENTS: 24 VDC 3.5 A.
3. ELECTRICAL INSTALLATION MUST BE IN COMPLIANCE WITH NATIONAL ELECTRICAL CODE (ANSI/NFPA 70) AND/OR ANY APPLICABLE NATIONAL OR LOCAL CODES.
2. MODULE IS NOT WEATHERPROOF.
1. APPROXIMATE WEIGHT: 24.2 LB (11.0 kg).

DIMENSIONS

INCH
[mm]

FIGURE 2-5 OUTLINE AND MOUNTING DIMENSIONS

NOTES

3.1 OVERVIEW

Prior to initial startup, the user should leak test the module as outlined in Section 2.

For the remainder of this section, Analyzer Module interconnection with a Platform or some interfacing component will be assumed. Display and Keypad information shall refer to that which the user can expect to see and do with regard to the Front Panel of the Platform.

(For a complete description of Platform Front Panel controls and indicators, see Section 1 of the Platform Components instruction manual.)

3.2 DISPLAYS SCREENS

Three kinds of Display Screens are available to the user (see Figures 3-1 through 3-6.):

- Run Mode
- Menu
- Help

3.2.1 RUN MODE DISPLAY

The Run Mode is the normal mode of operation. In this mode, the Display will show current gas measurement, the component of interest, the current operations of the softkeys, a graphic bar representing the displayed concentration as a percent of fullscale, and up to 4 user-selectable secondary variables and associated bargraphs.

If more than one Analyzer Module is connected to the system, the Run Mode display will show as many as four gas measurements on a single screen. Alarm messages may also appear on the display (See Table 3-1).

3.2.2 MENU DISPLAYS

The Menu structure enables the user to access data and functions, and put information onto the network.

The Main Menu (see Figure 3-2) is subdivided into three levels of control based generally on which personnel is likely to use it: Basic Controls, Expert Controls and Setup, and Technical Controls. (See Figures 3-3 through 3-5.) Many layers of the menu structure are described at appropriate places throughout this manual.

From the Run Mode display, press the MENUS softkey to gain access to the Main Menu. (See Figure 3-2.)

3.2.3 HELP DISPLAYS

The Help structure is on-line "tutorial," context-sensitive and topic-interconnected, so that the user can practically operate NGA 2000 without need of an instruction manual.

3.3 STARTUP PROCEDURE

Introduce zero gas into SAMPLE INLET and reference and source purge gas, if applicable, into their respective inlets. Ensure that gas pressures are set to requirements listed on the Specifications page of the Preface section of this manual.

Apply power to the NDIR Analyzer Module. If it is associated with a Platform, do this by plugging in the Platform to a power source. The Platform has no ON/OFF power switch. Once power has been supplied to the Platform, the NDIR Analyzer Module will be energized.

If the user's system contains only one Analyzer Module, all system components, the Controller Board and the network "self-install" (bind together) during initial startup. If the system contains more than one Analyzer Module, the startup procedure will interrogate the network to locate and identify all components on the network. The user will have to bind appropriate combinations of components after the startup sequence.

After the warm-up period (about one hour for the NDIR Analyzer Module), all modules are completely functional.

Check the tune and detector signal values against the factory settings listed in the Diagnostic Service menus. If both settings are within ±5% tolerance of factory setting, go to section 3.4 for binding and 3.5 for calibration. If not, refer first to section 4.11 for instructions about oscillator tune/source balance shutter adjustments

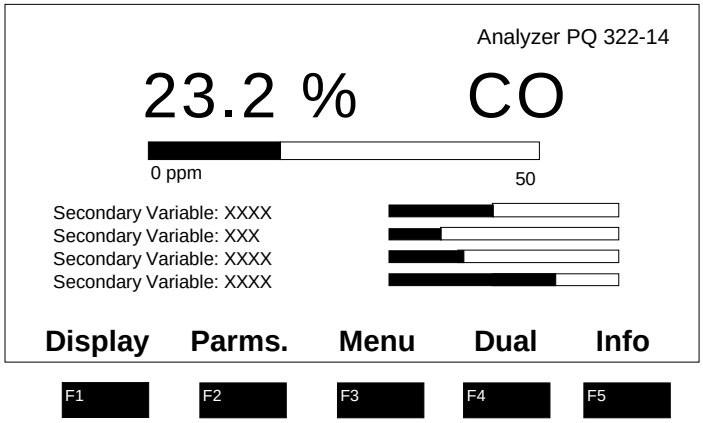


FIGURE 3-1. RUN MODE DISPLAY

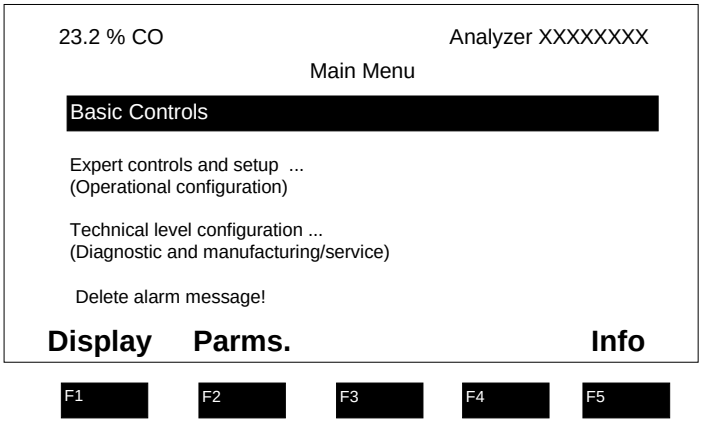


FIGURE 3-2. MAIN MENU DISPLAY

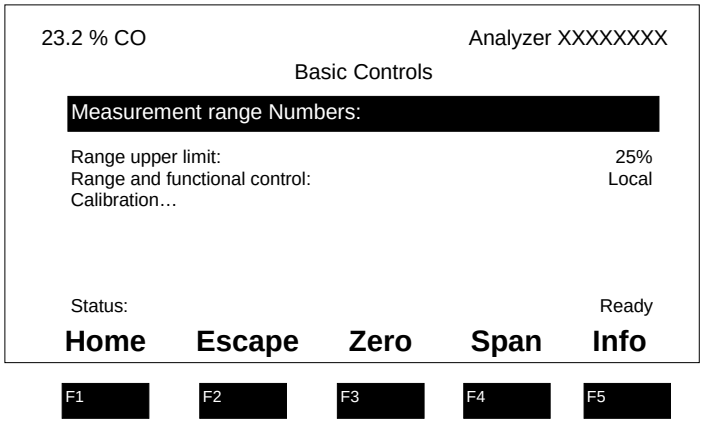


FIGURE 3-3. BASIC CONTROLS MENU

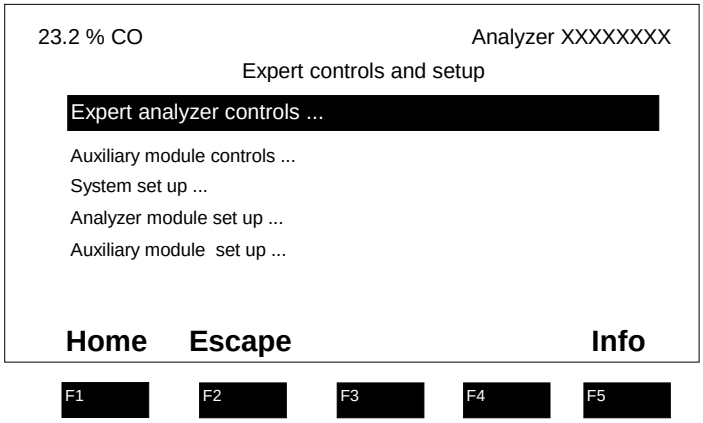


FIGURE 3-4. EXPERT CONTROLS AND SETUP MENU

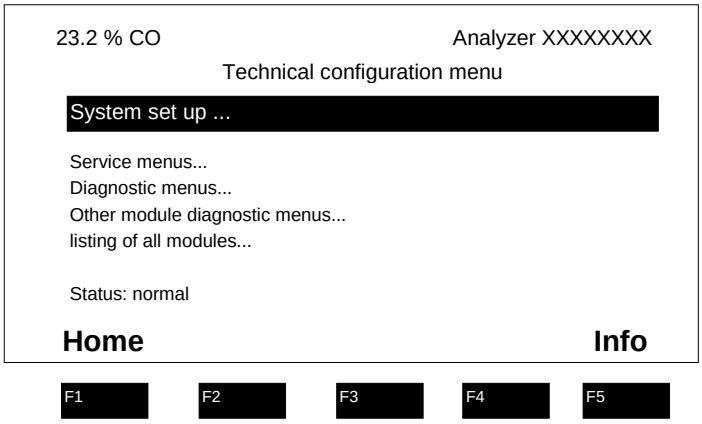


FIGURE 3-5. TECHNICAL LEVEL CONFIGURATION MENU

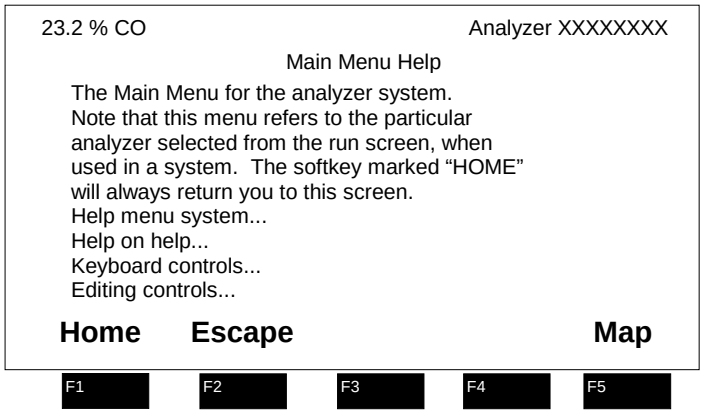


FIGURE 3-6. TYPICAL HELP SCREEN

3.4 BINDING

To achieve full coordination between Analyzer Modules and associated I/O Modules, the user must bind those components together in the System Set Up portion of the ***Technical Configuration Menu*** in software.

3.5 CALIBRATION

Calibration can be executed from the ***Basic Controls*** menu. Calibration gas data can be entered only through ***the Expert Controls and Setup*** menu.

To calibrate the Analyzer Module, introduce zero gas into the SAMPLE INLET, and do the following:

1. If the multi-Analyzer Module, split Run Mode display is shown, press the DISPLAY softkey until the desired Analyzer's Run Mode display is acquired.
2. Press the MENUS softkey to enter the ***Main Menu*** and make the following selections from the ***Main Menu***: Expert Controls and Setup, Analyzer Module Setup, Calibration Gases.
3. Input appropriate data in the ***Calibration Gas List*** menu.
4. Press the HOME softkey to return to the ***Main Menu.***
5. Use the ↓ arrow key to select Basic Controls.
6. Press the ZERO softkey to enter the ***Analyzer Zero*** menu, press ZERO again and wait.
7. Introduce span gas into the SAMPLE INLET, press SPAN softkey to enter the ***Analyzer Span*** menu, press SPAN again and wait.
8. Press HOME to re-enter the ***Main Menu.***
9. Press DISPLAY softkey for the Run Mode display.

If the user is unable to calibrate the Analyzer Module (i.e., when ZERO or SPAN is initiated, nothing happens), a possible solution relates to the use of an incorrect gas for zeroing or spanning (e.g., using a high concentration gas to zero or a zero gas to span the Analyzer Module). Simply recalibrating with the appropriate gas(es) will not correct the problem because the ZERO OFFSET or SPAN FACTOR has been set to an extreme value in the process.

To remedy the problem, do the following:

1. Select the following from the ***Main Menu***: Expert Controls and Setup, Analyzer Module Set Up, and Calibration Parameters.

2. Using the ↓ arrow, select Zero Ranges, press ENTER and, using the up/down arrows, toggle to SEPARATE. Do the same for the Calibrate Ranges selection. Do not press ESCAPE at any time unless retention of prior settings is desired.

3. Return to the ***Main Menu*** and make the following selections: Expert Controls and Setup, Expert Controls, CAL DATA softkey, FACTORS softkey, and Range 1 (2, 3, 4) Factors (do Steps 4 and 5 for each range).

4. Select Zero Offset, press ENTER, adjust the value to 500000 with the ↑ and ↓ arrow keys, and press ENTER. Do not press ESCAPE at any time unless retention of prior settings is desired.

5. Refer to the Data Sheet in the rear of this manual for Span Factors as originally set at the factory. Select Span Factor, press ENTER, adjust the value to match the values on the Data Sheet with the ↑ and ↓ arrow keys, and press ENTER. If Data Sheet is not available, enter 0.000015 with the ↑ and ↓ arrow keys, and press ENTER. Do not press ESCAPE unless retention of prior settings is desired.

6. Attempt to recalibrate the Analyzer Module according to the procedure outlined at the beginning of Section 3.4. If recalibration fails, return to the ***Range Factors*** menu, readjust factors and try calibrating again.

Another cause of failure to calibrate is the following: The value for "Maximum range" is lower than the upper limit value for the range in use. See the ***Range Settings*** menu for this information.

DISPLAY MESSAGE	DESCRIPTION	TYPE
BAROMETER	System Barometer	WARNING
CASE TEMP	Case Temperature	WARNING
CHOP SPEED	Chopper Speed	WARNING
CRUDE NOISE	Calculated Noise	WARNING
DET SIG	Detector Signal	WARNING
DET TEMP	Detector Temperature	WARNING
LIN ERROR	Linearizer Error	WARNING
N15 VOLTS	Power Supply, -15V	WARNING
P12 VOLTS	Power Supply, +12V	WARNING
P15 VOLTS	Power Supply, +15V	WARNING
P24 VOLTS	Power Supply, +24V	WARNING
P5 VOLTS	Power Supply, +5V	WARNING
PERCENT MOD	Percent Modulation	WARNING
RAW SIGNAL	Raw Signal	WARNING
SVFLOW	Sample Bypass Flow	WARNING
SW ERROR	Software Error	FAILURE

TABLE 3-1. NDIR ANALYZER MODULE ALARMS

3.6 LINEARIZATION

The NDIR Analyzer Module can be operated in linear and non-linear mode. Linearization can be toggled ON/OFF in ***the Expert Controls*** menu. In the OFF position, linearization is disabled for all ranges, and the component of interest is measured in percent of fullscale. In the ON position, measurement is in engineering units: Either ppm or percent of concentration.

The NDIR Analyzer Module is linearized with the following fourth-order polynomial:

$$Y = A_O + A_1X + A_2X^2 + A_3X^3 + A_4X^4$$

Where:

X = the normalized non-linear input

A_O, A_1, A_2, A_3, A_4 = linearization coefficients

Y = the normalized linear output

Linearization coefficients can be developed and stored for each range through the ***Expert Controls*** menu. The operating range is selected by entering RANGE = 1, 2, 3 or 4 in the Range Mode section that that menu.

Coefficients for each selected range are automatically used when the module is in Linearization Mode. The user instructs the Analyzer Module as to which set of coefficients are to be used for each range. Maximum dynamic range is 3:1.

When ordered, special linearization coefficients for non-standard fullscale ranges are entered in the appropriate range(s) at the factory. If a range is not specified, the set of coefficients will be for Range 4.

The operator may want the module to output measurement in engineering units (ppm). This response is linear over the operating range. The following coefficients will make no correction to the non-linear response, but will cause the NDIR Analyzer Module to output gas measurement in engineering units:

A0 = 0.00000

A1 = 1.00000

A2 = 0.00000

A3 = 0.00000

A4 = 0.00000

To calculate linearization coefficients other than those installed at the factory, take a minimum of 11 data points. (A more accurate curve can be obtained as the user approaches 21 data points. If urgent, a curve can be created with as few as four points, but this is only a temporary fix. A more accurate curve should be created as soon as possible.)

These data points can be obtained with an accurate gas divider or other flow mixing device. Before calculating coefficients, the data must be normalized to ranges of 0 to 1 units for both percent and concentration readings. Then, the axis must be reversed as illustrated in Figures 3-7 and 3-8. A multiple linear regression is then used to calculate coefficients. (For example: If the range is 0 to 5000 ppm and readings are 0 to 100%, then divide all of the concentrations by 5000 and the readings by 100. Put the normalized concentrations on the Y-axis and the normalized readings on the X-axis.)

These data points can be entered into any program capable of computing a fourth-order polynomial curve. This curve will be the mirror image of the curve on the Calibration and Data Sheet provided in the rear of this manual; however, the linearization coefficients will be different. Use the coefficients calculated with the curve in the polynomial shown on the previous page.

After taking the data points, the operator may determine coefficients for user-specific gas by either using any program capable of calculating a fourth-order curve fit or calling the factory to have the specific coefficients calculated.

When entering the operator-determined coefficients, note that the microprocessor only recognizes five significant digits to the right of the decimal point (e.g., 0.12345).

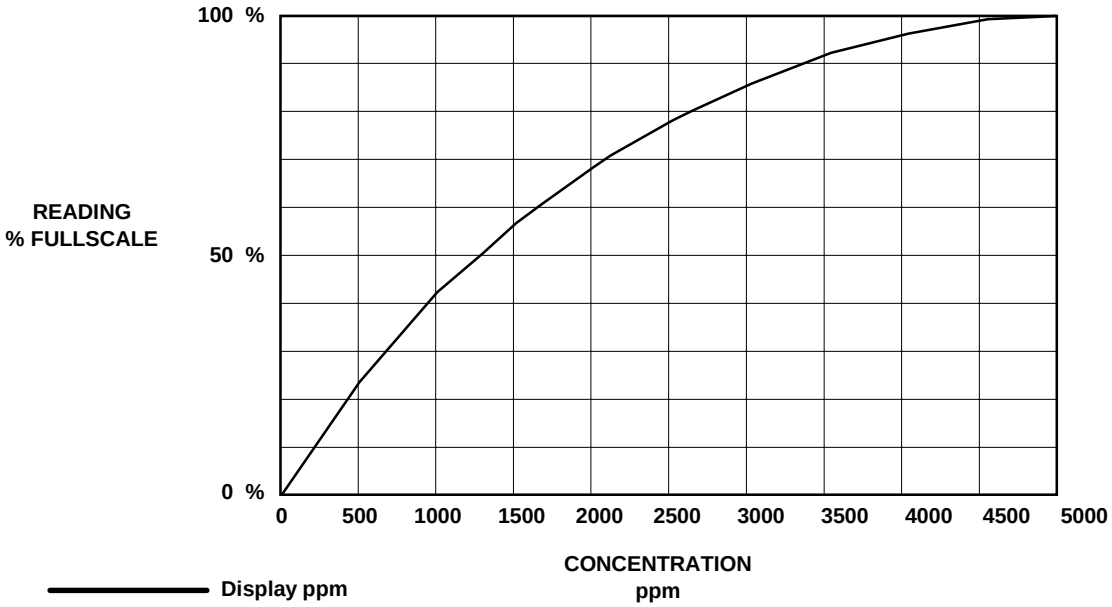


FIGURE 3-7. TYPICAL LINEARIZATION CURVE, LINEARIZER OFF

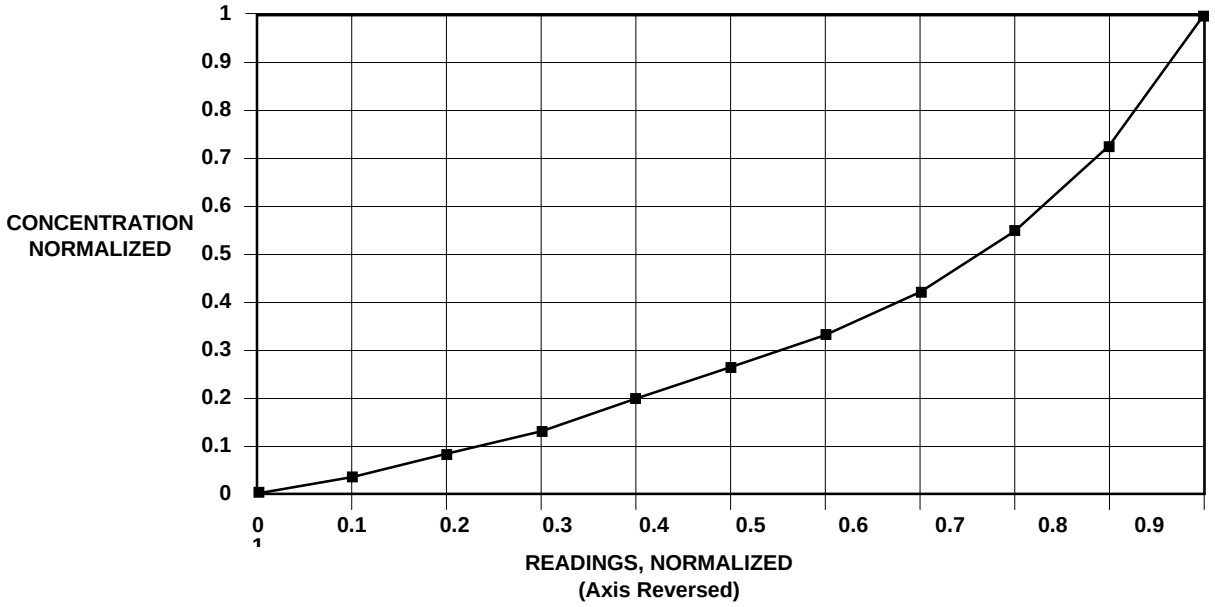


FIGURE 3-8. OPERATOR-DETERMINED LINEARIZATION CURVE (NORMALIZED)

3.7 ROUTINE OPERATION

Set the NDIR Analyzer Module for desired operating range. Zero and span the module, and then supply sample gas to the SAMPLE INLET at the rear of the module. The NDIR Analyzer Module will now automatically and continuously analyze the sample stream.

As a check of instrument performance, the operator should keep a log of zero/span status.

Maximum permissible interval between calibrations depends on the analytical accuracy required. A frequency of once every 24 hours is recommended initially, and that practice should be continued unless experience indicates that some other interval is more appropriate.

Readout accuracy is directly proportional to change in barometric pressure (i.e., a change in cell pressure of 7.6mm of mercury will result in a readout error of about 1% of reading). Therefore, if barometric pressure changes significantly, a recheck of calibration against a span gas is advised. Also, an optional Pressure Compensation Board is available that electronically compensates.

The Analyzer Module will not allow the user to increase the upper limit of a range beyond the "maximum range" software setting. To change the "maximum range" value, select the following from the Main Menu: Technical Configuration Menu, Service Menu, Manufacturing Data, Analyzer Manufacturing Data. Select Maximum Range, and use the arrow keys to scroll the indicated value. The same applies for "minimum range" setting.

NOTES



WARNING: ELECTRICAL SHOCK HAZARD
Servicing requires access to live parts which can cause death or serious injury. Refer servicing to qualified personnel.

4.1 OVERVIEW

NDIR Analyzer Module components that may require cleaning or replacement include:

- all printed circuit boards
- power fuse
- the module fan
- the chopper motor
- the source
- the detector
- flow sensor
- case temperature sensor
- Analysis cells and optical components
- RTD - detector temp. controller
- thermal fuse

The only components that may require adjustment are the oscillator tune and shutter balance adjustments. These are factory-set, and should be adjusted only in the following cases:

- if the operator has changed sources, oscillator board or detector
- if the operator disassembles the bench to any degree.

Also available for maintenance adjustment through the Front Panel display and keypad are the source current, preamplifier gain (referred to as Signal Gain on the sub-menu) and the modulation check.

4.2 PCB REPLACEMENT

Refer to Figure 4-1 for locations of the Signal, Micro, Power Supply, Oscillator and optional Pressure Compensation boards.

All PCBs, except the Oscillator Board and the LON Power Board, are secured to a side of the analyzer module that folds out while interconnect wiring is still in place. Remove the securing screws and fold out the entire panel.

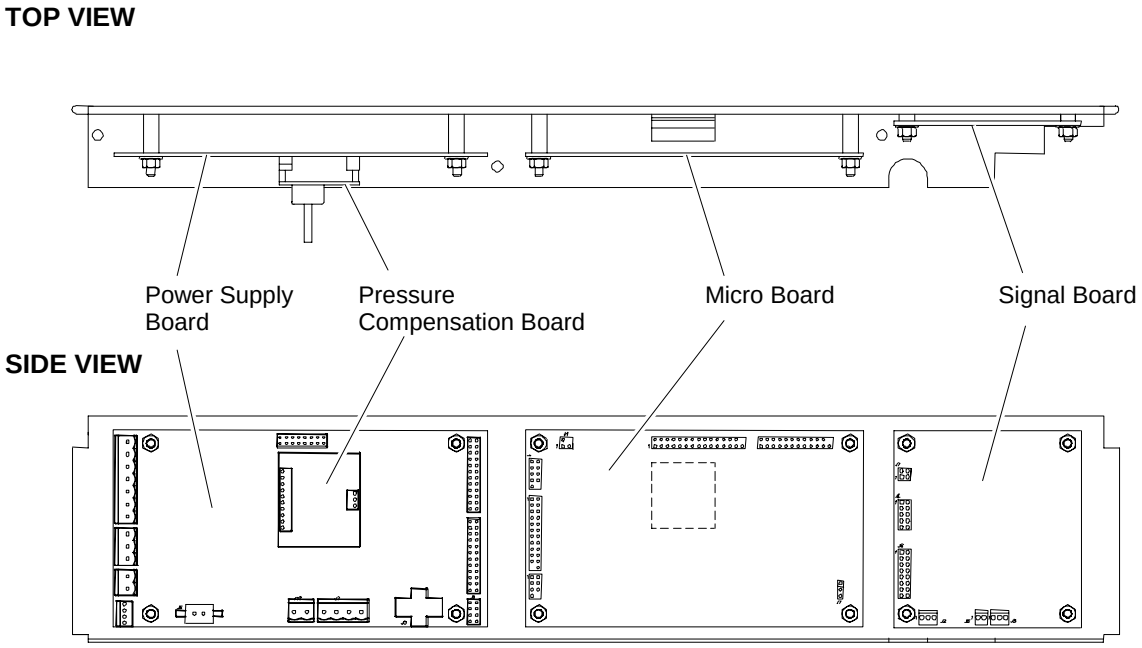


FIGURE 4-1. PRINTED CIRCUIT BOARD FOLD-OUT PANEL VIEWS

To remove a particular board on the fold-out panel, label and unplug all interconnect wiring, and remove securing hardware. (See Figure 4-1.) Do the reverse to install a new board. Use caution when installing connectors by observing correct position (polarity) and alignment of pins.

4.3 POWER FUSE REPLACEMENT

Remove power to the Analyzer Module prior to fuse replacement. To replace the Power Fuse, view the front panel of the Analyzer Module, as shown in Figure 4-2, and push and turn the fuseholder cap 1/4 turn counterclockwise. Remove and replace the fuse as required.

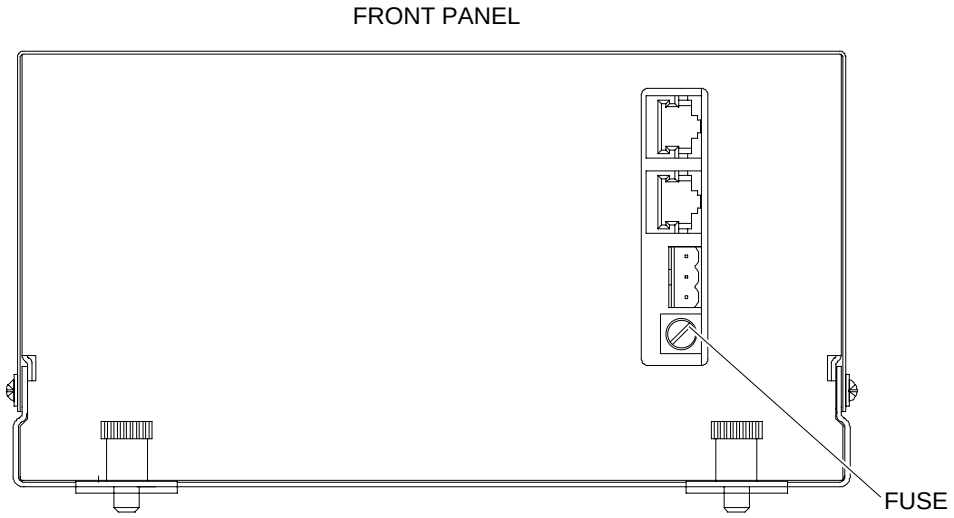


FIGURE 4-2. POWER FUSE LOCATION

4.4 MODULE FAN REPLACEMENT

The Analyzer Module fan assembly is disassembled as shown in Figure 4-3. Before doing so, the entire optical bench must be removed. See Figure 4-5.

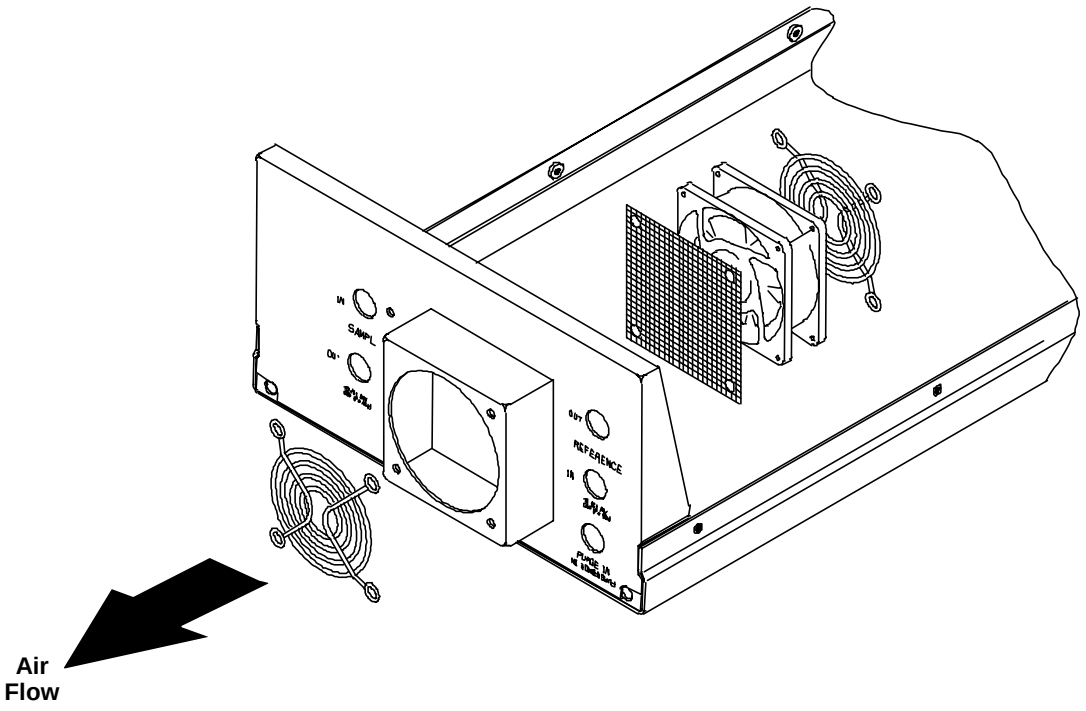


FIGURE 4-3. FAN ASSEMBLY

4.5 CHOPPER MOTOR REPLACEMENT

See Figure 4-4 for a exploded view of the Motor/Source Assembly. The entire optical bench must be removed to perform this replacement.

4.6 SOURCE REPLACEMENT

See Figure 4-4 for a exploded view of the Motor/Source Assembly. The entire optical bench must be removed to perform this replacement.

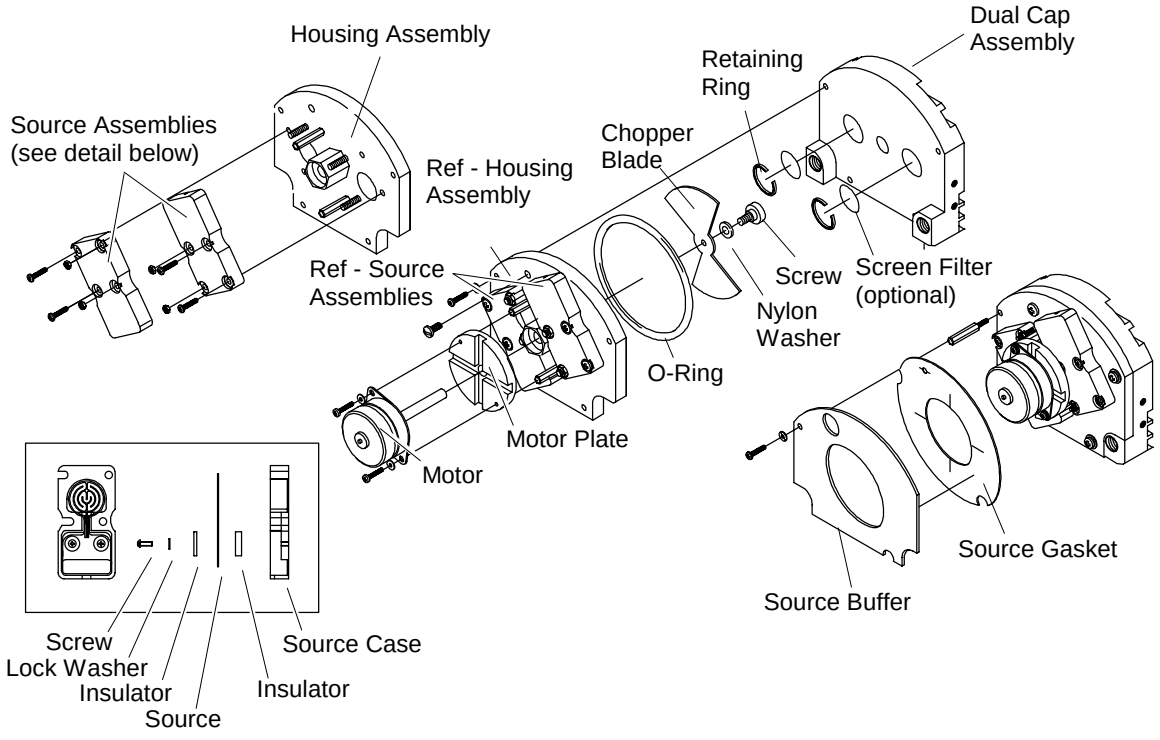


FIGURE 4-4. MOTOR/SOURCE ASSEMBLY

4.7 DETECTOR REMOVAL

See Figures 4-5 and 4-7 for breakdowns of the optical bench. The entire optical bench must be removed in order to perform this disassembly.

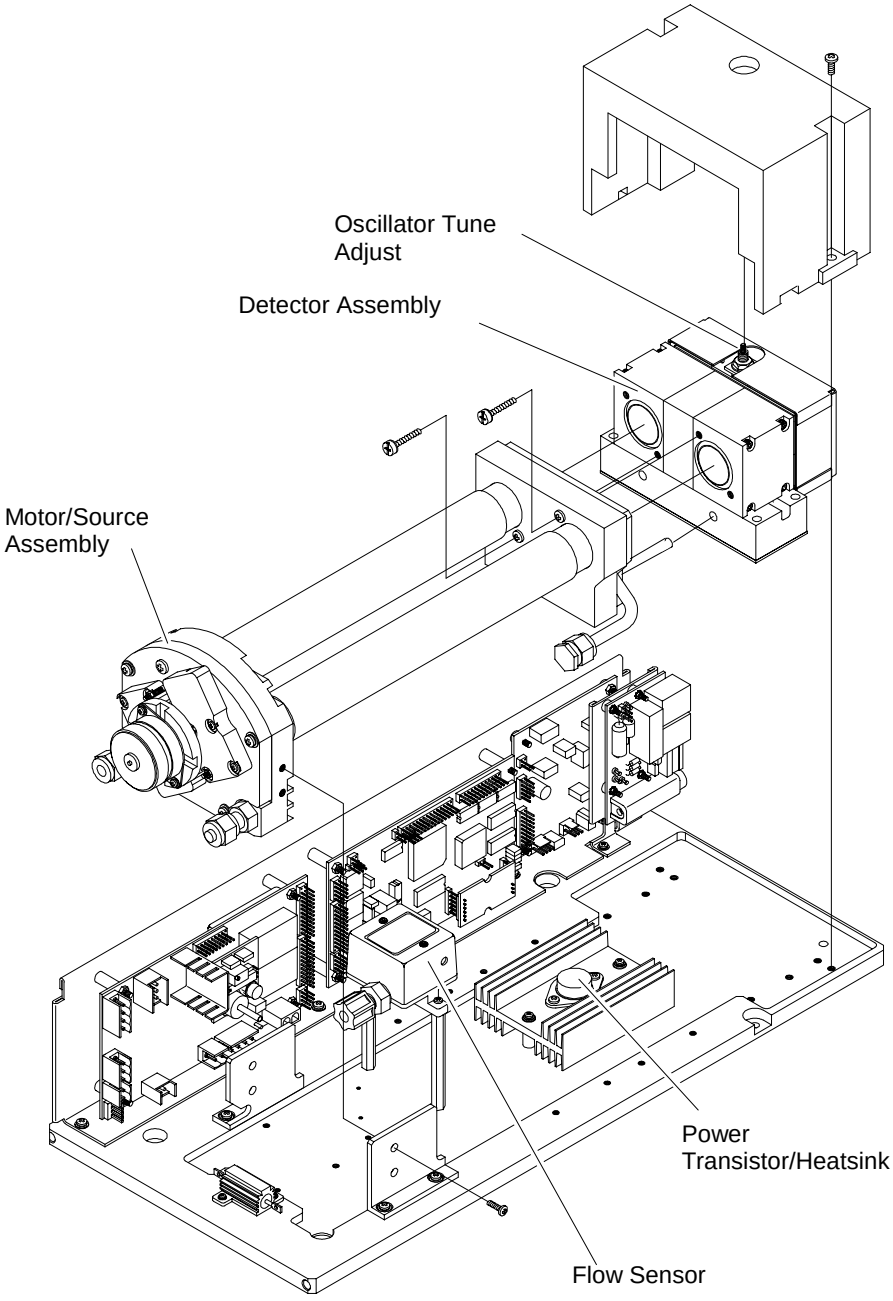


FIGURE 4-5. CELL, PCB ASSEMBLY – EXPLODED VIEW

4.8 FLOW SENSOR REPLACEMENT

See Figure 4-5 for Flow Sensor location. To replace Flow Sensor, remove all connecting hardware and undo connections to the sample line.

4.9 CASE TEMPERATURE SENSOR REPLACEMENT

Case Temperature Sensor is attached to the motor source assembly. To replace this sensor, cut the Ty-Rap® binder and disconnect the sensor connector. Reverse these instructions by reconnecting the new sensor and attaching with a new Ty-Rap®.

4.10 THERMAL FUSE REPLACEMENT

Disassemble and reassemble the Detector block according to Figure 4-7 to replace the Detector Thermal Fuse.

4.11 OSCILLATOR TUNE/SOURCE BALANCE SHUTTER ADJUSTMENT

The Analyzer Module is calibrated, tuned and balanced at the factory. If the diagnostic values for oscillator tune and detector signals are within ±5 % of the factory settings in Primary Variable Parameters and Modulation Check menus), no adjustment is necessary. If not, see Figure 4-5 and 4-6 for Oscillator Tune and Source Balance Shutter adjustments, and do the following:

1. Open Platform front panel, if present.



CAUTION: HAND INJURY HAZARD

Do not place hands or fingers in Platform front handles when the front panel is open. Dropping front panel while hand or fingers are inside either handle can cause serious injury.

2. Open Analyzer Module front panel

3. Access the oscillator tune value in the Primary Variable Parameters menu.

4. Adjust oscillator tune knob to its maximum setting and then turn it counterclockwise to 80 % of that maximum setting.
5. Access the detector signal value in the Modulation Check menu.
6. Flow zero gas (nitrogen) through the sample cell until the display reading stabilizes.



CAUTION: DELICATE COMPONENTS

The shutter is a delicate component with only a six-degree rotation. Take care when making the required adjustments.

7. Using an appropriate screwdriver that will fit through the Source Balance Adjustment Screw Holes (see Figure 4-5), rotate the sample shutter adjust screw until a minimum reading on the display is obtained. (A typical reading is 0.2 through 0.5.)
8. Add 0.5 V to the value obtained in Step 7 by adjusting the sample shutter adjust screw clockwise. (If this reading exceeds 1.2 V, then a cell cleaning is necessary; see Section 4.12.)
9. Rotate the shutter adjust screw clockwise until the display reads the value obtained in Step 8.
10. Reassemble the Analyzer Module and, if appropriate, the Platform.

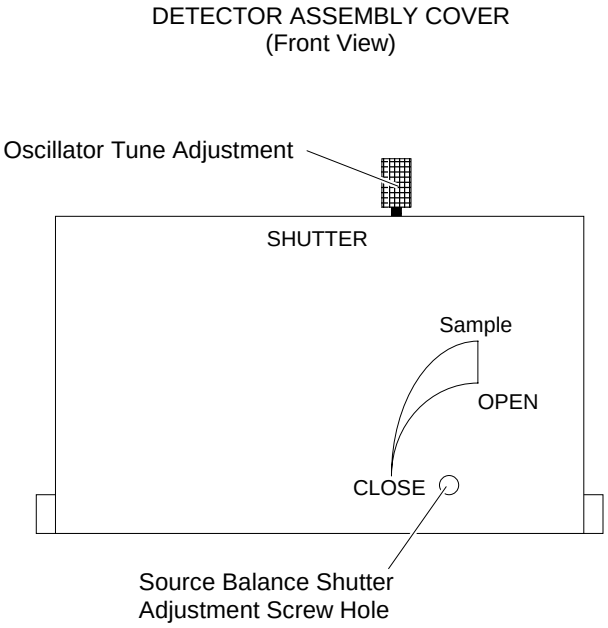


FIGURE 4-6. OSCILLATOR TUNE, SOURCE BALANCE SHUTTER ADJUSTMENTS

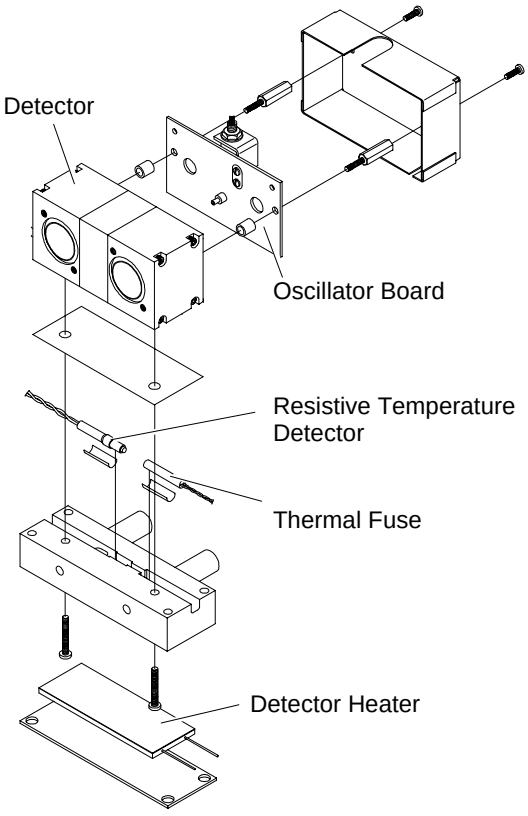


FIGURE 4-7. DETECTOR BLOCK (EXPLODED VIEW)

4.12 CLEANING CELLS

1. When zero gas is introduced in the SAMPLE IN inlet and the Detector signal is greater 1.2V, the cells and windows require cleaning. To do this, follow this procedure:
2. See Figure 4-8 to identify which detail drawing best matches the configuration in question.
3. Fold out the PCB panel.
4. Disassemble the optical bench according to Figure 4-5and the cells according to Figure 4-8.
5. Rinse the cell with acetone. If this does not remove all foreign matter, use a soft brush. Do not use any metallic object inside the cell because it will scratch the gold plating. Loss of gold plating may require cell replacement.
6. After all matter has been removed, rinse the cell with distilled water and allow to air dry. Do not use towels.
7. Inspect the cell inside by holding it up to a bright light. If particles are seen, repeat Steps 5 and 6 as often as necessary.
8. After cleaning cell, examine O-rings at the source, detector and end caps. If damaged, replace with new O-rings.
9. Remove any contaminants from windows with a lint-free cloth soaked in acetone. Do not use alcohol or other solvents. Allow to air dry.
10. Reverse disassemble instructions to reassemble the unit.
11. Perform a leak check.
12. Replace desiccant if required. (See Section 4.13.)
13. After cleaning cells, the Analyzer Module must be optically aligned if the diagnostic values for oscillator tune and detector signals are not within ±5% of the factory settings. If they are not within that range, follow Steps 7 through 10 of Section 4.11.

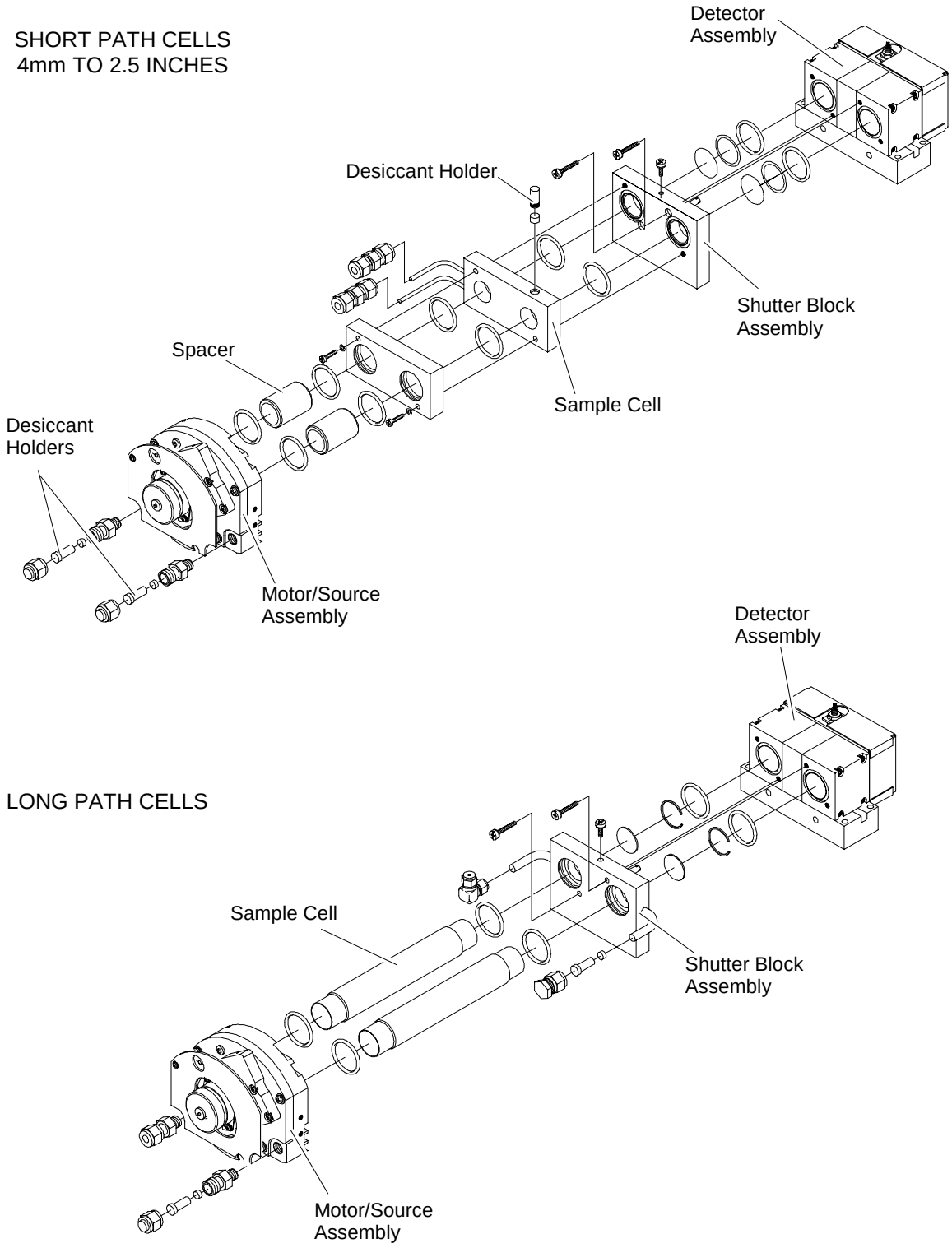


FIGURE 4.7. CELL DISASSEMBLY

4.13 CELL DESICCANT

The reference cell may use a flowing reference. If so, desiccant is required. A desiccant holder is used on the inlet and outlets to keep moisture from entering the reference cell (see Figure 4-7). The desiccant should be replaced each time the cell is opened, refer to Table 4-1. Before inserting desiccant, purge cell with dry inert gas (i.e., N_2).

GAS	DESICCANT	PART NUMBER
CO_2	Cardoxide	096218
CO	Mg $(C10_4)_2$	096217
H_20	Mg $(C10_4)_2$	096217
SOS	Mg $(C10_4)_2$	096217
CH_4	Mg $(C10_4)_2$	096217
Hexane	Mg $(C10_4)_2$	096217
CO + CO_2	Cardoxide + Mg $(C10_4)_2$	096217/09621

TABLE 4-1. CELL DESICCANT

4.14 MODULATION CHECK

The modulation check is a measure of the energy absorption capacity of a gas mixture, where total absorbency is 100% modulation and zero absorbency is 0% modulation. The modulation check can be used as a tool for tracking the sensitivity of the Analyzer Module and for discovering potential detector/source problems.

To perform a modulation check, do the following:

1. Access the Primary Variable Parameters menu.
2. Select Modulation Check.
3. Follow the *Instructions* and *Then* line commands, which are the following:
4. Flow zero gas, press START softkey and wait.
5. Flow span gas when prompted, press START softkey and wait.
6. When the *Instructions* line again prompts the user to flow zero gas, the modulation check is finished.
7. Note the value on the *Percent Modulation* line.

Find the Percent Modulation value on the Data Sheet in the rear of this manual. Some standard Analyzer Modules will not have a value. If a value is present, compare this to the new value.

If 100% span gas was used during the modulation check, the new value should be within ±10% of value on the Data Sheet. If it is out of this range, call the factory for further interpretation. If modulation checks are used for trending, variance from check to check should not exceed ±20% per month.

NOTES



WARNING: PARTS INTEGRITY

Tampering with or unauthorized substitution of components may adversely affect safety of this product. Use only factory-approved components for repair.

5.1 REPLACEMENT PARTS

While the following sections list parts which are common to all NDIR Analyzer Modules, the ***configuration number*** is required when ordering parts which are specific to an individual application. The configuration number is on the Data Sheet in the rear of this manual.

NL623998	Oscillator Board
NL657466	LON/Power Board
NL655729	Detector Heater
NL622917	Temperature Sensor, Detector
NL898733	Thermal Fuse with Q Pad
NL902931	Flow Sensor
NL655943	Case Temperature Sensor
NL655630	Power Supply Board
NL655670	Pressure Compensation Board
NL658350	Computer Analysis Board
NL655610	Signal Board
NL655893	Fan
NL655891	Chopper Motor
NL655925	Source (Matched Pair)

NOTES

Each analyzer is configured per the customer sales order. Below is the NDIR sales matrix which lists the various configurations available.

To identify the configuration of an analyzer, locate the analyzer name-rating plate. The 12-position sales matrix identifier number appears on the analyzer name-rating plate.

I	SINGLE CHANNEL NON-DISPERSIVE INFRARED ANALYZER MODULE

Code	Language
A	English
X	Special

Code	Configuration Identifier
A09, A10, A12, A20, B22, B23, B2B30, B36, B38	
A06, A07, A08, A11, B21, B24, B26, B76, F63	
A16, A28, B19, B25, B27, C31, C37, C39, D41, D44	
A14, A15, B46, E54, F64, F65, F66, F67, H73	
E56, H74, H75, J83, H84, J85, J88	
L99	SPECIAL Extended Length
S99	SPECIAL Standard Length

Code	
ZOO	No Selection

Code	Linearized Non-Standard Range Selection
A	Four Standard Ranges
B	One Non-Standard Range
C	Two Non-Standard Ranges
D	Three Non-Standard Ranges
F	Four Non-Standard Ranges
X	Special

Code	
Z	No **Selection**

Code	
Z	No Selection

I	A	A10	Z00	A	Z	Z	Example

NOTES

GENERAL PRECAUTIONS FOR HANDLING AND STORING HIGH PRESSURE GAS CYLINDERS

Edited from selected paragraphs of the Compressed Gas Association's "Handbook of Compressed Gases" published in 1981
Compressed Gas Association
1235 Jefferson Davis Highway
Arlington, Virginia 22202
Used by Permission

1. Never drop cylinders or permit them to strike each other violently.
2. Cylinders may be stored in the open, but in such cases, should be protected against extremes of weather and, to prevent rusting, from the dampness of the ground. Cylinders should be stored in the shade when located in areas where extreme temperatures are prevalent.
3. The valve protection cap should be left on each cylinder until it has been secured against a wall or bench, or placed in a cylinder stand, and is ready to be used.
4. Avoid dragging, rolling, or sliding cylinders, even for a short distance; they should be moved by using a suitable hand-truck.
5. Never tamper with safety devices in valves or cylinders.
6. Do not store full and empty cylinders together. Serious suckback can occur when an empty cylinder is attached to a pressurized system.
7. No part of cylinder should be subjected to a temperature higher than 125°F (52°C). A flame should never be permitted to come in contact with any part of a compressed gas cylinder.
8. Do not place cylinders where they may become part of an electric circuit. When electric arc welding, precautions must be taken to prevent striking an arc against the cylinder.

Rosemount Analytical Inc.
4125 EAST LA PALMA AVENUE • ANAHEIM, CALIFORNIA 92807-1802 • 714-986-7600 • FAX 714-577-8006
JULY 1997 • 748525-C • PRINTED IN USA

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WARRANTY

Goods and part(s) (excluding consumables) manufactured by Seller are warranted to be free from defects in workmanship and material under normal use and service for a period of twelve (12) months from the date of shipment by Seller. Consumables, glass electrodes, membranes, liquid junctions, electrolyte, o-rings, etc., are warranted to be free from defects in workmanship and material under normal use and service for a period of ninety (90) days from date of shipment by Seller. Goods, part(s) and consumables proven by Seller to be defective in workmanship and/or material shall be replaced or repaired, free of charge, F.O.B. Seller's factory provided that the goods, part(s) or consumables are returned to Seller's designated factory, transportation charges prepaid, within the twelve (12) month period of warranty in the case of goods and part(s), and in the case of consumables, within the ninety (90) day period of warranty. This warranty shall be in effect for replacement or repaired goods, part(s) and the remaining portion of the ninety (90) day warranty in the case of consumables. A defect in goods, part(s) and consumables of the commercial unit shall not operate to condemn such commercial unit when such goods, part(s) and consumables are capable of being renewed, repaired or replaced.

The Seller shall not be liable to the Buyer, or to any other person, for the loss or damage directly or indirectly, arising from the use of the equipment or goods, from breach of any warranty, or from any other cause. All other warranties, expressed or implied are hereby excluded.

IN CONSIDERATION OF THE HEREIN STATED PURCHASE PRICE OF THE GOODS, SELLER GRANTS ONLY THE ABOVE STATED EXPRESS WARRANTY. NO OTHER WARRANTIES ARE GRANTED INCLUDING, BUT NOT LIMITED TO, EXPRESS AND IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Limitations of Remedy. SELLER SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE. THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF WARRANTY SHALL BE LIMITED TO REPAIR OR REPLACEMENT UNDER THE STANDARD WARRANTY CLAUSE. IN NO CASE, REGARDLESS OF THE FORM OF THE CAUSE OF ACTION, SHALL SELLER'S LIABILITY EXCEED THE PRICE TO BUYER OF THE SPECIFIC GOODS MANUFACTURED BY SELLER GIVING RISE TO THE CAUSE OF ACTION. BUYER AGREES THAT IN NO EVENT SHALL SELLER'S LIABILITY EXTEND TO INCLUDE INCIDENTAL OR CONSEQUENTIAL DAMAGES. CONSEQUENTIAL DAMAGES SHALL INCLUDE, BUT ARE NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS, LOSS OF USE, LOSS OF REVENUE, COST OF CAPITAL AND DAMAGE OR LOSS OF OTHER PROPERTY OR EQUIPMENT. IN NO EVENT SHALL SELLER BE OBLIGATED TO INDEMNIFY BUYER IN ANY MANNER NOR SHALL SELLER BE LIABLE FOR PROPERTY DAMAGE AND/OR THIRD PARTY CLAIMS COVERED BY UMBRELLA INSURANCE AND/OR INDEMNITY COVERAGE PROVIDED TO BUYER, ITS ASSIGNS, AND EACH SUCCESSOR INTEREST TO THE GOODS PROVIDED HEREUNDER.

Force Majeure. Seller shall not be liable for failure to perform due to labor strikes or acts beyond Seller's direct control.

Rosemount Analytical

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FIELD SERVICE AND REPAIR FACILITIES

Field service and repair facilities are located worldwide.

U.S.A.

To obtain field service on-site or assistance with a service problem, contact (24 hours, 7 days a week):

National Response Center
1-800-654-7768

INTERNATIONAL

Contact your local Rosemount Sales and Service office for service support.

FACTORY

For order administration, replacement Parts, application assistance, on-site or factory repair, service or maintenance contract information, contact:

Rosemount Analytical Inc.
Process Analytical Division
Customer Service Center
1-800-433-6076

RETURNING PARTS TO THE FACTORY

Before returning parts, contact the Customer Service Center and request a Returned Materials Authorization (RMA) number. Please have the following information when you call: *Model Number, Serial Number, and Purchase Order Number or Sales Order Number.*

Prior authorization by the factory must be obtained before returned materials will be accepted. Unauthorized returns will be returned to the sender, freight collect.

When returning any product or component that has been exposed to a toxic, corrosive or other hazardous material or used in such a hazardous environment, the user must attach an appropriate Material Safety Data Sheet (M.S.D.S.) or a written certification that the material has been decontaminated, disinfected and/or detoxified.

Return to:

Rosemount Analytical Inc.
4125 East La Palma Avenue
Anaheim, California 92807-1802

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Rosemount Analytical

ADDENDUM

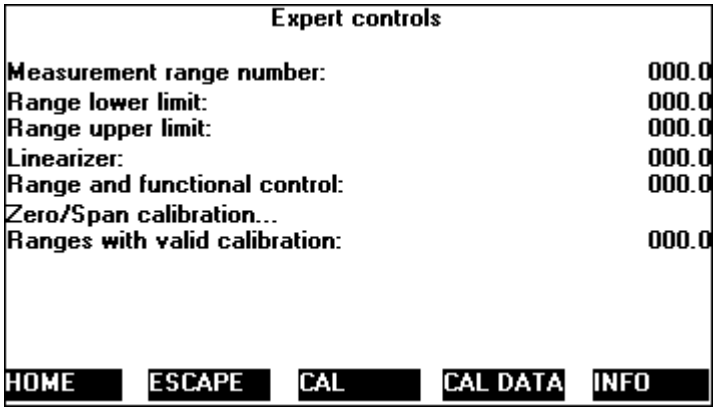
NDIR INSTRUCTION MANUAL 748417

This addendum serves as an amendment to the NDIR Instruction Manual 748417. The following information should be considered part of the manual, and supersedes any conflicting information in the body of the manual.

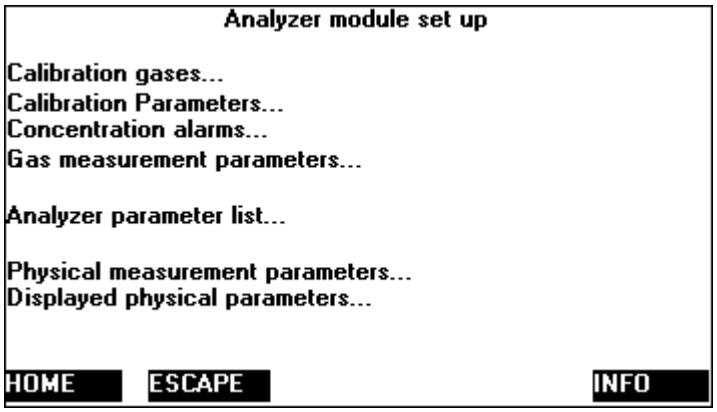
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MENU DISPLAYS

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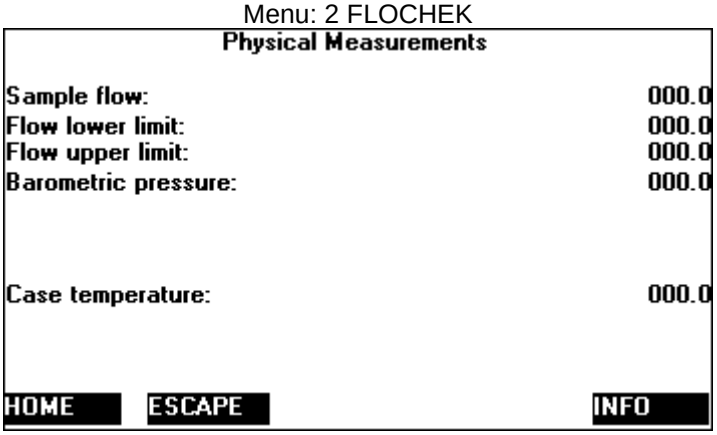


Menu: 1 ANALSET

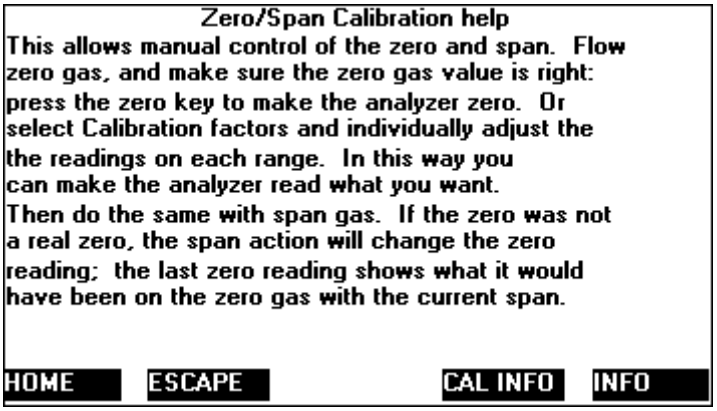


Rosemount Analytical Inc.
4125 EAST LA PALMA AVENUE • ANAHEIM, CALIFORNIA 92807-1802 • (714) 986-7600 • FAX: (714) 577-8006
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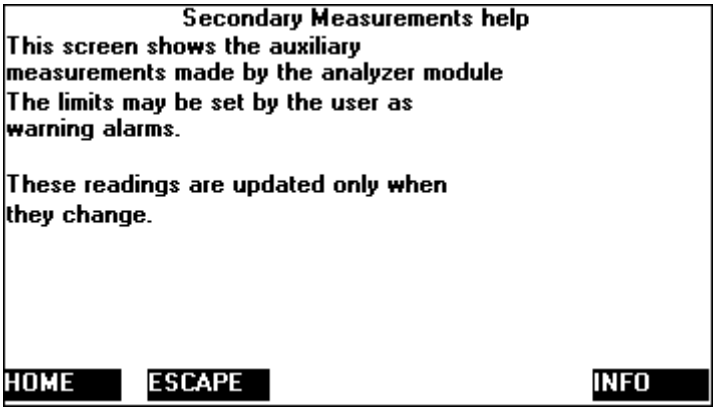
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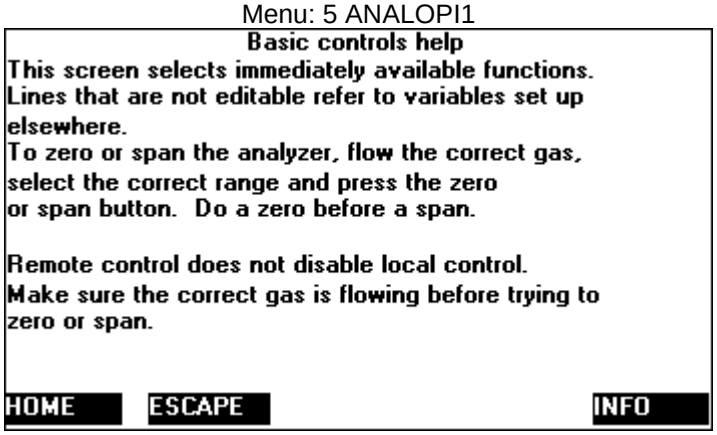
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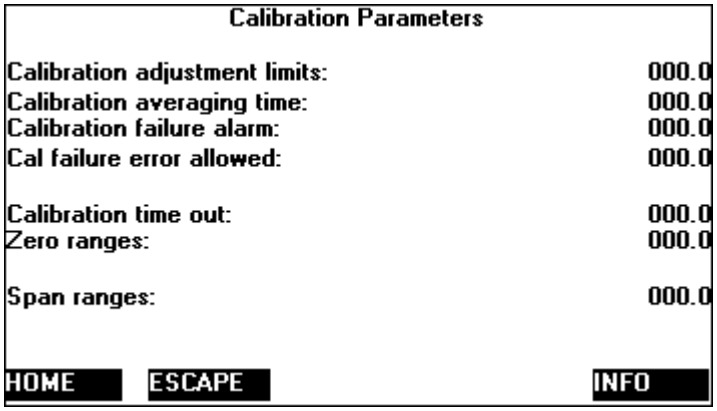
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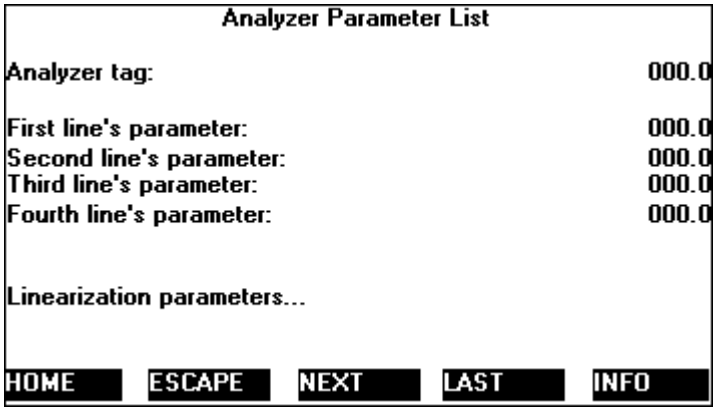
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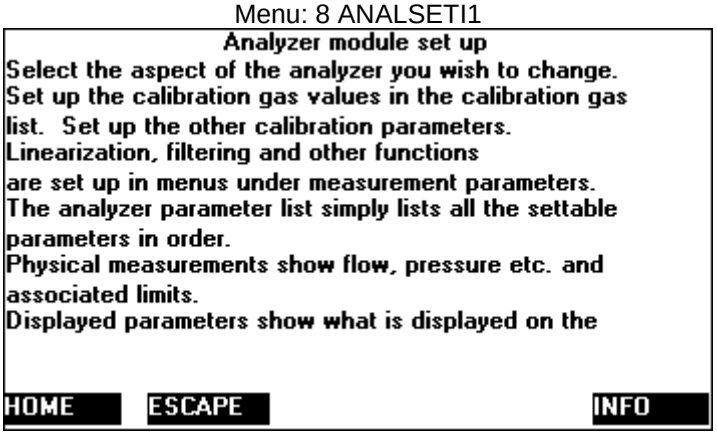
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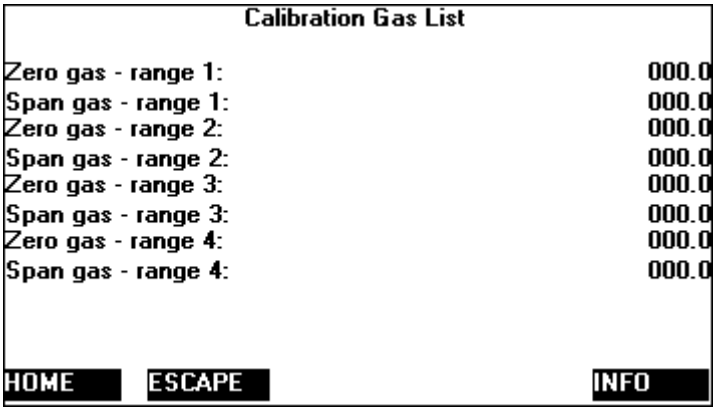
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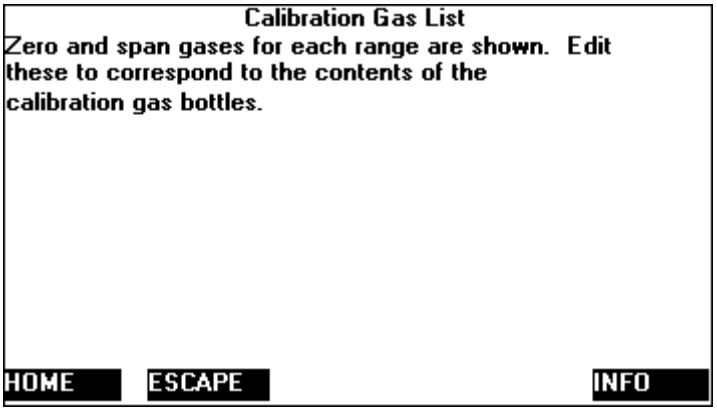
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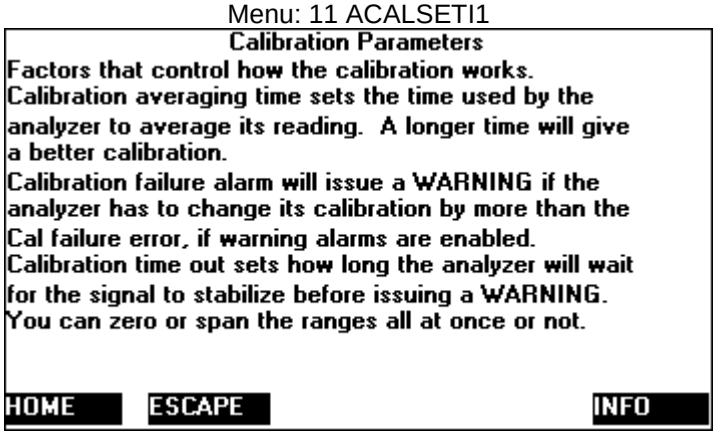
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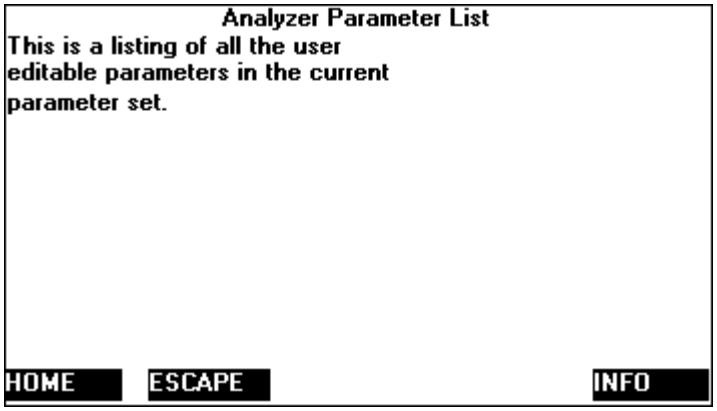
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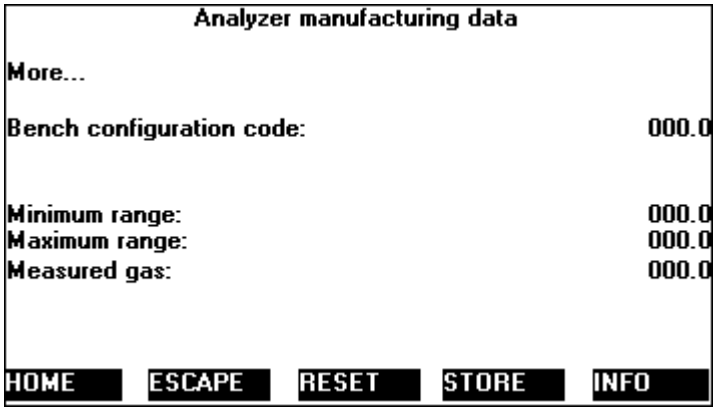
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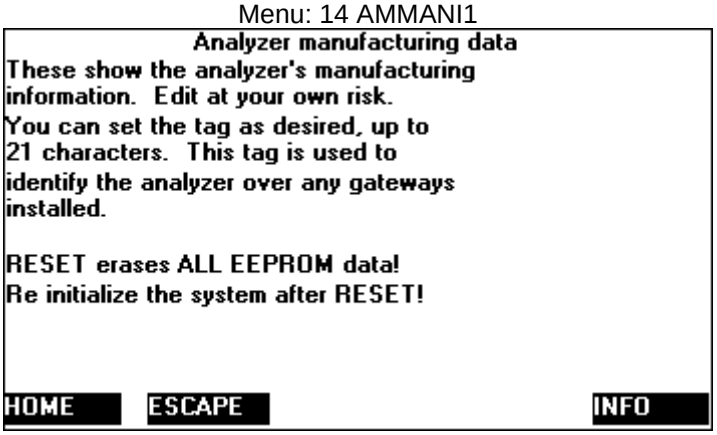
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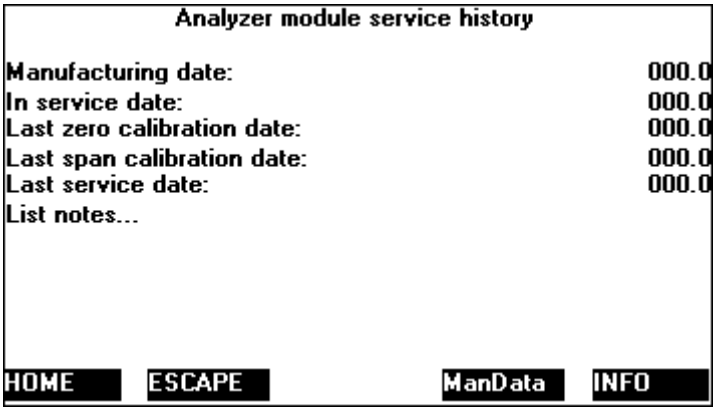
Menu: 13 AMMAN



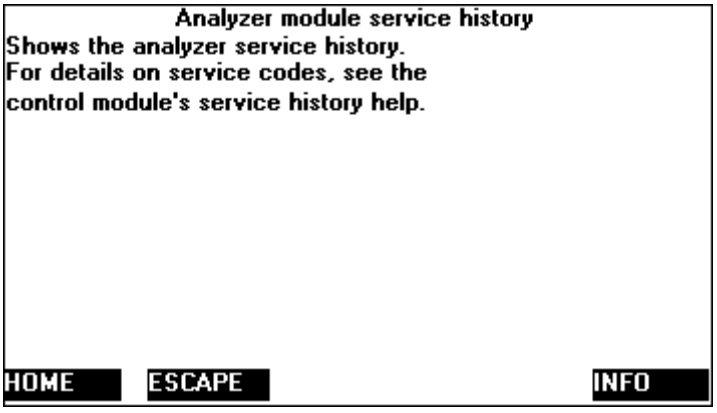
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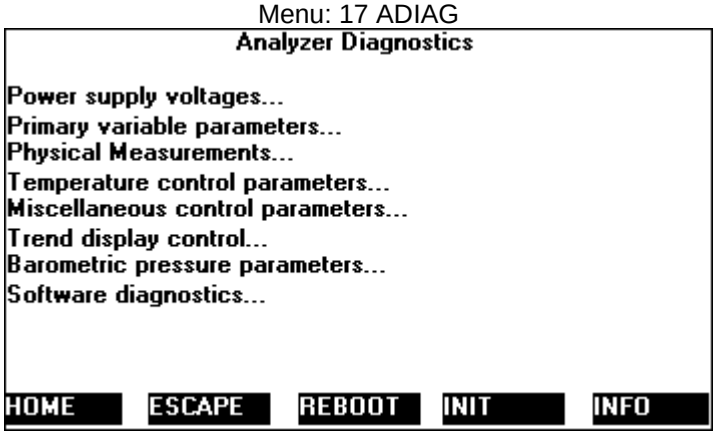
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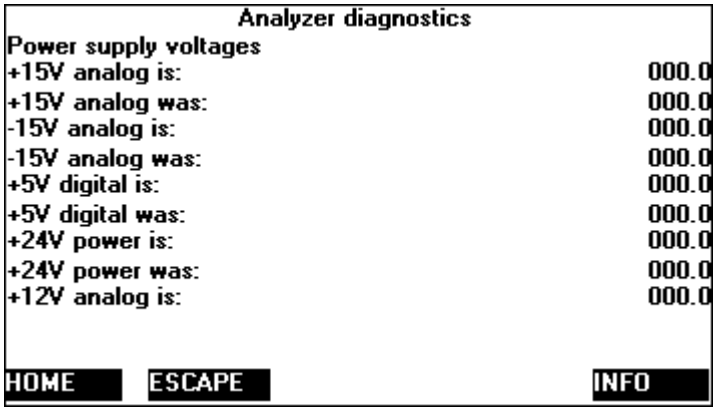
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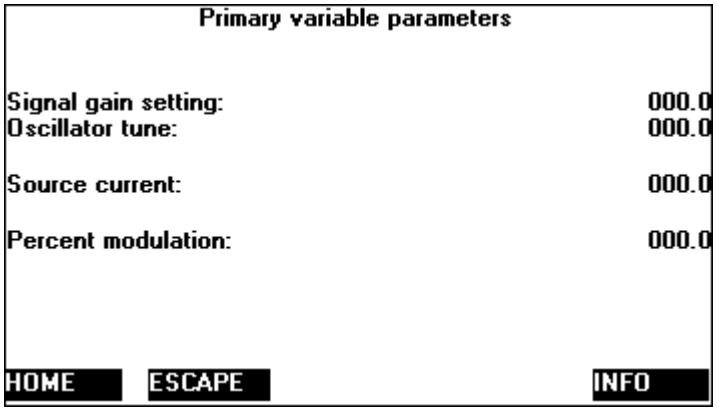
Menu: 17 ADIAG



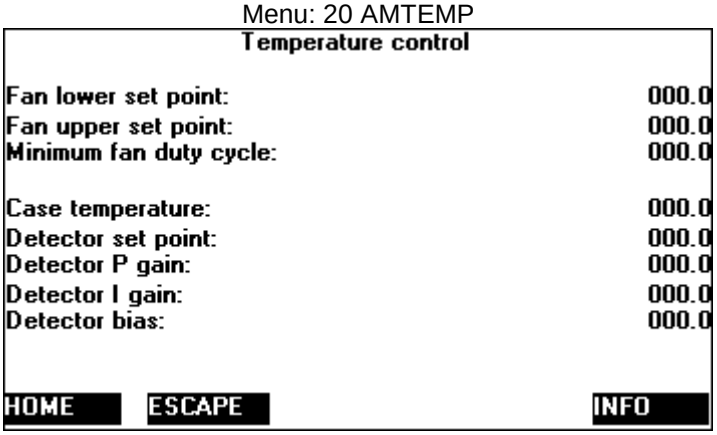
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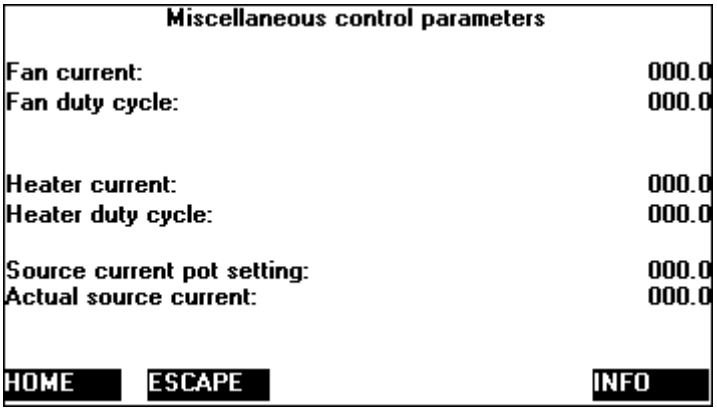
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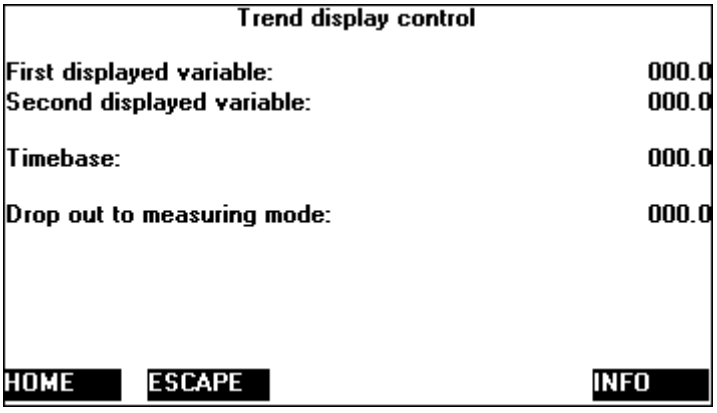
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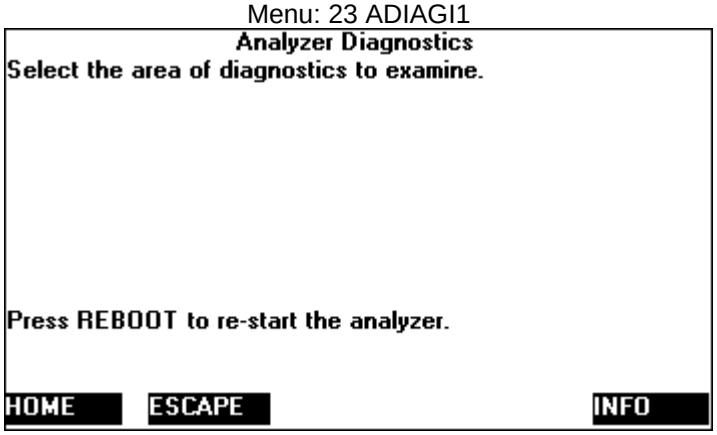
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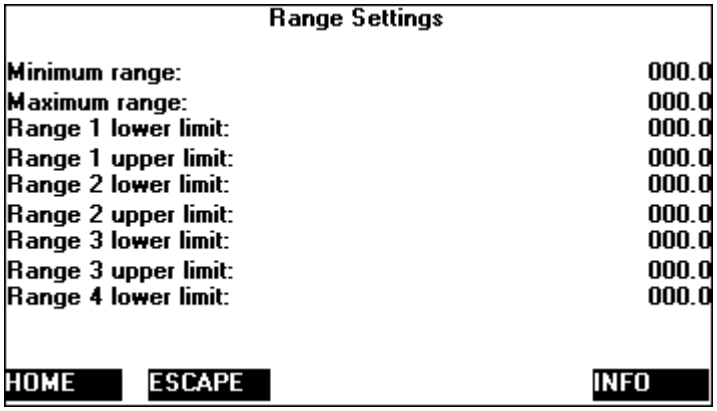
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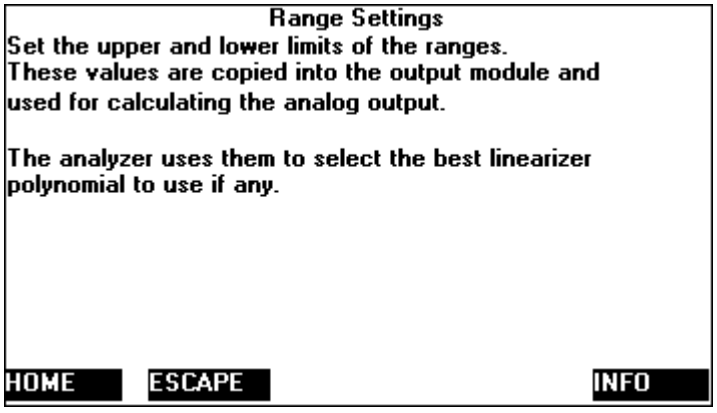
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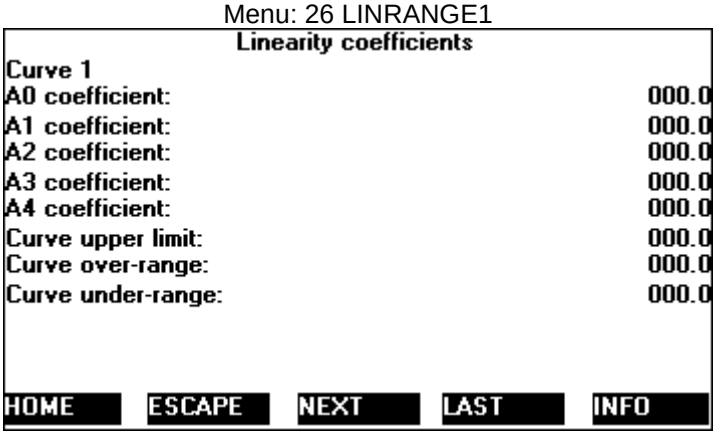
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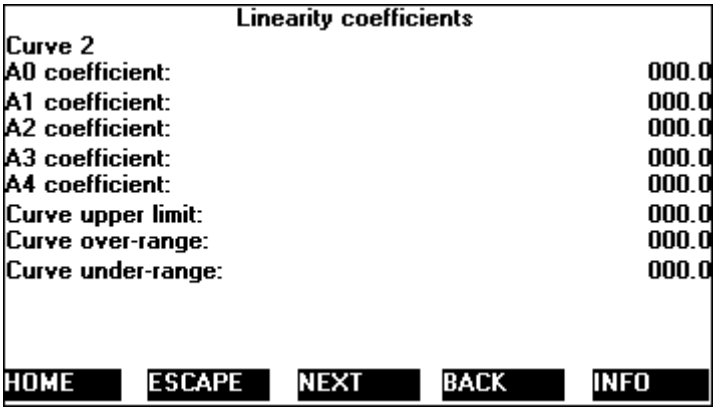
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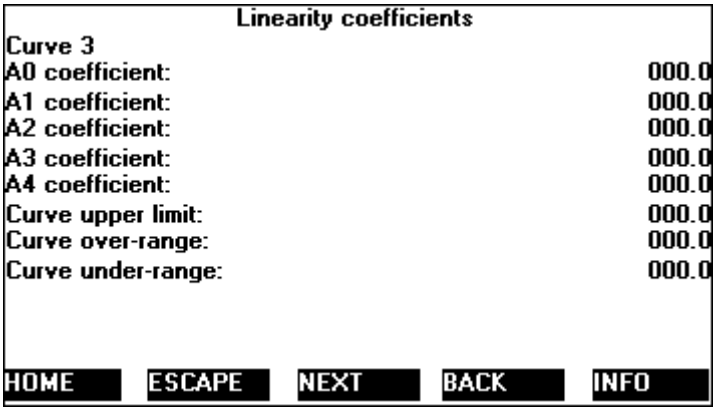
Menu: 26 LINRANGE1



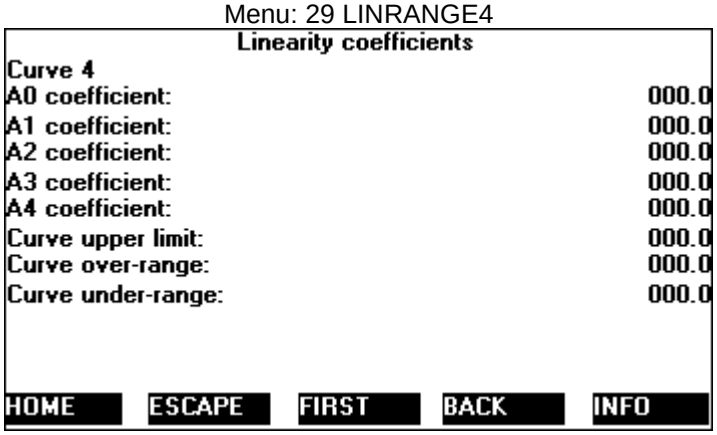
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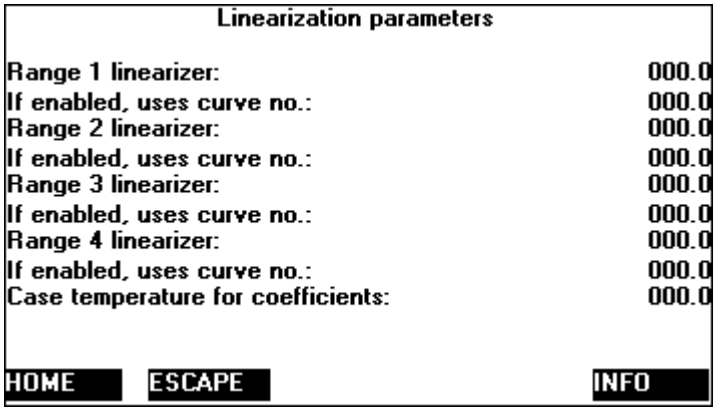
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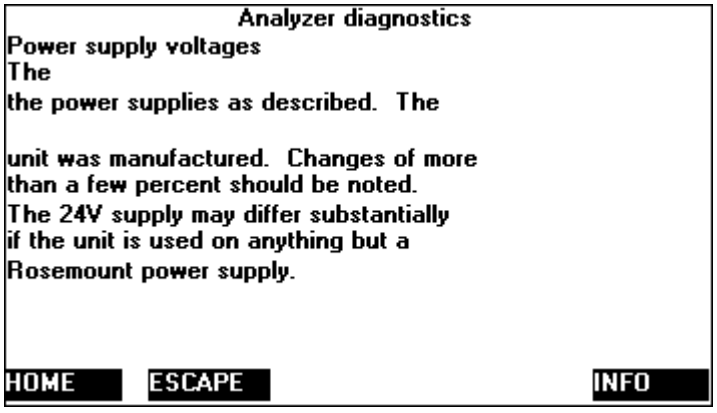
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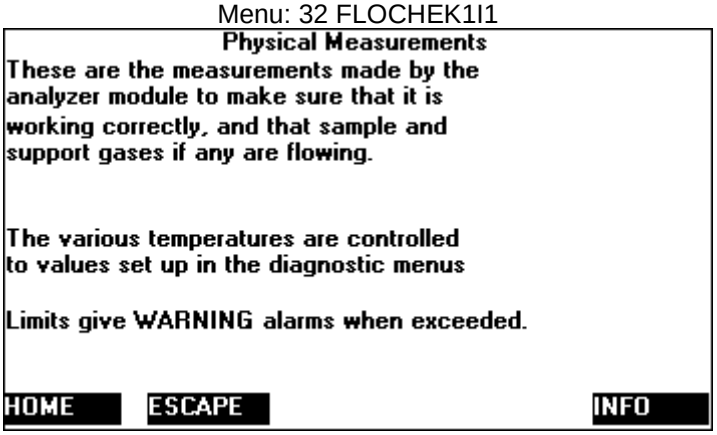
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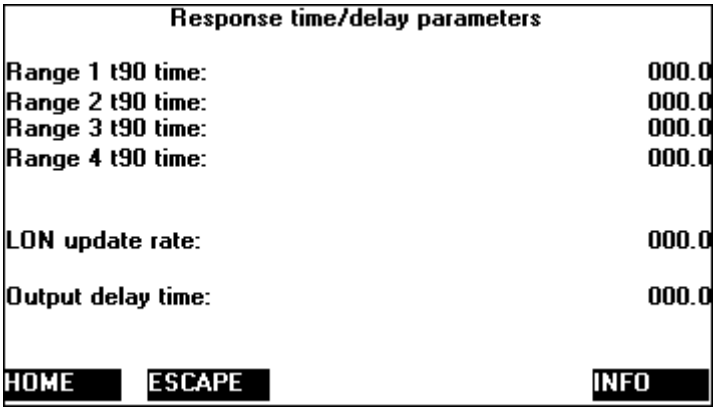
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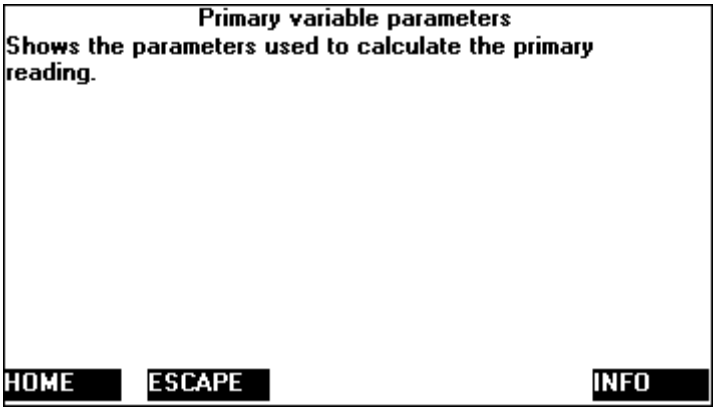
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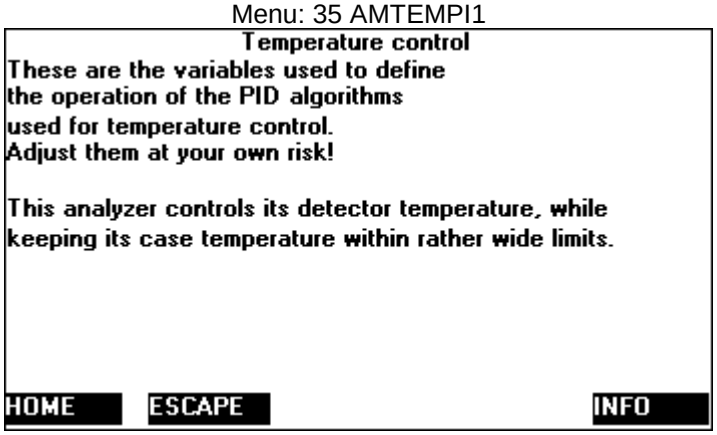
Menu: 33 FILTER



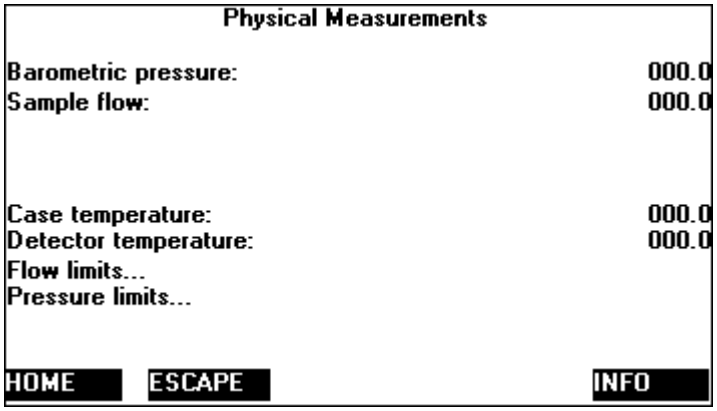
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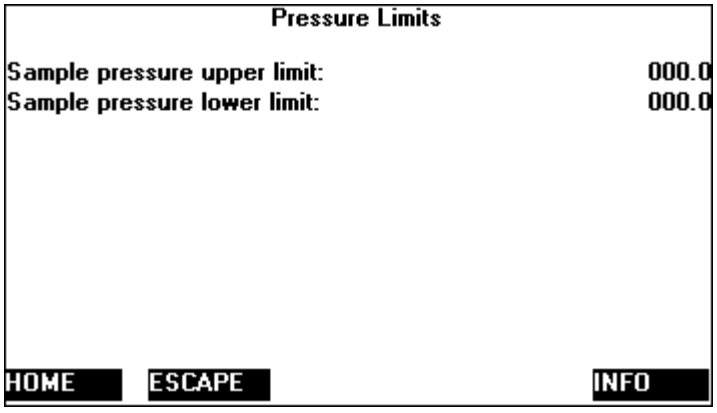
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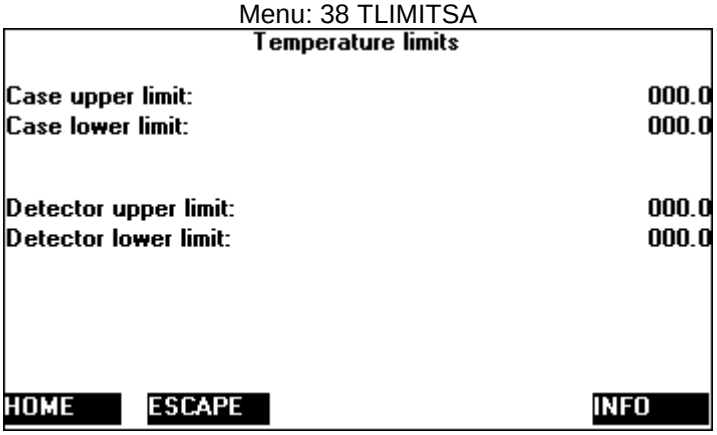
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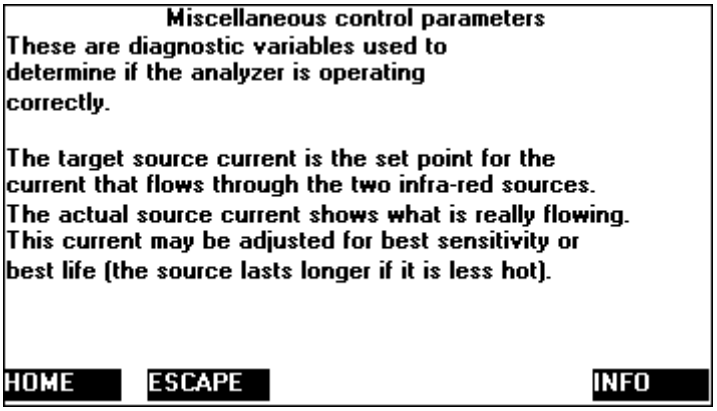
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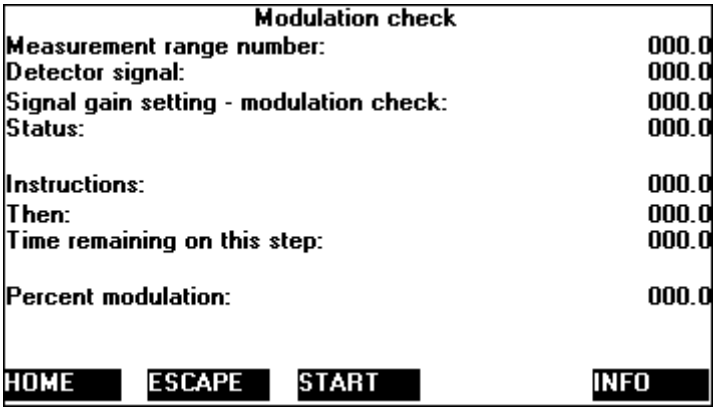
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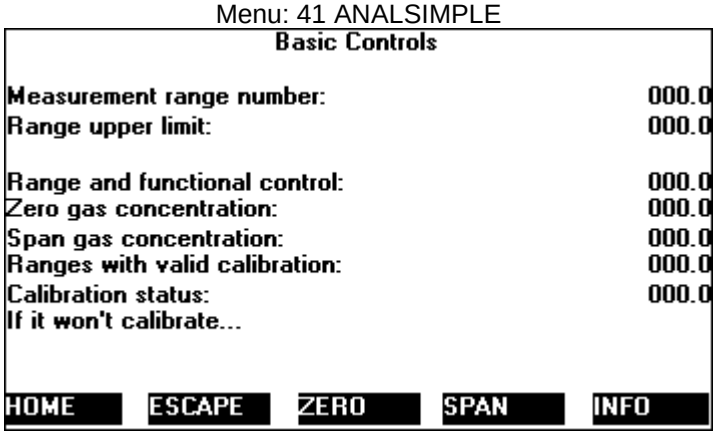
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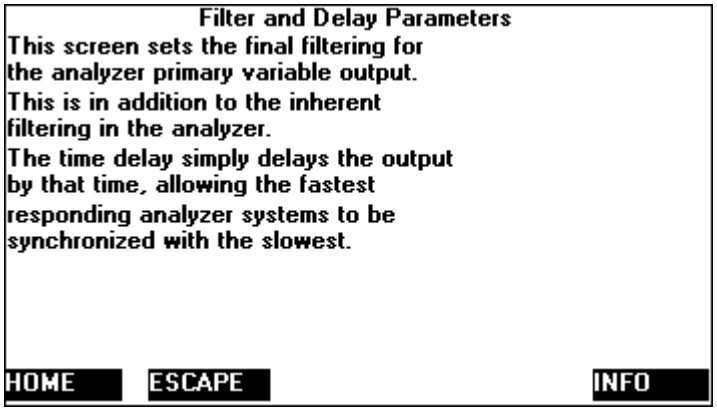
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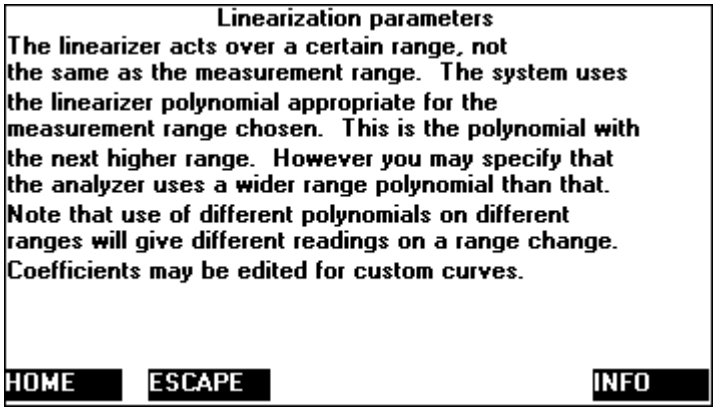
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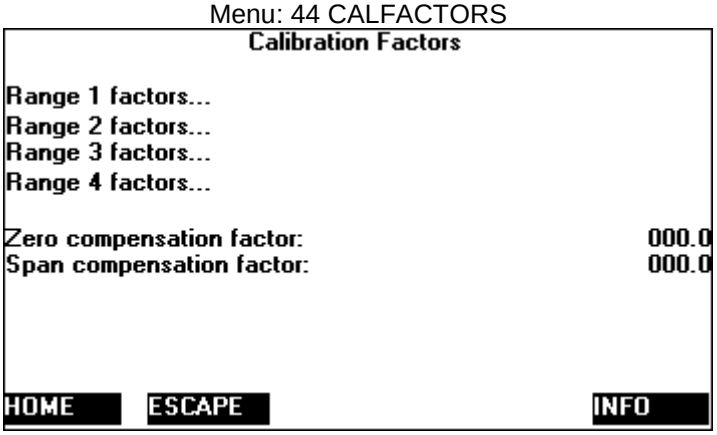
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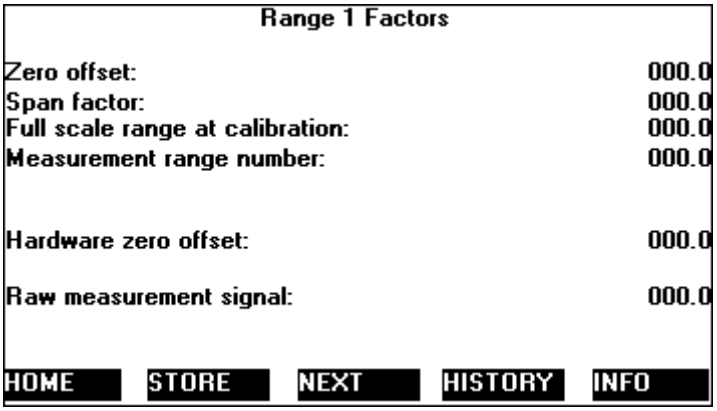
Menu: 43 LINRANGE0I1



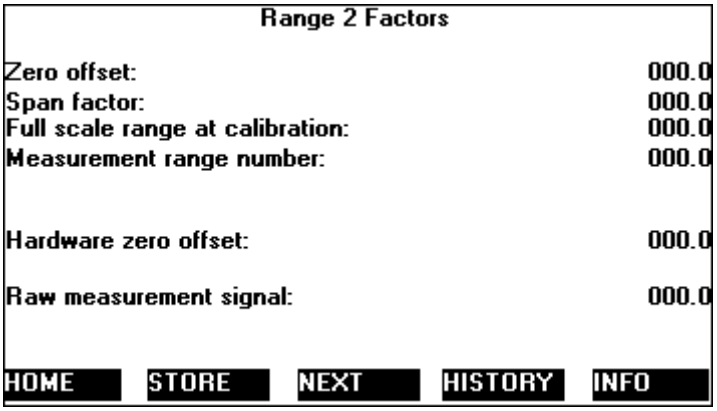
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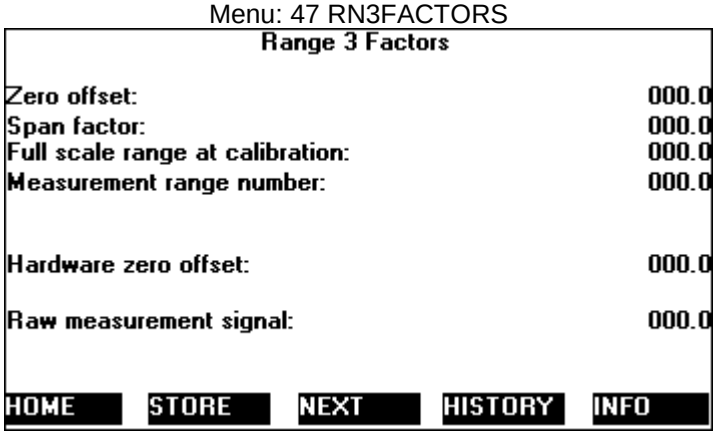
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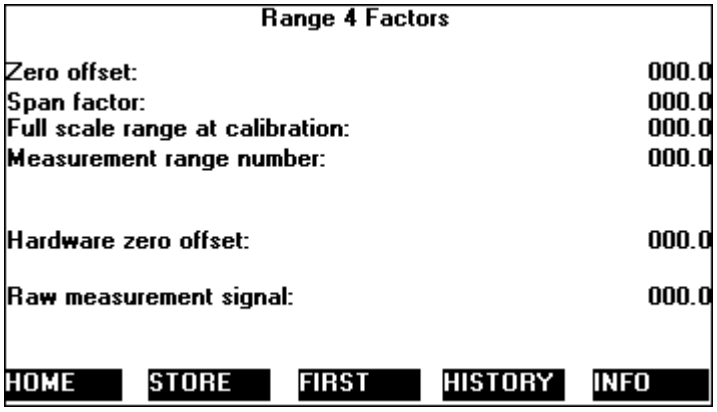
Menu: 46 RN2FACTORS



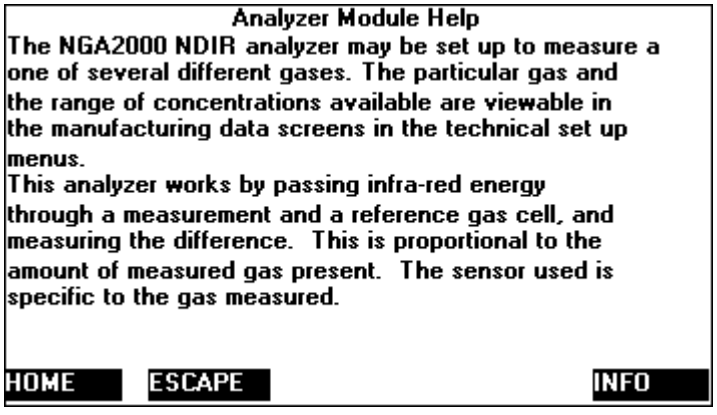
Menu: 47 RN3FACTORS



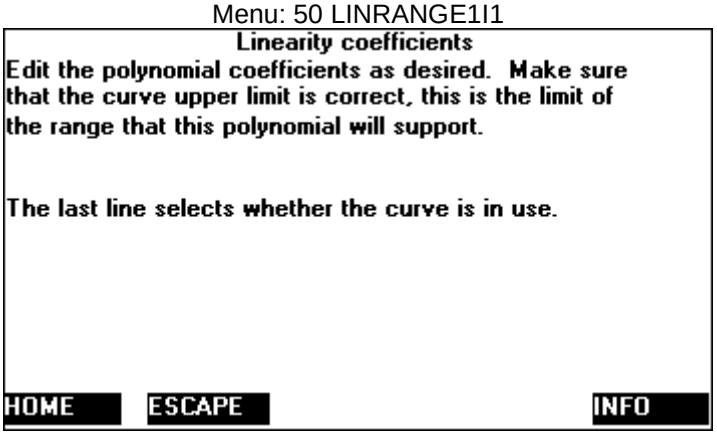
Menu: 48 RN4FACTORS



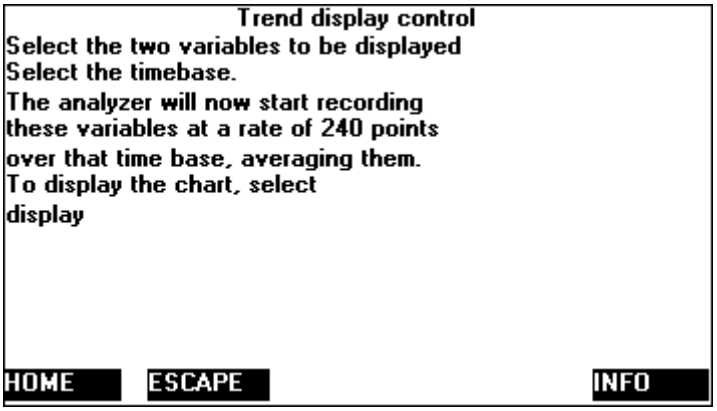
Menu: 49 AMHELPINDEX



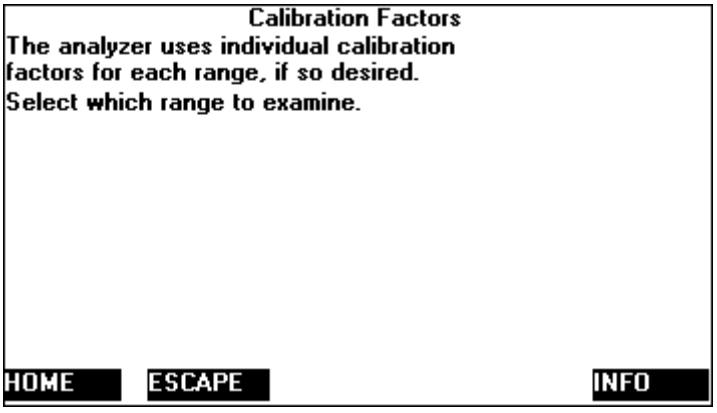
Menu: 50 LINRANGE1I1



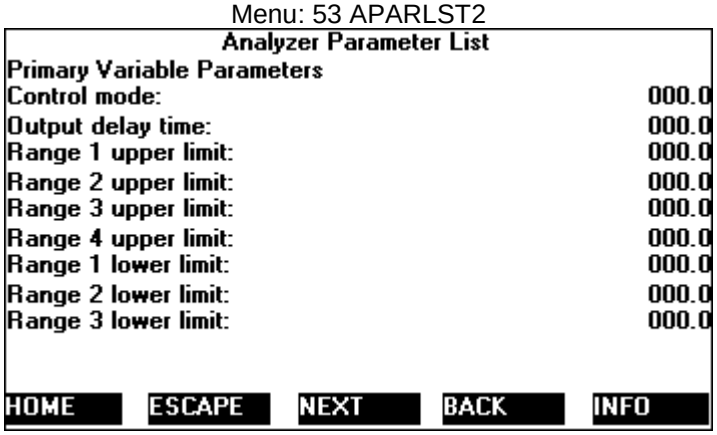
Menu: 51 AMTRENDI1



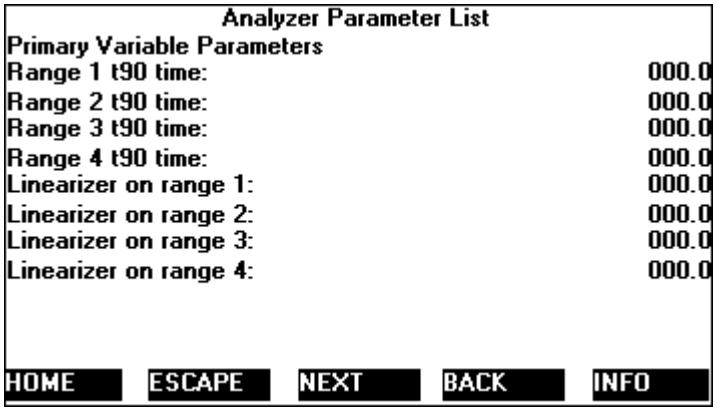
Menu: 52 CALFACTORSI1



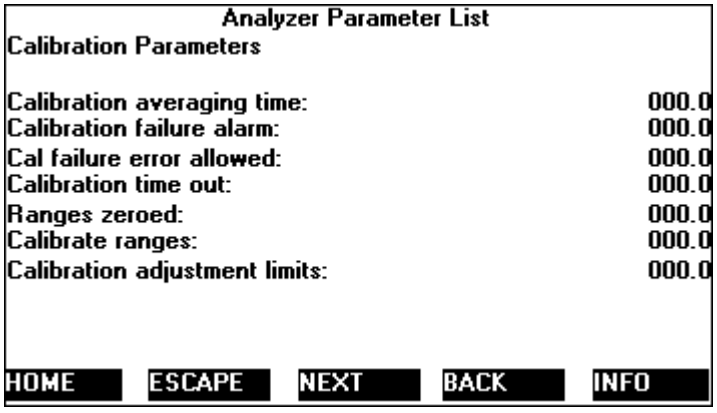
Menu: 53 APARLST2



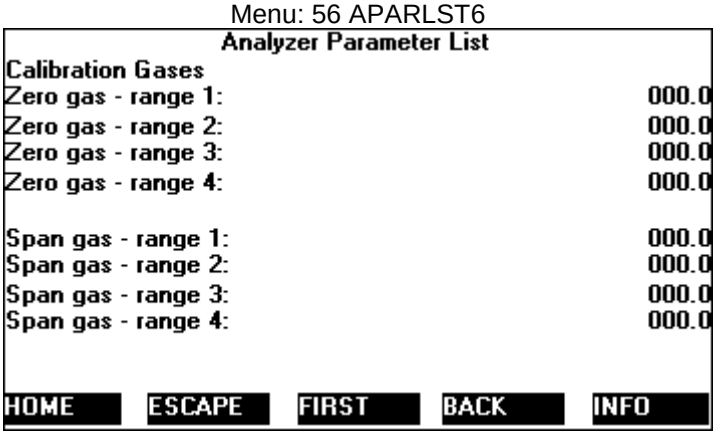
Menu: 54 APARLST4



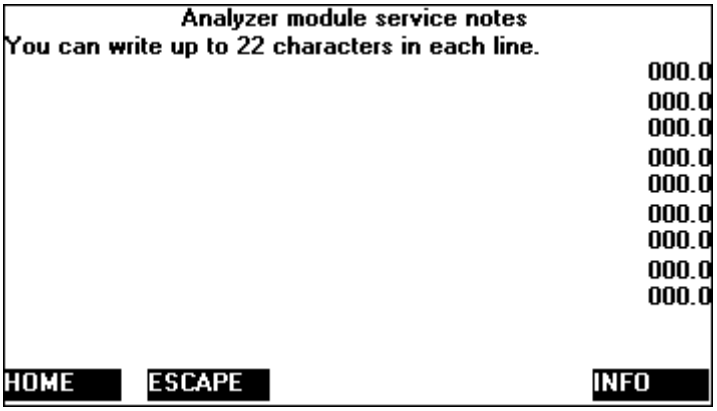
Menu: 55 APARLST5



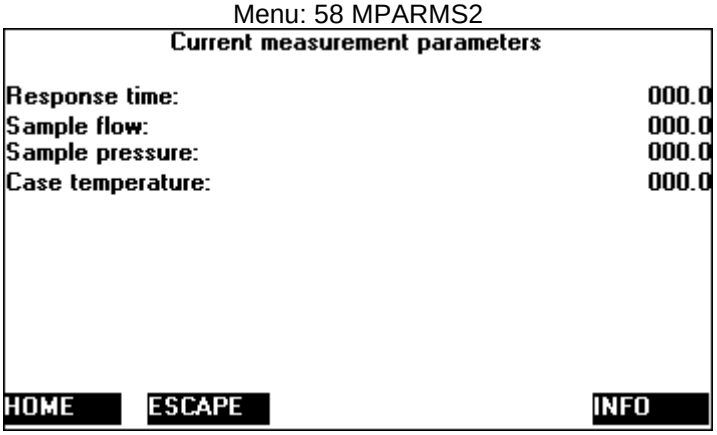
Menu: 56 APARLST6



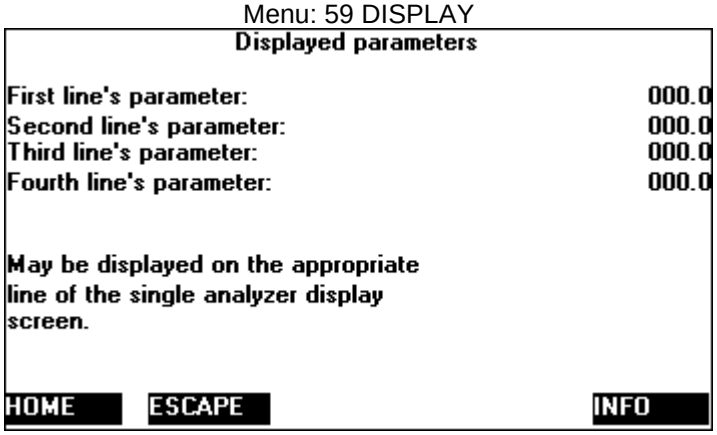
Menu: 57 LISTNOTES



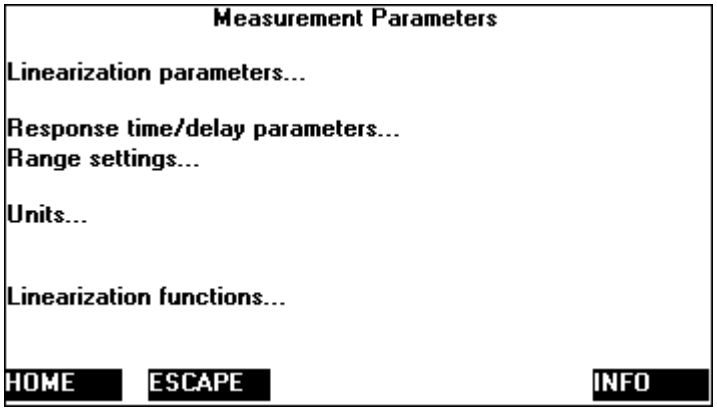
Menu: 58 MPARMS2



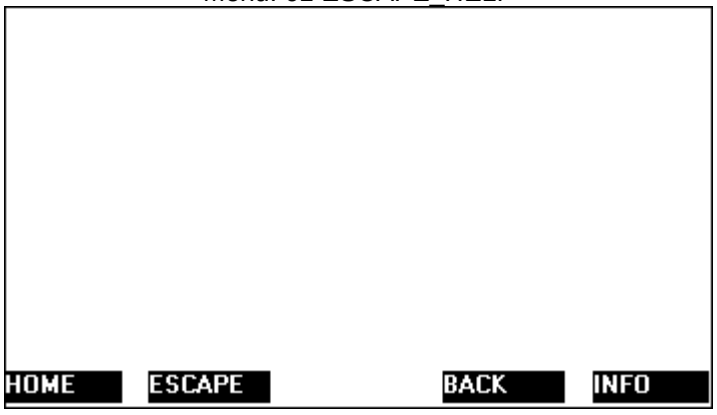
Menu: 59 DISPLAY



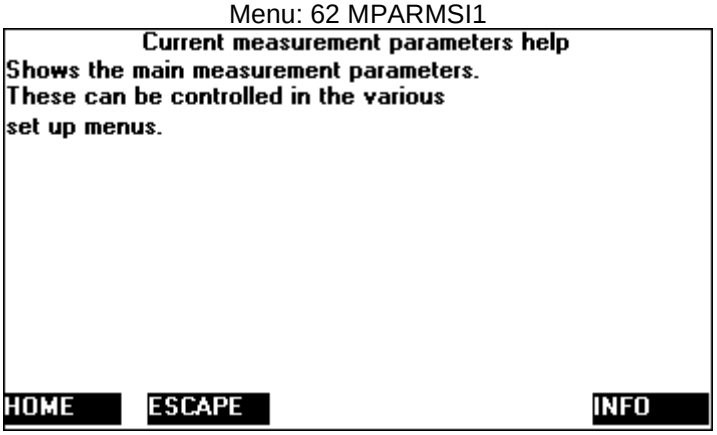
Menu: 60 ANALSET2



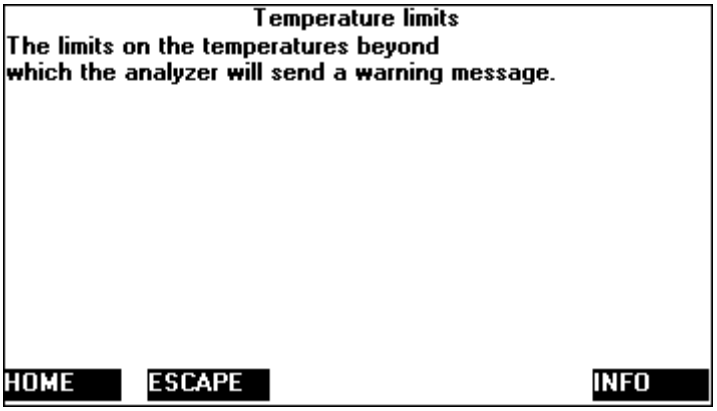
Menu: 61 ESCAPE_HELP



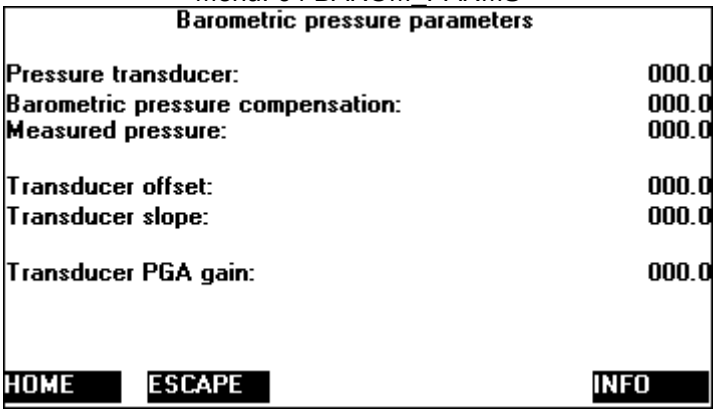
Menu: 62 MPARMSI1



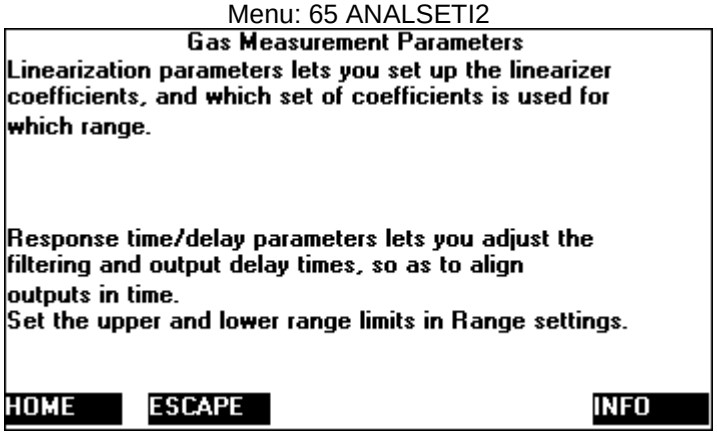
Menu: 63 TLIMITSIAI1



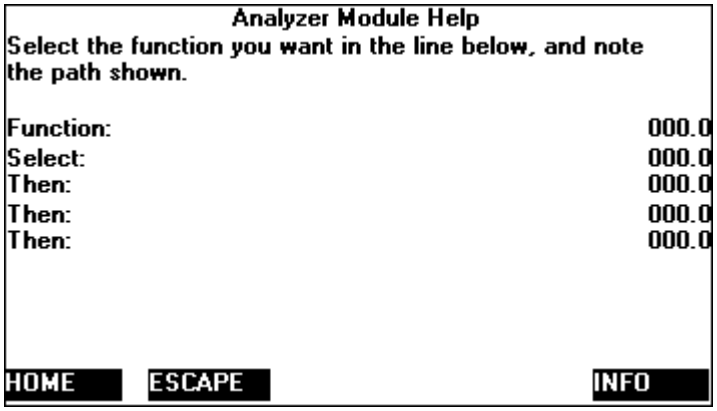
Menu: 64 BAROM_PARMS



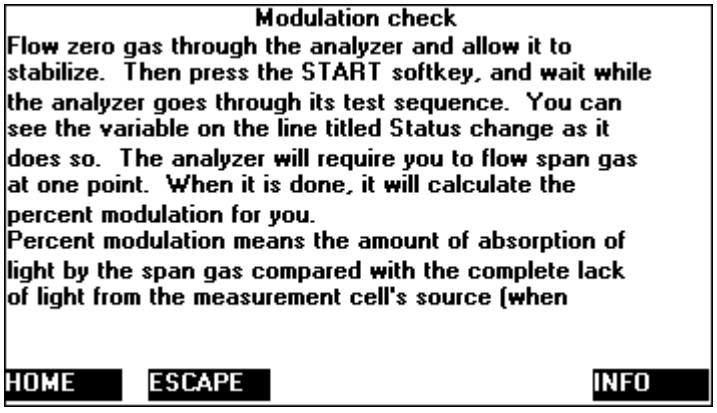
Menu: 65 ANALSETI2



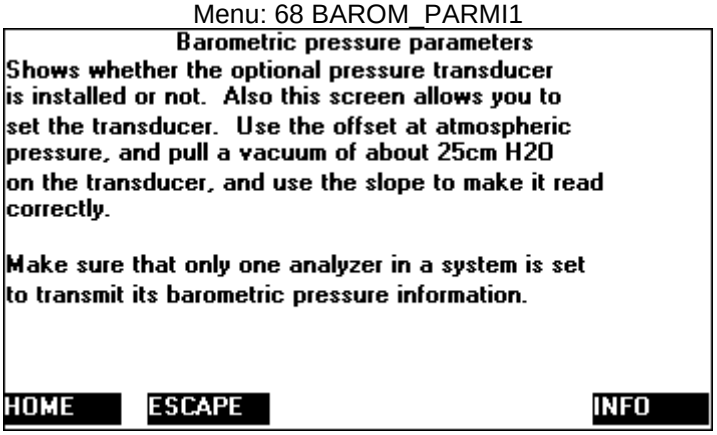
Menu: 66 AMHELPINDEX2



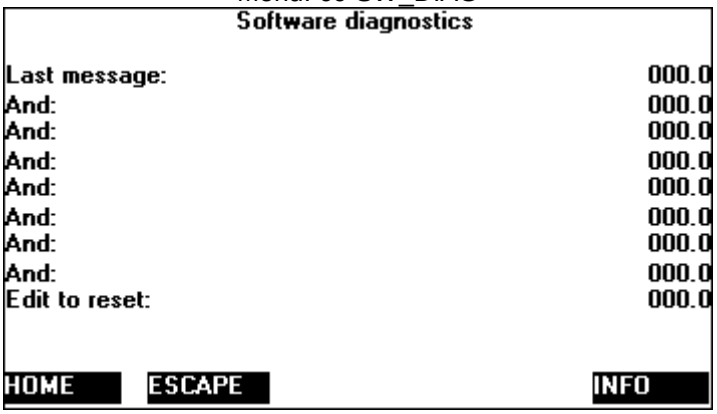
Menu: 67 MODTESTI1



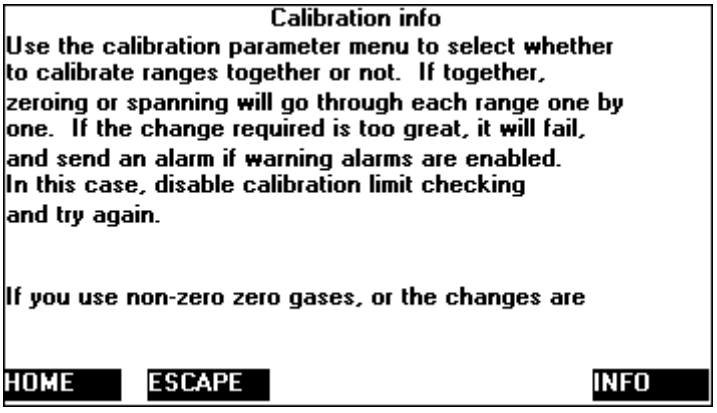
Menu: 68 BAROM_PARMI1



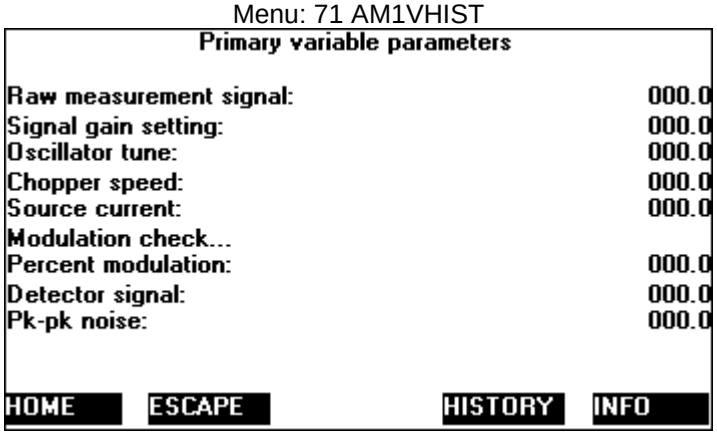
Menu: 69 SW_DIAG



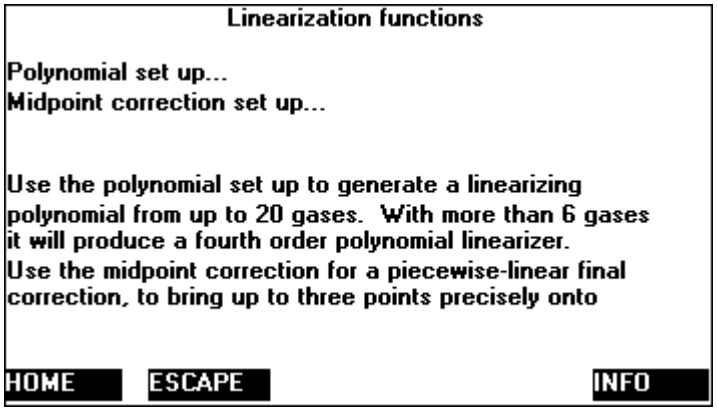
Menu: 70 CALI1



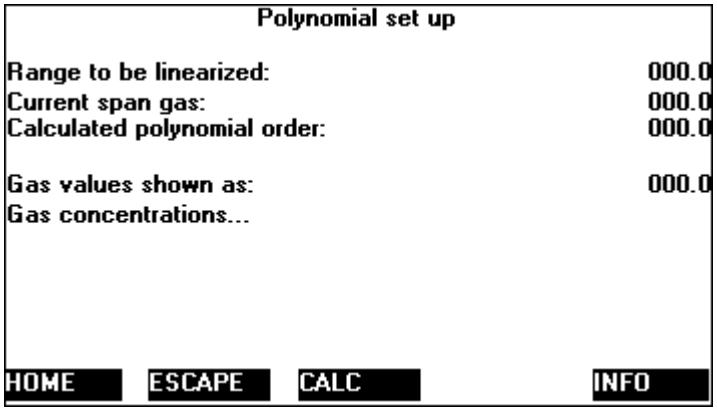
Menu: 71 AM1VHIST



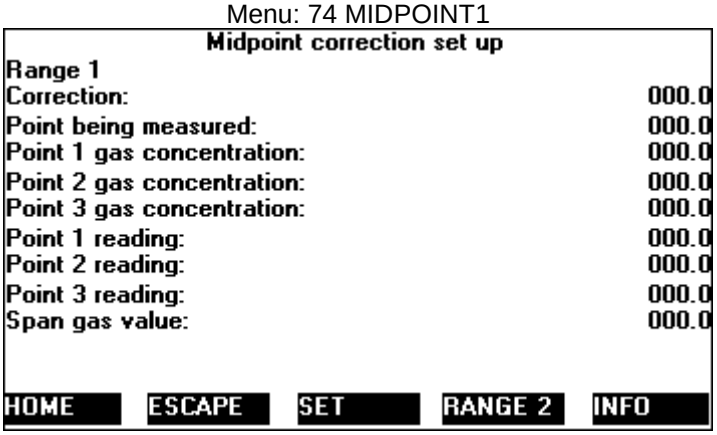
Menu: 72 LINFUNCT



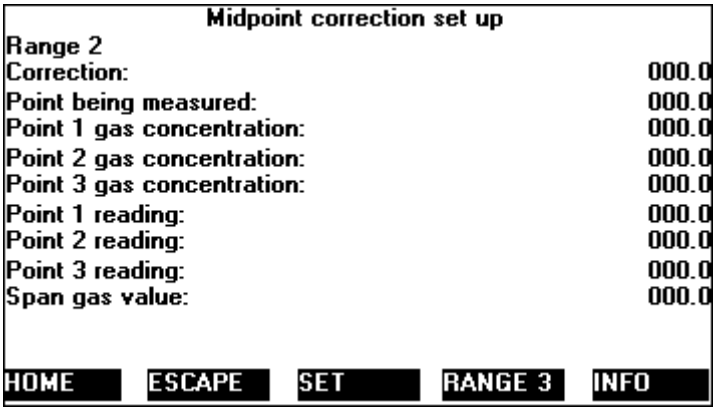
Menu: 73 POLYSETUP



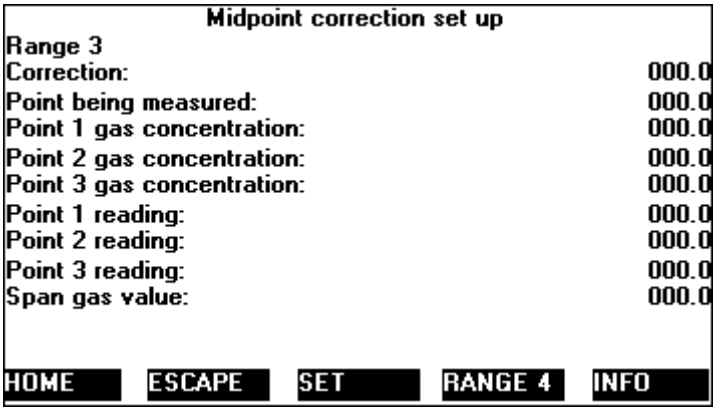
Menu: 74 MIDPOINT1



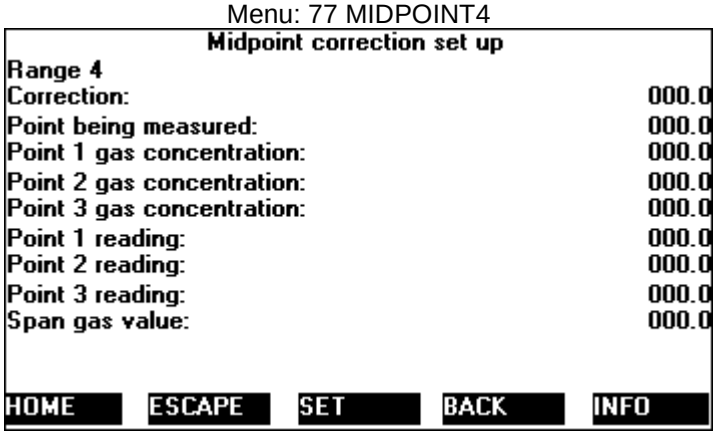
Menu: 75 MIDPOINT2



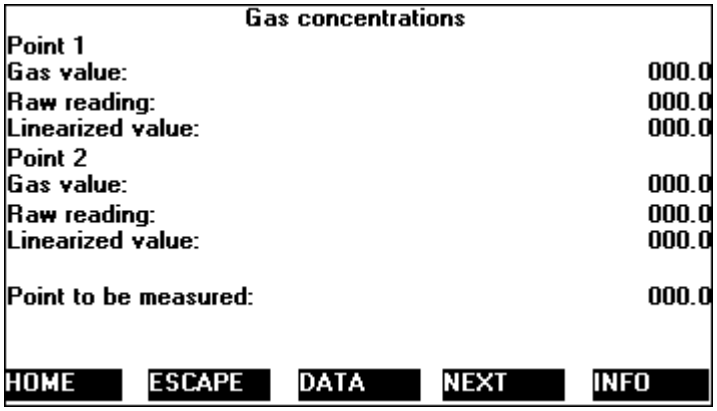
Menu: 76 MIDPOINT3



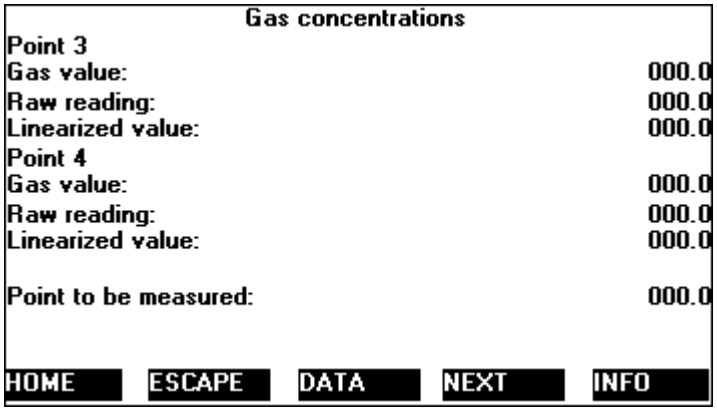
Menu: 77 MIDPOINT4



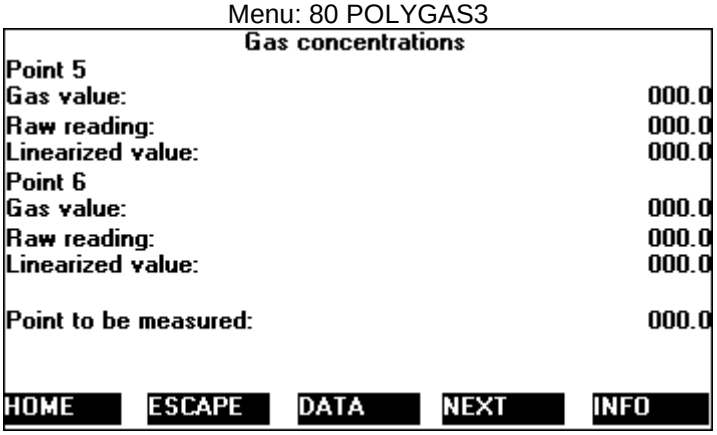
Menu: 78 POLYGAS1



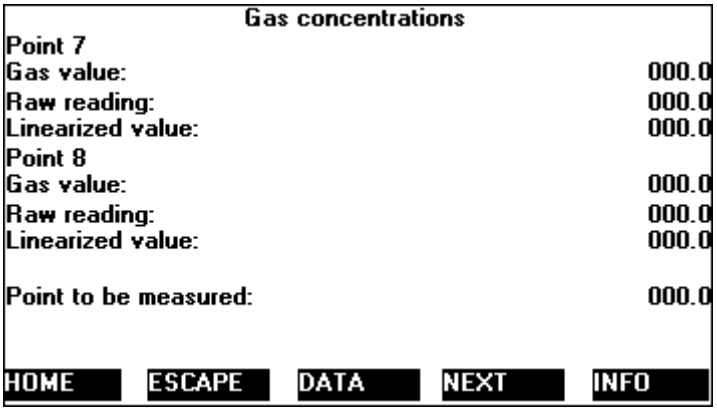
Menu: 79 POLYGAS2



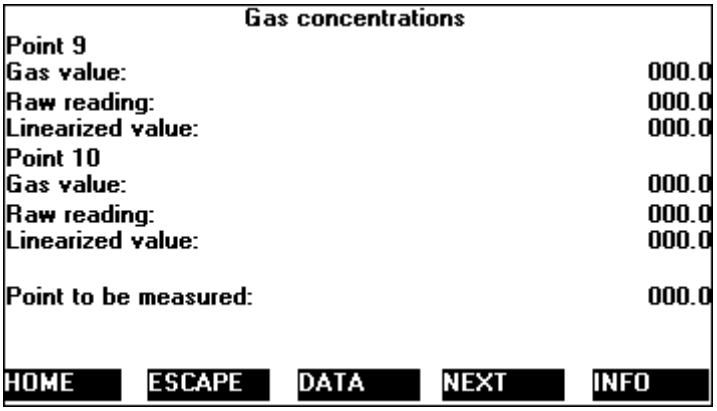
Menu: 80 POLYGAS3



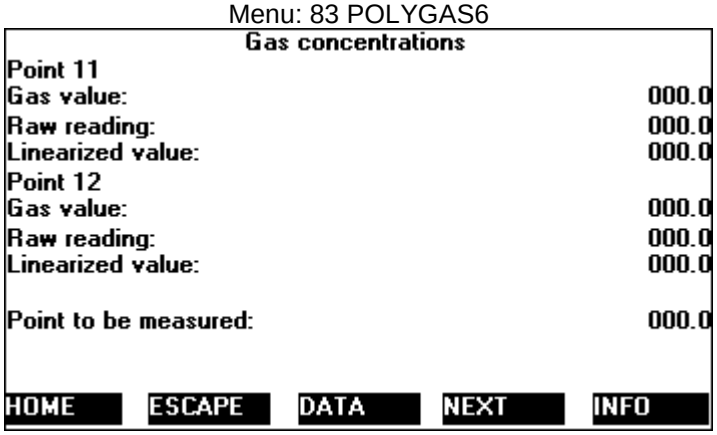
Menu: 81 POLYGAS4



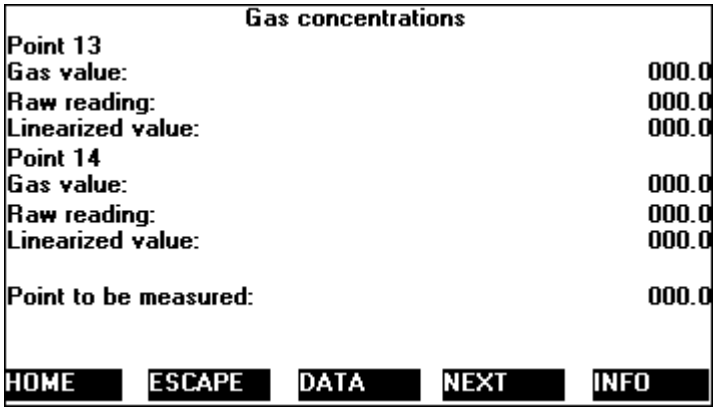
Menu: 82 POLYGAS5



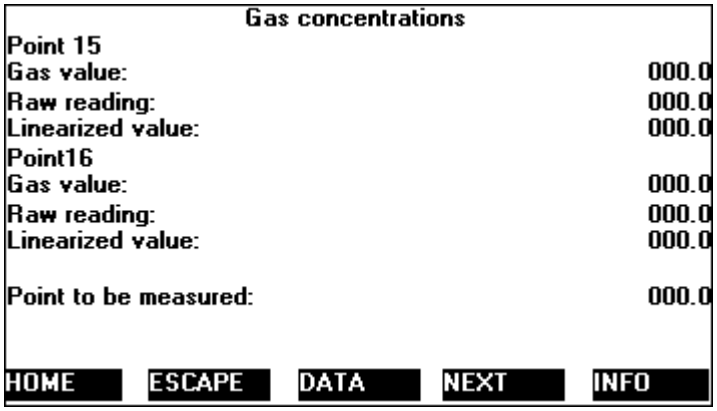
Menu: 83 POLYGAS6



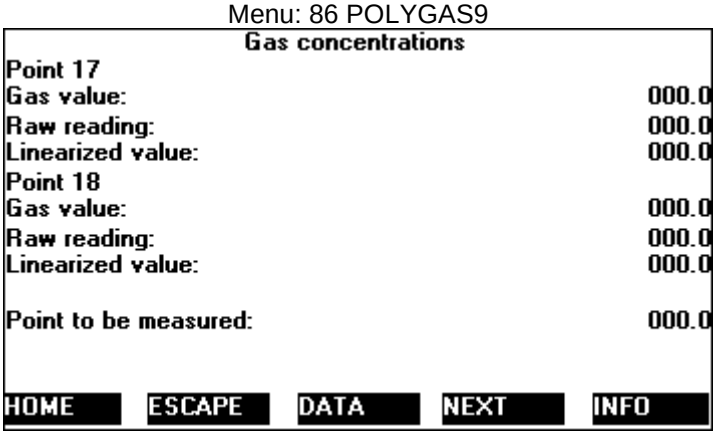
Menu: 84 POLYGAS7



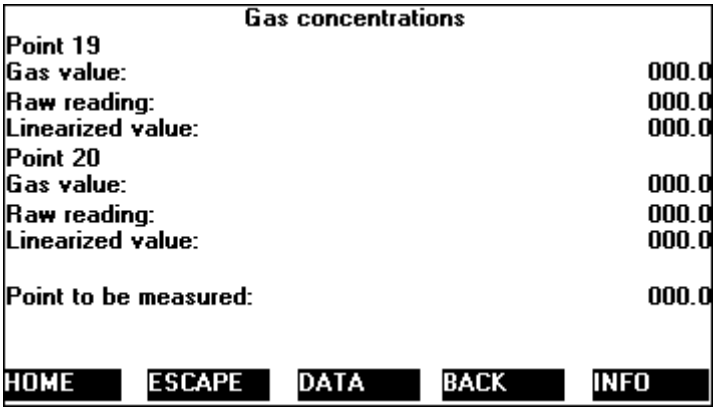
Menu: 85 POLYGAS8



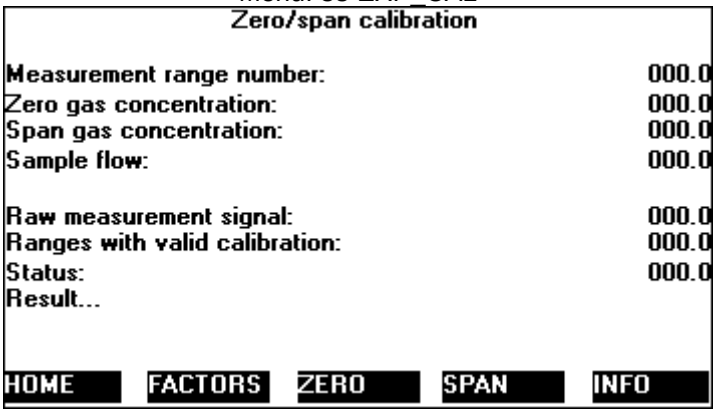
Menu: 86 POLYGAS9



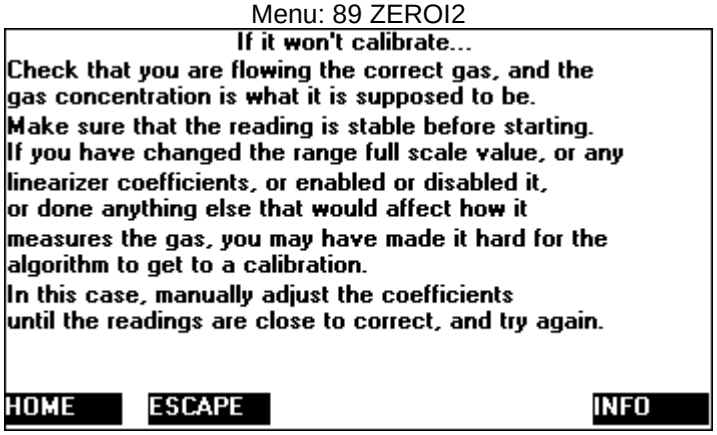
Menu: 87 POLYGAS0



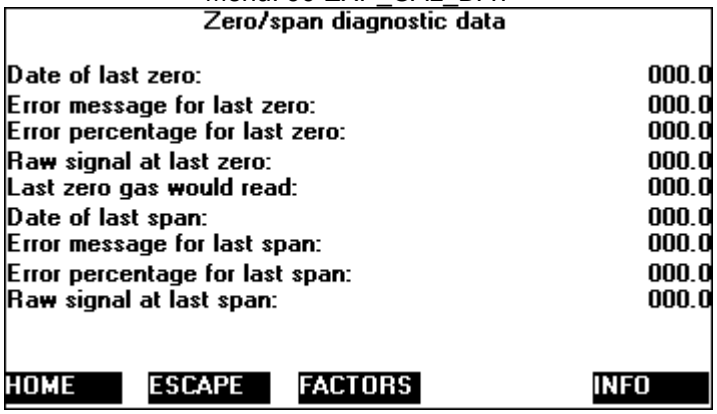
Menu: 88 EXP_CAL



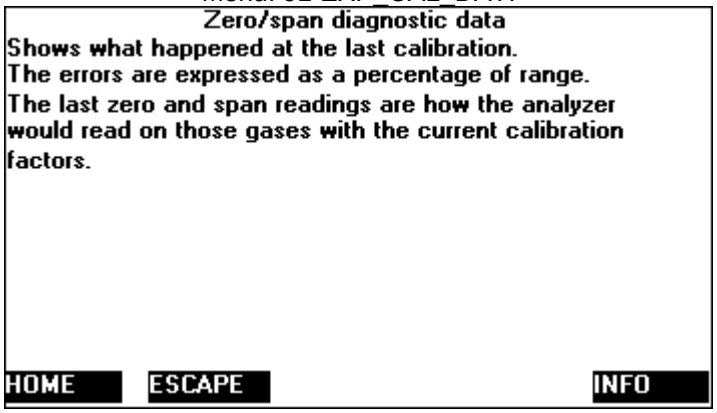
Menu: 89 ZEROI2



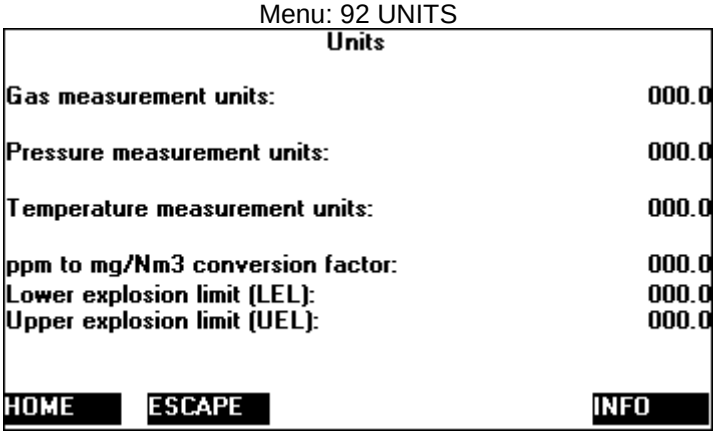
Menu: 90 EXP_CAL_DAT



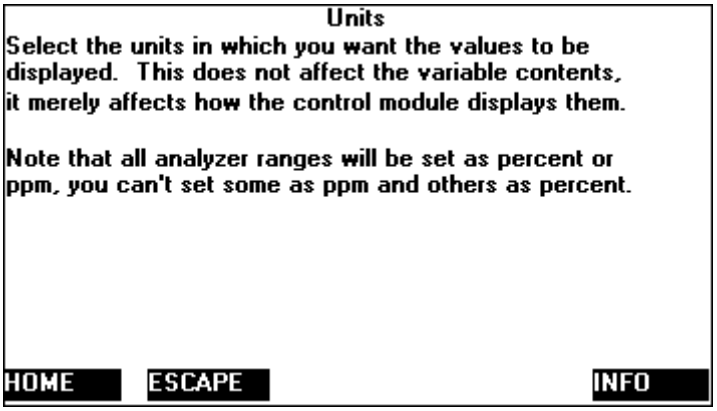
Menu: 91 EXP_CAL_DATI



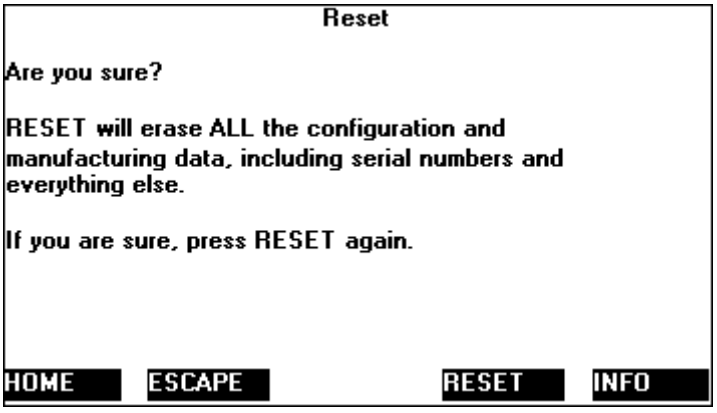
Menu: 92 UNITS



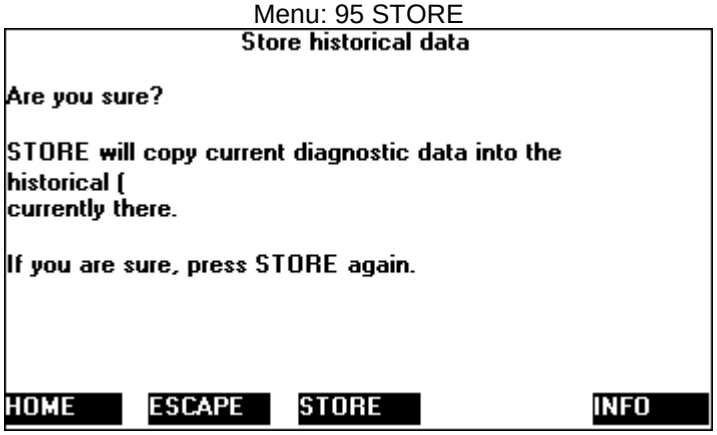
Menu: 93 UNITSI1



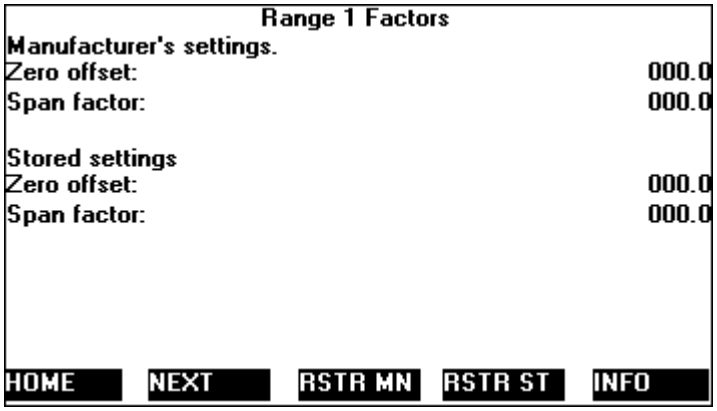
Menu: 94 RESET



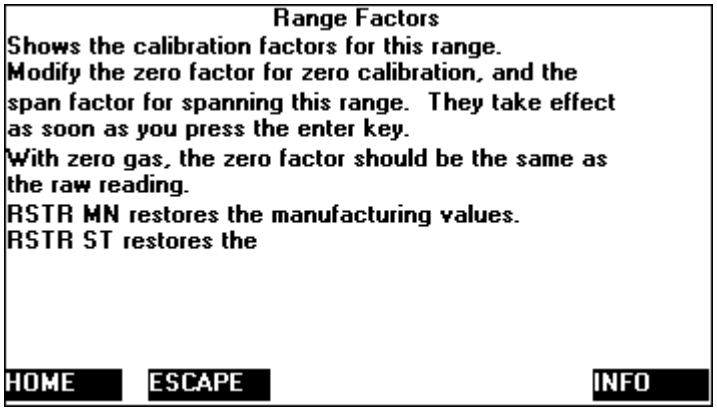
Menu: 95 STORE



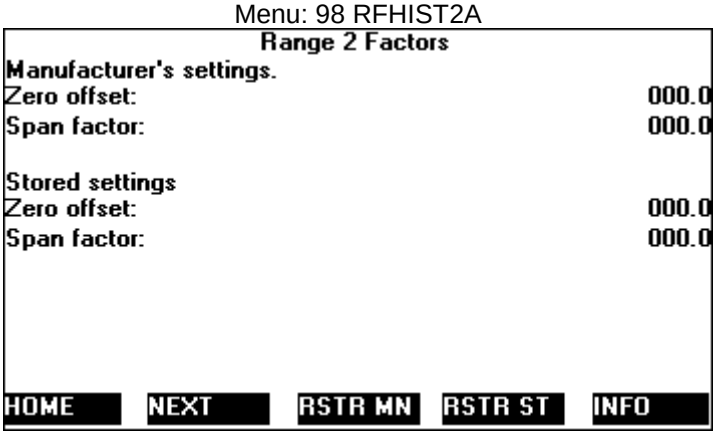
Menu: 96 RFHIST1A



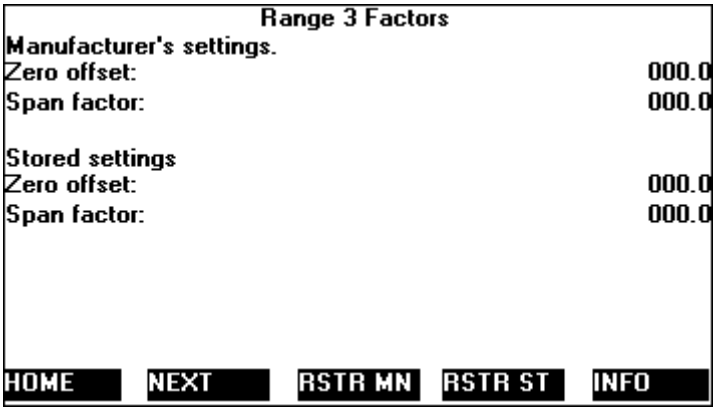
Menu: 97 RFACTORSIA



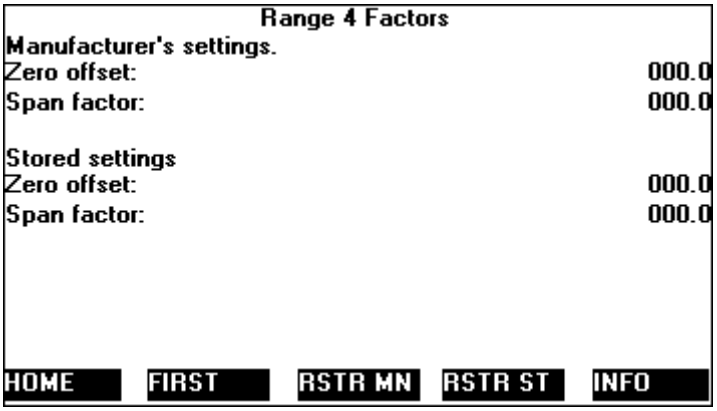
Menu: 98 RFHIST2A



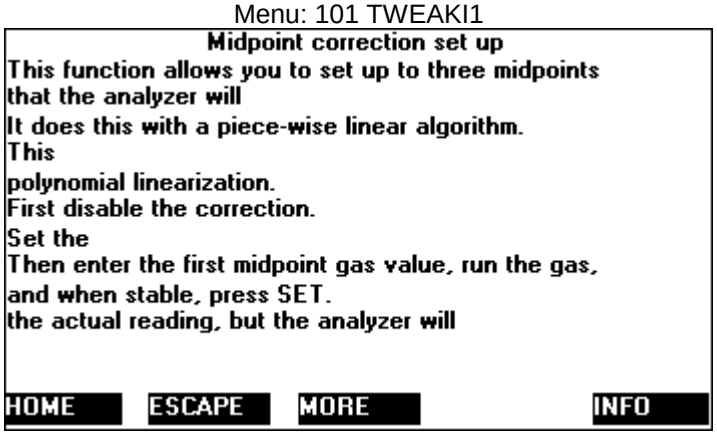
Menu: 99 RFHIST3A



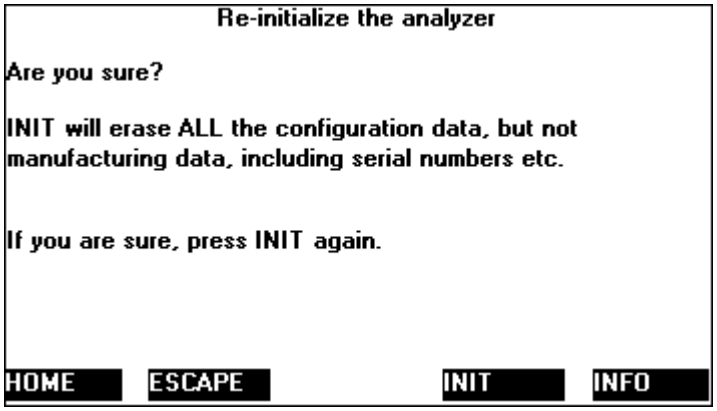
Menu: 100 RFHIST4A



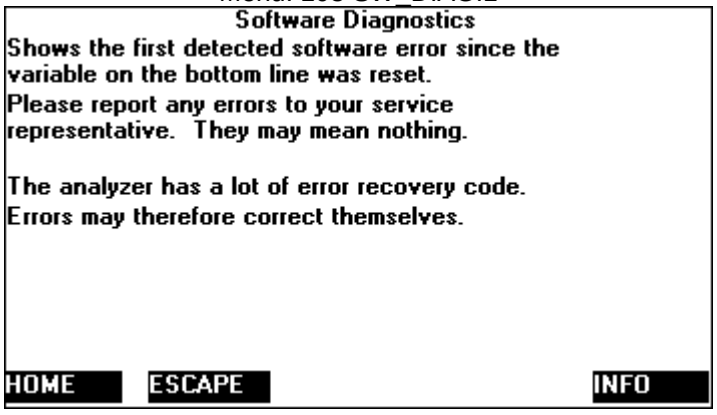
Menu: 101 TWEAKI1



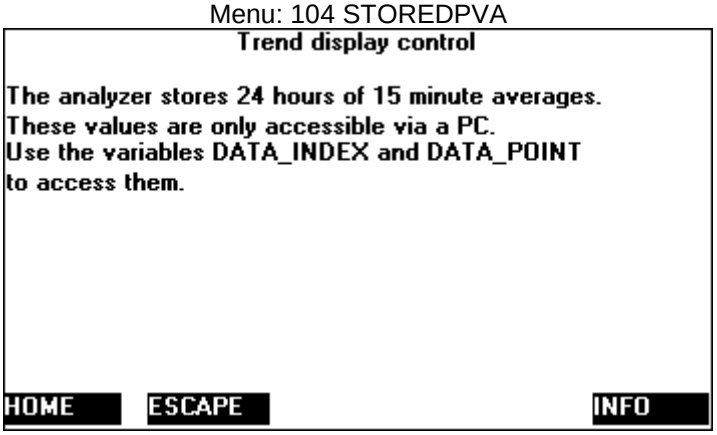
Menu: 102 INIT



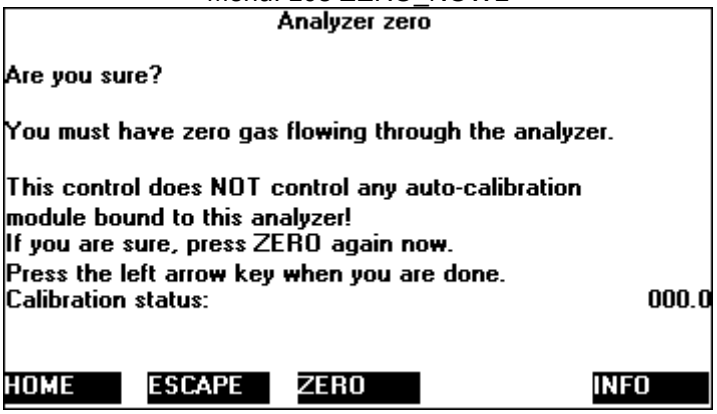
Menu: 103 SW_DIAGI1



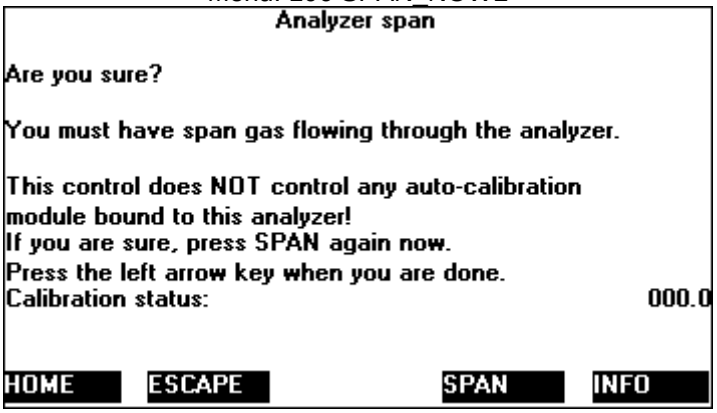
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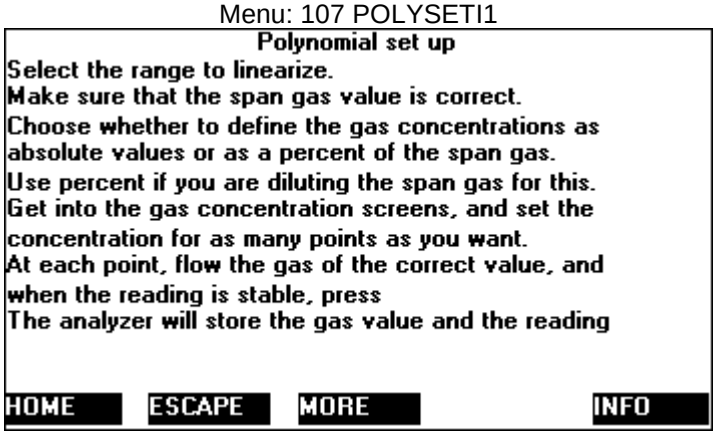
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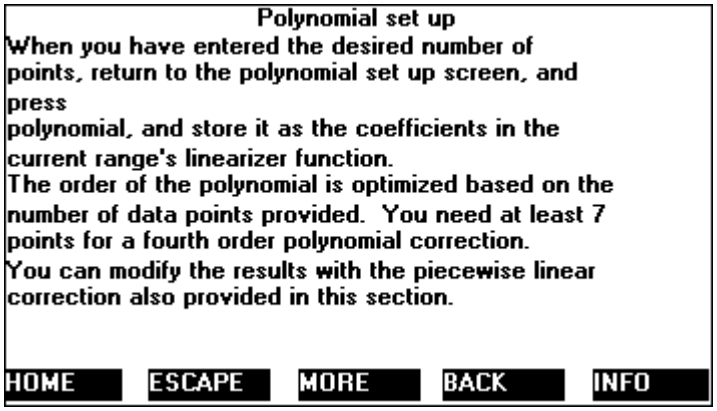
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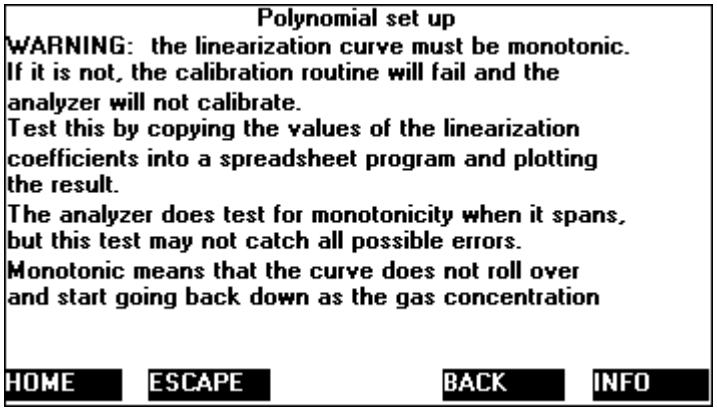
Menu: 107 POLYSETI1



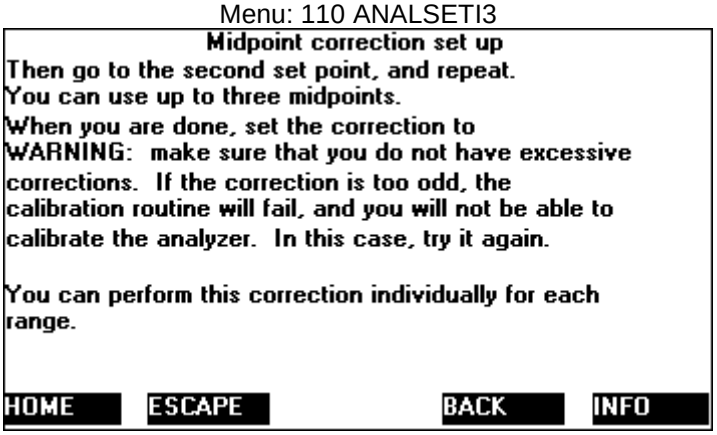
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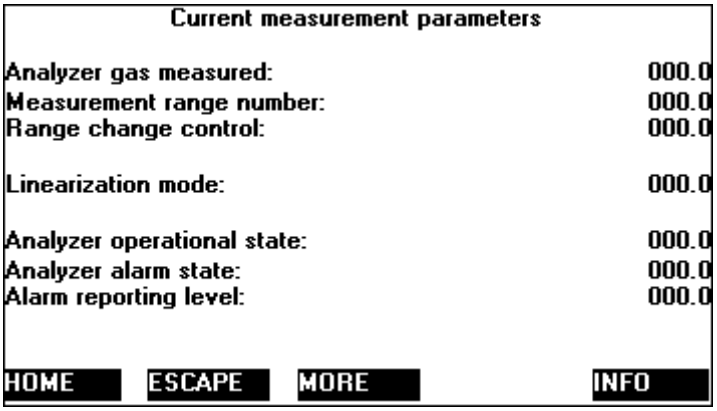
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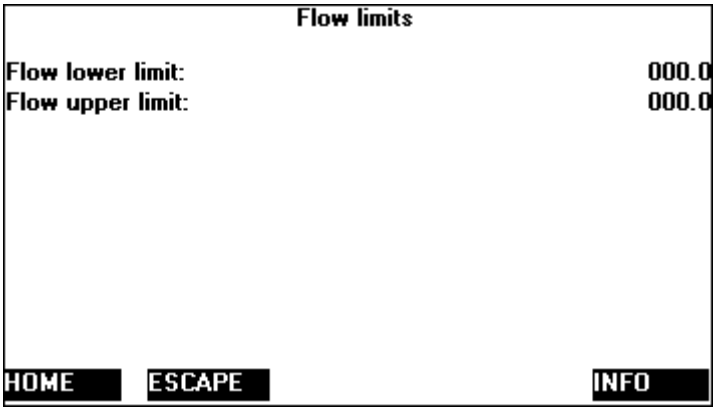
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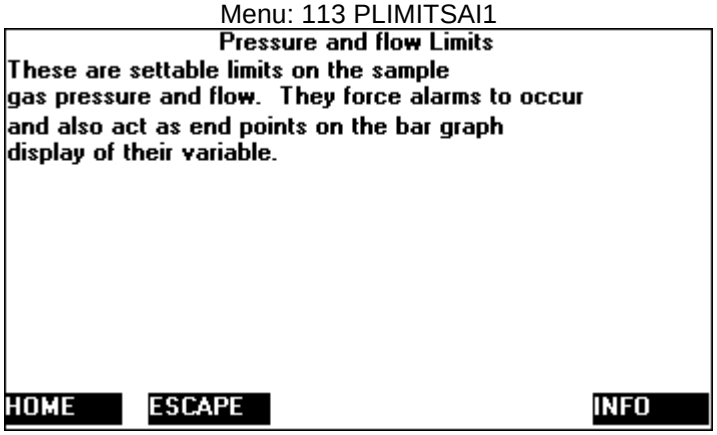
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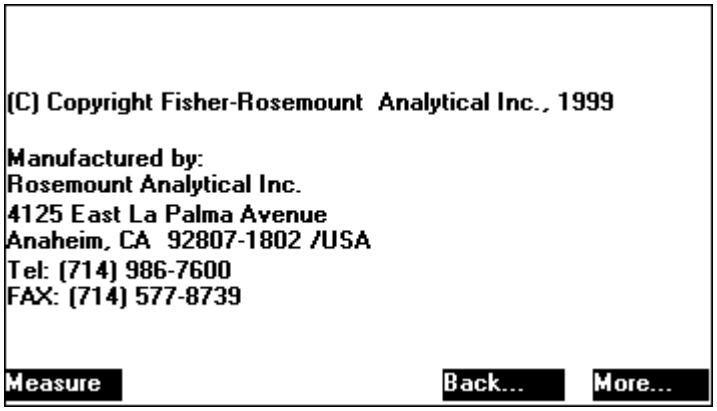
Menu: 112 FLOWLIMITS



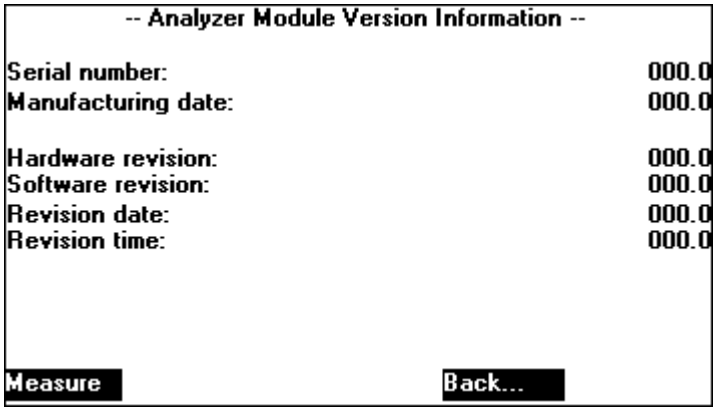
Menu: 113 PLIMITSAI1



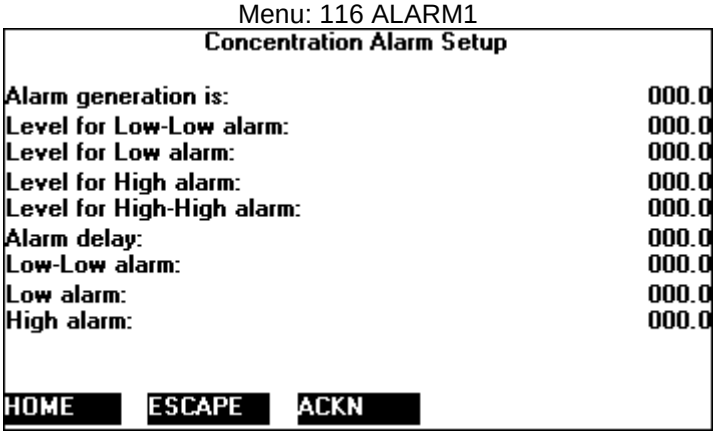
Menu: 114 ABOUT



Menu: 115 ABOUT1



Menu: 116 ALARM1



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