MODEL 600-NDIR
USERS MANUAL

This maual describes installation, calibration and operation of California Analytical Instrument Model 600-NDIR gas analyzer. To assure correct operation and accurate results, it is recommended that the user carefully read this document.

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Safety Alert
Caution or Warning

Temperature Hazard
Caution or Warning

Electrical Shock Hazard
Caution or Warning

Safety Information in this Manual

Note, caution and warning symbols appear on the instrument and throughout this manual to draw your attention to important operational and safety information.

A "**NOTE**" marks a short message to alert you to an important detail.

A "**CAUTION**" safety alert appears with information that is important for protecting your equipment and performance.

A "**WARNING**" safety alert appears with information that is important for protecting you, others and equipment from damage. Pay very close attention to all warnings that apply to your application.

The  symbol (an exclamation point in a triangle) precedes a general CAUTION or WARNING statement.

The  symbol (wavy vertical lines with an under score in a triangle) precedes an elevated temperature hazard CAUTION or WARNING statement.

The  symbol (a lightning bolt in a triangle) precedes an electric shock hazard CAUTION or WARNING statement.

Some or all of the above symbols may appear in this manual or on the equipment. This manual should be consulted whenever one of these symbols is encountered on the equipment.

ALWAYS REMOVE POWER BEFORE CONNECTING OR DISCONNECTING SIGNAL CABLES OR WHEN SERVICING THE EQUIPMENT.

The 600 series NDIR instruments meet or exceed the following directives and standards.

Application of Council Directive(s):

Electrical Safety:

Low Voltage Directive 73/23/EEC

Electromagnetic Compatibility:

EMC Directive 89/336/EEC

Standard(s) to which Conformity is Declared:

Electrical Safety:

Standard for Electrical Equipment for Measurement, Control, and Laboratory Use [EN 61010-1:2001 (2nd Edition)

Electromagnetic Compatibility:

EN 61326:1997 Electrical equipment for measurement, control and laboratory use - EMC requirements (Amendment A1: 1998 to EN 61326:1997; Amendment A2:2001 to EN 61326:1997)

600 NDIR Quick Start Guide

1) Plug in the analyzer and turn the power on.
2) Connect the appropriate gas lines and vents to the analyzer.
3) Allow the analyzer to stabilize for at least one (1) hour.
4) During the analyzer's stabilization period, setup the analyzer to the desired configuration.
   a) Set the analyzer's output as desired.
      i) From the Main Menu press F5 (Setup) then F7 (System Settings.)
      ii) Press F3 (output assignments) to setup the output channels.
         (1) Set to real time.
         (2) AUX 1
         (3) AUX 2
         (4) AUX 3
         (5) Press back to return to the system settings menu.
      iii) Press F4 (output range) to setup the output ranges
         (1) Set the Min and Max to zero (0). This will cause the outputs to default to the current ranges.
         (2) Set the outputs for milliamps (mA) or voltage (V) as desired.
            (a) The mA setting will give 4-20 mA or 2-10V (if 500 ohm resisters are installed.
            (b) The V setting will give 0-20mA or 0-10V (if 500 ohm resistors are installed.

Disconnect power before proceeding

5) Connect all appropriate analog outputs.
   a) Pin 1 is the output common (ground).
   b) Pins 2, 3, 4, and 5 are output channels 1, 2, 3, and 4 as setup in step 4.a.ii.
   c) If the output is set for voltages but there is no voltage output, you will need to install a 500 ohm resistor between pin 1 and the channel you are trying to measure. You will have to measure the voltage drop across this resistor.
6) Reconnect the power and turn on the analyzer. Press F1 from the analyzer's main Menu to get to the measurement screen.
7) Supply sample gas to the analyzer.
8) The measurement screen should indicate the concentration of the sample gas. If the concentration is incorrect, the analyzer will need to be calibrated using zero and span calibration gases. Please reference the appropriate section of the manual for a description on how to zero and span the analyzer.

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1. Introduction

1.1. Overview

Congratulations and thank you! You have just purchased one of the most reliable gas analyzers in the world. Before using the analyzer, please familiarize yourself with its operation by reading this manual. If you have any questions, please do not hesitate to call California Analytical Instruments for assistance. We want you to be a member of our thousands of satisfied customers.

1.2. Unpacking Instructions

Open the shipping container and carefully remove the analyzer from the packing materials. Inspect the instrument for any sign of damage. Remove the Top Cover retaining screws. Visually check for loose parts or connectors that are not properly seated. Verify all circuit boards and circuit board connections are secure. If all internal components look normal, re-install the cover.

1.3. Reporting Damage

Should there be any apparent damage either to the inside or outside of the instrument due to shipping or handling, immediately notify the shipper. The shipping container or packing materials should be retained for inspection by the shipper.

1.4. Contact Information

California Analytical Instruments, Inc.

1312 West Grove Avenue
Orange, CA 92865
714 974-5560
Fax 714 921-2531
Website: www.gasanalyzers.com

1.5. Warranty Certificate

Subject to the exceptions and upon the conditions stated below, California Analytical Instruments (CAI) warrants that the products sold under this sales order shall be free from defects in workmanship and materials for one year after delivery of the product to the original Buyer by CAI and if any such product should prove to be defective within such one year period, CAI agrees, at its option, either (i) to correct by repair or, at CAI's election, by replacement with equivalent product any such defective product, provided that investigation and factory inspection discloses that such defect developed under normal and proper uses, or (ii) to refund the purchase price. The exceptions and conditions mentioned above are as follows:

a. components or accessories manufactured by CAI that by their nature are not intended to or will not function for one year are warranted only to give reasonable service for a reasonable time. What constitutes reasonable time and reasonable services shall be determined solely by CAI. A complete list of such components and accessories is maintained at the factory;

b. CAI makes no warranty with respect to components or accessories not manufactured by it; in the event of defect in any such component or accessory CAI will give reasonable assistance to Buyer in obtaining from the respective manufacturer whatever adjustment is authorized by the manufacturer's warranty;

c. any product claimed to be defective must be returned to the factory transportation charges prepaid and CAI will return the repaired or replaced product freight collect;

d. if the product claimed to be defective requires on-site repair, such warranty labor will be provided at no charge; however, transportation and living expenses will be charged to Buyer;

e. if the product is a consumable or the like, it is warranted only to conform to the quantity and content and for the period (but not in excess of one year) stated on the label at the time of delivery or 90 days;

f. CAI may from time to time provide a special printed warranty with respect to a certain product, and where applicable, such warranty shall be deemed incorporated herein by reference;

g. CAI shall be released from all obligations under all warranties, either expressed or implied, if any product covered hereby is repaired or modified by persons other than its own authorized service personnel unless such repair by others is made with the written consent of CAI.

IT IS EXPRESSLY AGREED THAT THE ABOVE WARRANTY SHALL BE IN LIEU OF ALL WARRANTIES OF FITNESS AND OF THE WARRANTY OF MERCHANTABILITY AND THAT CAI SHALL HAVE NO LIABILITY FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND OR FROM ANY CAUSE WHATSOEVER ARISING OUT OF THE MANUFACTURE USE, SALE, HANDLING, REPAIR, MAINTENANCE OR REPLACEMENT OF ANY OF THE PRODUCTS SOLD UNDER THIS SALES ORDER. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THAT THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY HAVE OTHER RIGHTS, WHICH VARY FROM STATE TO STATE.

Representations and warranties made by any person, including dealers and representatives of CAI which are inconsistent or in conflict with the terms of this warranty, shall not be binding upon CAI unless produced in writing and approved by an expressly authorized officer of CAI.

1.6. Proper Operation

Personnel should be trained in the proper operation of this equipment before attempting to operate the equipment.

1.7. Possible Explosion Hazard

Do not apply power to the analyzer or attempt to energize the analyzer until determining the analyzer environment to be non-hazardous.

Use this analyzer in **a NON-HAZARDOUS** environment.

This analyzer has not been designed for use with a hazardous sample.

Tampering or use of substitute components may cause a safety hazard. Use only factory authorized replacement parts.

1.8. Electrical Shock Hazard

Disconnect power before removing cover. Servicing requires access to live electrical components that can cause death or serious injury. Refer servicing to qualified service personnel. For safety and proper performance, connect this instrument to a properly grounded three-wire receptacle.

Caution

1.9. Plug Removal

Do not operate this analyzer UNTIL REMOVING the red plastic ¼ inch plugs from the sample inlet and exhaust fittings on the rear panel.

Use of this equipment in a manner not approved by California Analytical Instruments is not recommended and may cause harm to the equipment or operating personnel.

2. Features

2.1. Description

The Model 600 series of NDIR analyzers incorporate a single-beam photometric system and a detector with a microflow sensor assuring high reliability, sensitivity, accuracy, and stability. The microflow detector is a sealed unit filled with the same gas as the component of interest (CO, CO_2, and CH_4). The length of the sample cell determines the most sensitive range for each component.

2.2. Features-General

The Model 600 series of NDIR analyzers have a 3 by 5 inch liquid crystal display and a 20 key data/operation input keyboard. The 16-bit microprocessor control board consists of the MSR-Card with 16 digital inputs, 16 digital outputs, 16 analog inputs and 4 analog outputs. The analyzer can be manually operated from the keypad or remotely via TCP/IP or RS-232C communications. After turning on the analyzer, it needs at least 30 seconds for initialization. During this time, the screen is illuminated.

IMPORTANT TIP: When the analyzer is powered up, it defaults to access level 1 (User). To operate ALL parameters, check the access level. See Section 5.

2.3. Features-General

High stability is provided by an improved photometric system, which assures less influence due to contamination of the measuring cell and higher long-term stability than conventional dual-beam analyzers.

- A dual-chamber type detector effectively minimizes influence due to concomitant gas components.
- A microflow sensor within the detector features high reliability, long service life, very low noise, and excellent resistance to vibration.
- The easily serviced single-beam photometric system does not require delicate adjustment of the optical-balance.
- Simple construction assures reliable performance.
- Modular component design simplifies maintenance. Independent elements are easily removed for maintenance.
- Low Power Consumption - The instruments are of energy-saving design with power consumption as low as 30 VA.

2.4. Infrared Gas Analyzers

The infrared gas analyzer measures gas concentration based on the principle that each type of gas component shows a unique absorption line spectrum in the infrared region.

The instrument consists of an infrared light source, a chopper, a measuring cell, and a detector filled with a gas mixture containing the gas component to be measured. The operating principle of the instrument is described with reference to Figure 2-1. The infrared light source emits infrared light in all directions. The light emitted forward is transmitted and reflected into the detectors.

The infrared light emitted backward is reflected by a reflecting surface and is added to the infrared light emitted forward. Arranged between the infrared light source and measuring cell is a chopper blade which rotates to modulate the infrared light beam at regular frequency. The modulated infrared light beam thus formed passes through the measuring cell filled with a sample gas where the light energy is partially absorbed or attenuated before it reaches the front chamber of the detector. Both the front and rear chambers of the detector are filled with the gas component to be measured.

The infrared light energy is partially absorbed in the front chamber and residual light is absorbed in the rear chamber, thereby increasing pressure in both chambers. Since the detector is designed to produce a pressure difference between the front and rear chambers, a slight gas flow is produced through a path connecting these chambers with each other.

This slight flow is converted into an AC electrical signal by a microflow sensor arranged in the path connecting the chambers with each other. The AC signal is amplified and rectified to a DC voltage supplied to the output terminals and indicator (Figure 2-4). Figure 2-2 shows the detector output signal with the greatest amplitude when zero gas is flowing in the measuring cell. Amplitude is reduced as the concentration of measured gas component increases (Figure 2-3)

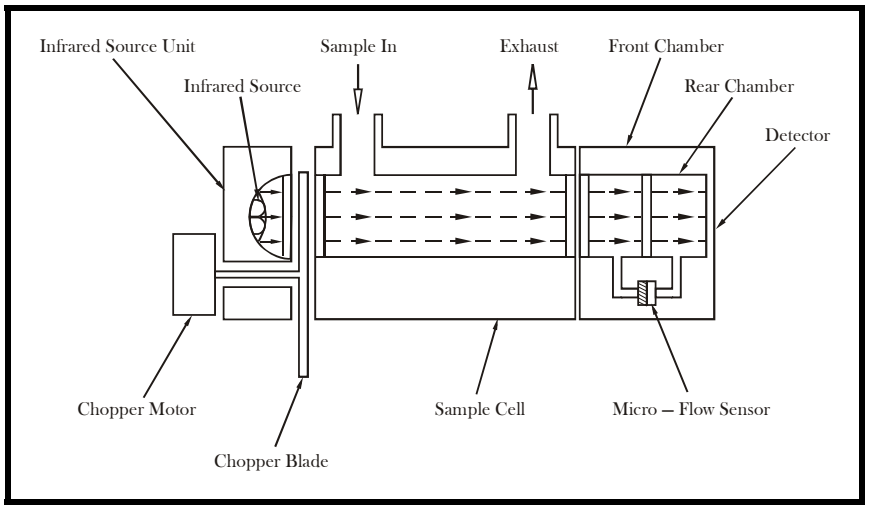


Figure 2-1 Single NDIR Analyzer

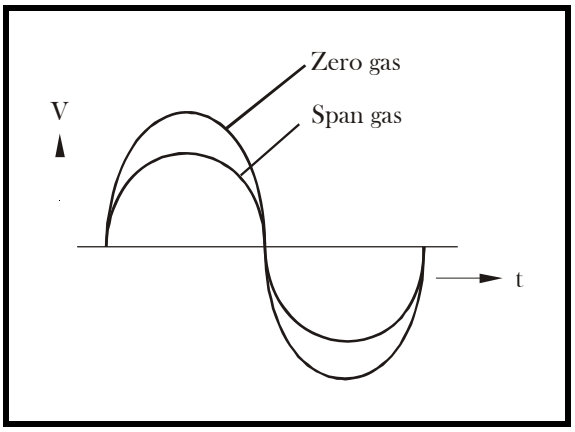


Figure 2-2 Detector Output Signal

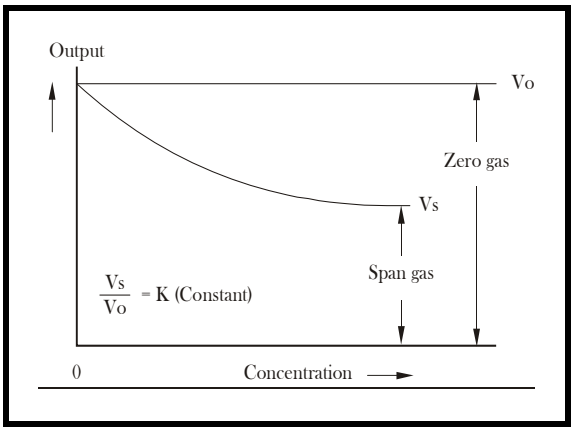


Figure 2-3 Absorption Characteristic of Detector

2.5. Interference Gases

Whenever a sample gas contains a gas component that has an absorption spectrum that overlaps the spectrum of the gas to be measured, that gas is commonly referred to as an interference gas. The Microflow Detector was specifically designed to minimize the effect of interference gases. When these gases are present, the pressure rises in the front and rear chamber of the detector cancel each other minimizing any response to the interference gases.

2.6. Electronics

The sinusoidal output signal of the detector's microflow sensor is transmitted to the AC amplifiers on the main circuit board. The signal frequency is related to the rate of the beam-interrupting chopper blade. The signal amplitude is related to the measured gas concentrations in the sample cell.

This signal is amplified by successive AC amplifiers and then demodulated and filtered. The resulting DC signal is further amplified and fed into two output buffer amplifiers. The DC signal output of the printed circuit board is the input to a microprocessor. Here it is digitized and linearized for digital display

The digitized information is then fed to a D/A Converter so it can be isolated and converted to a 0-10 VDC or 4-20 mA output. This output (along with optional alarm contacts) is sent to the 28-pin output connector located on the rear panel of the analyzer for customer connection.

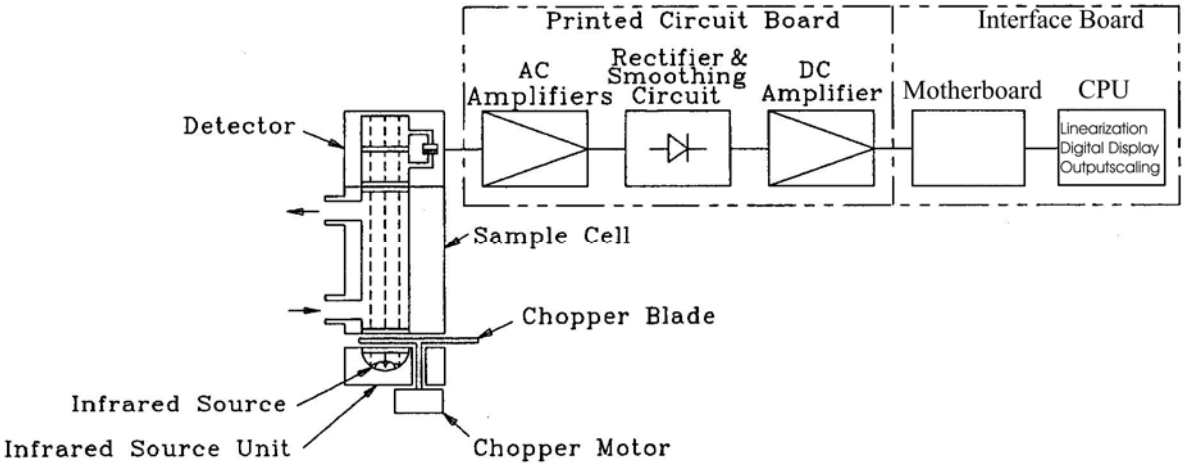


Figure 2-4 Block Diagram

2.7. Model 600 NDIR Specifications

IR ANALYSIS METHOD	Non-Dispersive Infrared (NDIR)
NDIR COMPONENTS	CO /CO_2 / CH_4 / C_3H_8 /SO_2
DETECTOR TYPE	Microflow
RANGE RATIO	50:1 (Highest Range/50 = Lowest Range)
RESPONSE TIME (IR)	T90 < 2 Seconds to 60 Seconds Adjustable (Depending on configuration)
IR SAMPLE CELL	Stainless Steel with Replaceable Gold Cell Liner
RESOLUTION	Displays Five Significant Digits
REPEATABILITY	Better than 1.0% of Full Scale
LINEARITY	Better than 0.5% of Full Scale of Factory Calibrated Ranges
NOISE	Less than 1% of Full Scale of Factory Calibrated Ranges
ZERO & SPAN DRIFT	Less than 1% of Full Scale per 24 Hours
ZERO & SPAN ADJUSTMENT	Via front panel, TCP/IP or RS-232
SAMPLE FLOW RATE	0.25 to 2.0 Liters/minute (LPM) (Consult Factory for other flow rates)
OXYGEN ANALYSIS METHOD	Paramagnetic
O_2 RANGES	0 — 1% up to 0 – 100% O_2 Full Scale, Four Definable Ranges
O2 RESPONSE TIME	90 < 2 Seconds

2.8. Model 600 NDIR Features

OUTPUTS AVAILABLE	TCP/IP, RS232, Four Scalable Analog 0-10 V / 4-20 mA (Allows Offset and Expandable Range DC Analog Outputs)	
DISCRETE CONTROL	Remote/Local Control, Range Change, Range Sense Mode (Al TTL Logic)	
DISCRETE ALARMS (Local & Remote Adjustable)	General Fault/ TTL Logic 0-5 VDC(Ground True) Calibration Failure/ TTL Logic 0-5 VDC (Ground True) High Concentration (2 each)/ TTL 0-5 VDC Logic (Ground True)	
KEYPAD DISPLAYS	Factory Settings TCP/IP Address Passwords (4)	Scalable Analog Output Voltages Full Scale Range Select Auto Cal Times
SPECIAL FEATURES	Auto Ranging Auto Calibration (adjustable through internal clock)	
DISPLAY	3” x 5” Back lit LCD	
SAMPLE TEMPERATURE	Up to 50°C Non-condensing	
AMBIENT TEMPERATURE	5 to 40°C	
AMBIENT HUMIDITY	Less than 90% RH Non-condensing	
WARM-UP TIME	1 Hour (Typical)	
FITTINGS	1/4 Inch Tube	
POWER REQUIREMENTS	115 V 60Hz (Option: 230V 50Hz), ±10%, 600W	
DIMENSIONS	5¼ H × 19 W × 23 D (Inches)	
WEIGHT	30-45 Pounds (Depending on configuration)	

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

3. Installation

3.1. General

The design of this instrument is for industrial applications. These installation instructions are for a typical site. Direct any questions regarding specific installation situations to Technical Service of California Analytical Instruments, Inc.

3.2. Site and Mounting

NOTE: The carefully observe the following precautions:

Select a site free from direct sunlight, radiation from a high temperature surface, or abrupt temperature variations.

This analyzer is not suitable for installation outdoors.

Select a site where the air is clean. Avoid exposing the instrument to corrosive or combustible gases.

The instrument must not be subject to severe vibration. If severe vibration is present, use isolation mounts.

The instrument is designed for rack-mounting. Optional rack mount slides are available.

Do not install near equipment emitting electromagnetic interference (EMI).

NOTE: A rear supporting brace or equivalent is required if the optional rack mount slides were not purchased.

The power on/off switch is accessible from the rear of the instrument only. DO NOT mount such that the power on/off switch is inaccessible.

3.3. Electrical

All wiring is connected at the rear of the instrument. The AC power is connected to the power/fuse/switch as shown below

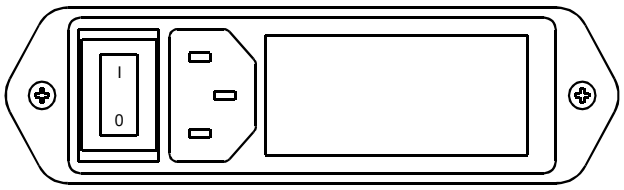


Figure 3-1 AC Power Switch, Connector, and Fuse.

NOTE: A defective ground may affect the operation of the instrument. The output voltages are connected per Table 8.1.1. Shielded wiring is recommended for output signals.

Replace fuses with recommended fuse size indicated on rear panel of instrument. Replacement with any other size fuse may cause damage to the instrument and possible injury to operating personnel.

3.4. Analog Output Connections (Appendix)

See Appendix for connector pinouts located on the analyzer rear panel. Remote range identification and range selection are obtained via the rear panel connections. When a range is selected, the corresponding control line is pulled low to zero VDC. Ranges not selected will remain at approximately 5 VDC. When remote range control is selected on the front panel switch, a contact closure is provided at the rear panel connector. Remote range selection is made by connection of the control line for the desired range to the analyzers zero VDC line provided in the connector. Five VDC is also provided.

3.5. Gases

1) Nitrogen or (zero air) in pressurized cylinder.
2) Standard span gas(es) near full-scale concentration with a nitrogen balance, in a pressurized, certified cylinder.

3.6. Gas Handling Equipment

1) Pressure regulators for zero gas (Air or N2), and span gas cylinders.
2) Corrosive resistant gas tubing.

3.7. Gas Connections

The tubing from the sampling system to the gas analyzer should be made from corrosive-resistant material such as Teflon or stainless steel. Even when the gases being sampled are corrosive themselves, rubber, or soft vinyl tubing should not be used since readings may be inaccurate due to gas absorption into the piping material. To obtain fast response, the tube should be as short as possible. Optimum tube internal diameter is 0.16 inch (4 mm). Couplings to the instrument are ¼-Inch tube.

Note: Be sure tubing and joints are clean. Dust entering the instrument may cause it to malfunction.

3.8. Sampling Requirements

3.8.1. Filtration

Dust must be eliminated completely. Use filters as necessary. The final filter must be capable of removing particles larger than 4 microns.

3.8.2. Condensation

Dew point of the sample gases must be lower than the instrument temperature to prevent accidental condensation within the instrument. Bypass the sample through a dehumidifier to reduce the dew point to about 2 to 4° C or less. If the sample contains an acid mist, use an acid mist filter, cooler or similar device to remove all traces of the mist.

3.8.3. Presence of Corrosive Gases

High concentrations of corrosive gases such as Cl_2, SO_2, F_2, HCl, in the sample gas shorten the useful service life of the instrument.

3.8.4. Gas Temperature

Do not exceed the maximum rating of the instrument 104º F (50º C) when measuring high temperature gases.

3.8.5. Sample Gas Bypass Outlet (Vent)

A sample gas bypass outlet connector is located on the rear panel (¼ Inch Tube). Pressure at this outlet should be kept at atmospheric level. **ANY** backpressure will cause an error in reading.

4. Basic Operation

The operation of the digital microprocessor conforms to the guidelines of the AK committee, originally developed in the German automotive industry. Via the serial port of the MSR-Card, the analyzer can be remote-controlled by a master computer. The serial communication fully corresponds to the specifications of the AK protocol. TCP/IP communication is also available.

Display

The analyzer's LCD display includes 16 lines with 30 characters each. The display also has background lighting that can be switched on and off via the Display key on the keyboard. The following example shows the measurement screen that is formatted into 4 information areas.

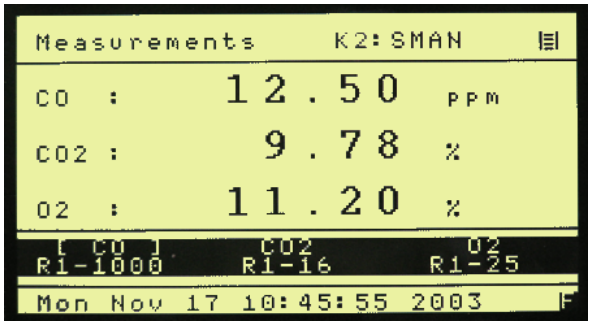


Figure 4-1 LCD Display

1) THE TOP INFORMATION AREA CONTAINS:

2) The AK Protocol Information. This capability is for advanced uses and may be toggled on and off in the setup screen, F5. Next to the symbol for the active operating mode, the device status is indicated. The status field is also displayed on all other screens.

3) SARE Auto range enabled

4) SMGA Measuring gas is flowing

5) SMAN Device is in manual operation status

6) SWET Device

7) Shown on the right is the Password Entry level with 1 to 4 horizontal lines.

8) THE LARGE INFORMATION AREA CONTAINS the data portion of the screen.

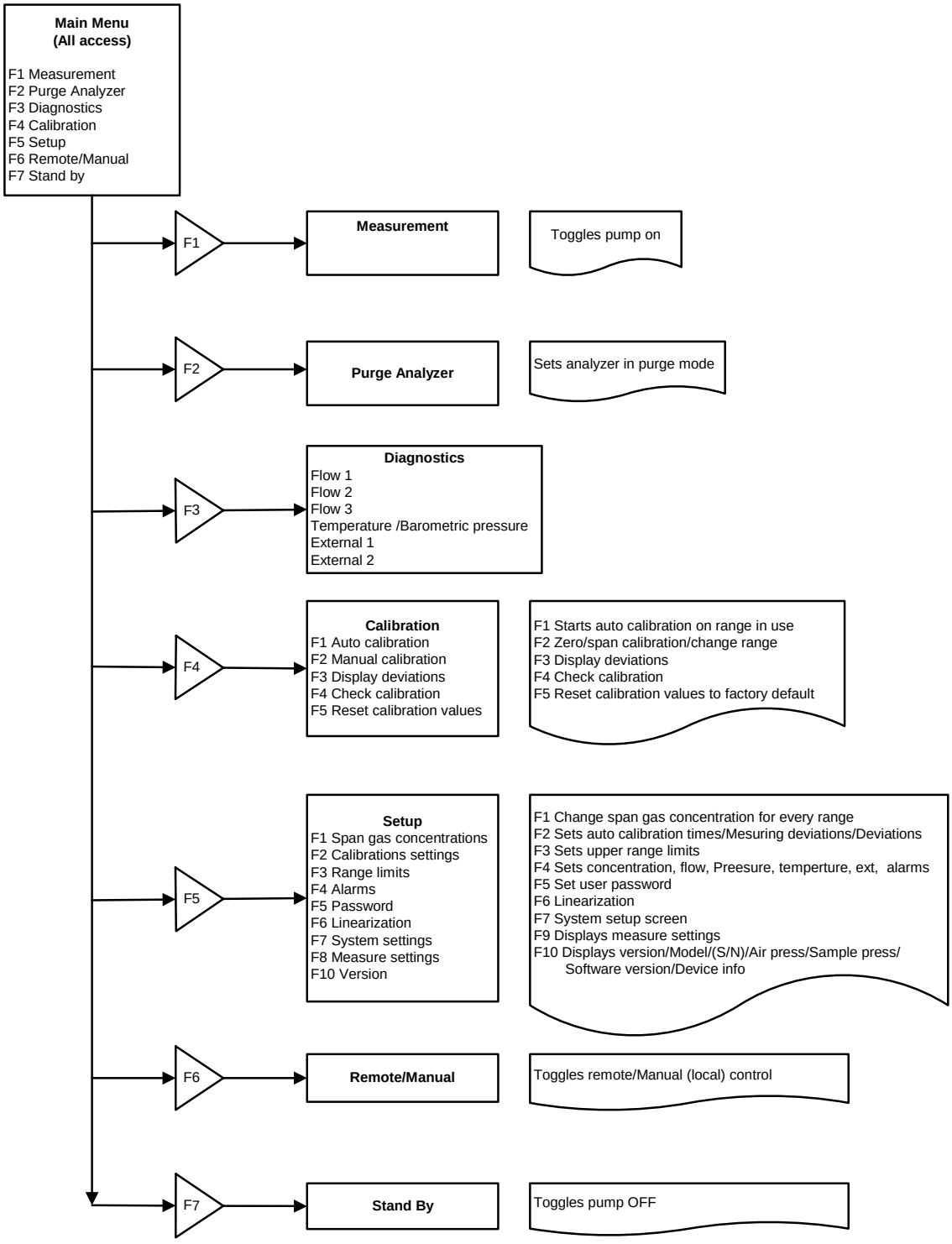
9) THE THIRD INFORMATION AREA CONTAINS the help information for the parameter selected, ranges, etc.

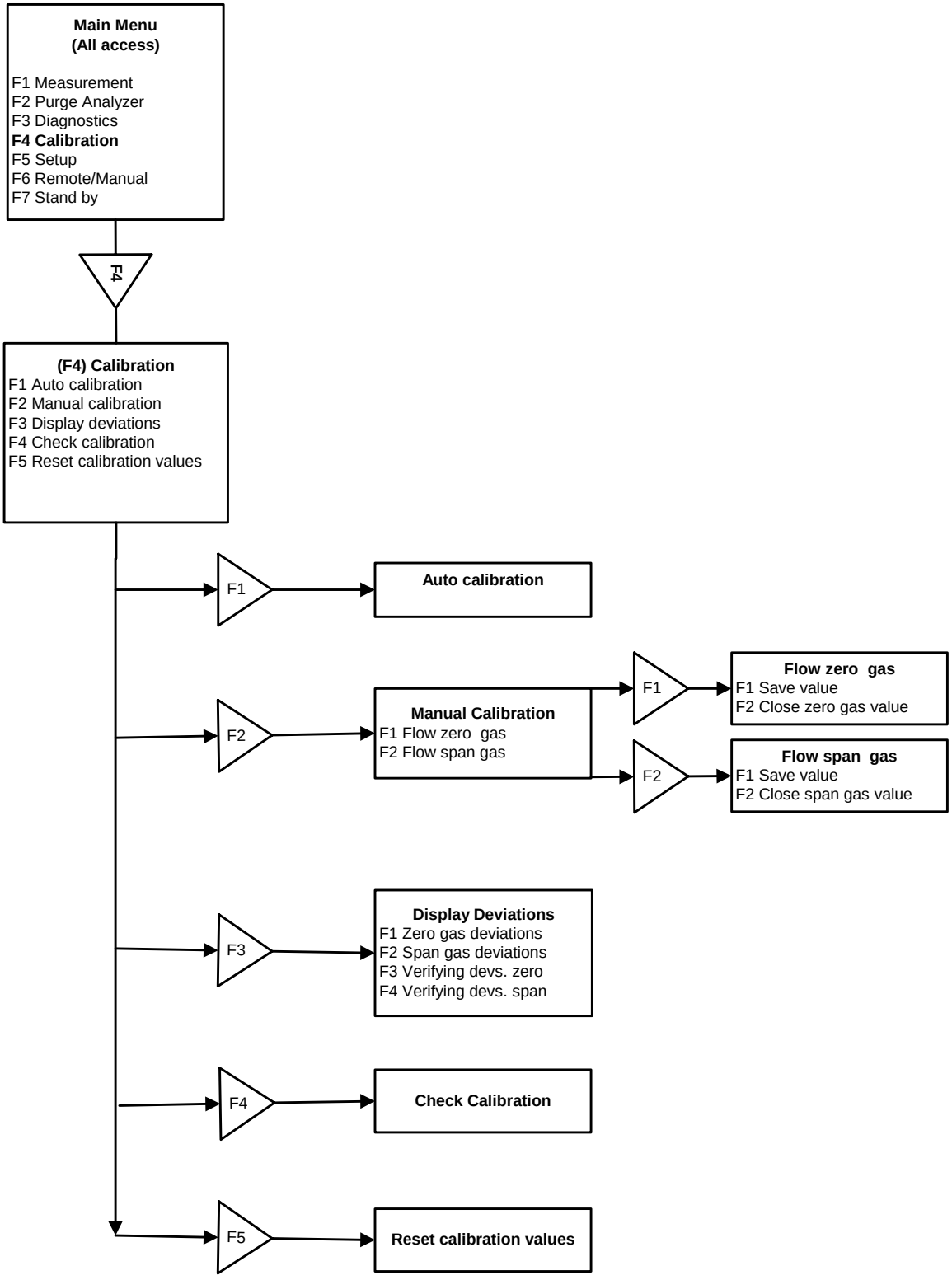
10) THE LOWER INFORMATION AREA CONTAINS The time and date and any error condition.

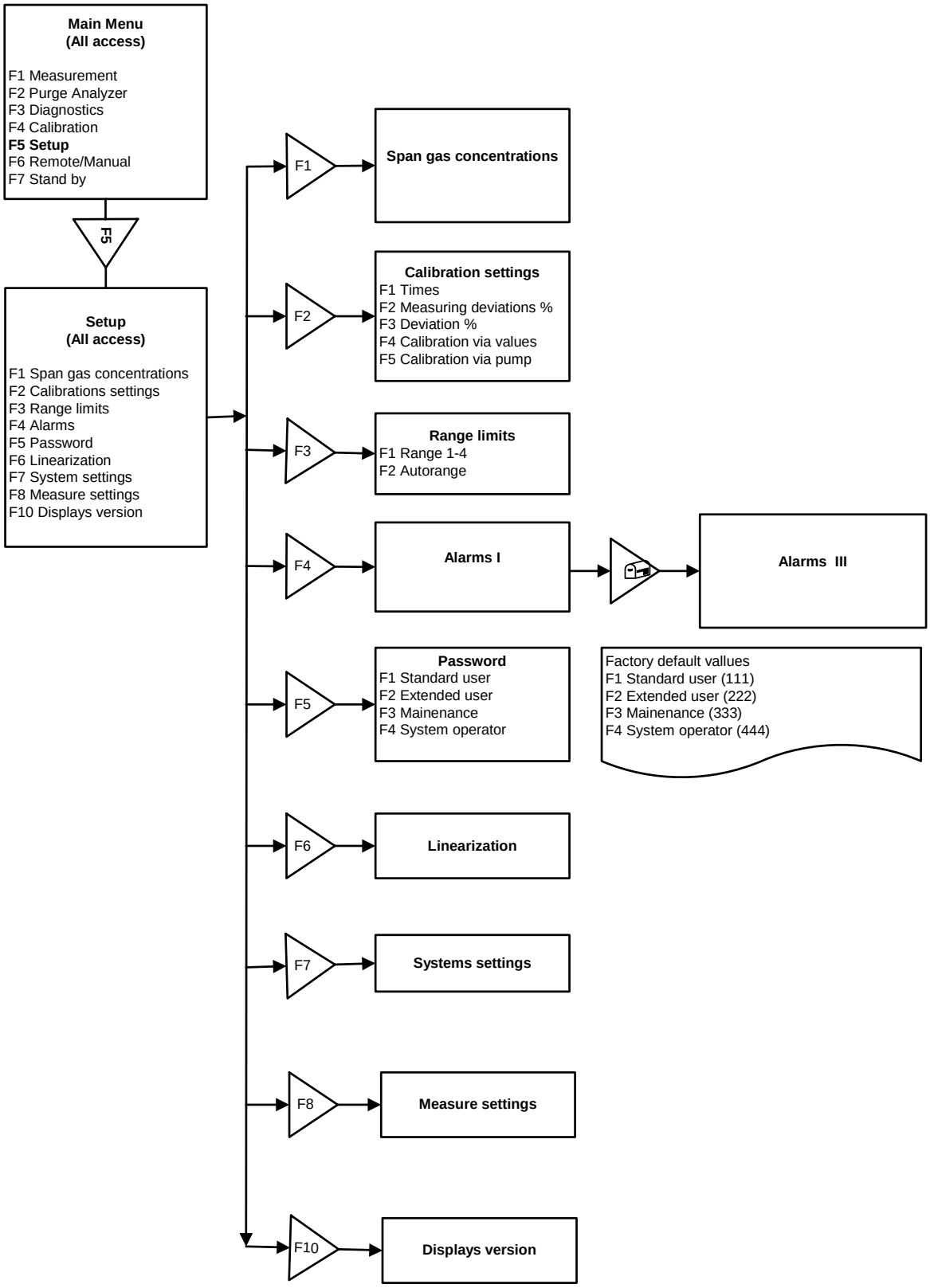
11) The symbol in the bottom right corner indicates the keyboard mode. In the example shown, the keyboard is in the function key mode. For input fields, the mode is usually switched to numerical input. Then, an N appears in the lower right of the screen. This symbol is displayed on all screens.

4.1. Menu Trees

Model 601 Menu Tree




Main Menu
(All access)
F1 Measurement
F2 Purge Analyzer
F3 Diagnostics
F4 Calibration
F5 Setup
F6 Remote/Manual
F7 Stand by
F4
(F4) Calibration
F1 Auto calibration
F2 Manual calibration
F3 Display deviations
F4 Check calibration
F5 Reset calibration values
F1
Auto calibration
F2
Manual Calibration
F1 Flow zero gas
F2 Flow span gas
F1
Flow zero gas
F1 Save value
F2 Close zero gas value
F2
Flow span gas
F1 Save value
F2 Close span gas value
F3
Display Deviations
F1 Zero gas deviations
F2 Span gas deviations
F3 Verifying devs. zero
F4 Verifying devs. span
F4
Check Calibration
F5
Reset calibration values


Main Menu
(All access)
F1 Measurement
F2 Purge Analyzer
F3 Diagnostics
F4 Calibration
F5 Setup
F6 Remote/Manual
F7 Stand by
F5
Setup
(All access)
F1 Span gas concentrations
F2 Calibrations settings
F3 Range limits
F4 Alarms
F5 Password
F6 Linearization
F7 System settings
F8 Measure settings
F10 Displays version
F1
Span gas concentrations
F2
Calibration settings
F1 Times
F2 Measuring deviations %
F3 Deviation %
F4 Calibration via values
F5 Calibration via pump
F3
Range limits
F1 Range 1-4
F2 Autorange
F4
Alarms I
Alarms III
F5
Password
F1 Standard user
F2 Extended user
F3 Mainenance
F4 System operator
Factory default vallues
F1 Standard user (111)
F2 Extended user (222)
F3 Mainenance (333)
F4 System operator (444)
F6
Linearization
F7
Systems settings
F8
Measure settings
F10
Displays version

4.2. Keyboard

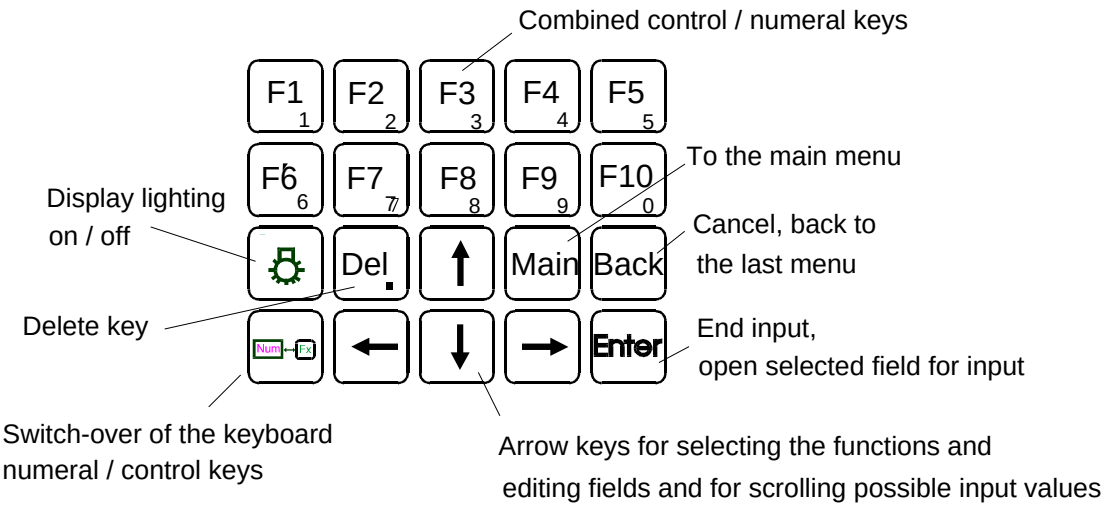


Figure 4-2 Keyboard

4.2.1. Operation with the Cursor Keys and the Enter Key

When operating the unit with the cursor keys, you select the various functions with the up/down cursor keys and start them with the Enter key. This method is particularly suitable for less proficient users since the system displays a short on-line help for nearly every function selected. The actual cursor position is shown as a black horizontal bar.

TIP: If you are not yet familiar with the screens and their fields, just press any cursor key after a screen appears. This moves the cursor from field to field and displays the corresponding online help.

4.2.2. Operation with the Function Keys

When using the function keys (Fl though F10), functions are directly accessed by pressing their corresponding function keys. This method is suitable for the advanced user since it is faster than the operation with the cursor keys.

4.2.3. Read/Change Parameters

To read and/or change parameters, you must switch to the parameter input mode by pressing the Enter key after calling the corresponding parameter screen. The input cursor (horizontal bar under the first character) then appears in the active edit field (black background). The cursor can be positioned with the right and left cursor keys, and the value displayed (number or letter) can be changed with the up and down cursor keys or entered directly. Every input has to be concluded by pressing the Enter key again, which causes the cursor to disappear.

5. Operating Structure

The analyzer's operation can be divided into 4 operating levels. The current level is always displayed as a stack of 1 to 4 horizontal bars in the top right corner of the screen. In the access level menu, you can choose between the following operating levels:

F1	User	(operating level 1)
F2	Advanced user	(operating level 2)
F3	Maintenance	(operating level 3)
F4	System user	(operating level 4)

A password can be assigned to each operating level. Only the system user, who normally has the highest operating priority, can assign the password. At the factory, the default passwords for the CAI analyzers are set as follows:

User:	111
Advanced user:	222
Maintenance:	333
System:	444

The default setting can be changed only by the system user. This manual is written to include all information for the advanced system user.

TIP: Because of the user settings, some of the parameters shown in this manual may not appear on your analyzer. Check the access level.

5.1. The Main Menu

Upon power up, the CAI logo is first displayed and then the main menu appears as below:

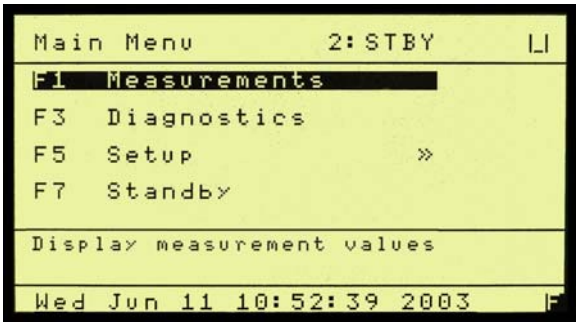


Figure 5-1 Main Menu on Power Up Screen

NOTE: F6 is not available because, on initial start up, the analyzer reverts to ONLY Level 1 access. See Section 7.5.5 for Password information.

All functions can be selected with the cursor keys and activated by pressing the Enter key, or directly with the function keys F1 through F7. A ">" to the right of a function means that one or more sub-menus are available. If this sign is missing, the function starts immediately after the activation.

NOTE: Access level is 4.

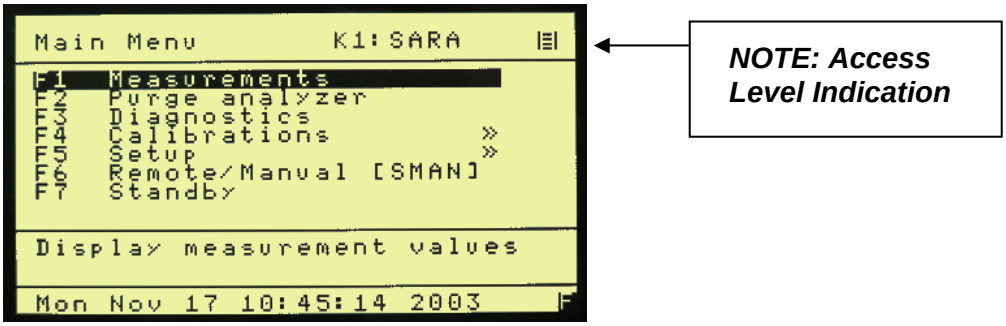


Figure 5-2 Main User Menu (Level 4)

6. Menu Structure

There are four operating levels based on the level of your password. This section shows the access rights of the single levels.

6.1. User Functions (Level 1)

Main Menu		Setup Menu		Password Menu	
F1	Measurements	F5	Password	F1	Enter password
F2	Purge Analyzer	F10	Version		
F3	Diagnostics				
F4	Calibrations				
F5	Setup				
F7	Standby				

6.2. Advanced User Functions (Level 2)

Main Menu		Setup Menu		Password Menu	
F1	Measurements	F3	Range Limits	F1	Enter password
F2	Purge Analyzer	F5	Password		
F3	Diagnostics	F10	Version		
F4	Calibrations				
F5	Setup				
F7	Standby				

6.3. Maintenance Functions (Level 3)

Main Menu		Setup Menu		Password Menu		System Settings Menu	
F1	Measurements	F1	Span Gas Concentration	F1	Enter password	F1	Real Time Clock
F2	Purge Analyzer	F3	Range limits	F2	Reset password	F5	Status Line on/off
F3	Diagnostics	F5	Password	F7	Auto Startup		
F4	Calibrations	F7	System Settings				
F5	Setup	F8	Measure Settings				
F7	Standby	F10	Version				

6.4. System User Functions (Level 4)

All Function described in this manual may be accessed from Level 4.

7. Main Menu Function Descriptions

7.1. F1 Measurements

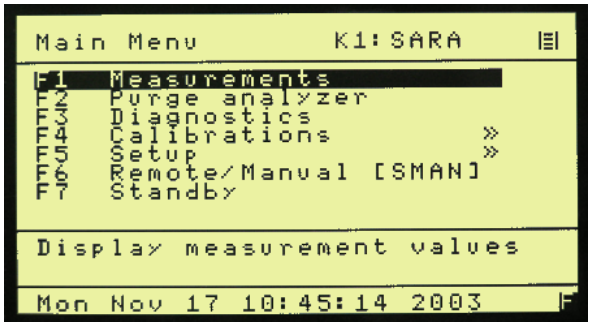


Figure 7-1 Main Menu Screen

7.1.1. F1 Measurement

The measurements screen is activated by pressing F1 on the Main Menu screen. The concentration is displayed in actual engineering units.

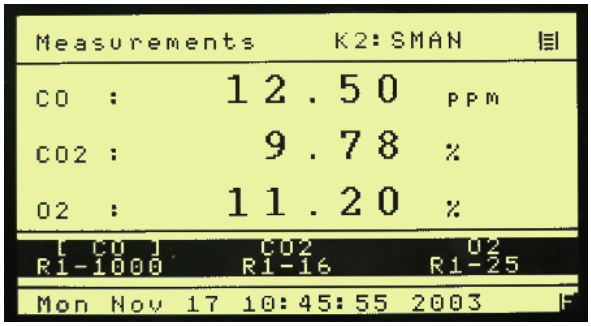


Figure 7-2 Measurements Screen

7.1.2. Range Select

With the arrow keys, the ranges 1 to 4 can be selected and locked in which will disable the auto range capability. Continue pressing the arrow keys will recycle the analyzer back to auto range. The range and/or auto range is displayed on the measurement screen. If the limits are exceeded while not in the auto range mode, a warning "Over Range" appears on the screen.

Figure 7-3 Set to Auto Range (601)

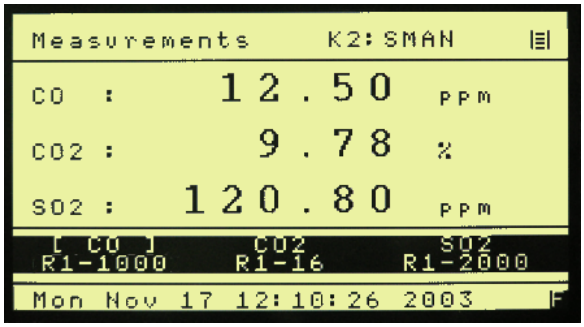


Figure 7-4 Analyzer set to Range 1 (603)

7.2. F2 Purge Analyzer

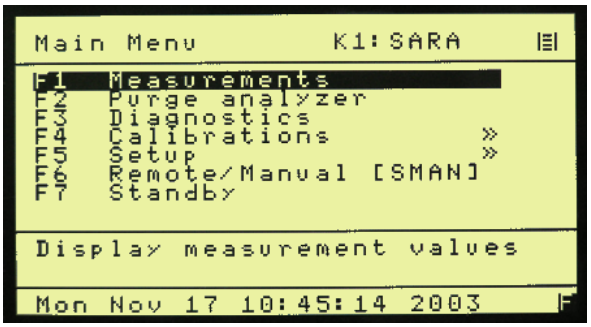


Figure 7-5 Main Menu (User Level 4)

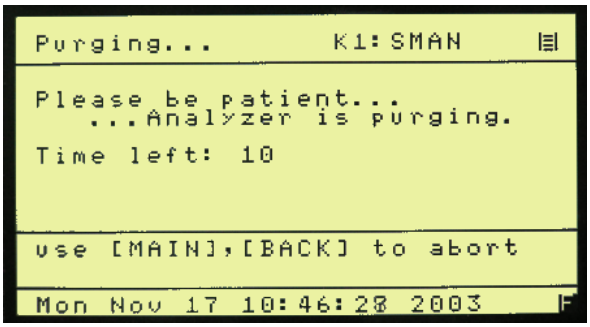


Figure 7-6 Purge Screen

F2 from the Main Menu activates the Purge (analyzer) function if equipped.

7.3. F3 Diagnostics

F3 from the Main Menu activates the Diagnostics function. F3 brings up the two diagnostics screens. The Diagnostics screens may be brought up from **EITHER** the Main Menu or the Measurements screen.

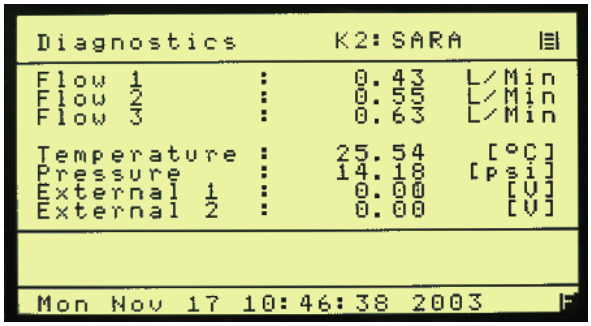


Figure 7-7 Diagnostics Screen I

7.4. F4 Calibrations

F4 from the Main Menu activates the Calibrations screen. Calibrations may be automatic or manual. Deviations can also be displayed. Calibration values can be reset to default values and the range to be calibrated can be changed.

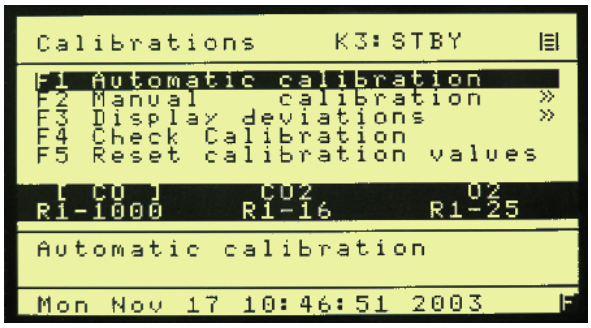


Figure 7-8 Calibration Screen

7.4.1. F1 Automatic Calibration

From the Calibrations screen, F1 starts automatic calibration. If auto range is selected, the actual range in use will be calibrated. Auto calibration works as follows: First, zero gas is purged a certain time, called purge-time. Then the measurement begins. The measured value must be a minimum-time, called measuring-time, and within an upper and a lower limit to be saved as new offset value. The maximum length of measuring time is 9 seconds. If the measured value was constant during calibration time, it is checked to determine if this value deviates from the preceding value. If the deviations are too large, a warning "Deviation error!" appears and the user can choose if the new value is saved or not. At last, the zero gas is flowed a further time, verifying time, so it can be checked if the signal is still constant. All of these times can be changed. After zero gas calibration, the same happens with span gas. During auto calibration, "Calibration in progress" is displayed. It also shows which gas is flowing and which time runs. When auto calibration has finished it is displayed. If the span value of the selected range is 0 (see section 5.6.1), then it will not be calibrated. If one range is calibrated and the span value for the lower ranges is zero, calibration parameters will be copied to this range. To calibrate all ranges with the same span gas, you must enter the gas concentration in the Span Gas Calibration screen for ALL RANGES. You must also calibrate each range. Offsets and scalors are NOT copied to other ranges.

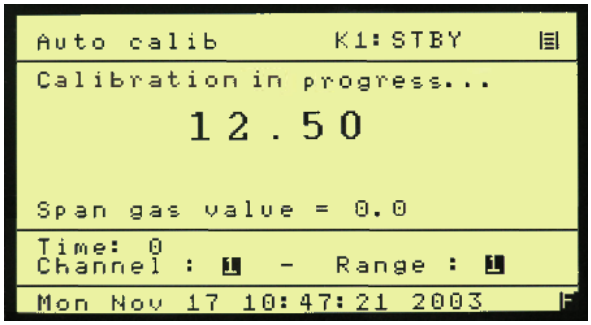


Figure 7-9 Auto Calibration Screen

7.4.2. F2 Manual Calibration

From the Calibration screen, F2 starts manual calibration. If auto range is selected, calibration is not possible, and the appropriate range can be selected.

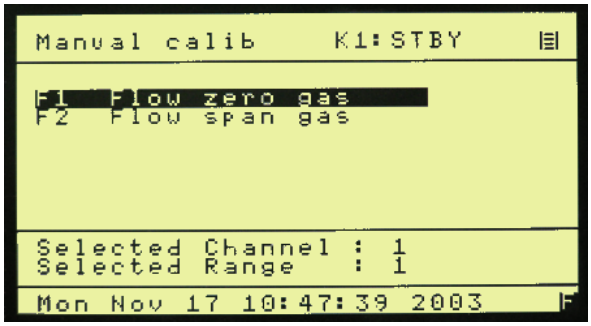


Figure 7-10 Manual calibration

In the manual calibrations menu, two options are possible:

F1 Flow zero gas
F2 Flow span gas

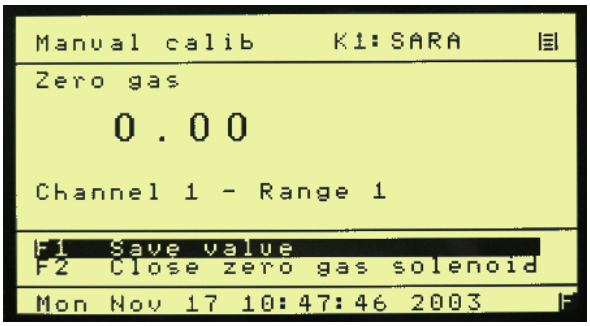


Figure 7-11 Manual zero calibration

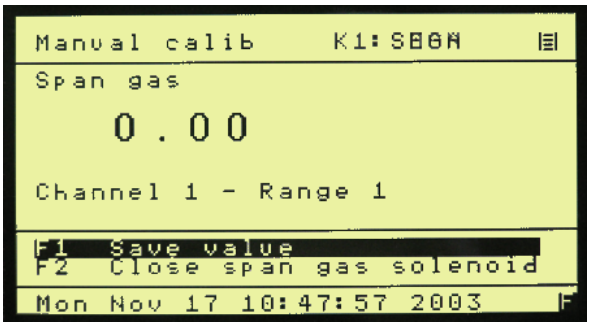


Figure 7-12 Manual span calibration

When zero or span gas is flowing, the measured value can be saved by pressing F1. If the screen is left by pressing the buttons ”Main” or ”Back”, the measured value is not saved. Solenoids are closed by pressing F2.

7.4.3. Display Deviations – from Calibration menu F3

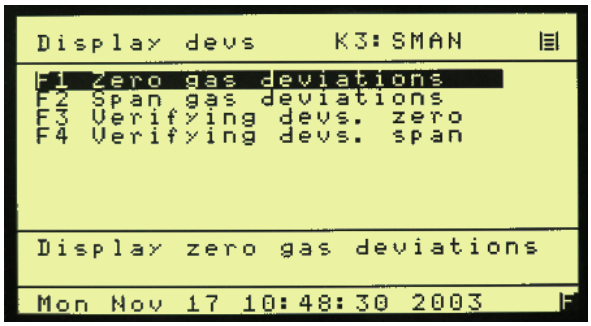


Figure 7-13 Display deviations

After every calibration, the deviations are calculated for zero and for span gas.

F1 Zero gas deviations

F2 Span gas deviations

F3 Deviations of zero gas during verifying

F4 Deviations of span gas during verifying

F1 and F2 deviations are displayed in percent.

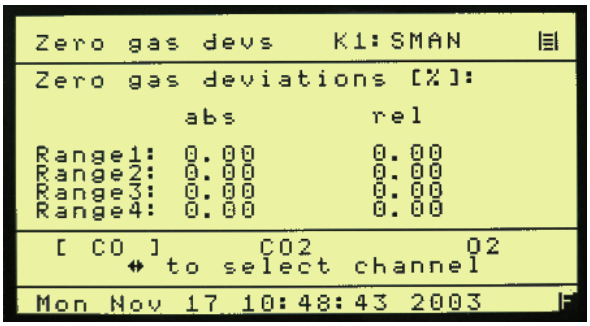


Figure 7-14 Zero gas deviations

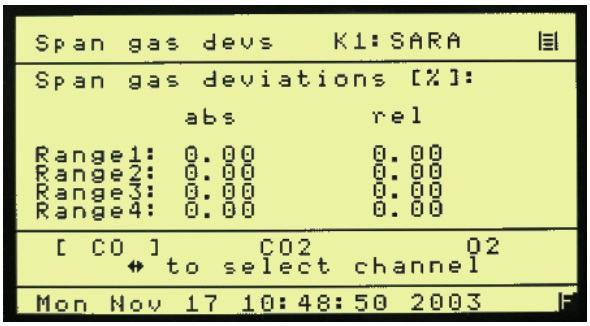


Figure 7-15 Span gas deviations

During calibration, there is verification for zero and span gas. With option F3 and F4, you can view the deviations during the verification time. Absolute deviation is the absolute average difference from the saved value in ppm. Relative deviation is the absolute average difference in percent, related to the range limit.

7.4.4. Absolute Zero Gas Deviation

Absolute zero gas deviation is zero gas content calculated by the factory polynomial related to the range limit of the calibrated range.

7.4.5. Relative Zero Gas Deviation

Relative zero gas deviation is the actual deviation minus the deviation of the previous calibration related to the range limit of the calibrated range.

7.4.6. Absolute Span Gas Deviation

Absolute span gas deviation is span gas bottle value minus span gas value calculated by the factory-polynomial related to the range limit of the calibrated range.

7.4.7. Relative Span Gas Deviation

Relative span gas deviation is the actual deviation minus the deviation of the previous calibration related to the range limit of the calibrated range.

7.4.8. F4 Check Calibration

There is a default calibration. Pressing F4 activates an automatic zero and span check for verification.

7.4.9. F5 Reset Calibration Values

There is a default calibration. Pressing F5, a new screen appears and asks if the user is sure to reset calibration values to the default calibration values. F1 confirms and the calibration values are reset to default calibration values. F2 leaves this menu without resetting to default values. This function will overwrite all calibrations with factory values. In addition, the linearization polynomial will be overwritten with the factory values.

7.4.10. F6 Range Select

This allows a range change to be activated from the calibration menu.

7.5. F5 Setup

From the Main Menu, F5 brings up the setup menu. Span gas concentrations, calibration settings, range limits, alarms, password, linearization, system and measure settings can be changed. The Setup menu begins as shown below. A description of each parameter is shown in the information box. NOTE: Use the down arrow key to obtain the additional setup parameters.

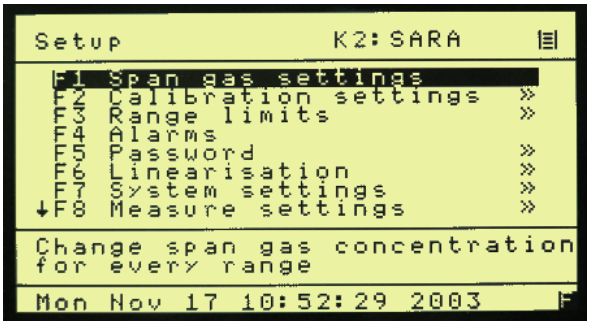


Figure 7-16 Setup menu screen I

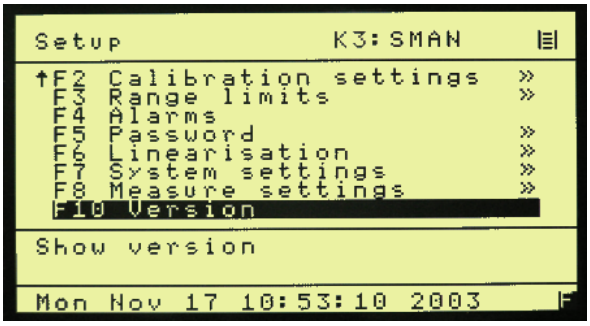


Figure 7-17 setup menu screen II

7.5.1. F1 Span Gas Concentration

Note: If you do not have a specific gas for a specific range, the calibration will use the previous ranges calibration. You must have a least one span gas.

For calibration, it is necessary to input the concentration of the span gas in ppm. For every range, the span gas concentration can be changed. After pressing F1 in the setup menu, a screen appears in which changes can be made. Select with the cursor buttons the range to change. The selected field turns black. To change parameters, switch to parameter input mode by pressing the Enter key. The input cursor (horizontal bar under the first character) then appears in the active edit field (black background). The cursor can be positioned with the right and left cursor keys, and the value displayed (number or letter) can be changed with the up and down cursor keys or entered directly. Every input has to be concluded by pressing the Enter key again. Then the input cursor disappears and a new range can be selected. The changes are saved by leaving the screen by pressing "Main" or "Back." At the right side of the screen, the range limits of the 4 ranges are displayed. They cannot be changed in this screen.

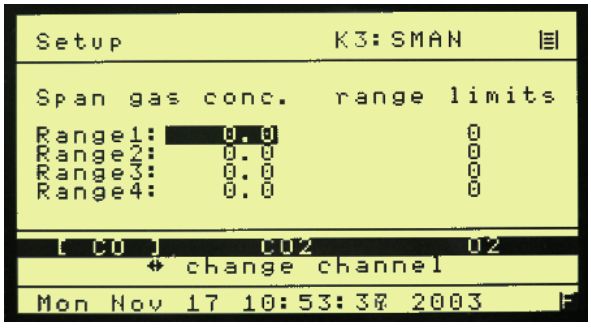


Figure 7-18 Change Span Gas Settings

7.5.2. Calibration Settings

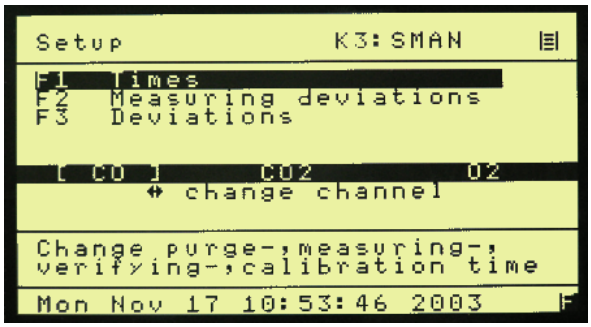


Figure 7-19 Change Auto Calibration Settings

In the calibration settings menu, times and, deviations can be changed.

7.5.3. F1 Times

There are four times (in seconds) for auto calibration that can be changed. Purge, measuring, calibration and verifying time. Changes are made and saved as above.

7.5.4. F2 Measuring Deviations

During auto calibration, the measured value is only saved if it is within a certain time within an upper and a lower limit. These two limits format a working window. In the setup menu, the deviation is in percent.

7.5.5. F3 Deviations

Here you can change absolute and relative deviation in percent. After auto calibration, it is checked to assure the deviations are within this limit. If the deviations are not in this limit, a warning "Deviation error!" appears.

7.5.6. F3 Range Limits

There are 4 different ranges. The user can define the upper range limits in ppm.

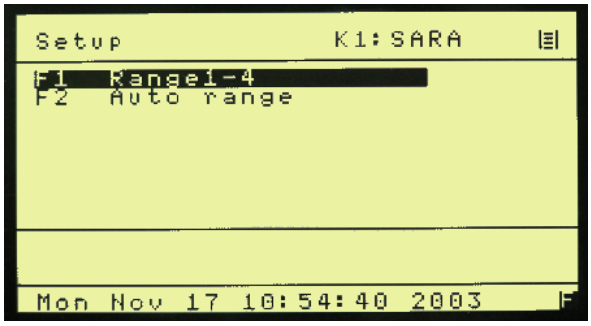


Figure 7-20 Change Range Limits

7.5.7. F1 Range 1-4 (Change Upper Range Limits)

In this menu, the upper range limits can be changed. The new settings are saved by pressing MAIN or BACK. The auto range limits are automatically adapted. This means that if the upper range limit of range 1 for example has reached 90% of the upper range limit in the auto range mode, it is switched automatically to the second range.

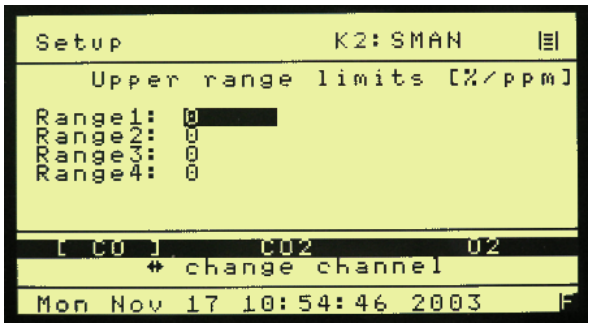


Figure 7-21 Change Upper Range Limits

7.5.8. F2 Change Auto Range Limits

Although the auto range limits are adapted automatically, it is possible to define them manually. Up means the value when the next higher range is selected in auto range mode, down the value when the next lower range is selected.

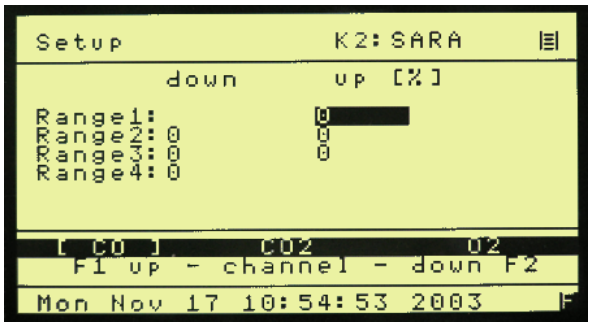


Figure 7-22 Change Auto Range Limits

7.5.9. F4 Alarms

Error reports are always displayed in the lowest line of the screen. There are two pressures, three temperatures, one concentration, and two voltages with alarm limits that can be defined. The user can define the range limits and, if exceeded, will display an error-message.

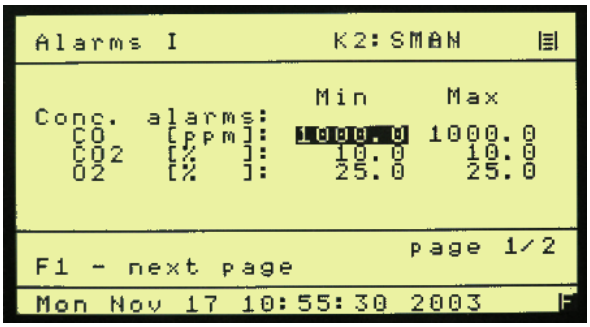


Figure 7-23 Alarm screen I

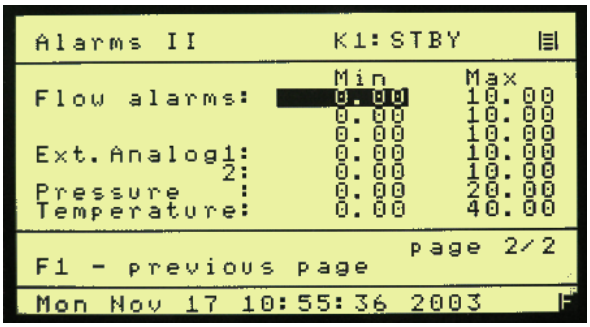


Figure 7-24 Alarm screen II

Set Temperature Alarms Set Concentration, Pressure and Voltage Alarms

7.5.10. F5 Password

After turning on the analyzer, you are in access level 1. To change the access level or to change the passwords, press F5 (Setup) in the main menu and Press F5 (Password) again. The following screen appears:

Figure 7-25 Enter / Change Password

7.5.11. F1 Enter Password

To change access level, press F1. The following screen appears:

Figure 7-26 Access Level Screen

F1 to F4 selects an access level. Move the cursor to the access level to be modified. You must enter the correct password for the access level desired. The passwords for the various operation levels consist of three numbers that must to be entered on the numeric keypad. If the code word is incorrect, you are asked to re-enter the codeword.

IMPORTANT TIP: When a new analyzer is powered up, it defaults to access level 1 (User). To operate ALL parameters and gain complete access, select F4. Press the Enter key twice and enter 444.

7.5.12. F2 Change Password

The passwords can only be changed, if you are in access level 4. After F2, enter your new 3 digit passwords.

IMPORTANT TIP: You MUST remember and record this new password. If this is lost, you will need to consult the factory for the default password!

7.5.13. F3 Reset Passwords

The passwords can only be changed, if you are in access level 4. Reset passwords will revert to the factory defaults.

7.5.14. F6 Linearization

Pressing F6 on the Setup screen brings up the Linearization screen. The analyzer can be linearized by a polynomial with 5 coefficients. By pressing F1, these 5 coefficients can be changed for each range. By pressing F2, the raw value can be displayed. This is the value before linearization and offset span correction. There are two values on the screen: The value at the top is the linearized, offset-span-corrected value, and the other value is the raw-value.

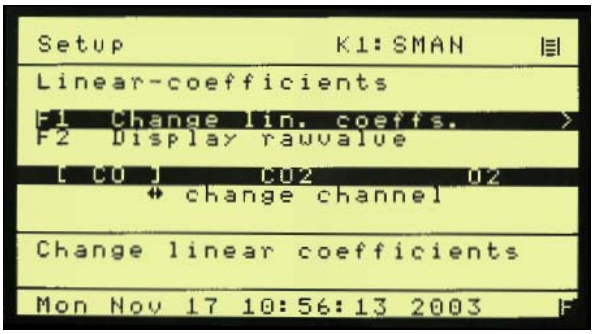


Figure 7-27 Linearization Screen

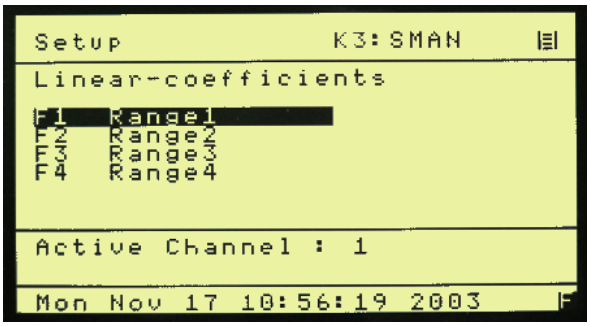


Figure 7-28 Coefficients Range Select

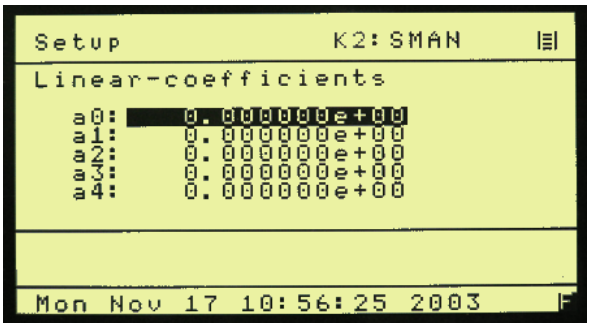


Figure 7-29 Change Coefficients

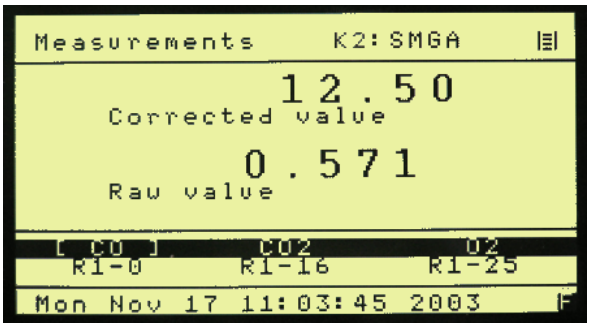


Figure 7-30 Linearized and raw data

7.6. F7 System Settings

This screen allows all the system settings to be displayed and modified.

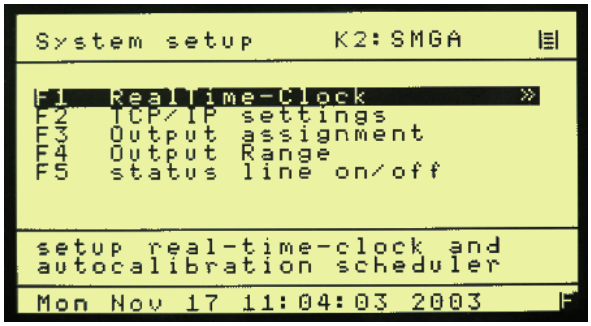


Figure 7-31 System Setup Screen

7.6.1. F1 Real Time Clock

This brings up the clock time set screen; auto cal and auto cal enable screens.

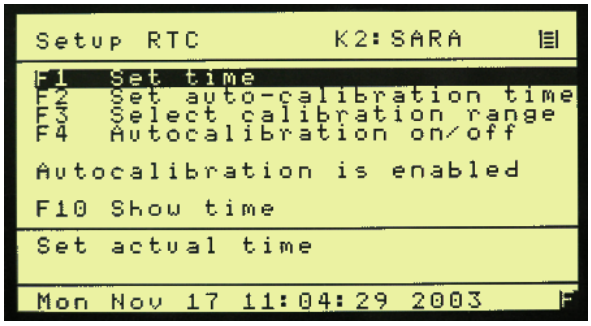


Figure 7-32 Clock and Timing Setup Screen

Figure 7-33 Clock set screen

The current time may be set by using the cursor to highlight the entry and using the numeric keys to change the values.

F2 brings up the auto cal time set. As above, the date and times can be set by using the cursor to highlight the entry and using the numeric keys to change the values. F3 Sets autocalibration ranges.

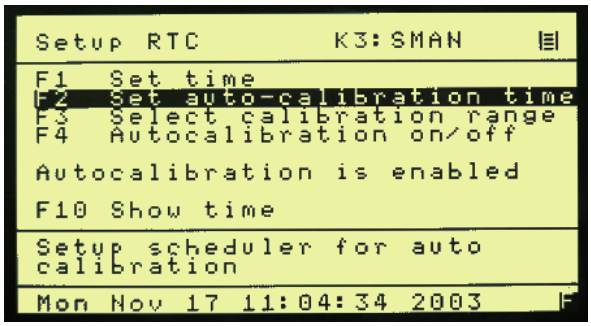


Figure 7-34 Set Auto Cal Timing

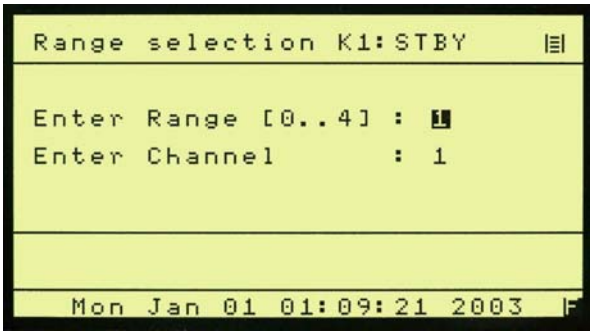


Figure 7-35 Set Auto Cal Ranges

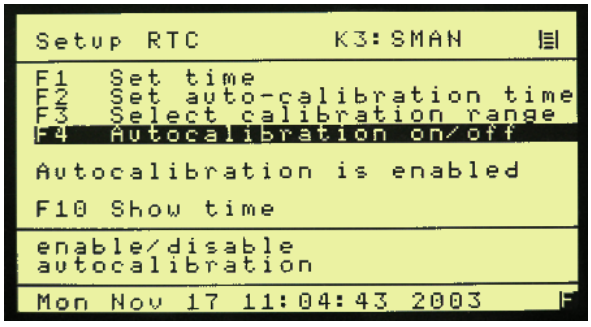


Figure 7-36 F4 Toggles Auto Cal ON of OFF

7.6.2. System Setup F2 Displays TCP/IP Address

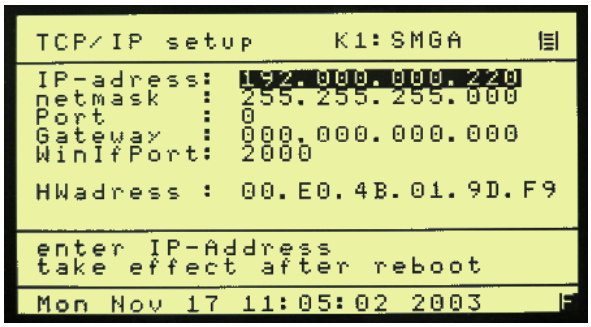


Figure 7-37 TCP/IP Address

7.6.3. Systems Setup F3 Displays Output Signal Assignments
(Used to Adjust Analog Output Channels)

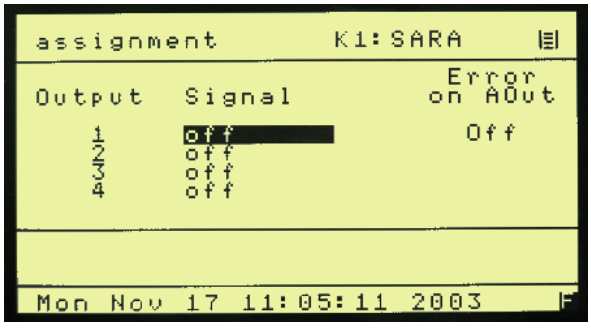


Figure 7-38 Output Assignments

7.6.4. System Setup F4 Displays Output Ranges
(Used to Adjust Scale of Analog Output Channels)

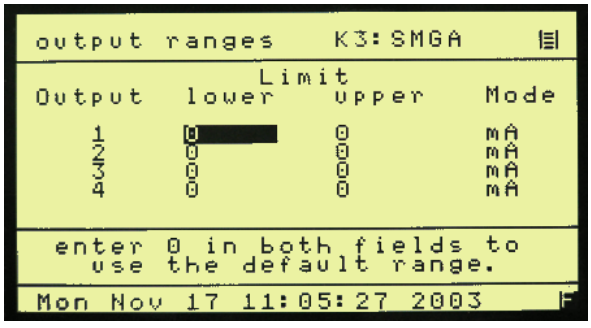


Figure 7-39 Output Ranges

7.6.5. F5 Turns Status Line On or Off

The status line displays the AK Protocol action on the top line of the display.

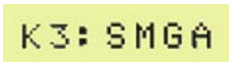


Figure 7-40 Status line

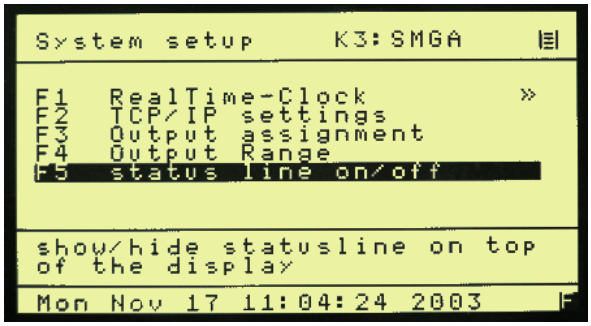


Figure 7-41Status line on/off

7.6.6. F8 Measure Settings

This screen allows several of the system settings to be displayed and modified.

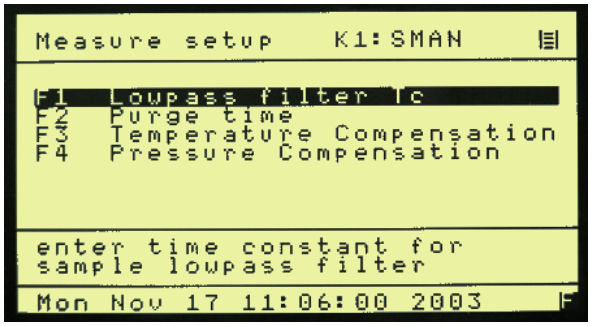


Figure 7-42 Measure setup

7.6.7. F1 Set Lowpass filter

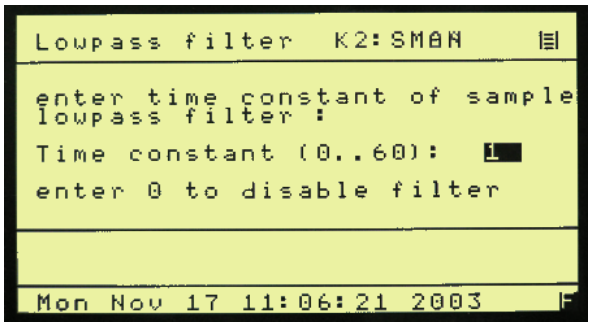


Figure 7-43 Lowpass filter

7.6.8. F2 Purge Time

F2 on the Menu Settings screen the sets the purge time before continuing with a zero or span calibration.

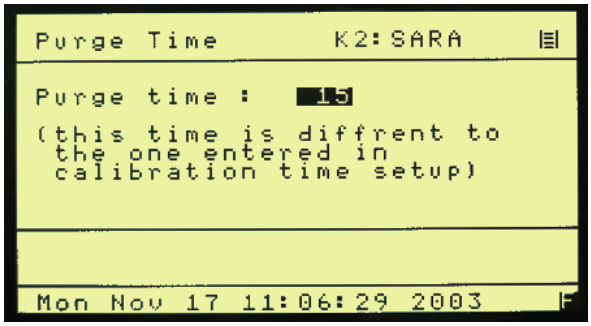


Figure 7-44 Purge Time

7.6.9. F3 Set Temperature Compensation

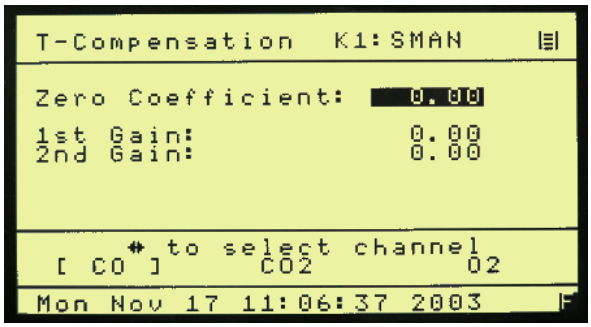


Figure 7-45 T-compensation

7.6.10. F4 Pressure Compensation

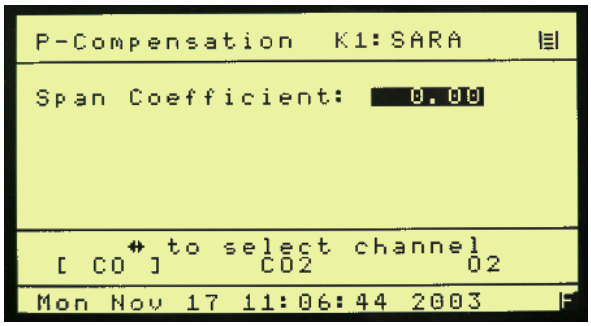


Figure 7-46 P-Compensation

7.6.11. F3 Low Pass Filter Time Constant

F3 on the Menu Settings screen allows the software time constant to be set between 1 and 60 seconds. This is very useful in eliminating noise when measuring low-level concentrations.

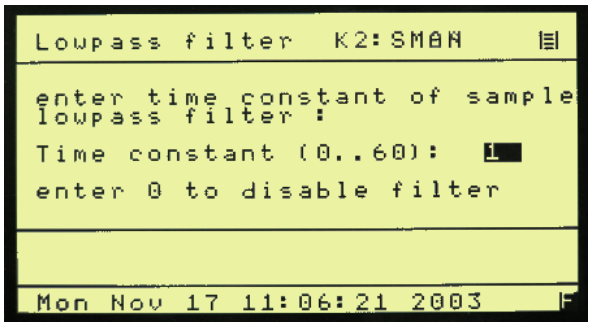


Figure 7-47 Low pass filter time constant

7.6.12. F10 Displays the Current Analyzer and Software Versions

This displays the analyzer's information, including the factory recommended air and sample pressure settings.

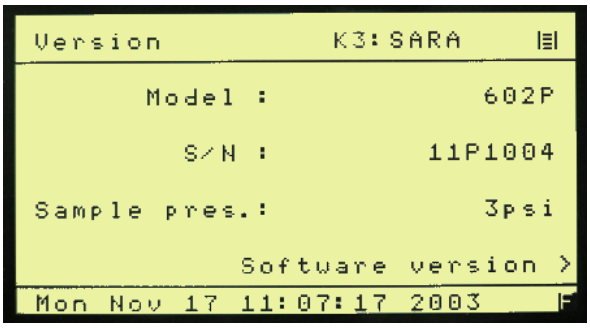


Figure 7-48 Analyzer Information

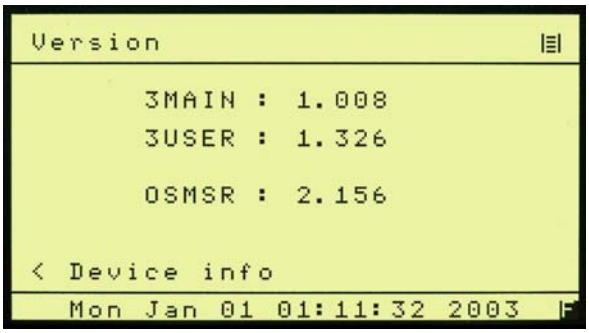


Figure 7-49 Software Version

7.7. F7 Remote / Manual Control

The analyzer can be remote-controlled either by a master computer or via contact closures. The TCP/IP and serial communication fully corresponds to the specifications of the AK protocol. To change remote/manual control, press F6 in the main menu. This toggles between remote and manual control.

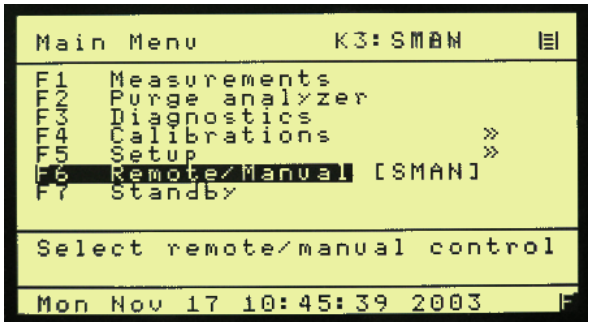


Figure 7-50 F6 Remote/Manual

Main Menu (User Level 4)

7.8. F8 Standby

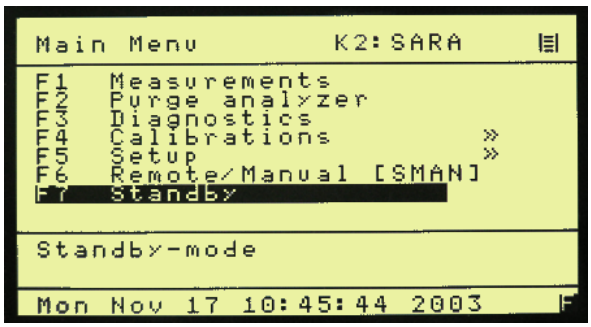


Figure 7-51 F7 Standby

Main Menu (User Level 4)

In Standby mode, pump is turned off and the solenoids are closed. The CAI logo is displayed.

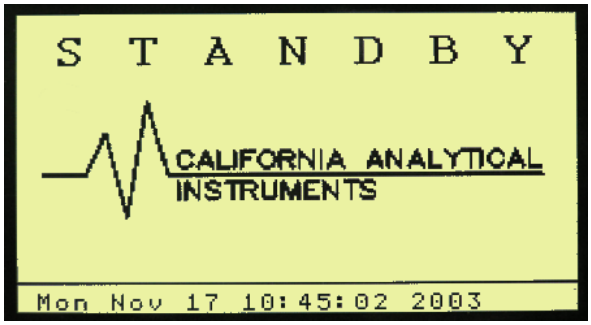


Figure 7-52 Standby Mode

8. Analyzer Components

8.1. Rear Panel

The following details the rear panel connections:

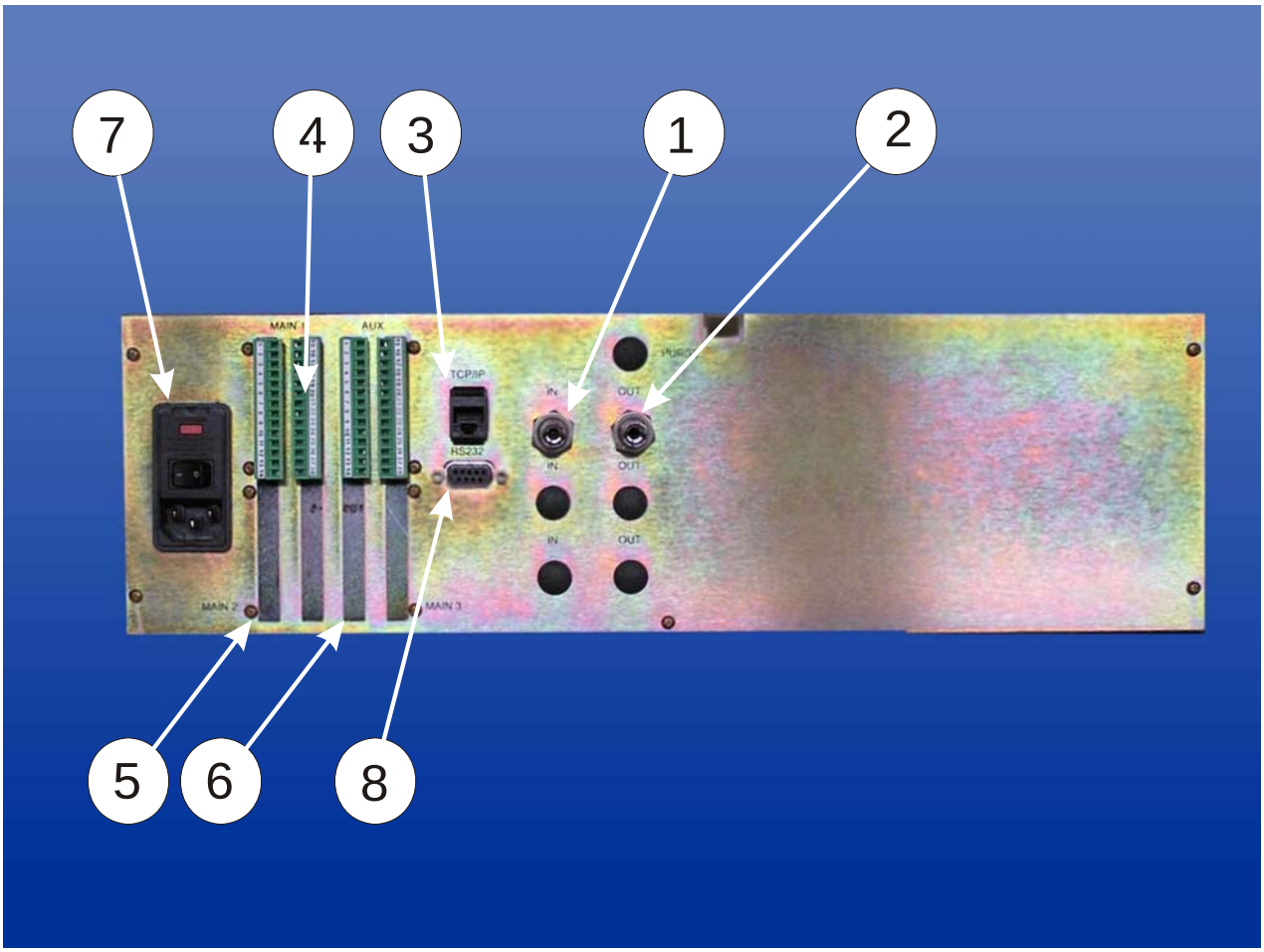


Figure 32: Rear Panel

1) **Sample Gas Inlet:** Feeds sample gas to the analyzer. ¼ Inch Tube.
2) **Sample Gas Bypass Outlet (Vent):** Exhaust for sample. ¼ Inch Tube.
3) **TCP/IP Connection:** Connect Network Connector.
4) 28 Pin output terminal strip/main 1 (standard).
5) 28 Pin output terminal strip/main 2 (optional).
6) 28 Pin output terminal strip/main 3 (optional).
7) **Power Entry Module:** Power connection, power switch, fuse compartment (2 Amp) **With Rear Panel Power ON/OFF Switch:** Turns ON/OFF line power to instrument
8) **Serial Connector:** Connect Serial Connector

8.2. Rear Panel Connectors

28 Pin Main Connector Assignments:							**28 Pin Auxiliary Connector Assignments:**		
Signal Type	**Main 1 Analog**		**Main 2 Optional Analog**		**Main 3 Optional Analog**		**Signal Type**	**601, 602, 603 Analog**	
	Pin #		Pin #		Pin #		Spare	Pin #	
A Output	1	GND (analog)	1	GND (analog)	1	GND (analog)	A Input	1	GND (analog)
A Output	2	Channel 1	2	Channel 1	2	Channel 1	A Input	2	External Analog 1
A Output	3	Channel 2	3	Channel 2	3	Channel 2	A Input	3	External Analog 2
A Output	4	Channel 3	4	Channel 3	4	Channel 3	A Input	4	Spare analog
A Output	5	Aux	5	Aux	5	Aux	A Input	5	Spare analog
		Digital		**Digital**		**Digital**	**Alarms**		**Digital**
D Output	6	GND (Digital)		GND (Digital)		GND (Digital)	D Output	6	GND (Alarm)
D Output	7	Sense AutoRange		Sense AutoRange		Sense AutoRange	D Output	7	General Alarm
D Output *	8	Sense Range 4		Sense Range 4		Sense Range 4	D Output	8	Ch. 1 Conc. 1 Alarm
D Output *	9	Sense Range 3		Sense Range 3		Sense Range 3	D Output	9	Ch. 1 Conc. 2 Alarm
D Output *	10	Sense Range 2		Sense Range 2		Sense Range 2	D Output	10	Ch. 2 Conc. 1 Alarm
D Output *	11	Sense Range 1		Sense Range 1		Sense Range 1	D Output	11	Ch. 2 Conc. 2 Alarm
		* Hi = True							
D Input	12	Set AutoRange	12	Set AutoRange	12	Set AutoRange	D Output	12	Ch. 3 Conc. 1 Alarm
D Input	13	Control Range 1	13	Control Range 1	13	Control Range 1	D Output	13	Ch. 3 Conc. 2 Alarm
D Input	14	Control Range 2	14	Control Range 2	14	Control Range 2	D Output	14	Reserved
D Input	15	Control Range 3	15	Control Range 3	15	Control Range 3	D Output	15	GND (Alarm)
D Input	16	Control Range 4	16	Control Range 4	16	Control Range 4	D Output	16	Calibration Alarm 1
D Input	17	Auto Cal	17	Auto Cal	17	Auto Cal	D Output	17	Calibration Alarm 2
D Input	18	Calibrate	18	Calibrate	18	Calibrate	D Output	18	Calibration Alarm 2
D Input	19	Zero	19	Zero	19	Zero	D Output	19	Reserved
D Input	20	Span	20	Span	20	Span	D Output	20	Spare
D Input	21	Pump	21	Pump	21	Pump	D Output	21	Spare
D Output	22	Zero Gas Flow	22	Zero Gas Flow	22	Zero Gas Flow	D Output	22	Spare
D Output	23	Span Gas Flow	23	Span Gas Flow	23	Span Gas Flow			Spare
D Output	24	Sample Gas Flow	24	Sample Gas Flow	24	Sample Gas Flow			Spare
D Output	25	Local/Remote	25	Local/Remote	25	Local/Remote			Spare
D Output	26	Read Cal Mode	26	Read Cal Mode	26	Read Cal Mode			Spare
D Output	27	Reserved	27	Reserved	27	Reserved			Spare
D Output	28	Reserved	28	Reserved	28	Reserved			Spare

8.3. Digital Outputs

8.3.1. RS-232 (Standard 9 Pin DIN Connector)

Pin	Function
1	DCD Carrier Detect
2	RxD Receive Data
3	TxD Transmit Data
4	DTR Data Terminal Ready
5	Ground
6	DSR Data Set Ready
7	RTS Ready to Send
8	CTS Clear to Send
9	RI Ring Indicator

8.3.2. TCP/IP (8 Pin RJ-47 Connector)

Pin	Function
1	TDX+
2	TDX-
3	RXD+
4	Open
5	Open
6	RXD-
7	LNLED
8	LNLED

IMPORTANT TIP: For direct connect to a PC a crossover cable is required. Connection to a hub requires a straight cable.

8.4. Internal Component Locations

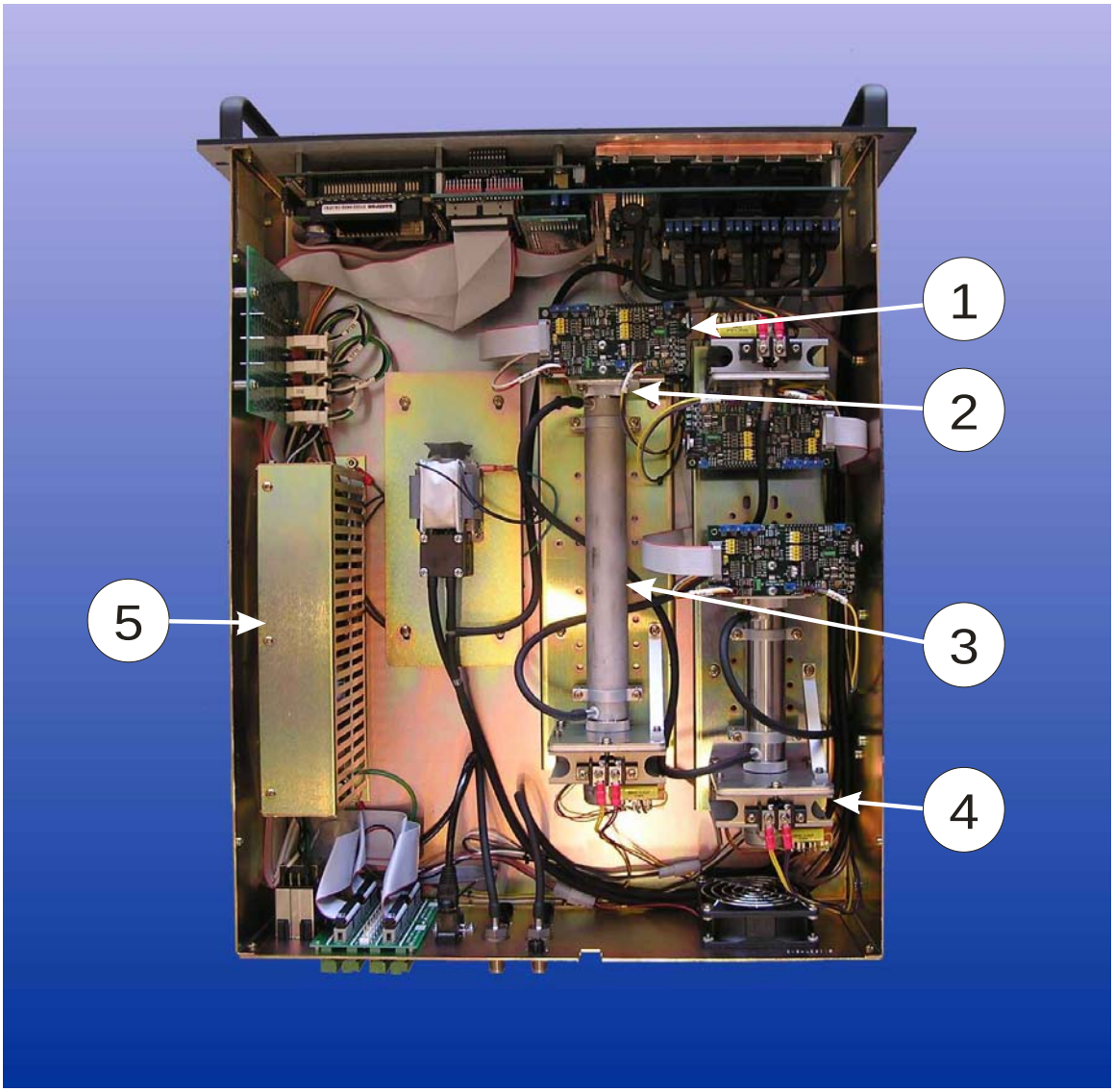


Figure 8-1 Internal components

1) Signal conditioning PCB.
2) NDIR detector.
3) Sample cell.
4) IR source and chopper motor assembly.
5) DC power supply module.

8.5. Main Electronics Board (Potentiometers)

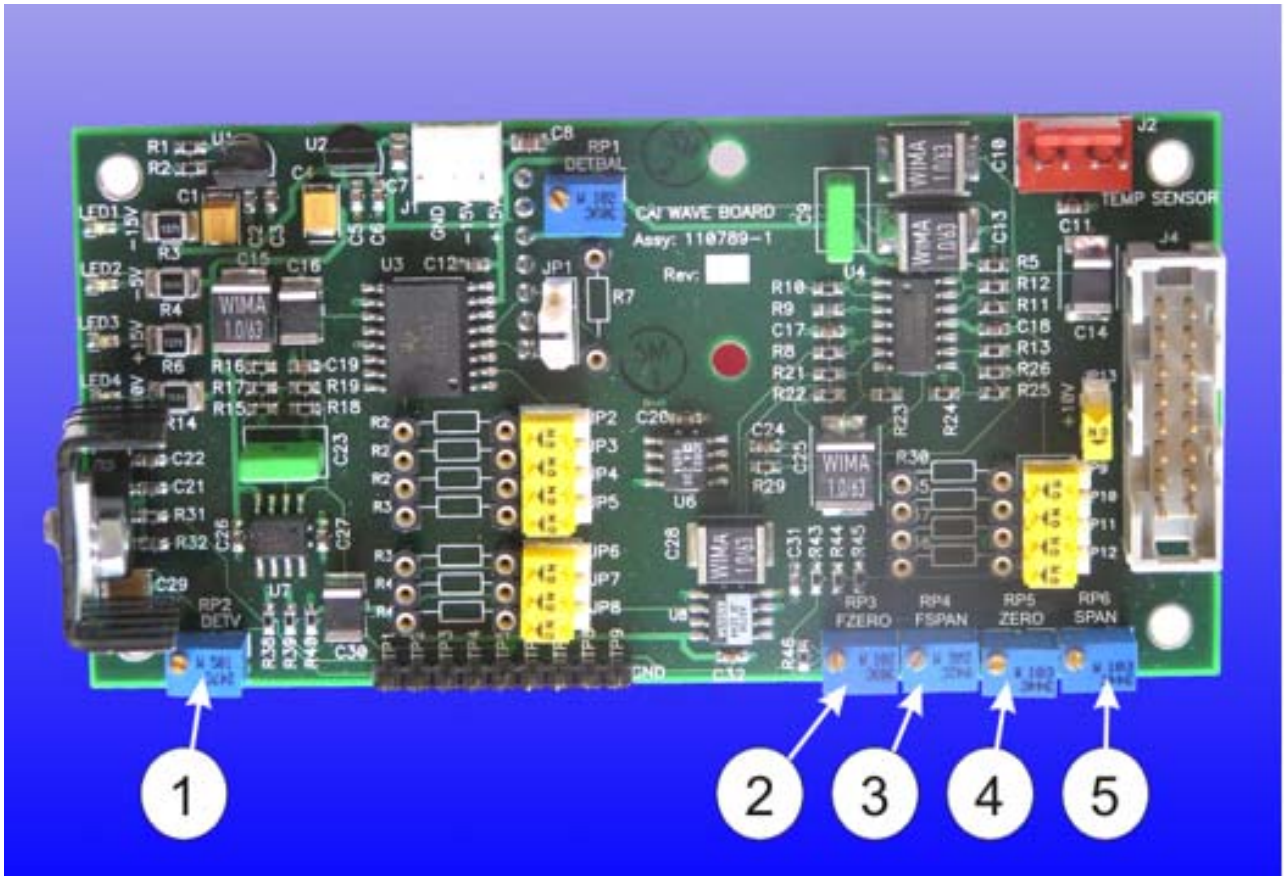


Figure 8-2 Main Electronic Board Potentiometers

1	RP2	Detector voltage adjust
2	RP3	Fine zero adjust
3	RP4	Not used (Fully CW)
4	RP5	Coarse zero adjust
5	RP6	Span adjust

NOTE: Potentiometers are clearly labeled on both sides of the Wave PCB.

8.6. NDIR Detector Assembly

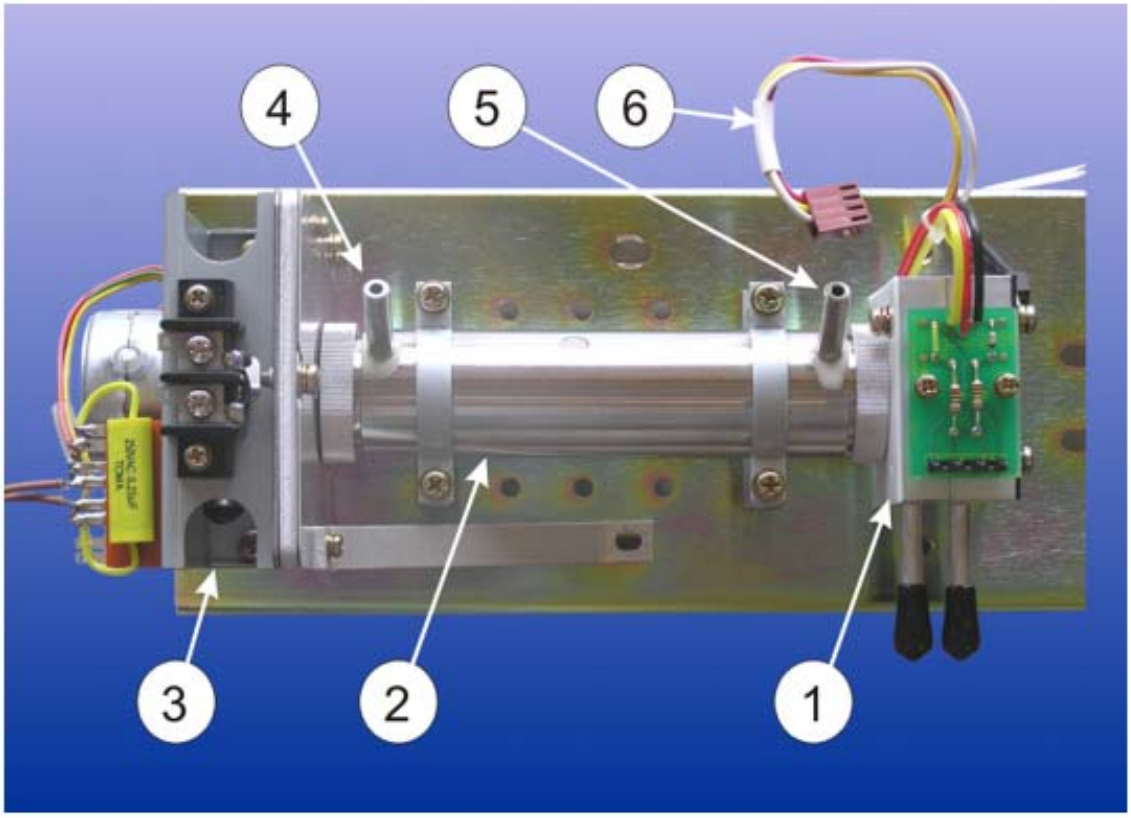


Figure 8-3 NDIR detector assembly

1) Detector Assembly.
2) Sample cell assembly.
3) Light source and chopper motor assembly
4) Sample inlet.
5) Sample outlet.
6) Temperature sensing element (to J2 of Wave PCB)

9. Operation

9.1. External Wiring

Make sure that the external wires have been connected as described in Section 3 Installation.

9.2. External Piping

Review Section 3, 3.7 and 3.8

9.3. Operation & Calibration

9.3.1. Power On:

Turn on the power switch (located on the rear panel). The LCD display should illuminate. Allow the instrument to warm up for approximately one hour. It is preferable, but not essential, that zero gas flow through the instrument at a rate of about 1 Liter/minute (LPM).

Note: To achieve final stability, the analyzer may require an additional warm-up period of up to four hours (depending on variables in the analyzer's environment).

9.3.2. Zero/San Adjustment:

Follow the "Quick Start Guide" at the front of this manual.

Note: Span gas concentration should not be less than 80% of the range to be spanned.

9.3.3. Start-Up and Routine Maintenance:

Prepare and check the sample system. Adjust the flow of sample gas to about 1 L/min. The instrument should show a meter indication. The infrared gas analyzer is designed for extended operation and may be left switched on continuously.

10. MAINTENANCE

Warning

All replacement parts must be as supplied and/or specified by California Analytical Instruments. Failure to used specified parts may reduce the safety features of the instrument or create a hazardous condition.

10.1. Zero and Span Calibration

The zero and span levels should be checked and/or calibrated daily (or as often as required.)

10.2. Cleaning of the Optical Bench Measuring Cell (Infrared Analyzers Only)

Dust or water droplets entering the measuring cell may cause drift due to contamination. When it is impossible to adjust the zero level with the zero control mounted on the front panel, check the measuring cell for contamination. If contamination is present, check the sampling system, especially the filters, to eliminate the source of contamination. Periodic maintenance is generally not required. Cleaning is accomplished by use of a cleaning agent (such as isopropyl alcohol or household glass cleaner) and a non-abrasive, lint-free cloth or tissue.

10.3. Optical Bench Configuration

Infrared analyzers may be configured with three types of optical benches: with a pipe cell; with a block cell; or with both a pipe cell and a block cell (see Table 10-1))

Table 10-1 Optical Bench Configuration

Optical Bench Type	Illustration	Paragraph
Pipe Cell (Cell length: 64 mm, 125 mm, or 250 mm).	Figure 10-1 This figure illustrates the pipe cell	10.3.1 describes the disassembly cleaning and reassembly
Block Cell (Cell length: 4 mm, 8 mm, 16 mm or 32 mm)	Figure 10-2 This figure illustrates the block cell.	10.3.2 describes the disassembly cleaning and reassembly
Combination	Figure 10-3 This illustrates the combination assembly.	10.3.3 describes the disassembly cleaning and reassembly

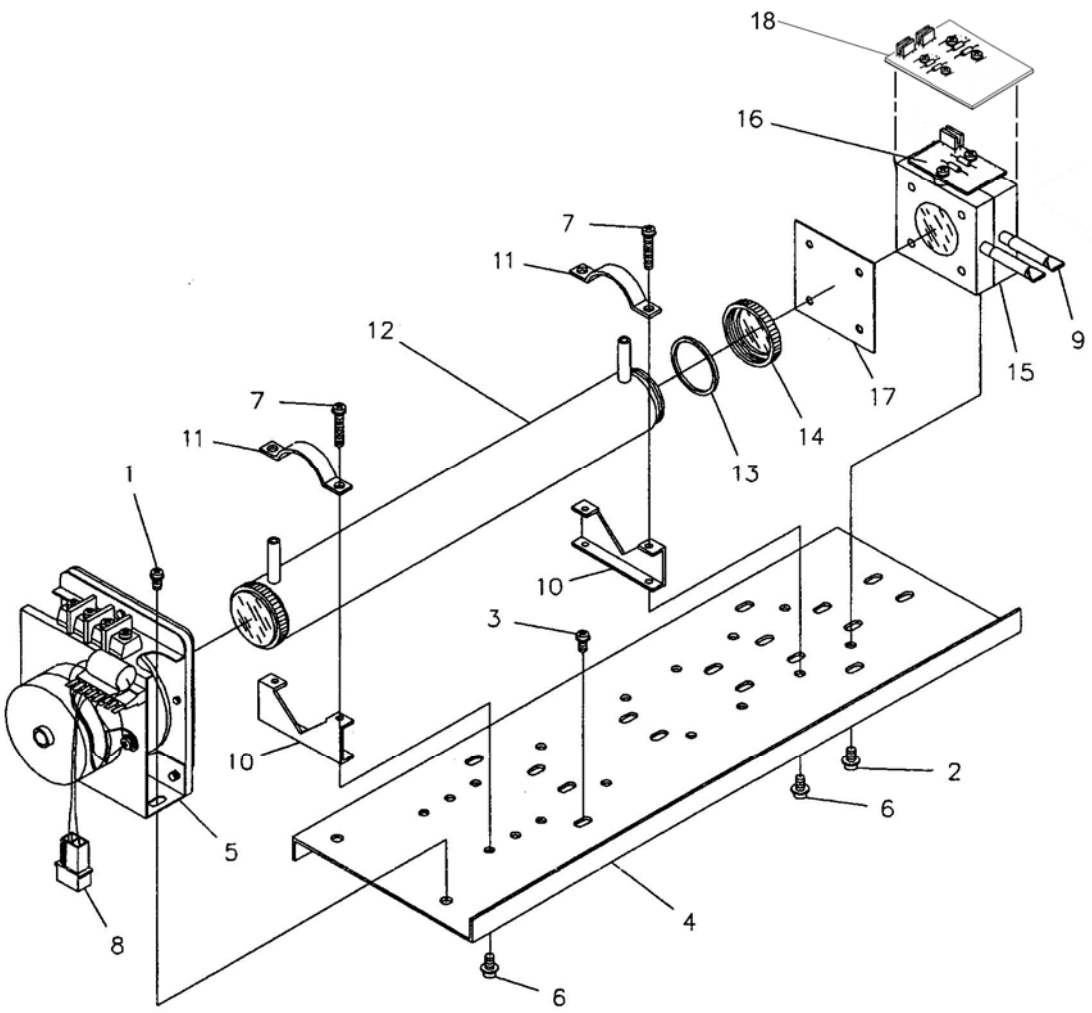


Figure 10-1 Optical Bench with Pipe Sample Cell

Item	Description	Item	Description
1-3	Screw (M4)	12	Pipe sample cell
4	Base	13	O-Ring
5	Infrared source unit	14	Window
6-7	Screw (M4)	15	Detector
8	Connector	16	Bridge circuit board
9	Sealed tubes	17	Optical filter (if installed)
10	Support	18	Wave PCB
11	Clamp		

Note: Pipe cell foil liner not shown

10.4. Removal of Pipe Cell

(Figure 10-1)

1) Discontinue the sample gas flow. When it contains harmful gas, purge the measuring cell sufficiently with zero gas.

2) Turn the power switch to OFF.

3) After loosening the retaining screws on the sides of the top cover, lift off top cover and locate the pipe cell.

4) Disconnect the sample gas inlet and outlet tubes from the measuring cell.

5) After loosening (do not remove) the two screws (No. 1 in Figure 10-1) which are used for securing the infrared light source unit (No. 5 in Figure 10-1) to the base plate, shift the infrared light source away from the pipe cell (No. 12 in Figure 10-1) to form a gap.

6) After removing the pipe cell retainer screws (No. 7 in Figure 10-1), remove the retaining clamps (No. 11 in Figure 10-1).

7) Carefully remove the cell from the optical bench and remove both windows (right-hand threaded) (No. 14 in Figure 5-1).

8) At this time, inspect the O-Ring (No. 13 in Figure 10-1) for signs of deterioration. Replace if necessary.

9) The CaF_2 window is bonded to the window holder. Inspect and clean the windows as necessary using cotton swabs and a suitable cleaning solution.

Alcohol or an alcohol-based glass cleaner is a suitable cleaning solution. A soft cloth or tissue that will not deposit lint should be used to clean the liner & windows.

10) The pipe cells contain a reflective metal foil liner (not shown in Figure 10-1) to enhance the light energy through put in the cell. Normally it is not necessary to remove the liner for cleaning; however, the liner should be removed if the cell is subjected to grossly excessive moisture. If necessary, clean both sides of the liner and the inside of the pipe cell. If the liner has been subjected to a corrosive substance, it should be replaced. In either case, ensure that the small gas holes in the liner are aligned with the gas fittings at both ends of the pipe cell before reassembling the windows.

11) The pipe cell can be re-assembled by following the reverse of the disassembly procedures. In re-assembly, reserve gaps of approximately 0.5 mm between the infrared light source unit and cell and between the cell and detector, respectively. Larger gaps are undesirable.

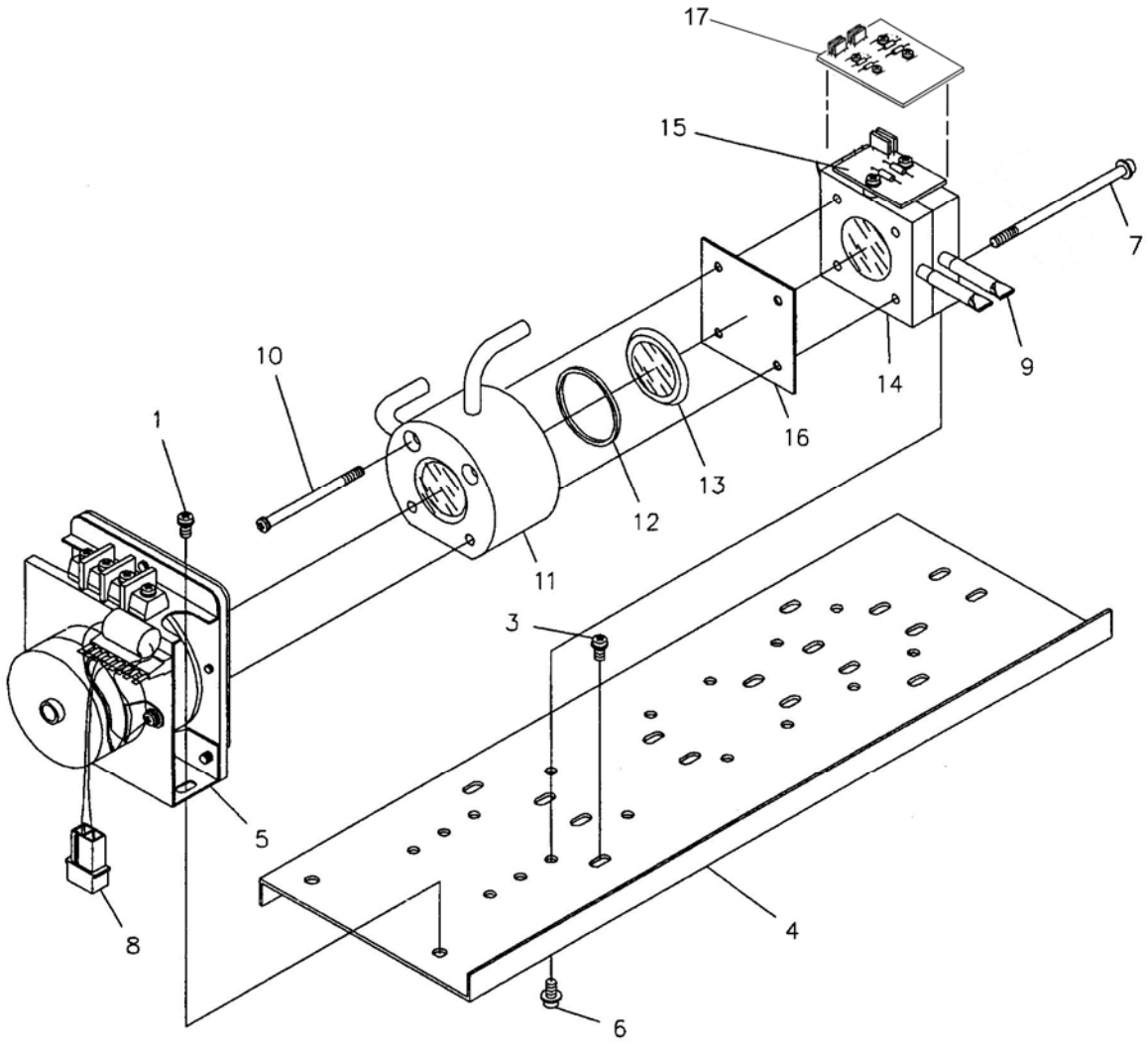


Figure 10-2 Optical Bench with Block Sample Cell

Item	Description	Item	Description
1-3	Screw (M4)	11	Block sample cell
4	Base	12	O-Ring
5	Infrared source unit	13	Window
6	Screw (M4)	14	Detector
7	Screw (Round or Pan Head)	15	Bridge circuit board
8	Connector	16	Optical filter (if installed)
9	Sealed tubes	17	Wave PCB
10	Screw (Flat Head)		

10.5. Removal of Block Cell

(Figure 10-2)

1) Discontinue the sample gas flow. When it contains harmful gas, purge the measuring cell sufficiently with zero gas.
2) Turn the power switch to OFF.
3) After loosening the retaining screws on the sides of the top cover, lift off the top cover and locate the block cell.
4) Disconnect the sample gas inlet and outlet tubes from the measuring cell.
5) Disconnect the detector output-cable-connector from the main circuit board.
6) Remove the two screws (No. 7 in Figure 10-2) attaching the detector to the infrared light source assembly and remove the detector from the optical bench. The cell is removed together with the detector as a unit.
7) While holding the detector in the palm of your hand, remove the two flat-head screws (No. 10 in figure 10-2) which fix the cell to the detector.

Note: The cell window (No. 10 in figure 10-2) is loose and is only retained by the clamping action between the detector and the block sample cell. Take care not to drop the window when separating the block cell from the detector.

8) Clean the cell interior and CaF_2 windows using a soft cloth or tissue (see Note on previous page). Inspect the O-Ring for flatness or deterioration and replace if necessary.
9) The block cell can be re-assembled by following the reverse of the disassembly procedures. Note the orientation of the loose window and 0-ring during disassembly.

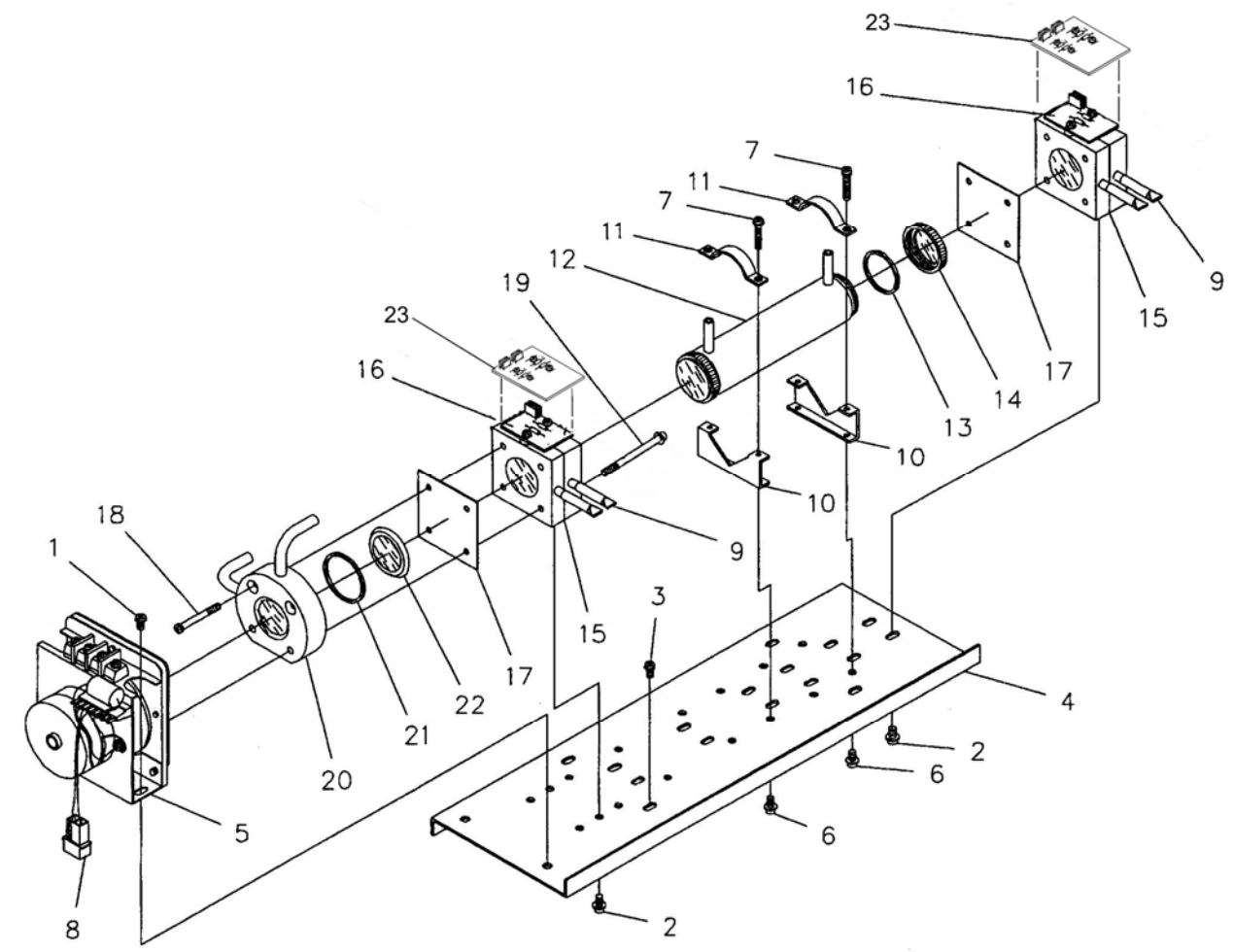


Figure 10-3 Optical Bench with Pipe and Block Type Sample Cells

Item	Description	Item	Description
1-3	Screw (M4)	14	Window
4	Base	15	Detector
5	Infrared source unit	16	Bridge circuit board
6	Screw (M4)	17	Optical filter (if installed
7	Screw	18	Screw (Flat Head)
8	Connector	19	Screw (Round or Flat Head)
9	Sealed tubes	20	Block Sample Cell
10	Support	21	0-Ring
11	Clamp	22	Window
12	Pipe sample cell	23	Wave PCB
13	O-Ring		

10.6. Disassembly of Combination Pipe & Block Type Cells

(Figure 10-3)

1) Discontinue the sample gas flow. When it contains harmful gas, purge the measuring cell sufficiently with zero gas.
2) Turn OFF the power switch.
3) After loosening the retaining screws on the sides of the top cover, lift off top cover and locate the block cell.
4) Disconnect the inlet and outlet tube from both measuring cells.
5) Disconnect the wires from the two terminal screws of the infrared source unit and unplug the 2-pin connector (No. 8 in figure 10-3) from the chopper motor.
6) Disconnect the block cell's detector output-cable-connector from the main circuit board.
7) Remove the two screws (No. 1 in figure 10-3) that secure the infrared source unit to the base.
8) Remove the sub-assembly consisting of the source unit, block cell, and detector.
9) Remove the two screws (No. 19 in figure 10-3) that secure the detector to the infrared source then separate the detector and block cell from the infrared source unit.
10) While holding the detector in the palm of your hand, remove the two flat-head screws (No. 18 in figure 10-3) which fix the cell to the detector.

Note: the cell window (No. 10 in figure 10-3) is loose and is only retained by the clamping action between the detector and the block ample cell Take care not to drop the window when separating the block cell from the detector.

11) Clean the cell interior and CaF_2 windows using a soft cloth or tissue (see Note on previous page). Inspect the O-Ring for flatness or deterioration and replace if necessary.
12) The block cell can be re-assembled by following the reverse of the disassembly procedures. Note the orientation of the loose window and 0-ring during disassembly.

Note: Before re-installing the infrared source unit, block cell and detector sub-assembly you should first remove and clean the pipe cell.

13) Remove the pipe cell retaining screws (No. 7 in figure 10-3)
14) Remove the retaining clamps (No. 11 in figure 10-3).
15) Lift the pipe cell out of its two supports (No. 10. in figure 10-3) and remove both windows (right-hand threaded) (No. 14 in figure 10-3).
16) At this time, inspect the O-Ring (No. 13 in Figure 10-3) for signs of deterioration. Replace if necessary.
17) The CaF_2 window is bonded to the window holder. Inspect and clean the windows as necessary using cotton swabs and a suitable cleaning solution.

Alcohol or an alcohol-based glass cleaner is a suitable cleaning solution. A soft cloth or tissue that will not deposit lint should be used to clean the liner & windows.

18) The pipe cells contain a reflective metal foil liner (not shown in Figure 10-3) to enhance the light energy through put in the cell. Normally it is not necessary to remove the liner for cleaning; however, the liner should be removed if the cell is subjected to grossly excessive moisture. If necessary, clean both sides of the liner and the inside of the pipe cell. If the liner has been subjected to a corrosive substance, it should be replaced. In either case, ensure that the small gas holes in the liner are aligned with the gas fittings at both ends of the pipe cell before reassembling the windows.

19) The pipe cell can be re-assembled and installed by placing it in its supports and securing with its retaining brackets.

Note: Before tightening the retaining brackets, be certain that a gap of approximately 0.5-1.0 mm exists between the pipe cell and the pipe cell detector.

20) Reinstall the infrared source unit, block cell and detector sub-assembly by performing steps e, f, g, h, and I in reverse, being sure to leave a slight gap of approximately 0.5-1.0 mm between the back of the block cell and the front pipe-cell window.

11. ADJUSTMENTS CHECKS AND REPAIRS

11.1. Adjustment of Detector Voltage (NDIR'S only)

Note: Adjustment is required if detector or NDIR amplifier board is replaced. Important: Turn RP2 to its maximum counter clockwise position before initial power up of a replacement detector or NDIR.

The detector operating voltage is specified on the label attached to the side of the detector below the Serialization Number and Type designation. On the NDIR amplifier board, the voltage supplied to the detector can be measured between TP-1 (+) and TP-9 (common). Adjust RP2 to achieve the voltage specified on the detector to within 0.001 VDC.

WARNING: The detector may be damaged if the applied voltage is excessive. For this reason, it is recommended to adjust RP2 to its maximum counter clockwise position before initial power up of a replacement detector or NDIR amplifier board.

11.2. Coarse Zero Adjustment

With zero gas still flowing connect a DC voltmeter to TP7 (+) and TP9 (common). Switch JP8 to the on position and leave JP6 and JP7 in the off position. The target DC voltage for TP7 is 0mV. Adjust RP5 first and use RP3 for the final adjustment.

11.3. Span Gain Adjustment

With a full-scale span gas flowing connect a DC voltmeter to TP8 (+) and TP9 (common). The target voltage for TP8 with a full-scale span gas flowing is 8.00VDC. Turn RP4 fully clockwise (12 turns). To achieve this voltage select a resistor value, or combination of values to install into R30, R35, R36, and / or R37. Set the corresponding Jumper (JP9-JP12) to the on position for each resistor used to set the gain. The value needed may range between 1K and 100K ohms. A smaller resistor value increases the gain and achieves a larger DC voltage at TP8 when span gas is flowing. RP6 can be used to make a small gain adjustment when the target voltage is close. When finished setting the gain adjustment, flow zero gas again and repeat the previous to step to achieve a good zero at TP8.

11.4. Check and Repair Detector

(No. 15 in Figure 10-1 and Figure 10-3, No. 14 in Figure 10-2)

11.4.1. Problem:

Microflow sensor broken, bridge resistor defective or gas leak in detector.

11.4.2. Symptom:

Zero adjustment impossible.

11.4.3. Check and/or replace:

1) The microflow sensor and bridge resistors (No. 16 in Figure 10-1) are normal when DC voltages of about 1.5 to 2V are measured between bridge circuit board terminals numbered 1-3 and between terminals numbered 2-3, respectively, and the difference between these voltages is a few tenths of a volt. These two voltage readings can be measured from the top of the NDIR amplifier board between ground (TP9) and pin 1 of J3 and pin 3 of J3 respectively when R7 is removed. J3 is not labeled on the top of the circuit board as it is mounted on the bottom side of the circuit board. The pins are accessible on the top of the board between U3 and JP1. Pin 1 is designated with a square pad.

2) Connect an oscilloscope between the NDIR amplifier board check terminals TPp (common) and TP3. When the NDIR amplifier board, infrared light source unit, and chopper are normal, but ac waveform (approximately 10 Hz) is not observable at TP3, gas is leaking in the detector and the detector should be replaced.

3) When check in item 1 (above) indicates abnormal voltage, turn the power switch to OFF, and disassemble the NDIR amplifier board from the top of the detector to access the bridge circuit board mounted on the detector.

4) Check the microflow sensor for its resistance. Measure resistance values between terminals 1-3 and between terminals 2-3, respectively, on the bridge circuit board. When the resistance values are about 25 to 50 ohms, the microflow sensor is normal, but the bridge resistor is defective. If the resistance is infinite, the microflow sensor is faulty.

5) Replacement: Replace the detector with a new one (refer to 10-1). If the instrument is using the pipe cell, the detector is attached to the optical bench from below. Remove the four screws (No. 3 of Figures 10-1and 10-3) that secure the base (No. 4 of Figures 10-1and 10-3) to access the detectors retaining screws (No. 2 of figures 10-1and 10-3).

6) After the detector has been replaced, adjust the detector voltage to the specified value (refer to section 11.1 of this manual).

7) Adjust zero and span.

11.5. Check and Repair Infrared Light Source Unit

(No. 5 in Figure 10-1)

11.5.1. Problem:

A faulty infrared light source or a leaky gas seal.

11.5.2. Symptom:

The unit reads off scale or the output is unstable.

11.5.3. Check and/or replace:

1) After turning the power switch to OFF and disconnecting the lead wires from the two terminal screws, measure the resistance between the two terminals. The resistance should normally be about 38 ohms. If the resistance is infinite, the infrared light source is faulty (Output drifts in the negative direction as resistance decreases).

2) When indicator output drifts due to influence from atmosphere in spite of normal operations of the detector and main circuit board, gas may be leaking into the infrared light source unit.

Note: In the case of a low-concentration CO_2 analyzer, the indicator output may fluctuate due to atmospheric CO_2 penetrating the gaps in the optical bench. This would be normal and not necessarily indicative of a problem. Purge the analyzer case with N_2 gas.

3) Replacement: After disconnecting wires from the two terminal screws and motor connector, remove the two screws that are used to attach the infrared light source unit to the optical bench. The light source assembly can be replaced, referring to Figure 10-1 or Figure 10-2.

4) After replacement of the infrared light source unit, adjust the zero level and span.

11.6. Check and Replace Chopper

(See Figure 2-1)

11.6.1. Problem:

Rotation abnormal.

11.6.2. Symptom:

Indicator output unstable or unresponsive.

11.6.3. Check and/or replace:

1) With the power switch turned ON, listen for a frictional noise from the chopper blade. If noise can be heard, it is necessary to adjust the chopper blade so that no contact is made with other parts. Remove the infrared light source assembly and detach the protective cover for access to the chopper blade. Take care not to damage the blade, as it is made of thin material. No adjustment is required as long as the output is normal.

2) If the motor shaft does not rotate after energizing the instrument, disconnect the power supply connector from the motor and check to see if AC 100 Volts is

supplied to the connector on the power supply side. When power is supplied but the motor shaft does not rotate, check the shaft and blade sector for an obstruction. When the motor does not rotate, and there is no abnormal contact on the shaft or sector blade, the motor itself is defective.

3) Replacement: When the motor is defective, the infrared light source assembly must be replaced.

11.7. Check and Repair Measuring Cell

Detector Window and Infrared Light Source Window

11.7.1. Problem:

Cell and window badly contaminated.

11.7.2. Symptom:

Zero adjustment impossible.

11.7.3. Check and or replace:

After removing the measuring cell, check the cell and windows for contamination. If contaminated, remove contaminant with a soft cloth and alcohol. Take care not to damage the windows since they are fragile. For details, refer to section 10 of this manual.

11.8. Check and Repair Tubing Trouble

11.8.1. Problem:

Tubing loosened, disconnected, contaminated, or restricted.

11.8.2. Symptom

Indicator output unstable or response is too to slow.

11.8.3. Check and/or replace:

1) When tubing is disconnected or loosened, firmly reconnect it.

2) When tubing is contaminated or restricted, disconnect it and blow out contaminants with high-pressure air, or replace the tubing.

Caution

Cracked, broken or frayed tubing may cause a hazardous condition. Replacement tubing must be as specified by California Analytical Instruments to prevent possible damage to operating personnel or equipment.

11.9. Check and Repair Amplifier Circuit

1) Connect an oscilloscope across check terminals TP3 (signal) and TP9 (common) and observe the ac waveform. While zero gas is flowing, the amplitude of the waveform should be between 2.48Vpp and 2.8Vpp as shown below. This can be adjusted by following the procedure described under section 12.2 before making this adjustment it is recommended that a check for contamination in the cell and cell windows be done first, as this can lead to a reduction in amplitude of the ac signal. ***Note: Check cell first for contamination and clean if necessary.***

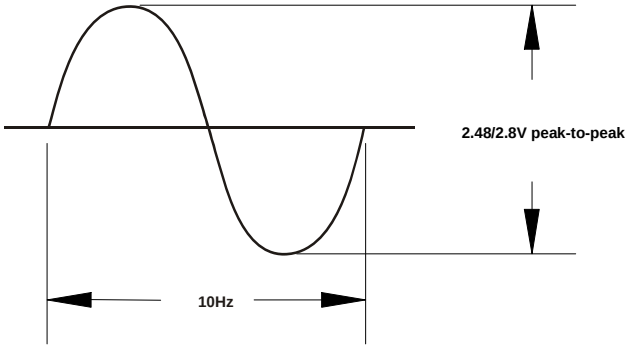


Figure 11-1 Amplifier circuit ac wave form

2) If an ac waveform cannot be observed in step a) above, observe the ac waveform across terminals TP4 (signal) and TP9 (common). If an ac waveform of 10 Hz and “peak-to-peak” amplitude of 147mV to 164mV is observed, ac amplifier U1 is normal and AC amplifier U7 is not functioning.

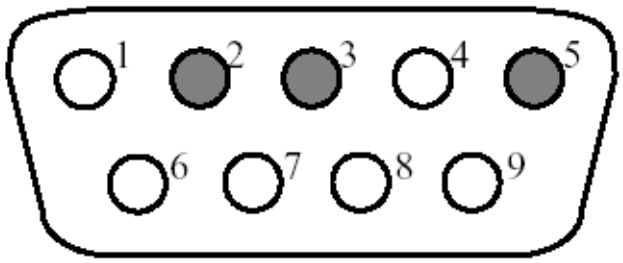
3) If an AC Waveform is not observed across terminals TP4 (signal) and TP9 (common), check the detector per section 12.4 of this manual.

12. Communication Master Computer / Analyzer (AK Protocol)

12.1. Serial Interface and AK-Commands

The serial interface enables remote control of the analyzer by a master computer. It is implemented as an RS232 V24 interface and meets all requirements of the AK protocol.

A 9-pin male connector at the back of the unit is used to connect a master computer with the following pin assignment:



Pin 2 = Rxd (receive)

Pin 3 = Txd (transmit)

Pin 5 = Gnd (ground)

Figure 12-1 Serial Interface

12.2. Interface Specifications

Speed:	9600 bps
Character Length	1 start bit
	8 data bits
	1 stop bit
Parity:	none
Handshake	no

12.3. Protocol Description

12.3.1. Instruction command

	Character	Explanation
1st Byte	STX	ASCII code 02
2nd Byte	Don't Care	Any ASCII code
3rd Byte	Function Code 1	AK instruction e.g.: ASTF
4th Byte	Function Code 2	
5th Byte	Function Code 3	
6th Byte	Function Code 4	
7th Byte	Blank	
8th Byte	K	
9th Byte	0	
10th Byte	Blank	
	D	AK instruction parameters, length is variable
	A	
	T	
	A	
nth Byte	ETX	ASCII code 03

Table 12-1 Structure of an instruction command

12.3.2. Acknowledgement command

	Character	Explanation
1st Byte	STX	ASCII code 02
2nd Byte	Don't Care	Any ASCII code
3rd Byte	Function Code 1	Echo of the AK instruction command
4th Byte	Function Code 2	
5th Byte	Function Code 3	
6th Byte	Function Code 4	
7th Byte	Blank	
8th Byte	K	
9th Byte	0	
10th Byte	Blank	
	D	AK acknowledgement parameters, length is variable
	A	
	T	
	A	
nth Byte	ETX	ASCII code 03

Table 12-2 Structure of an acknowledgement command

12.3.3. Data Description

Each command begins with STX (Start of Text) in the fist byte. The “don't care” byte can be any ASCII character. Generally, a blank or an underscore (_) is used for readability reasons. The four function bytes represent the AK command. A blank comes next, followed by K and the channel number. The analyzer is a single-channel device, and because of that the channel number is usually 0. For delimiting the command parameters from the channel number, another blank follows. This may be followed by command parameters with a variable length. Every command ends with the ETX (End of Text) character. The error status byte in the acknowledgment command signals if internal errors in the analyzer occurred. It is zero when no error appeared, and it is unequal zero when one or more errors occurred. Every time a change in the errors happens the error status byte is incremented by one, no matter if one or several errors disappear or are added. If it had the value 10, it would be reset to 1. The error status byte does not indicate the real number of errors. If the analyzer does not have errors, the error status byte contains the value 0.

In general, AK commands are subdivided into three classes:

- Control commands (Sxxx)
- Inquiry commands (Axxx)
- Configuration commands (Exxx)

12.3.4. Error Handing

It might happen that an unknown instruction is sent, that the analyzer is busy with a function which is not the desired one, or that an error occurred in the command parameters. Table 1-4 summarizes all errors that can appear upon any master instruction.

Analyzers Acknowledgement	Explanation
???? f1	Analyzer does not know the instruction sent.
xxxx[2] f BS	Analyzer is busy with another function.
xxxx f SE	Syntax error within command parameters or incomplete command.
xxxx f NA	Requested function or data are not available.
xxxx f DF	Data error: The kind or number of given parameters are not valid.
xxxx f OF	Offline: Analyzer is offline, i.e. analyzer is in local Mode. Only inquiry commands and SREM (set analyzer in remote mode) are allowed.

Table 12-3 Acknowledgment response in case of error

[1] f stands for the error status byte.
[2] xxxx stands for the function code of the sent master command

12.4. Scan Commands

12.4.1. **AKON:** Measured concentration value

Command	Response	Description
_AKON_K0	_AKON_s_z.z_y.y_x.x_w.w	Measured concentration value of all channels is responded t = Timestamp (1/10 sec)
_AKON_Km	_AKON_s_z.z_t	Measured concentration value of channel m is responded t = Timestamp (1/10 sec)

12.4.2. **AEMB:** Get measuring range

Command	Response	Description
_AEMB_K0	_AEMB_s_Mn_Mn_Mn	Current measuring range of all channels is responded
_AEMB_Km	_AKON_s_Mn	Current measuring range of channel m is responded

12.4.3. **AMBE:** Measuring range limit

Command	Response	Description
_AMBE_K0	_AMBE_s_M1_w.w _M2_x.x _M3_y.y _M4_z.z	All existing measuring range limits of channel m are responded
_AMBE_K0_Mn	_AMBE_s_Mn_z.z	Range limit of Range Mn is responded

12.4.4. **AKAK:** Calibration gas concentrations

Command	Response	Description
_AKAK_Km	_AKAK_s_M1_w.w _M2_x.x _M3_y.y _M4_z.z	All existing calibration gas values are responded for selected channel m
_AKAK_Km_Mn	AKAK_s_Mn_z.z	For selected channel m calibration gas value of Range Mn is responded

12.4.5. **AMBU:** Upper and lower range switchover values for auto range

Command	Response	Description
_AMBU_Km	_AMBU_s_M1_w.w_W.W _M2_x.x_X.X _M3_y.y_Y.Y _M4_z.z_Z.Z	Lower and upper range switchover value of auto range are responded for channel m
_AMBU_Km_Mn	_AMBU_s_Mn_w.w_W.W	Lower and upper range switchover value of auto range are responded for channel m range n

12.4.6. **ASTZ:** Normal device status

Command	Response	Description
_ASTZ_K0	_ASTZ_s_K1_State1_State2_State3 _K2_State1_State2_State3 _K3_State1_State2_State3	Respond device status for all channels
_ASTZ_Km	_ASTZ_s_State1_State2_State3	Respond device status only for channel m

Possible states:

State 1	**State 2**	**State 3**
SREM: remote	STBY: standby	SARE: auto range on
SMAN: manual	SPAU: pause	SARA: auto range off
	SMGA: measuring gas	
	SNGA: zero gas	
	SEGA: end gas	
	SATK SNGA: zero gas during auto cal	
	SATK SEGA: end gas during auto cal	

12.4.7. **ASTF:** Error status

Command	Response	Description
_ASTF_K0	_ASTF_s_f1_f2_f3_…_f10	Current error numbers of all are responded

Errors:

1	Channel 1 Flow Failure	8	Channel 1 not calibrated
2	Channel 2 Flow Failure	9	Channel 2 not calibrated
3	Channel 3 Flow Failure	10	Channel 3 not calibrated
4	External Analog 1 Failure	11-13	Ch1…3: Low concentration warning
5	External Analog 2 Failure	14-16	Ch1…3: High concentration warning
6	Pressure Failure	17-19	Ch1…3: Temperature failure
7	Temperature Failure	20-22	Ch1…3: EPC Voltage failure

12.4.8. **AKEN:** Device identification

Command	Response	Description
_AKEN_K0	_AKEN_s_devicename	Device identification is responded
_AKEN_K1	_AKEN_s_model	Device model
_AKEN_K2	_AKEN_s_serialno	Device serial number
_AKEN_K3	_AKEN_s_samplepressure	Suggested input sample pressure

12.4.9. **ARMU:** Raw value

Command	Response	Description
_ARMU_K0	_ARMU_s_z.z_y.y_x.x_t	Raw value before linearization and offset-span-correction is responded for all channels t = Timestamp (1/10 sec) Raw value before linearization and offset-span-correction is responded for channel m t = Timestamp (1/10 sec)

12.4.10. **ATEM:** Temperatures

Command	Response	Description
_ATEM_K0	_ATEM_s_z.z	Device temperature in degrees Celsius is responded
_ATEM_Km	_ATEM_s_z.z	Detector temperature of channel m is returned in z.z

12.4.11. **ADRU:** Pressures/ Valve voltage

Command	Response	Description
_ADRU_K0	_ADRU_s_z.z	Pressure in is responded
_ADRU_Km	_ADRU_s_z.z	EPC voltage of channel m is returned in z.z

12.4.12. **ADUF:** Flows

Command	Response	Description
_ADUF_K0	_ADUF_s_z.z_y.y_x.x	Sample gas flow of all channels is responded
_ADUF_Km	_ADUF_s_z.z	Sample gas flow of channel m is responded

12.4.13. **AGRD:** Polynom coefficients

Command	Response	Description
_AGRD_Km_Mn	_AGRD_s_Mn_a0_a1_a2_a3_a4	Polynomial coefficients of channel m range Mn are responded

12.4.14. **AANG:** Deviation from zero point after autocalibration

Command	Response	Description
_AANG_Km	_AANG_s_M1_z.z_da_dr _M2_z.z_da_dr _M3_z.z_da_dr _M4_z.z_da_dr	Verifying deviations from zero point after auto calibration. Values: measured value (z.z), absolute dev (da), relative dev (dr)

12.4.15. **AAEG:** Deviation from end point after autocalibration

Command	Response	Description
_AAEG_Km	_AANG_s_M1_z.z_da_dr _M2_z.z_da_dr _M3_z.z_da_dr _M4_z.z_da_dr	Verifying deviation from end point after auto calibration Values: measured value (z.z), absolute dev (da), relative dev (dr)

12.4.16. **AFDA:** Purge and Autocalibration times

Command	Response	Description
_AFDA_Km_SATK	_AFDA_s_z_y_x_w	Auto calibration times of channel m: z: Purge time y: Calibration time x: Total calibration time w: Verify time (z, y, x, w in seconds)
_AFDA_K0_SSPL	_AFDA_s_z	Purge time will be responded

12.4.17. **APAR:** Request Autocalibration tolerance values

Command	Response	Description
_APAR_Km_SATK	_APAR_s_z.z_y.y_x.x_w.w	Autocalibration tolerance value (%): z.z: Range 1 y.y: Range 2 x.x: Range 3 w.w: Range 4

12.4.18. **AKAL:** Deviations from calibration

Command	Response	Description
_AKAL_Km_	_AKAL_s_M1_z.z_y.y_x.x_w.w _M2_z.z_y.y_x.x_w.w _M3_z.z_y.y_x.x_w.w _M4_z.z_y.y_x.x_w.w	Deviation: z.z: Zero gas relative last calibration y.y: Zero gas factory calibration. x.x: Span gas relative last calibration. w.w: Span gas factory calibration

12.4.19. **ASYZ:** Respond System Time

Command	Response	Description
_ASYZ_K0_	_ASYZ_s_yymmdd_hhmmss	System time: yymmdd: year, month, day (each 2 characters wide, no spaces) hhmmss: hour, minute, second (each 2 characters wide, no spaces)

12.4.20. **AT90:** Respond Lowpass filter time

Command	Response	Description
_AT90_K0_	_AT90_s_t	Respond low pass filter time t=filter time in seconds

12.4.21. **ADAL:** Diagnostic alarm limits

Command	Response	Description
_ADAL_K0	_ADAL_s_a1.min_a1.max_... _a16.min_a16.max	All alarms limits are responded
_ADAL_K0_x	_ADAL_s_x.min_x.max	Alarm limits of x

Alarm Limits:

1	Sample gas flow channel 1	7	Temperature
2	Sample gas flow channel 2	8	Sample concentration channel 1
3	Sample gas flow channel 3	9	Sample concentration channel 2
4	External input 1	10	Sample concentration channel 3
5	External input 2	11-13	Temperature channel 1…3
6	Barometric -Pressure	14-16	EPC voltage channel 1…3

12.4.22. **ATCP:** Query TCP/IP settings

Command	Response	Description
_ATCP_K0	_ADAL_s_zzz.zzz.zzz.zzz _yyy.yyy.yyy.yyy _xxxx	zzz: TCP/IP Address yyy: TCP/IP subnet mask xxxx: TCP/IP port

12.4.23. **AVER:** Query Software version

Command	Response	Description
_AVER_K0	_AVER_s_3MAIN_z_3USER_y_OSMSR_x	z: Main version x.xxx.b_dd.mm.yyyy y: User version x.xxx.b_dd.mm.yyyy x: OSMSR version x.xxx_dd.mm.yyyy

12.4.24. **AH2O:** QueryH_2O correction parameter

Command	Response	Description
_AH2O_Km	_AH2O_s_z.z_y.y_x.x	z.z: Dry – voltage of A in with no water present y.y: 1st order coefficient x.x.: 2nd order coefficient

12.4.25. **ACO2:** Query CO_2 correction parameter

Command	Response	Description
_ACO2_Km	_ACO2_s_z.z_y.y_x.x_w.w	z.z: Offset – voltage of A in with no CO_2 present y.y: Min A in – if A in is below this value no CO_2 correction will be done. x.x: 1st order coefficient w.w.: 2nd order coefficient

12.4.26. **AUPD:** Query UDP data streaming parameter

Command	Response	Description
_AUDP_K0	_AUDP_s_<UDPPort>_<DataFrequeny>_[<Mode>]_[<UDP_IP>]	Port: port for open the UDP connection DataFrequency: Frequency for transmit the data in Hz Mode: A: ASCII Mode UDP_IP: Alternative IP address for open the UDP connection when it should not use the IP of connected TCP/IP client

12.5. Control commands

12.5.1. **SRES:** Reset

Command	Response	Description
_SRES_K0	_SRES_s	Reset

12.5.2. **SPAU:** Pause

Command	Response	Description
_SPAU_K0	_SPAU_s	Pause mode

12.5.3. **STBY:** Standby

Command	Response	Description
_STBY_K0	_STBY_s	Standby mode for all channels
_STBY_Km	_STBY_s	Standby mode for channel m

12.5.4. **SNGA:** Open valve for zero gas calibration

Command	Response	Description
_SNGA_K0	_SNGA_s	Open all three zero gas valves
_SNGA_Km	_SNGA_s	Open valve for zero gas calibration of actual measuring range
_SNGA_Km_Mn	_SNGA_s	Open valve for zero gas calibration of range Mn

12.5.5. **SEGA:** Open valve for end gas calibration

Command	Response	Description
_SEGA_K0	_SEGA_s	Open all three end gas valves
_SEGA_Km	_SEGA_s	Open valve for end gas calibration of actual measuring range
_SEGA_Km_Mn	_SEGA_s	Open valve for end gas calibration of range Mn

12.5.6. **SSPL:** Purge Analyzer with zero gas

Command	Response	Description
_SSPL_K0	_SSPL_s	Open zero gas valve and purge all channels

12.5.7. **SATK:** Start automatic calibration

Command	Response	Description
_SATK_Km	_SATK_s	Start automatic calibration with selected range of channel m
_SATK_Km_Mn	_SATK_s	Start automatic calibration for channel m, Range n

12.5.8. **SEMB:** Set measuring range

Command	Response	Description
_SEMB_Km_Mn	_SEMB_s	Set measuring range Auto range will be disabled

12.5.9. **SARE:** Auto range on

Command	Response	Description
_SARE_K0	_SARE_s	Set auto range on for all channels
_SARE_Km	_SARE_s	Set auto range on for channel m

12.5.10. **SARA:** Auto range off

Command	Response	Description
_SARA_K0	_SARA_s	Set auto range off for all channels
_SARA_Km	_SARE_s	Set auto range off

12.5.11. **SREM:** Remote mode for AK-commands

Command	Response	Description
_SREM_K0	_SREM_s	Set device in remote mode

12.5.12. **SMAN:** Manual control to control device manually

Command	Response	Description
_SMAN_K0	_SMAN_s	Set device in manual mode

12.5.13. **SMGA:** Start measuring

Command	Response	Description
_SMGA_K0	_SMGA_s	Start measuring Open all sample valves
_SMGA_Km	_SMGA_s	Open sample valve of channel m

12.5.14. **SNKA:** Saves measured value as new offset.

Command	Response	Description
_SNKA_K0	_SNKA_s	Saves measured value of actual range for each channel as new offset if zero valve is opened
_SNKA_Km	_SNKA_s	Saves measured value of actual range as new offset if zero valve is opened

12.5.15. **SEKA:** Saves measured value as new span value

Command	Response	Description
_SEKA_K0	_SEKA_s	Saves new span values for each channel if span valve is opened
_SEKA_Km	_SEKA_s	Saves measured value of actual range as new span value if span valve is opened

12.5.16. **SUDP:** Start /Stop UDP data streaming

Command	Response	Description
_SUDP_K0_ON	_SUDP_s	Start Data streaming via the UDP channel. You need to configure the channel before with EUDP command
_SUDP_K0_OFF	_SUDP_s	Stop streaming via the UDP channel

12.6. Settings

12.6.1. **EKAK:** The four span gas concentration values are set

Command	Response	Description
_EKAK_Km_M1_w.w_M2_x.x_M3_y.y_M4_z.z	_EKAK_s	Set end gas values for channel m

12.6.2. **EMBE:** The four measuring range end values are set

Command	Response	Description
_EMBE_Km_ M1_w.w_M2_x.x_M3_y.y_M4_z.z	_EMBE_s	Set range limits

12.6.3. **EMBU:** The upper and the lower range switchover for auto range are set

Command	Response	Description
_EMBU_Km_M1_w.w_W.W_M2_x.x_X.X_M3_y .y_Y.Y_M4_z.z_Z.Z	_EMBU_s	Set lower and upper range switchover limits

12.6.4. **EKEN:** Set new device identification and information

Command	Response	Description
_EKEN_K0_new device-name	_EKEN_s	Set new device identification Maximum length of device name is 40 characters

NOTE: To change device identification, you must first rename the device to "RESET". Now a name up to 40 characters can be given.

NOTE: The device name must not have any blanks between characters, e.g. "CAI CLD" is not allowed. You can use underscores, e.g.. "CAI_CLD".

12.6.5. **EGRD:** Set polynom coefficients

Command	Response	Description
_EGRD_Km_Mn_a0_a1_a2_a3_a4	_EGRD_s	Set polynomial coefficients of range Mn on channel m

12.6.6. **EFDA:** Set autocalibration and purge times

Command	Response	Description
_EFDA_Km_SATK_z_y_x_w	_EFDA_s	Set auto cal. times for channel m: z: Purge time y: Calibration time x: Total calibration time w: Verify time (z, y, x, w in seconds)
_EFDA_K0_SSPL_z	_EFDA_s	Set analyzer purge time to z seconds

12.6.7. **EPAR:** Set autocalibration tolerance values

Command	Response	Description
_EPAR_Km_SATK_z.z_y.y_x.x_w.w	_EPAR_s	Autocalibration tolerance value (%): z.z= Range 1 y.y= Range 2 x.x= Range 3 w.w= Range 4

12.6.8. **ESYZ:** Set System Time

Command	Response	Description
_ESYZ_K0_yymmdd_hhmmss	_ESYA_s	Set system time: yymmdd: year, month, day (each 2 characters wide, no spaces) hhmmss: hour, minutes, seconds (each 2 characters, no spaces)

12.6.9. **ET90:** Set Lowpass Filter Time

Command	Response	Description
_ET90_K0_t	_ET90_s	Set lowpass filter time: t= filter time in seconds

12.6.10. **EDAL:** Diagnostic alarm limits

Command	Response	Description
_EDAL_K0_a1.min_a1.mas_..._a12max	_EDAL_s	Set all alarm limits
_EDAL_K0_x_x.min_xmax	_EDAL_s	Set alarm limits of x

Alarm Limits:

1	Flow of channel 1	7	Temperature
2	Flow of channel 2	8	Sample concentration channel 1
3	Flow of channel 3	9	Sample concentration channel 2
4	External analog in 1	10	Sample concentration channel 3
5	External analog in 2	11-13	Temperature alarm limits channel 1…3
6	Pressure	14-16	EPC voltage alarm limits channel 1…3

12.6.11. **ETCP:** Set TCP/IP Parameters

Command	Response	Description
_ETCP_K0_zzz.zzz.zzz.zzz _yyy.yyy.yyy.yyy _xxxx	_EDAL_s	zzz= TCP/IP address yyy= TCP/IP subnet mask xxxx= TCP/IP port All changes take effect after next power on cycle

12.6.12. **EH2O** Set H_2O correction parameters

Command	Response	Description
_EH2O_Km_z.z_y.y_x.x	_EH2O_s	z.z: dry y.y: 1st order coefficient x.x: 2nd order coefficient

12.6.13. **ECO2** Set CO_2 correction parameters

Command	Response	Description
_EH2O_Km_z.z_y.y_x.x	_EH2O_s	z.z: dry y.y: 1st order coefficient x.x: 2nd order coefficient

12.6.14. **EUDP** Set UDP Data streaming parameters

Command	Response	Description
_EUDP_K0_<UDPPort>_<DataFrequeny>_[<Mode>]_[<UDP_IP>]	_EUDP_s	Configure an UDP channel for data streaming of the measuring values via Ethernet UDP. Port: port for open the UDP connection DataFrequency: Frequency for transmit the data in Hz Mode: A: ASCII Mode (optional) UDP_IP: Alternative IP address for open the UDP connection when it should not use the IP of connected TCP/IP client (optional)

12.6.15. Format of the streaming Data via UDP:

ASCII Mode:

The measuring values will be sent with ASCII signs. The format is:

<Sequence number>_x.x_y.y_z.z

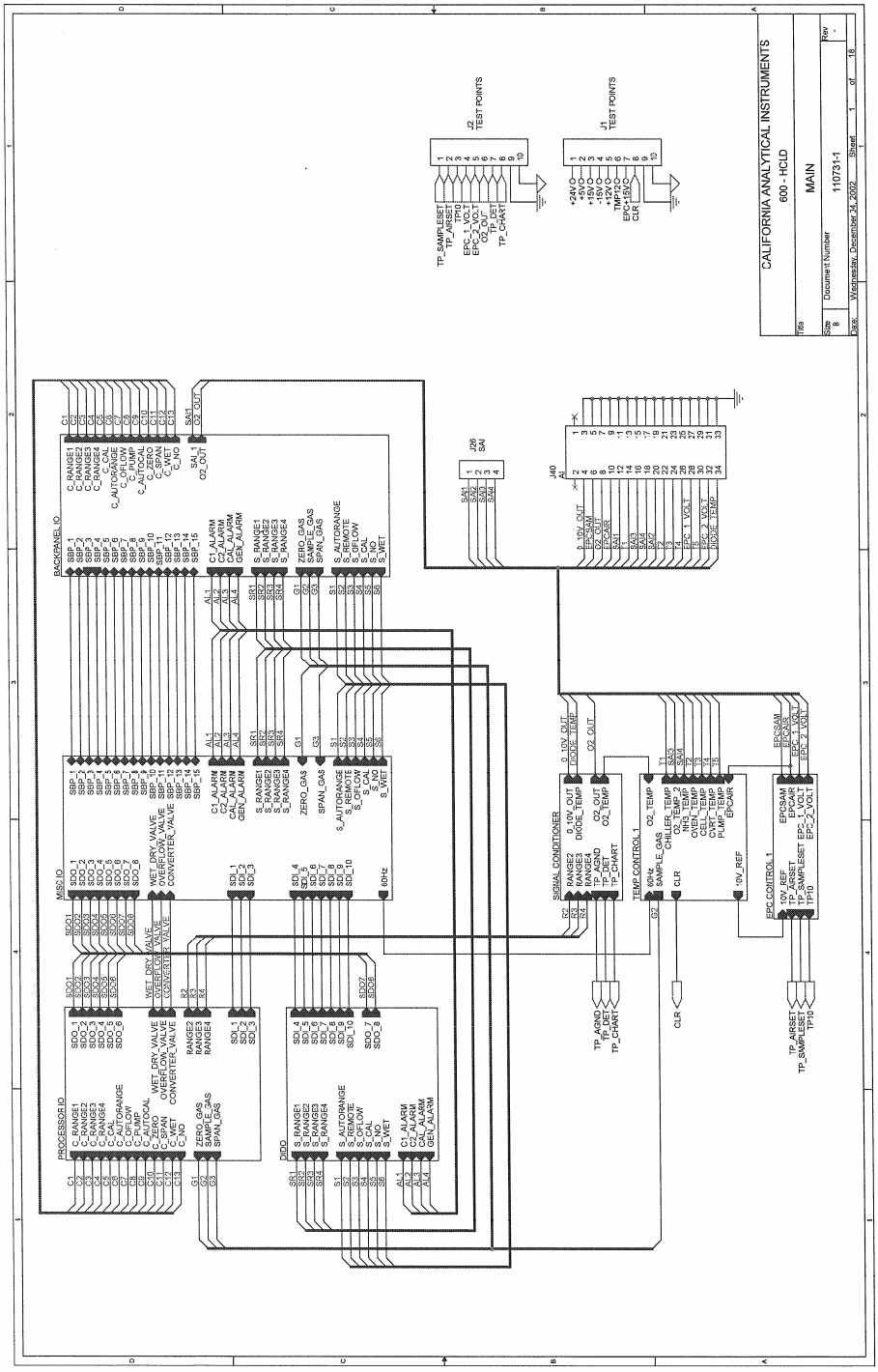
The sequence number will be incremented with every data packet, which is sent.

The measuring values x.x, y.y and z.z will be sent like in AKON K0 telegram

12.7. Abbreviations used

Km	: K' + channel Number (→K1….K3
Mn	: Measuring range number
M1 .. M4	: Measuring Range 1 .. 4
w.w..zz	: Numerical value
W.W…Z.Z	: Numerical value
T	: Numeric integer value
x	: Number
a0 .. a4	: Polynomial coefficients
s	: Status

13. Appendix Electrical Block Diagram



AK-Protocol

CAI – NDIR-Analyzer

Version 1.7 01.10.2004
Program Version: 3Main.mpa 1.025

Title: AK-Protocol specification for CAI-NDIR analyzer	
Project: CAI	
PEUS Systems GmbH Grabener Str. 19, 76646 Bruchsal, GER Postfach 21 09, 76611 Bruchsal, GER T: + +49-7251-7118 - 0 F: + +49-7251-7118 - 99	**Confidential Level: PEUS customer** **Division: (MAT Software, MAT Hardware,...)**

Author: **Michael Speck**	**Checked by**	**Approved by**
Date: August 21, 2001	**Date**	**Date**
Signature: MSp	**Signature:**	**Signature:**

Version	Release Date	Changed Sections	Reason of Change
1.0	xx/xx/xxxx		First public release
1.1	xx/xx/xxxx		New features implemented
1.2	11/22/2002	Chapter 1 2.1.7 ASTF Error status	Added chapter 1 Additional errors
1.3	11/26/2003	2.1.7 ASTF Error status 2.1.10 ATEM 2.1.11 ADRU 2.1.21 ADAL 2.1.24 AVER 2.1.25 AH2O 2.1.26 ACO2 2.1.27 AUDP 2.2.16 SUDP 2.3.11 EDAL 2.3.13 EH20 2.3.14 ECO2 2.3.15 EUDP	Additional errors Added new temperatures Added new EPC voltages Additional alarm limits New: Version numbers New: Query H_2O parameter New: Query CO_2 parameter New: Query UDP streaming New: UDP on/off Added new alarm limits New: Set H_2O parameter New: Set CO_2 parameter New: Set UDP streaming
1.4	01/13/2004	2.3.11 EDAL 2.3.15 EUDP	Changed functionality Parameter change
1.5	03/19/2004	2.1.28 ARAW 2.1.29 AGRW 2.2.17 SFGR 2.3.16 EGRW	New command New command New command New command
1.6	06/25/2004	2.1.10 ATEM 2.1.11 ADRU 2.1.27 AUDP	changed format changed format changed format
1.7	10/01/2004	2.1.25 AH2O 2.1.26 ACO2	Changed format Changed format

Addressee	Return Until	Expected Problems	

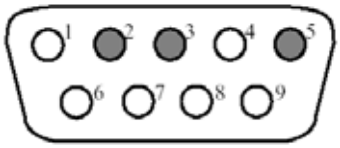
Table of contents

1 Communication Master Computer / Analyzer

The communication between master computer and analyzer is accomplished via serial interface. The data transmission as well as starting or ending functions is exclusively performed at command of the master computer. The master sends an instruction telegram and the driver's aid answers with an acknowledgment telegram. The protocol, which is to be kept necessarily, has been implemented according to the standards of the „Standardisierung Abgasmesstechnik“ (association of the German automobile industry). In the following, this protocol is briefly called AK protocol.

1.1 Interface Specifications

The serial interface is a RS 232C (V24) interface. At the back of the analyzer, a 9-pin D-sub female connector (see Figure 1-1) serves for connecting a master computer.



Pin number	Signal name
2	RxD (input)
3	TxD (output)
5	GND

Figure 1-1: Front view serial interface

Type	RS232
Speed	9600 bps
Character length	1 start bit
	8 data bits
	1 stop bit
Parity	none
Handshake	no

Table 1-1: Interface Specifications

1.2 Protocol Description

1.2.1 Instruction Telegram

	Character	Explanation
1st Byte	STX	ASCII code 02
2nd Byte	DON´T CARE	any ASCII code
3rd Byte	FUNCTION CODE 1	AK instruction e.g.: ASTF
4th Byte	FUNCTION CODE 2	
5th Byte	FUNCTION CODE 3	
6th Byte	FUNCTION CODE 4	
7th Byte	BLANK	
8th Byte	K	
9th Byte	0	channel number
10th Byte	BLANK	
	D	AK instruction parameters, length is variable
	A	
	T	
	A	
nth Byte	ETX	ASCII code 03

Table 1-2: Structure of an instruction telegram

1.2.2 Acknowledgment Telegram

	Character	Explanation
1st Byte	STX	ASCII code 02
2nd Byte	DON´T CARE	any ASCII code
3rd Byte	FUNCTION CODE 1	Echo of the AK command
4th Byte	FUNCTION CODE 2	
5th Byte	FUNCTION CODE 3	
6th Byte	FUNCTION CODE 4	
7th Byte	BLANK	
8th Byte	ERROR STATUS	error status byte
9th Byte	BLANK	
	D	AK acknowledgement parameters, length is variable
	A	
	T	
	A	
nth Byte	ETX	ASCII code 03

Table 1-3: Structure of an acknowledgment telegram

1.2.3 Data Description

Each telegram begins with **STX** (**S**tart of **Te**x**t**) in the fist byte. The “don't care” byte can be any ASCII character. Generally, a blank or an underscore (_) is used for readability reasons. The four function bytes represent the AK command. A blank comes next, followed by **K** and the channel number. The

analyzer is a single-channel device, and because of that the channel number is almost always **0**. For delimiting the command parameters from the channel number another blank follows. This may be followed by command parameters with a variable length. Every telegram ends with the **ETX** (**E**nd of **T**e**x**t) character.

The error status byte in the acknowledgment telegram signals if internal errors in the analyzer occurred. It is zero when no error appeared, and it is unequal zero when one or more errors occurred. Every time a change in the errors happened the error status byte is incremented by one, no matter if one or several errors disappeared or were added. If it had the value 10 it would be reset to 1. The error status byte does not indicate the real number of errors. If the analyzer does not have errors, the error status byte contains the value 0.

In general, AK commands are subdivided into three classes:

- Control commands (**S**xxx)
- Inquiry commands (**A**xxx)
- Configuration commands (**E**xxx)

1.2.4 Error Handling

It might happen that an unknown instruction is sent, that the analyzer is busy with a function which is not the desired one, or that an error occurred in the command parameters. Table 1-4 summarizes all errors that can appear upon any master instruction.

Analyzers Acknowledgment	Explanation
???? f[1]	Analyzer does not know the instruction sent.
xxxx[2] f BS	Analyzer is busy with another function.
xxxx f SE	Syntax error within command parameters or incomplete command.
xxxx f NA	Requested function or data are not available.
xxxx f DF	Data error: The kind or number of given parameters are not valid.
xxxx f OF	Offline: Analyzer is offline, i.e. analyzer is in local mode. Only inquiry commands and SREM (set analyzer in remote mode) are allowed.

Table 1-4: Acknowledgment telegram in case of error

[1] f stands for the error status byte

[2] xxxx stands for the function code of the sent master command

2 AK-Commands

2.1 Scans

2.1.1 AKON: Measured concentration value

Command	Response	Description
_AKON_K0	_AKON_s_z.z_z.z_z.z_t	Measured concentration value of all channels is responded t = Timestamp (1/10 sec)
_AKON_Km	_AKON_s_z.z_t	Measured concentration value of channel m is responded t = Timestamp (1/10 sec)

2.1.2 AEMB: Get measuring range

Command	Response	Description
_AEMB_K0	_AEMB_s_Mn_Mn_Mn	Current measuring range of all channels is responded
_AEMB_Km	_AKON_s_Mn	Current measuring range of channel m is responded

2.1.3 AMBE: Measuring range limit

Command	Response	Description
_AMBE_Km	_AMBE_s_M1_w.w _M2_x.x _M3_y.y _M4_z.z	All existing measuring range limits of channel m are responded
_AMBE_Km_Mn	_AMBE_s_Mn_z.z	Range limit of Range Mn of channel m is responded

2.1.4 AKAK: Calibration gas concentrations

Command	Response	Description
_AKAK_Km	_AKAK_s_M1_w.w _M2_x.x _M3_y.y _M4_z.z	All existing calibration gas values are responded for selected channel m
_AKAK_Km_Mn	_AKAK_s_Mn_z.z	For selected channel m calibration gas value of Range Mn is responded

2.1.5 AMBU: Upper and lower range switchover values for auto range

Command	Response	Description
_AMBU_Km	_AMBU_s_M1_w.w_W.W _M2_x.x_X.X _M3_y.y_Y.Y _M4_z.z_Z.Z	Lower and upper range switchover value of auto range are responded for channel m
_AMBU_Km_Mn	_AMBU_s_Mn_w.w_W.W	Lower and upper range switchover value of auto range are responded for channel m range n

2.1.6 ASTZ: Normal device status

Command	Response	Description
_ASTZ_K0	_ASTZ_s_K1_State1_State2_State3 _K2_State1_State2_State3 _K3_State1_State2_State3	Respond device status for all channels
_ASTZ_Km	_ASTZ_s_State1_State2_State3	Respond device status only for channel m

Possible states:

State1	**State2**		**State3**
SREM: remote	STBY:	standby	SARE: auto range on
SMAN: manual	SPAU:	pause	SARA: auto range off
	SMGA:	measuring gas	
	SNGA:	zero gas	
	SEGA:	end gas	
	SATK SNGA:	zero gas during auto cal	
	SATK SEGA:	end gas during auto cal	

2.1.7 ASTF: Error status

Command	Response	Description
_ASTF_K0	_ASTF_s_f1_f2_f3_…_f10	Current error numbers of all are responded

Errors:

1	Channel 1 Flow Failure
2	Channel 2 Flow Failure
3	Channel 3 Flow Failure
4	External Analog 1 Failure
5	External Analog 2 Failure
6	Pressure Failure
7	Temperature Failure
8	Channel 1 not calibrated
9	Channel 2 not calibrated
10	Channel 3 not calibrated
11…13	Ch1…3: Low concentration warning
14…16	Ch1…3: High concentration warning
17…19	Ch1…3: Temperature failure
20…22	Ch1…3: EPC Voltage failure

2.1.8 AKEN: Device identification and information

Command	Response	Description
_AKEN_K0	_AKEN_s_devicename	Device identification is responded
_AKEN_K1	_AKEN_s_model	Device model
_AKEN_K2	_AKEN_s_serialno	Device serial number
_AKEN_K3	_AKEN_s_samplepressure	Suggested input sample pressure

2.1.9 ARMU: Raw value

Command	Response	Description
_ARMU_K0	_ARMU_s_z.z_y.y_x.x_t	Raw value before linearization and offset-span-correction is responded for all channels t = Timestamp (1/10 sec)
_ARMU_Km	_ARMU_s_z.z_t	Raw value before linearization and offset-span-correction is responded for channel m t = Timestamp (1/10 sec)

2.1.10 ATEM: Temperature

Command	Response	Description
_ATEM_K0	_ATEM_s_z.z_y.y_x.x_w.w	z.z: Device temperature y.y: Detector 1 Temperature x.x: Detector 2 Temperature w.w: Detector 3 Temperature All Temperatures in degrees Celsius
_ATEM_Km	_ATEM_s_z.z	Detector temperature of channel m is returned in z.z

2.1.11 ADRU: Pressure / Valve voltage

Command	Response	Description
_ADRU_K0	_ADRU_s_z.z_y.y_x.x_w.w	z.z: Environment-Pressure y.y: Sample Pressure 1 x.x: Sample Pressure 2 w.w: Sample Pressure 3
_ADRU_Km	_ADRU_s_z.z	EPC voltage of channel m is returned in z.z

2.1.12 ADUF: Flows

Command	Response	Description
_ADUF_K0	_ADUF_s_z.z_y.y_x.x	Sample gas flow of all channels is responded
_ADUF_Km	_ADUF_s_z.z	Sample gas flow of channel m is

		responded

2.1.13 AGRD: Polynomial coefficients

Command	Response	Description
_AGRD_Km_Mn	_AGRD_s_Mn_a0_a1_a2_a3_a4	Polynomial coefficients of channel m range Mn are responded

2.1.14 AFGR: Factory set polynomial coefficients (calibration defaults) NOT FOR CUTOMERS!

Command	Response	Description
_AFGR_Km_Mn	_AFGR_s_Mn_a0_a1_a2_a3_a4	Factory default polynomial coefficients of channel m range n are responded

2.1.15 AANG: Deviation from zero point after auto calibration

Command	Response	Description
_AANG_Km	_AANG_s_M1_z.z_da_dr _M2_z.z_da_dr _M3_z.z_da_dr _M4_z.z_da_dr	Verifying deviations from zero point after auto calibration. Values: measured value (z.z), absolute dev (da), relative dev (dr)

2.1.16 AAEG: Deviation from end point after auto calibration

Command	Response	Description
_AAEG_Km	_AANG_s_M1_z.z_da_dr _M2_z.z_da_dr _M3_z.z_da_dr _M4_z.z_da_dr	Verifying deviation from end point after auto calibration Values: measured value (z.z), absolute dev (da), relative dev (dr)

2.1.17 AFDA: Purge and auto calibration times

Command	Response	Description
_AFDA_Km_SATK	_AFDA_s_z_y_x_w	Auto calibration times of channel m: z: Purge time y: Calibration time x: Total calibration time w: Verify time (z, y, x, w in seconds)
_AFDA_K0_SSPL	_AFDA_s_z	Purge time will be responded

2.1.18 APAR: Request auto calibration tolerance values

Command	Response	Description
_APAR_Km_SATK	_APAR_s_z.z_y.y_x.x_w.w	Auto calibration Tolerance value [%]: z.z: Range 1

	y.y: Range 2 x.x: Range 3 w.w: Range 4

2.1.19 AKAL: Deviation from end point after auto calibration

Command	Response	Description
_AKAL_Km	_AKAL_s_M1_z.z_y.y_x.x_w.w _M2_z.z_y.y_x.x_w.w _M3_z.z_y.y_x.x_w.w _M4_z.z_y.y_x.x_w.w	Deviation: z.z: Zero gas relative last calib. y.y: Zero gas factory calib. x.x: Span gas relative last calib. w.w: Span gas factory calib.

2.1.20 ASYZ: System time

Command	Response	Description
_ASYZ_K0	_ASYZ_s_yymmdd_hhmmss	System time: yymmdd: year, month, day (each 2 characters wide, no spaces) hhmmss: hour, minute, second (each 2 characters wide, no spaces)

2.1.21 AT90: Low pass Filter time

Command	Response	Description
_AT90_K0	_AT90_s_t	Respond low pass filter time. t: filer time constant in seconds

2.1.22 ADAL: Diagnostic alarm limits

Command	Response	Description
_ADAL_K0	_ADAL_s_a1.min_a1.max_... _a16.min_a16.max	All alarm limits are responded
_ADAL_K0_x	_ADAL_s_x.min_x.max	Alarm limits of x

Alarm Limits:

1	Sample gas flow channel 1
2	Sample gas flow channel 2
3	Sample gas flow channel 3
4	External input 1
5	External input 2
6	Baro-Pressure
7	Temperature
8	Sample concentration channel 1
9	Sample concentration channel 2
10	Sample concentration channel 3
11…13	Temperature channel 1…3
14…16	EPC voltage channel 1…3

2.1.23 ATCP: Query TCP/IP settings

Command	Response	Description
_ATCP_K0	_ADAL_s_zzz.zzz.zzz.zzz _yyy.yyy.yyy.yyy _xxxx	zzz: TCP/IP address yyy: TCP/IP subnet mask xxxx: TCP/IP port

2.1.24 AVER: Query software version

Command	Response	Description
_AVER_K0	_AVER_s_3MAIN_z_3USER_y_OSMSR_x	z: Main version x.xxx.b_dd.mm.yyyy y: User version x.xxx.b_dd.mm.yyyy x: OSMSR version x.xxx_dd.mm.yyyy

2.1.25 AH2O: Query H_2O correction parameter

Command	Response	Description
_AH2O_Km	_AH2O_s_Ext2_z.z_y.y_x.x	Ext2: Voltage at External 2 analog input z.z: Dry – voltage of Ain with no water present y.y: 1st order coefficient x.x.: 2nd order coefficient

2.1.26 ACO2: Query CO_2 correction parameter

Command	Response	Description
_ACO2_Km	_ACO2_s_Ext1_z.z_y.y_x.x_w.w	Ext1: Voltage at External 1 analog input z.z: Offset – voltage of Ain with no CO_2 present y.y: Min Ain – if Ain is below this value no CO_2 correction will be done. x.x: 1st order coefficient w.w.: 2nd order coefficient

2.1.27 AUDP: Query UDP data streaming parameter

Command	Response	Description
_AUDP_K0	_AUDP_s_<UDPPort>_<DataFrequeny>_[<Mode>]_[<UDP_IP>]_[Data]_[On/Off]	Port: port for open the UDP connection DataFrequency: Frequency for transmit the data in Hz Mode: A: ASCII Mode UDP_IP: Alternative IP address for open the UDP connection when it should not use the IP of connected TCP/IP client. Data: AK commands that will be streamed over UDP On/Off: 0 – UDP streaming is off 1 – UDP streaming is on

2.1.28 ARAW: Raw detector volts

Command	Response	Description
_ARAW_K0	_ARAW_s_z.z_y.y_x.x_t	z.z: Raw detector volts – channel 1 y.y: Raw detector volts – channel 2 x.x: Raw detector volts – channel 3 t: Timestamp
_ARAW_Km	_ARAW_s_z.z_t	z.z: Raw detector volts – channel m t: Timestamp

2.1.29 AGRW: Request maximum allowed absolute/relative deviations

Command	Response	Description
_AGRW_Km_Mn	_AGRW_s_z.z_y.y	Allowed deviations of range n [%]: z.z : absolute y.y : relative Channel m

2.2 Control commands

2.2.1 SRES: Reset

Command	Response	Description
_SRES_K0	_SRES_s	Reset

2.2.2 SPAU: Pause

Command	Response	Description
_SPAU_K0	_SPAU_s	Pause mode

2.2.3 STBY: Standby

Command	Response	Description
_STBY_K0	_STBY_s	Standby mode for all channels
_STBY_Km	_STBY_s	Standby mode for channel m

2.2.4 SNGA: Open valve for zero gas calibration

Command	Response	Description
_SNGA_K0	_SNGA_s	Open all three zero gas valves
_SNGA_Km	_SNGA_s	Open valve for zero gas calibration of actual measuring range
_SNGA_Km_Mn	_SNGA_s	Open valve for zero gas calibration of range Mn

2.2.5 SEGA: Open valve for end gas calibration

Command	Response	Description
_SEGA_K0	_SEGA_s	Open all three end gas valves
_SEGA_Km	_SEGA_s	Open valve for end gas calibration of actual measuring range
_SEGA_Km_Mn	_SEGA_s	Open valve for end gas calibration of range Mn

2.2.6 SSPL: Purge Analyzer with zero gas

Command	Response	Description
_SSPL_K0	_SSPL_s	Open zero gas valve and purge all channels

2.2.7 SATK: Start automatic calibration

Command	Response	Description
_SATK_Km	_SATK_s	Start automatic calibration with selected range of channel m
_SATK_Km_Mn	_SATK_s	Start automatic calibration for channel m, Range n

2.2.8 SEMB: Set measuring range

Command	Response	Description
_SEMB_Km_Mn	_SEMB_s	Set measuring range Auto range will be disabled

2.2.9 SARE: Auto range on

Command	Response	Description
_SARE_K0	_SARE_s	Set auto range on for all channels
_SARE_Km	_SARE_s	Set auto range on for channel m

2.2.10 SARA: Auto range off

Command	Response	Description
_SARA_K0	_SARA_s	Set auto range off for all channels
_SARA_Km	_SARA_s	Set auto range off

2.2.11 SREM: Remote mode for AK-commands

Command	Response	Description
_SREM_K0	_SREM_s	Set device in remote mode

2.2.12 SMAN: Manual control to control device manually

Command	Response	Description
_SMAN_K0	_SMAN_s	Set device in manual mode

2.2.13 SMGA: Start measuring

Command	Response	Description
_SMGA_K0	_SMGA_s	Start measuring Open all sample valves
_SMGA_Km	_SMGA_s	Open sample valve of channel m

2.2.14 SNKA: Saves measured value as new offset.

Command	Response	Description
_SNKA_K0	_SNKA_s	Saves measured value of actual range for each channel as new offset if zero valve is opened
_SNKA_Km	_SNKA_s	Saves measured value of actual range as new offset if zero valve is opened

2.2.15 SEKA: Saves measured value as new span value

Command	Response	Description
_SEKA_K0	_SEKA_s	Saves new span values for each channel if span valve is opened
_SEKA_Km	_SEKA_s	Saves measured value of actual range as new span value if span valve is opened

2.2.16 SUDP: Start / Stop UDP data streaming

Command	Response	Description
_SUDP_K0_ON	_SUDP_s	Start Data streaming via the UDP channel. You need to configure the channel before with EUDP command
_SUDP_K0_OFF	_SUDP_s	Stop streaming via the UDP channel

2.2.17 SFGR: Reset calibration settings to factory default

Command	Response	Description
_SFGR_Km	_SFGR_s	Reset calibration settings of channel m to their factory default settings.

2.3 Settings

2.3.1 EKAK: The four span gas concentration values are set

Command	Response	Description
_EKAK_Km_M1_w.w_M2_x.x_M3_y.y_M4_z.z	_EKAK_s	Set end gas values for channel m

2.3.2 EMBE: The four measuring range end values are set

Command	Response	Description
_EMBE_Km_M1_w.w_M2_x.x_M3_y.y_M4_z.z	_EMBE_s	Set range limits

2.3.3 EMBU: The upper and lower range switchover for auto range are set

Command	Response	Description
_EMBU_Km_M1_w.w_W.W_M2_x.x_X.X_M3_y.y_Y.Y_M4_z.z_Z.Z	_EMBU_s	Set lower and upper range switchover limits

2.3.4 EKEN: Set device identification and information

Command	Response	Description
_EKEN_K0_new device-name	_EKEN_s	Set new device identification Maximum length of device name are 40 characters

To change device identification, you must first rename the device to “RESET”.
Now a name up to 40 letters can be given.
Note: The device name must not have any blanks between, e.g. “CAI CLD” is not allowed. You can use underscore instead, e.g. “CAI_CLD”.

2.3.5 EGRD: Set polynomial coefficients

Command	Response	Description
_EGRD_Km_Mn_a0_a1_a2_a3_a4	_EGRD_s	Set polynomial coefficients of range Mn on channel m

2.3.6 EFGR: Set factory polynomial coefficients (calibration defaults) NOT FOR CUSTOMERS!

Command	Response	Description
_EFGR_Km_Mn_a0_a1_a2_a3_a4	_EFGR_s	Set FACTORY polynomial coefficients of range n on channel m

2.3.7 EFDA: Set auto calibration and purge time

Command	Response	Description
_EFDA_Km_SATK_z_y_x_w	_EFDA_s	Set auto cal. times for channel m: z: Purge time y: Calibration time x: Total calibration time w: Verify time (z, y, x, w in seconds)
_EFDA_K0_SSPL_z	_EFDA_s	Set analyzer purge time to z sec.

2.3.8 EPAR: Set auto calibration tolerance values

Command	Response	Description
_EPAR_Km_SATK_z.z_y.y_x.x_w.w	_EPAR_s	Autocalibration tolerance value [%]: z.z:Range 1 y.y:Range 2 x.x:Range 3 w.w:Range 4

2.3.9 ESYZ: Set system time

Command	Response	Description
_ESYZ_K0_yymmdd_hhmmss	_ESYZ_s	Set system time: yymmdd: year, month, day (each 2 characters wide, no spaces) hhmmss: hour, minutes, seconds (each 2 characters, no spaces)

2.3.10 ET90: Set low pass filter time

Command	Response	Description
_ET90_K0_t	_ET90_s	Set low pass filter time: t: filter time constant in seconds

2.3.11 EDAL: Set diagnostic alarm limits

Command	Response	Description
_EDAL_K0_x_x.min_x.max	_EDAL_s	Set alarm limits of x

Alarm Limits:

1	Flow of channel 1
2	Flow of channel 2
3	Flow of channel 3
4	External analog in 1
5	External analog in 2
6	Pressure
7	Temperature
8	Sample concentration channel 1
9	Sample concentration channel 2
10	Sample concentration channel 3
11…13	Temperature alarm limits (channel 1…3)
14…16	EPC voltage alarm limits (channel 1…3)

2.3.12 ETCP: Set TCP/IP parameters

Command	Response	Description
_ETCP_K0_zzz.zzz.zzz.zzz _yyy.yyy.yyy.yyy _xxxx	_EDAL_s	zzz: TCP/IP address yyy: TCP/IP subnet mask xxxx: TCP/IP port All changes take effect after next power on cycle

2.3.13 EH2O: Set H2O correction parameters

Command	Response	Description
_EH2O_Km_z.z_y.y_x.x	_EH2O_s	z.z: dry y.y: 1st order coefficient x.x: 2nd order coefficient

2.3.14 ECO2: Set CO2 correction parameters

Command	Response	Description
_ECO2_Km_z.z_y.y_x.x_w.w	_ECO2_s	z.z: Offset y.y: MinAin x.x: 1st order coefficient w.w: 2nd order coefficient

2.3.15 EUDP: Set UDP Data streaming parameters

Command	Response	Description
_EUDP_K0_<UDPPort>_<DataFrequeny>_[<Mode>]_[<UDP_IP>]_[DATA]	_EUDP_s	Configure an UDP channel for data streaming of the measuring values via Ethernet UDP. Port: port for open the UDP connection DataFrequency: Frequency for transmit the data in Hz Mode: A: ASCII Mode (optional) UDP_IP: Alternative IP address for open the UDP connection when it should not use the IP of connected TCP/IP client (optional). DATA: See description below (optional)

DATA format:

DATA is any number of AK commands delimited by a semicolon (;). Replace spaces in the AK command with a underscore (_).
If data is given UDP_IP has to be set to a legal IP address or a hyphen (-) if default address should be used.
If DATA is omitted, “AKON K0” is used as default streaming data.

Format of the streaming Data via UDP:

ASCII Mode:
The measuring values will be sent with ASCII signs. The format is:
<Sequence number> <data>

The sequence number will be incremented with every data packet, which is sent.
<data> is the AK four character code followed by the answer. See corresponding AK command description.

Example:

Sending “EUDP K0 7001 2 A – AKON_K0;ADUF_K0” will give following streaming result:
“123 AKON 4.07 901.33 22.50 3481639460 ADUF 4.30 4.59 4.45”, where 123 is the sequence number.

2.3.16 EGRW: Set maximum allowed absolute/relative deviations

Command	Response	Description
_EGRW_Km_Mn_z.z_y.y	_EGRW_s	Allowed deviations for range n [%]: z.z : absoulte y.y : relative Channel m

2.4 Abbreviations

Km	: 'K' + channel number (→K1 .. K3)
Mn	: Measuring range number
M1 .. M4	: Measuring Range 1 .. 4
w.w .. z.z.	: Numerical value
W.W .. Z.Z.	: Numerical value
T	: Numeric integer value
x	: Number
a0 .. a4	: Polynomial coefficients
s	: Status