Reference Manual
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NGA2000 Reference

ROSEMOUNT
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Process Management

ESSENTIAL INSTRUCTIONS

READ THIS PAGE BEFORE PROCEEDING!

Rosemount Analytical designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you **MUST properly install, use, and maintain them** to ensure they continue to operate within their normal specifications. The following instructions **MUST be adhered to** and integrated into your safety program when installing, using, and maintaining Rosemount Analytical products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- **Read all instructions** prior to installing, operating, and servicing the product.
- If you do not understand any of the instructions, **contact your Rosemount Analytical representative** for clarification.
- **Follow all warnings, cautions, and instructions** marked on and supplied with the product.
- **Inform and educate your personnel in the proper installation, operation, and maintenance of the product**.
- **Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes**. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, **use qualified personnel** to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Rosemount. Unauthorized parts and procedures can affect the product's performance, place the safe operation of your process at risk, **and VOID YOUR WARRANTY**. Look-alike substitutions may result in fire, electrical hazards, or improper operation.
- **Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury**.

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

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PREFACE

INTENDED USE STATEMENT

This is a reference manual for the NGA series of analyzers. It contains in depth discussion of the various features and operational elements of the analyzers, together with information about their use with computers. It is not intended to be a stand-alone document, but should be combined with the individual analyzer and platform manuals.

A major part of this manual is the description of the NGA variables. These are the names of the packets of information that are communicated over the NGA digital communication network, and are available for external access. It is vital that no attempt be made to directly affect their values without a complete understanding of the results of doing so. Serious damage to the analyzers may result from incorrect assignments.

DEFINITIONS

The following definitions apply to DANGERS, WARNINGS, CAUTIONS and NOTES found throughout this publication.

DANGER

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

WARNING

Highlights an operation or maintenance procedure, practice, condition, statement, etc. If not strictly observed, could result in injury, death, or long-term health hazards of personnel.

CAUTION

Highlights an operation or maintenance procedure, practice, condition, statement, etc. If not strictly observed, could result in damage to or destruction of equipment, or loss of effectiveness.

NOTE

Highlights an essential operating procedure, condition or statement.

SAFETY SUMMARY

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

DANGER

ELECTRICAL SHOCK HAZARD

Operate this equipment only when covers are secured. Servicing requires access to live parts which can cause death or serious injury. Refer servicing to qualified personnel.

For safety and proper performance, this module must be connected to a properly grounded three-wire source of electrical power.

DANGER

POSSIBLE EXPLOSION HAZARD

This equipment may contain modules used in the analysis of sample gases which may be flammable. If used for analysis of such gases, the module must be protected by a continuous dilution purge system in accordance with Standard ANSI/NFPA 496-1993, Chapter 6.

WARNING

HAND INJURY HAZARD

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

WARNING

PARTS INTEGRITY

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

GLOSSARY OF TERMS

AK

A European automotive protocol that runs on RS232 or RS485.

Analog I/O Module

A self contained computer that uses the Echelon Neuron chip as its processor. It gets data from the network, and it performs the necessary calculations to produce the analog output and the relay indications.

Analyzer Module

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

Backplane

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

Bind

The process of connecting various variables in the analyzer module with equivalent variables in the I/O modules

Calibrate

In ICEE monitoring, to zero, span and linearize an analyzer. In other industries, to zero and span an analyzer.

CLD

Chemiluminesense Detector Analyzer module

Control Module

The Operator Interface plus the Controller Board.

Controller Board

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

DDE

Dynamic Data Exchange - a Microsoft Windows function that allows programs to talk to other programs.

DDE Server

Rosemount Analytical NGA2000 PC Interface Suite, consisting of software and hardware elements that allow communication between NGA2000 components and a personal computer (PC).

DIO

Digital Input/Output board, a special I/O Module that works with the Platform to provide many digital I/O lines.

Distribution Assembly

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

Echelon

Echelon Corporation.

Enumerated

An integer number whose value corresponds to a phrase. These are used to express one of several possibilities.

Expansion Module

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

Expert

Refers to the controls and configuration capability appropriate for engineering personnel.

Failure

A form of alarm: Failure indicates an unrecoverable hardware or software failure such as some component not responding to network communications or a safety related failure such as lack of purge air in a FID module.

FID

Flame Ionization Detector Analyzer module.

Floating point

A four byte IEEE floating point number (in Motorola format). This is a number that can take a very wide range of values, but provides only about seven digits of precision. The analyzer main reading is expressed as a floating point number. There can be up to 7 floating point variables in an array.

Health

Alarm status.

HFID

Heated Flame Ionization Detector Analyzer module.

I/O Module

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

Inrush Current Limiting

To limit the current drawn by a piece of electronics when it is first switched on.

IIR

Infinite-Impulse-Response

IR

Infra-red. Also short for NDIR.

Integer

A number between 0 and 65535, expressed as a 16-bit number. There can be up to 10 integer variables in an array.

Linearization

The function of making sure that the readings in between the zero and span point read correctly

LON

The digital network used by NGA2000 analyzers.

MCFID

Multi Component Flame Ionization Detector Analyzer module.

Modbus

A protocol that operates over RS232 or RS485 links. It is a master-slave protocol - a master requests or writes information, and the slave responds. In the NGA case, the NGA control module (Platform) is a slave.

NDIR

Non-Dispersive Infrared Analyzer module

NGA2000

The patented system of Rosemount Analytical Platform(s), Analyzer Module(s), I/O Module(s) and Expansion Module(s).

NGA Reference Manual

Provides detailed general information about the operation of the NGA system. Its use is intended for the serious user, system integrator, or those writing software that interfaces directly with the system

Operator Interface

The Display and Keyboard.

Paramagnetism

The quality of certain materials, particularly oxygen, of being attracted to a magnetic field, like a very weak form of iron.

Platform

Any workable collection of the following: Controller Board, Power Supply, Distribution Assembly, Enclosure and Operator Interface. Provides detailed general information about the operation of the NGA system.

PMD

Paramagnetic Detector Analyzer module

Polynomial

A mathematical term meaning an expression (a function of a variable) containing several terms, each of which contains a power of he variable.

Power Supply

Any of a variety of components that provides conditioned power to other NGA2000 components, from the Power Supply Board that plugs into the front of the Backplane in a stand-alone instrument to several larger ones that can power larger collections of modules and components.

Primary Variable

The measured species concentration value from an Analyzer Module.

Range

The bounds of concentration over which the analyzer's reading is accurate, or possible.

Response Factor

The relative response of the analyzer to different gases to which it is sensitive.

Routers

A component (manufactured by Echelon Corporation) used to connect more than one control module to a single computer.

Safety Failure

Indicates a failure of the analyzer safety system, with resultant shut down of the analyzer.

Secondary Variable

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

Serial Number

A number assigned to the module at time of manufacture. It is stored in the network variable AMSN, and marked on a Name-Rating Plate on the module enclosure.

Serial I/O Module

A non-LON I/O module that can produce up to 8 channels of 12-bit analog outputs, as well as 3 alarm contacts and a serial (either RS232 or RS485) port.

Single Autocal Module

Calibration of a single analyzer module or using separate zero and span gas paths into multiple analyzer modules.

SIO

See Serial I/O Module.

Softkeys

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

Span

The range over which something works, or the act of standardizing the upper end of the range.

String

These are numbers which refer to the standard letters, numbers and odd symbols in the ASCII character set. A string variable contains up to 31 characters of ASCII.

System

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

System Autocal Module

Synchronize calibrations of up to four analyzer modules in a system, using a common sample system.

System Integrator

An individual or organization who designs and/or builds analytical systems.

Technical Level

In the NGA2000 menus system, refers to the controls and configuration capability, and diagnostic information appropriate for analyzer technicians.

THC

Total Hydrocarbons, a term for the total quantity of hydrocarbons present, regardless of their type.

Tweak

A slang term meaning to adjust.

TO2

Trace Oxygen Analyzer module.

Variable

Data sent over the LON as discrete packets.

VBA

Visual Basic for Applications.

Warning

A form of alarm.

Zero

To make the analyzer read zero on zero gas, by calibrating its offset. Also the operation that accomplishes this.

SECTION 1
INTRODUCTION

This manual provides detailed general information about the operation of the NGA system. It is intended for the serious user or system integrator, or those writing software that interfaces directly with the system.

Sections are arranged in a how-to fashion, each chapter normally having a basic, advanced, detailed, and troubleshooting section.

- Basic sections give the essential operational procedure
- Advanced gives the complete procedure for analyzer experts
- Details shows the inner workings of the analyzer
- Troubleshooting gives some suggestions to help resolve problems
- Some sections are not formally split in this fashion

This manual is intended to be used with the Platform manual, and also with each individual analyzer manual, such as those for the CLD, FID, NDIR and PMD analyzer modules.

1-1 GENERAL INSTRUCTIONS

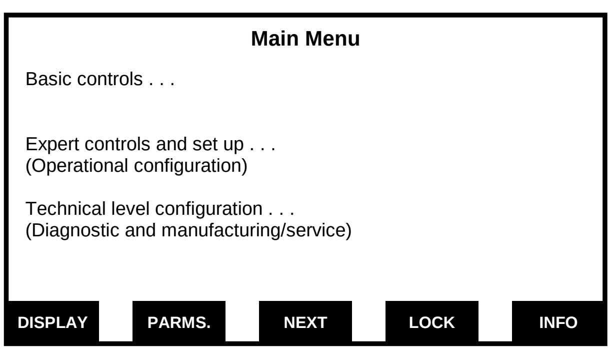

Figure 1-1. Typical Menu

The NGA menus have three separate paths, called **basic**, **expert** and **technical**. These paths are setup so as to separate the functions of the three main varieties of personnel expected to use the analyzer systems, that is Operators, Engineers and Maintenance Technicians. The security system outlined below is designed to restrict access in this manner.

Basic menus allow an operator to perform the normal, simple analyzer functions such as zeroing, spanning and changing ranges.

The expert menus allow an expert analyzer user to configure the analyzer as he desires, and to perform the more advanced controls, as well as perform the basic controls with more information and options allowed.

The technical menus provide control over the system operation, and access to the manufacturing data, the service data and the diagnostic data.

These menus are found under the main three choices in the *Main menu*.

In normal operation, the control module screen shows either a single analyzer display, or the multiple analyzer display. From the latter you can select a single analyzer to examine, by pressing the "SELECT" key twice.

From the single analyzer display you can either select the menus by pressing the "'MENUS" softkey, or you can select a couple of screens that provide basic essential information about the analyzer. Access these by pressing the "PARMS" (short for parameters) softkey.

If you press the "MENUS" softkey, you will enter the *Main menu*. This menu, like all menus, has five softkeys labeled at its foot. In all menus other than this one (with a few unintentional exceptions!) the button in the bottom left hand comer will jump you to the *Main menu*. The button in the bottom right hand corner will jump you into the help screen for the menu you are on.

1-2 SYSTEM SETUP

The usual NGA system consists of a control module, one or more analyzer modules, and one or more I/O modules. If you have only the one analyzer module, the system will set itself up automatically, but if you have more than one you will have to give it some instructions as to how to configure itself. In particular, you have to tell it which analyzers are connected to which I/O modules.

If you have no I/O modules,. you can skip this section.

If you have more than one control module in a system, whether or not you have more than one display in it, you will need to read the advanced section here.

a. Basic Instructions

Verify you have all the modules you are going to use, and that they are all connected to the power supplies, and to the LON. Power connections are normally made through the three pin connector on the front of each analyzer module, or through the audio connector on the back of the platforms. You can power a single analyzer from the internal power supply in a platform, but if you have more than one analyzer you will need some sort of additional power supply, such as the 24V, 30 amp Bulk Power Supply made by Rosemount Analytical. Each analyzer draws about 5 amps, so a 30 amp supply can handle about five analyzers.

WARNING

IMPROPER CONNECTION

The internal LON connection in the platform is for use with internally mounted and powered analyzers only. Using this connection for external analyzers or LON components could result in short-circuiting the 24V power supply through the cable, with resultant damage.

b. Binding

You have to tell the system which I/O module is bound to which analyzer.

Version 2.2 control modules:

Verify that all the analyzers and I/O modules are present:

Enter the *Main menu*.

Enter Technical level configuration...

Enter Listing of all modules...

Verify they are all there. (Note that system Autocal modules are listed as five separate modules.)

Enter the *Main menu* (press "HOME" or "MENUS")

Select Technical level configuration...

Select System setup..

Select Module binding...

Verify that the analyzer listed on the *Analyzer module selected*: line is the correct one.

If it isn't, select *View bindings...*. press "NEXT" until the desired analyzer is shown on the *Analyzer module selected*: line.

Press the left arrow key to return to the *Module binding* menu

Select the desired module. You will jump back to the previous menu.

Check that the I/O module selected is correct for the analyzer shown - NOT the analyzer at the very top of the screen!

Press "BIND".

Wait while the system restarts, and then re-enter the binding menu.

Repeat the procedure for each I/O module until all are bound.

NOTE

If you have made a mistake, press "UN-BIND". Then repeat the binding procedure.

Version 2.3 control modules:

Verify that all the analyzers and I/O modules are present:

Enter Listing of all modules...

Verify they are all there. (Note that system Autocal modules are listed as five separate modules.)

Enter the *Main menu* (press "HOME" or “MENUS”).

Select Technical level configuration...

Select System setup..

Select Module binding..

Note that each analyzer is listed on this screen. For each in turn, select the analyzer.

Press the right arrow key.

Select, from the list of I/O modules shown, one module to be bound to the analyzer.

Press the ENTER key. Continue until all desired I/O modules are selected.

Press the BIND softkey.

Verify that all the analyzers and I/O modules are present.

NOTE

To unbind particular I/O modules, select them in the Module binding menu, and press UNBIND.

c. Advanced Instructions

Analyzer Power

The quality of the analyzer power is important. It must be within a couple of volts of 24 V, and it must be reasonably quiet. 100 mV of noise is adequate. Earlier analyzers required inrush current limiting if the leads supplying power were longer than a couple of feet. Later analyzers (with the CE mark) were not as touchy. If such protection was not provided, the analyzers might blow fuses upon start up. In this case, replace the fuse and try again. Don't plug in the analyzer power while it is turned on.

Naming Analyzers

Verify the I/O modules are named appropriately. You want to be able to tell which I/O module is which, so you can bind it to the appropriate analyzer. The variable TAG is used for this. Later I/O modules are able to tell which slot they are plugged into on the control module Backplane, but most I/O modules cannot do this, and so they rely on your knowing which one they are in some other way.

An easy way to do this is as follows:

Plug the I/O modules into the platform one by one. Do this with no analyzers connected.

Power up the Platform.

Press the button marked "RE-INIT" as the control module initializes itself.

When it is showing its main display, press the button marked "MENUS".

Select *Technical level configuration...*

In the resulting menu, select *Listing of all modules...*

Select the listed I/O module.

On the bottom line of the resulting menu edit the I/O module tag to something that you will recognize.

Do this for each I/O module in turn. Then reconnect the whole system, including the analyzers, and again press the “RE-INIT” button.

Verify you know which analyzer is which. Normally this is easy, but if you have several examples of the same kind of analyzer, you will need to verify they are named appropriately.

You can do this even though all the analyzers are hooked up at once, since you can look at them and see what their serial numbers are.

From the main screen, press "MENUS"

Select *Technical level configuration*...

Select *Service menus...*

Select *Manufacturing data...*

Select Analyzer module data. Read Analyzer module s/n: and determine which analyzer you are looking at.

Edit the *User tag number:* line to make the tag whatever you want it to be. The tag is the heading on the top of the screen for the analyzer you are looking at. This line won't change until you enter another menu, but the analyzer will remember whatever you enter, up to 31 characters.

Press "HOME".

Press "NEXT" (it selects the next analyzer in its list.).

Repeat the procedure for the new analyzer.

An alternative is to start the Rosemount Analytical DDE server program in a PC connected to the system. When it has completed its network interrogation, open the DDE server program icon and click on "File". Select "Nodelist". Click on each module's TAG in turn, and edit them as you like. Then exit and restart the DDE server before attempting to use any application with it.

d. Details

TAG Variable

All modules use the variable called TAG to contain their name. Modules also have a node name, and a program id, and these are used internally in the LON. They are not normally accessible externally, though both may be used by non-NGA LON nodes such as a PC setup to monitor the NGA system.

Analyzer Modules also have a serial number in their variable AMSN. This should match the serial number assigned to the analyzer and visible on a label on their sides.

The control module puts the contents of TAG onto the main display screens, and also onto the top line of the menu screens. It regards menus as belonging to an analyzer, the one selected in the main screen or selected by pressing the NEXT button in higher level menus. The TAG and the present time reading are always displayed on the top line of every menu screen.

NOTE

TAGs should be kept as short as possible, and should not contain blanks, dashes or other mathematical signs. This will avoid problems when using a PC to interface with the module.

The gas measured is shown in the variable GAS. This is normally straightforward, but in the case of the FID you should verify that this variable is matched with the response factor, whether the analyzer is measuring in C1 or C3 (methane or propane) units, for example.

The analyzer sensitivity is described in coded form in its bench code (AMBC). Particularly in the case of NDIR analyzers, the bench has to be setup for the analysis desired.

Individual analyzers may also have internal serial numbers reported in other variables visible in their *Manufacturing data screen.*

Network variables: TAG, AMSN, AMBC, GAS, CARBON_ATOMS.

Binding

Binding is the process of connecting various variables in the analyzer module with equivalent variables in the I/O modules. Normally the LON expects to bind individual variables, but the NGA system simplifies this by binding whole groups of them at once. Once they are bound, an update to one variable on one node will automatically cause the variable bound to it on another node to be updated as well. This allows the I/O module to track the main reading (PVA) of the analyzer automatically, and it allows the I/O module to change the range of the analyzer by updating its CRANGE0 variable, thus changing the analyzer's CRANGE variable which is bound to CRANGE0.

Subsequent revisions of the control module software (from V2.3) will allow you to bind all the I/O modules at once, rather than making you bind each one, waiting for the system to reset between each module.

Binding is only necessary for systems with I/O modules. Systems that have no control module, and which rely on a computer to get data from analyzers, do not need to do any binding.

Controller Module Memory Issues

The control module has a restricted amount of memory, just as do all computers. It can therefore handle only a certain number of analyzers and I/O modules. It stores all of the data from each module within itself. If an analyzer module is removed and replaced, the control module will remember the data from the analyzer, so if the analyzer is replaced the control module can recognize it and bring it back on line immediately. However this also means that the control module will remember all the analyzers it has ever seen, so that it will eventually run out of memory. The limit with a V2.2 control module is about 6 analyzers. With a V3.0 control module it is 15 analyzers.

Replacing an Analyzer

If you replace an analyzer with a new one, you will have to reset the control module so that it can recognize the new analyzer. If you run out of memory in the process, the control module may hang and not complete the initialization. In this case, press the "RE-INIT" button and rebind all the I/O module all over again. If the control module is so lost that the "RE-INIT" button doesn't work, remove power from it briefly and replace the power, and then press the "RE-INIT" button as soon as it appears. Then go through the binding process again.

This procedure should be improved with the V3.0 control module software.

Multiple Control Modules

In V3.1 or earlier, it is not possible to connect more than one control module on a system. If it is desired to connect them to a single computer, it is necessary to use "Routers" (a component sold by Echelon Corporation) to isolate the control modules from each other.

e. Troubleshooting

Control module hangs up during a reset…

Control module out of memory. Press "RE-INIT" button, or remove power, replace power and then press "RE-INIT" button.

You may have several analyzers updating their readings as fast as they can, saturating the network. In this case, only connect up one at once, and when it comes up, set its LON update rate to 10 per second or once per second. See "Response time" below. Then hook them all back up and try again. Don't forget to remove the I/O modules while you do this - if they were not already bound, they will all bind themselves to the first analyzer you try this with.

"RE-INIT" button doesn't work…

Control module crashed. Remove power, replace power, then press "RE-INIT" again.

Even after power up, "RE-INIT" button doesn't work…

Battery backed RAM is corrupted. Open the control module, remove the jumper next to the battery (the cylindrical object above the board at the near end - the jumper is just next to the positive end's wire connection to the board); wait for two minutes, replace the jumper and replace the board in the control module. Then press "RE-INIT" when power comes up.

I/O doesn't respond to the analyzer signals…

The I/O modules aren't bound. This happens after a "RE-INIT". Don't press this button unless you mean it! You have to go through the binding procedure again. You may have bound all the I/O modules to one analyzer by powering the system up with only one analyzer connected, but all the I/O's connected. If so, press the "RE-INIT" button and start again. The LON may be saturated. Try reducing the LON update rate of all the analyzers to 10 per second. After a short time the I/O modules should respond once again.

Several I/O's have the same name…

New I/O modules are all called the same thing. In order to tell the difference between them, you have to name them. See the procedure earlier in this.

Later I/O modules can tell which slot they are plugged into. You can use this information to identify them. It is located in the same place as the I/O tag name, under "Listing of all modules.."

1-3 ANALYZER MEASUREMENT RANGES

NGA analyzer modules have four ranges available. These ranges normally do not correspond to any physical settings in the analyzer, they are there for operator convenience. It is possible to separately zero, span and linearize each range, in which case you may well not get the same reading on a given gas, if you change the operational range. Some analyzers do change an internal setting on a range change, though they never do this dynamically based on the signal within a range. If they do this, or if the filtering time is set to a value greater than zero, there will normally be a short term "glitch" as the analyzer reaches its new value.

The dynamic range of the analyzer on a single range is normally quite great, and it is often only necessary to change ranges if you are recording the analog output of the I/O module. However for traditional reasons some users like- to operate between 20% and 80% of a range, and thus change ranges anyway, even though this makes no actual difference to the analyzer's operation or resolution.

It is possible to set the I/O module to produce an output independently of the analyzer's current range. You can make the I/O module stay on a particular range, regardless of the analyzer, or you can make the analyzer stay on a particular range and force the I/O to change its ranges in response to a remote (digital line) command. You can connect two or more I/O's to a single analyzer, and make them respond to different analyzer ranges, thus getting two simultaneous outputs, one for low range resolution, and the other for upset conditions.

If you make the I/O operate independently of the analyzer, it will change its output range within about 120 micro seconds of a remote command (for an I/O with a 5 MHz clock, later I/O's with a 10 MHz clock respond within 80 micro seconds). There is no "glitch" at all in this case, since the analyzer is not affected by the range change request.

If the I/O has to make the analyzer range change, the total transaction may take up to half a second, and there may be a glitch in this time.

In general the only reason for making a real range change is to use a different linearizer curve on a lower signal. It may also be useful to get a better signal to noise ratio if the range change is drastic, such as changing from 0 - 10,000 ppm. to 0 - 10 ppm on a FID. On the former range the resolution is about 0.1 ppm, whereas on the latter it is about 0.01 ppm.

a. Basic Instructions

1. Enter the *Main menu*
2. Select *Basic controls...*
3. Edit the *Measurement range number:* line.

b. Advanced instructions

To change range fullscale values

1. Enter the *Main menu*.
2. Select *Expert controls and setup*
3. Select Analyzer module setup.
4. Select *Gas measurement parameter*s..
5. Select *Range setting*s.. .
6. Edit the range upper and lower setpoints as desired.
7. Press the left arrow key.
8. Select *Linearization parameters*...
9. Edit any linearization parameters you have to due to the range change, such as which linearizer is used on which range, or what the linearization coefficients are.

To alter the maximum or minimum possible ranges

1. Press "HOME" or enter the *Main menu*.
2. Select *Technical level configuration*...
3. Select *Service menus...*

4. Select *Manufacturing data...*
5. Select *Analyzer module data.*
6. Edit the minimum and maximum ranges as desired.

c. Details

The analyzer won't let you edit the fullscale range to a value higher than the maximum range, or lower than the minimum range. Outside these bounds the analyzer won't meet its specifications, probably. Only edit these if you have made a hardware change to the analyzer so that it can now cover a new range.

If you increase a range by more than 10% without changing the linearizer range, the analyzer will disable that linearizer. However, don't simply increase the linearizer range to avoid this - the coefficients must be changed as well, or you will have linearity errors.

Any bound I/O module will get its ranges from the analyzer, you don't have to change them in the I/O module as well.

Network variables: RNGHI, RNGLO, CRANGE, CURRENTRNGHI, CURRENTRNGLO, MAXRANGE, MINMANGE, LINRNGHI, LINA0_, LINA1_, LINA2_, LINA3_, LINA4_

d. Troubleshooting

I changed a range and now my linearity is wrong…

You have to change the linearizer parameters if you change a range value. You can't use a linearizer that covers less than 90% of the range you axe on. Either select the linearizer from the next higher range, or re-linearize the present range.

It won't let me make the range bigger (or smaller)…

You have reached the editing limits set by the minimum range or the maximum range. You probably should not be setting the ranges outside of these limits. If you have made a physical change to the analyzer, or you are willing to live with the lower specifications, you can edit the minimum or maximum ranges in the *Manufacturing data* screen.

1-4 ZERO AND SPAN GAS SETTINGS

It is essential that the zero and span gases are correctly described to the analyzer. It zeros and spans by making the reading it is getting from its measurement signal equal to what it has been told is the zero or span gas value. If it is zeroing or spanning ranges separately it may well produce bogus answers if the zero or span gases are entered incorrectly.

Zero and span gas values are entered into the Calibration gases menu under Expert controls and setup.

a. Basic Instructions

Select the analyzer you want to zero.

Press "MENUS" or "HOME" to enter the *Main menu*.

Select Expert controls and setup

Select Analyzer module setup…

Select Calibration gas list…

Edit the zero and span gases until they refer to the values on the bottles.

Press "HOME" to return to the *Main menu*.

b. Advanced Instructions

Zero gases are normally simply of zero concentration, but in some cases it is desirable to "zero" off a non-zero gas. In this case, it may be necessary to iterate between zero and spanning a few times until the results are accurate enough.

Gas cylinders are notoriously inaccurate. Even when they are specified at ±2% certified accuracy, you can still have considerable errors. Some users prefer to zero and span off gases of mediocre quality, but to "name" the gases by comparison with a known high precision reference gas. In this case, carefully zero and span the analyzer on the reference gas, and then measure the "span" gas with the analyzer. Enter the result as the span gas "name" both on the bottle and in the *Calibration gas list*. When it is time to replace this bottle, "name" the replacement in the same way.

The span value has to be between 20% and 110% of the fullscale range. Ideally it should be about 80% of the range.

The FID analyzer can be set to be calibrated on various kinds of hydrocarbons, such as methane or propane. Its response factor must be adjusted accordingly. On the same *Calibration gas list* screen, the FID includes a line marked *Calibration gas HC response factor:*. Edit this to the desired response factor, 1 for methane, 3.14 or so for propane. The analyzer will then regard the span concentration as referring to that kind of gas.

c. Details

The analyzer compares its reading on the span or zero gas with the value entered into the *Calibration gas list* value for the range it happens to be on. It adjusts its internal zero and span factors so as to make its reading correspond to the value entered as the span or zero gas concentration. It is therefore vital that the value entered be correct.

The *Calibration gas list* is located under the *Expert controls* menu so as to keep it away from the lower skilled operators. Entry of an incorrect value will completely invalidate the analyzer's readings thereafter.

Network variables: SPANGAS, ZEROGAS, NOSPANGAS, NOXSPANGAS, ZERO, SPAN, CARBON_ATOMS, NO_NOX

1-5 GENERAL ZERO/SPAN SETUP

During a zero or span the analyzer reads the signal from the gas detector, calculates the apparent gas level, compares it with the desired level as entered in the *Calibration gas list*, and modifies the internal calibration factors until the reading is within a small error value of the desired value. The error is 0.02% of the upper range value.

During the calibration sequence the analyzer monitors the reading over a period of time set by the CALTIME variable, located in the *Calibration parameters.* screen under Analyzer Module setup .... If it detects a drift of the reading, it will wait for a longer time until the reading is stable, or until the time out period set by CALTIME-OUT, also located in the *Calibration parameters* menu as Calibration time out: This value is normally set at about 2 minutes. The analyzer will perform its zero or span anyway at the end of the timeout time.

If the gas value is wrong, or the analyzer has drifted excessively, the analyzer will check the reading on the calibration gas against the named value in the *Calibration gas list*, and if it is set to check its limits, it will not calibrate. Conversely, if the analyzer is set to ignore limit checking, it will calibrate anyway, unless the span gas value is outside the allowed range of 20% - 110% of the range value.

You can select whether to zero or span all the ranges together or separately. If you make them separate, unless this is the first time that this analyzer has ever been calibrated, it will only zero or span the range that you are on. Other ranges will not be affected. If you elect to zero or span them together, the results will depend on the gas values and the range values already set in the analyzer.

If the ranges are all zero based, and the zero gas is of zero concentration, the analyzer will have no difficulty zeroing all the ranges at once. It does this by changing the range to range 1, zeroing it, changing to range 2, waiting for stability and zeroing that, and so on.

When it tries to span the ranges, if the span gas is above 10% and below I/O% of the range value on any range, it will span that range, but if not it will not perform a span. Thus if the span gas is 900 ppm, and the ranges are 10, 100, 1000 and 10,000 ppm, and you are on range 3 (0 - 1000 ppm), it will only span range 3, even if you tell it to span all the ranges together. In general, with widely spaced ranges such as this example, it is best or indeed essential to span the ranges separately.

Bear in mind that the NGA analyzers have very good linearity and dynamic range, and it is normally quite practical to operate them over a dynamic range of 30:1 or more on a single range, if you are using a digital output.

a. Calibrate Ranges Separately Or Together

From the *Main menu*:

Select *Expert controls and setup*

Select *Analyzer module setup*

Select *Calibration parameters*

Edit the zero and span calibration lines as desired.

b. Calibrate Ranges Using An Autocal Module

There are two Autocal modules available for the NGA systems (other than the on-stack sample control module). One of them is designed to work with a single analyzer, and to calibrate individually its separate ranges, the other is designed to work with up to four analyzers, providing up to four span gases to span any number of analyzer ranges. You can set these modules up to zero and span the analyzers on a timed basis, and you can make them perform a zero or span or both at will. You achieve the latter by entering their control screen, under *Expert controls and setup* then *Auxiliary module controls*.. ., then select the Autocal module. If you have already setup the module to zero and span as you desire, you can simply press the "START" button and it will put the gases on the analyzer(s), wait the appropriate time, zero them and span them. It is a common error to assume that the analyzer basic controls "ZERO" and "SPAN" buttons will make this happen - it won't, you have to control them from the auxiliary module controls as described above. A future version (post V2.2) of software will rectify this automatically. See the Autocal module manuals for details on how to set them up.

Network variables: CALTIME, CALTIMEOUT, ZERO, SPAN, AMFN, CALCHKLIMITS, ZERORNGS, CALRANGES, CALFAIL, CALFPC

c. Troubleshooting

Analyzer will not zero…

Verify you have a real zero gas; verify that the zero gas in the *Calibration gas list* is set to whatever the zero gas really is.

See the *Result..* menu in the Expert controls section under Zero/span calibration. The line marked *Result of last zero*: should give you a hint as to what happened.

If the analyzer has been changed in some way, so that its zero reading is quite different from what it should be, verify that the limits checking is turned off in the *Calibration parameters* menu. Zero it, then turn the limits checking back on.

Verify the limits checked for are reasonable in the *Calibration parameters* menu.

If all else fails, get into the *Factors* menu. Find this under *Expert controls and setup, Expert analyzer controls...,* "CAL" softkey, "FACTORS" softkey, and then select factors for the range you are using. You can read the raw signal for the zero gas at the bottom of this screen. If you edit the *Zero factor:* number to be the same as the raw signal, you will effectively zero the analyzer.

You can see what the stored zero and span factors were by pressing the softkey marked "HISTORY". If desired, you can load the stored or the manufacturing values into the current values by pressing one or other of the two RSTR ... softkeys. This will at least bring the analyzer back to the calibration factors it used to have. When you are satisfied that you do have a good calibration, you can store the values into the *Stored values* variables by pressing the "STORE" button on the factors screen.

If you have made a large span change, the zero may be offset excessively. In this case simply redo the zero and span again.

Analyzer will not span correctly…

See the *Analyzer will not zero* paragraph above. In addition, there are a few additional details.

The values of the span gases must be entered correctly. See the discussion elsewhere about errors in span gas bottle naming. It is easy to replace a span gas bottle, but to forget to enter the new span gas values, and therefore to get an inaccurate span. You can guard against this to some degree by enabling the calibration error checking, and setting the failure margin to a low enough value to avoid the worst mistakes. However this may mean that the analyzer will not be able to calibrate itself due to normal drifts, temperature excursions etc.

If the analyzer has excessive noise, it may not span to the correct number. In this case it is necessary to troubleshoot the analyzer itself.

The fullscale range value must be within 90% to 110% of the linearization range value, or the linearizer will not be allowed to apply. In this case, the span may be wrong. Also the linearizer curve must be monotonic between -5% and +110% of the fullscale range.

The analyzer will not span at all…

The span gas value must be within 20% to 110% of the fullscale range value. If it is outside these limits, the analyzer will simply not span. Change the fullscale range value, or the span gas value if that is wrong, so that you are within these limits.

The calibration limits are enabled, and the span drift is greater than that allowed. Disable the limits and try again, or make the limits wider and try again.

You expect the Autocal module to put a span gas on the analyzer, but you have pressed the SPAN button in the *Basic controls* screen. The Basic controls screen only controls the analyzer, it doesn't control the Autocal module. If you press it, you have to verify the gas is present first! If you want to use the Autocal module to control the gas flow, you have to get into the Autocal module control screen under Expert controls, then auxiliary module controls.

One range calibrates, but others don't…

You are probably trying to span all ranges together when the analyzer cannot do it. Set the analyzer to span ranges separately, and span each range on its own span gas. Alternatively, if you only want to operate on one range, set all the ranges to the same fullscale value, then it won't matter which range you are on and you can span them all together.

Nothing seems to work, I'm lost…

We have put a back-up, fail-safe into the design. There are enough settings and special circumstances that it is quite possible for both you and the analyzer to get confused, particularly if you have modified the analyzer hardware or software in some way.

The first back up is to put the last stored calibration factors back into the present ones, by getting into the "Range (n) factors" screen for the range you are on, and then getting into the "HISTORY" screen. Press "RSTR ST" to put the last good factors into the present set. Alternatively you can restore the manufacturing factors with "RSTR MN".

This won't do you much good perhaps if you have changed the hardware, since the conditions may be very different now. In this case, you can get into the factors screen for the range you are on, and manually edit the factors on zero gas (edit the zero factor) and span gas (edit the span factor). Usually, you can just make the reading approximately right, and then do a zero or span using the softkeys in the calibration screen.

1-6 ZEROING

Zeroing is the function of adjusting the analyzer's offset so that when given a zero gas, it reads zero, no matter how the analyzer span is set. By extension this includes adjusting the low end of a suppressed range, although in this case the span setting will have an effect on the low end reading.

a. Basic instructions

No Autocal Module

Select the analyzer you want to zero.

Flow zero gas through the analyzer.

Press "MENUS" or "HOME" to enter the *Main menu*.

Select *Basic controls...*

When it is stable, press "ZERO".

Press "ZERO again on the "*Are you sure?"* screen.

Press "HOME" to get back to the *Main menu*.

Autocal module

Select the analyzer you want to zero.

Press "MENUS" or "HOME" to enter the *Main menu*.

Select *Expert controls and setup*

Select *Auxiliary module controls...*

Select the Autocal module, whatever you have called it.

Either do a complete auto-calibration from the first screen that appears (by pressing "START"), or

Select *Manual calibration function...*

Set the *Gas to be used for calibration:* to "Zero gas".

Select the correct range to zero with *Measurement range number:*

Select CAL in the *Calibration or QC check:* line.

Press "START".

You can press "ABORT" to abort the calibration, and then press it again to cut short the sample purge time if you want.

b. Advanced Instructions

No Autocal module

Select the analyzer you want to zero.

Flow zero gas through the analyzer.

Enter the *Main menu*.

Select *Expert controls and setup*

Select *Expert analyzer controls...*

Select the range you want to zero.

Verify gas flow.

Press CAL or select *Zero/span calibration...*

Press "ZERO".

Press "ZERO" again.

Press the left arrow.

Select *Result…*

Examine the *Calibration results* screen to see how well you did.

If desired, press the left arrow key to return to the calibration screen.

Press "FACTORS".

Select the calibration factors for the range you are on.

View the factors, and if desired, edit the "Zero factor" to the raw signal number shown on the bottom of the screen. This will produce a zero output on the gas you have flowing.

Autocal Module Present

Select the analyzer you want to zero.

Enter the *Main menu*.

Select *Expert controls and setup*

If you have not configured the Autocal module, do so.

Select *Auxiliary module controls...*

Press "START".

Alternatively, select *Manual calibration...*

Select the gas desired, the range desired and the operation desired, then press "START".

c. Details

Certain analyzers can take a long time to get a good zero reading. If the analyzer has been exposed to a high level gas, it may take many time constants to get down to zero again. This means that you should be careful about doing a "Zero - span - zero" check: the analyzer may not read the same thing on the second zero, simply because it has not had a chance to get back to it. The NGA analyzers are capable of reading gases with a great deal of precision, so you can easily see if the zero reading is not correct, and this can be confusing.

Two kinds of analyzer are particularly prone to zero problems. FID analyzer measure hydrocarbons, and they are more responsive to high molecular weight hydrocarbons than anything else. Oils, in particular, produce high readings due to the large size of the molecules. If there are oils or other high molecular weight hydrocarbons in the sample system, they will stick to the sample tubing walls and take a very long time indeed to evaporate away. If you expose the analyzer to a really high concentration of such materials, such as by spilling gasoline near the sample intake, you may have to disassemble it and clean all the plumbing before it will read a good zero again.

The symptom of hydrocarbon contamination is that the analyzer reads high on zero gas, and this reading very slowly decays over a matter of weeks. You can speed up the process by cleaning out the tubing with alcohol and distilled water, or by flowing argon through it while heating the tubing to red heat with a flame. Needless to say, this should not be done to Teflon tubing! You should use stainless steel components and tubing, and the tubing should be cleaned before use. Otherwise, if you do use Teflon or copper tubing, and you do not take precautions, you will suffer from this bleeding down effect for a long time.

Trace oxygen and water vapor analyzers have similar zero problems. Both water vapor and oxygen are present in the air at very high vapor pressures, and thus will leak or diffuse into sample systems with great ease. Water vapor will stick to walls even worse than hydrocarbons do, and may take many weeks to be removed. Both water and oxygen will readily diffuse through any plastic components, and you will not be able to reach levels around 1 ppm unless you make the entire sample system out of stainless steel, including valve and regulator diaphragms. Even when you have made the sample system perfect, you will find that getting down to sub 1 ppm levels may take several days. After exposure to air for a short time, for example while replacing a sensor, the system may take a day to come back to zero.

For these reasons, zeroing trace analyzers is not an easy thing to do. If you go ahead and zero them anyway, you may find that you get negative readings as the sample system cleans out, and your readings around the zero point may be quite unreliable.

Trace levels around the 10 ppm value are normally comparatively unaffected by the above considerations, unless you have made a gross error in the sampling system.

You should take the above warnings very seriously if you are trying to measure in the I ppm or less band.

If you think that you are not getting good results at these low levels, the reasons are almost invariably due to sample contamination. Make sure you rule out any possible sources of contamination before deciding that you have an analyzer problem.

Network variables: CALTIME, CALTIMEOUT, ZERO, SPAN, AMFN, CALCHKLIMITS, ZERORNGS, CALRANGES, CALFAIL, CALFPC

d. Troubleshooting

Zero drifts down over time…

If a FID, or trace 02, analyzer, you have sample contamination. In the case of the FID, you must determine where the contamination is coming from, possibly by connecting zero gas directly to the sample inlet, using new ultra-cleaned stainless steel tubing, and verify that the analyzer itself is not contaminated. If it is, it will clean itself out in time if you leave it, but if this is not practical, you have to send it back to the factory for disassembly and cleaning. Otherwise, replace your tubing with stainless steel, and clean all the sample components, preferably with a blow torch while flowing argon gas through it.

For oxygen analyzers, an elevated zero means a leak. Remember that oxygen diffuses through any kind of plastic. Also remember that it is the partial pressure difference that controls the diffusion rate - the fact that your sample is at 3000 psig means nothing to the oxygen atoms. To them, a bottle of pure nitrogen is a vacuum, and they whistle into it if given a chance. It is normal for an oxygen analyzer to take a day or two to come to a good zero reading, leave it for a while and see if it stabilizes before worrying.

You can test for leaks by shutting the sample flow off both upstream (first!) and downstream of the analyzer. The oxygen reading should stabilize at a low level of a ppm or so, if it goes up to a significant level you have a leak.

After a zero, the reading is very erratic…

Put a span gas in and see what it reads. If you have spanned on a zero gas, with the calibration limits disabled, you will have made the span setting much too sensitive. In this case, verify you do indeed have span gas in the analyzer, and span it again (disabling the limit checking first), then zero it again.

Similarly, if you have zeroed with a span gas, zero it with a real zero gas and respan, then zero again. Now enable the limit checking so this doesn't happen again.

It refuses to zero…

Verify you do have a real zero gas in the analyzer, and disable limit checking. Then zero it again. Also, zero on all ranges independently.

After a span, it won't go back to zero…

Leave it on zero gas for a long time, at least a hundred times the response time of the analyzer. See if it made it back to zero again. If not, check for leaks of span gas into the zero gas. If the zero is now lower than it was before, i.e. negative, re-zero and then re-span. If it is higher, and the previous zero happened within a few minutes, something is wrong with the zero gas, the sample system, or possibly the analyzer. If the analyzer temperature has changed, such as by opening a door and allowing cold or hot outside air to blow on the analyzer, let its temperature stabilize again and try again.

It may be that the analyzer span is now very different from before. Check your span gas for correctness, and that you did indeed have flow of gas during the span. If all is well, re-zero and then re-span.

1-7 SPANNING

Spanning is the function of adjusting an analyzer's measurement gain such that a near fullscale gas reads correctly. Since this reading depends on the zero, it is essential that you perform a zero before a span. It is also essential that you verify that the span gas value has been entered correctly in the calibration gas screens.

Linearization is the function of making sure that the readings in between the zero and span point also read correctly. See the section below for this.

a. Basic instructions

Set Span Gas Concentrations

Get into the *Main menu*.

Select *Expert controls and setup*

Select *Analyzer module setup.*

Select *Calibration gas list..*

Change any zero or span gas concentrations as desired. (Span gas values must be within 20 - 120% of the range fullscale.)

Perform A Span

Get into the *Main menu*.

Flow the appropriate span gas through the analyzer.

Select *Basic controls...*

Verify sample gas flow.

Press "SPAN", then "SPAN" again.

Press the left arrow or "HOME" when you are done.

b. Advanced instructions

As per basic controls, except do the span through the *Expert controls and setup* menu.

Enter the *Main menu*.

Flow the appropriate span gas through the analyzer.

Select *Expert controls and setup*

Select *Expert controls...*

Verify sample gas flow.

Press "SPAN", then "SPAN" again.

Press the left arrow key, then press *Results...*

Examine this screen for data about the most recent calibration.

Press the left arrow or "HOME" when you are done.

c. Details

Spanning is less critical than zeroing. The analyzer will take several time constants to get to a good span value, so verify its signal is really stable before spanning.

Most span problems are due to the use of an incorrect span gas, or an incorrect span gas setting.

Network variables: CALTIME, CALTMEOUT, ZERO, SPAN, AMFN, CALCHKLIMITS, ZERORNGS, CALRANGES, CALFAIL, CALFPC

d. Troubleshooting

After a span, zero reads OK but the span gas doesn't read right…

You may not have left the span gas in long enough to get a stable span. Put the span gas back into the analyzer, and watch the trend of its reading on a chart recorder or computer screen. The reading should be stable when you do a span. If it is still trending upwards, you have not spanned on the real span gas. Either leave it to stabilize more, or troubleshoot your sample system until you get a good span gas stability. For example, entrained condensate in the system will affect the span stability. So will the presence of interfering compounds, such as ammonia added to control NOx emissions. You must remove these somehow.

After a span, the reading is very erratic…

You have spanned with a gas of much lower concentration than you think, typically zero gas or the measuring sample. Troubleshoot the sample system until you are sure that you are spanning off the real span gas, and also enter into the analyzer menu the real span gas concentrations. Enable limit checking so that this does not happen again.

The analyzer refuses to span…

If the analyzer considers that it has to change its span factor by more than the allowed amount, it will refuse to span, if the calibration limit checking is enabled. Verify that you have the correct span gas, and its concentration is correctly entered into the analyzer. If so, troubleshoot why the analyzer's span has changed so much.

Possible cause are:

- Contaminated sample cells in the NDIR and CLD analyzers
- Loss of ozone production in the CLD
- Flame out in the FID
- Incorrect flame position in the FID
- Incorrect pressures and flows in all analyzers
- Rapid temperature changes (greater than 10°C per hour change)
- Temperatures outside specification
- Foreign substance contamination such as water carry-over
- Large ambient pressure changes
- Sample leaks either within or outside the analyzer
- Exhaust back pressure changes
- Incorrect linearizer coefficients
- Span gas outside allowable range

1-8 LINEARIZATION

Analyzers often have a non-linear response to concentration changes in the sample, due to the physical principles on which they work. In particular, NDIR analyzers operate more-or-less on Beer's law, which states a logarithmic relationship between optical absorption and concentration. It is more or less logarithmic because practical gases are not ideal, particularly C02 at higher concentrations. The normal form of linearization used by NGA analyzers is the fourth order polynomial approximation. This is used for traditional and regulatory reasons. The theoretical solution would be to use a logarithmic approximation, however in computer terms this is merely a higher order polynomial, no different from the fourth order in precision in most circumstances.

Although in V2.2 analyzers there are a series of menus for automatic self-linearization, these are not operational in this edition of software. Instead it is necessary to enter or download the polynomial coefficients. These are determined by an external calculation, flowing known gases through the analyzer and recording its un-linearized readings, and calculating the appropriate corrections.

Frequent problems in doing this include errors in the dilution system used to generate the points, errors in the time allowed for the analyzer to stabilize after entering a gas, and errors in the calculation that determines the coefficients.

The NGA allows you to use up to four sets of linearization coefficients, and to assign these to any of the ranges, subject to certain limitations. Each set of coefficients has a range over which it is valid, and this has to be at least as great as 90% of the range to which it is supposed to apply. For each range you can select which set of coefficients to use, and whether to use any such set at all. If you select a set of coefficients that are not allowable, the analyzer will automatically select the next higher set, or the highest set if those sets are themselves valid for this range.

a. Basic Instructions

In the *Main menu*:

Select Expert setup and controls...

Select Analyzer module setup.

Select Gas measurement parameters...

Select Linearization parameters…

Select which set of coefficients to use for each range.

Select Linearization coefficients...

Press "NEXT" if necessary until you are dealing with the desired range.

Edit the linearization coefficients as desired.

Edit the linearization fullscale range as appropriate.

b. Advanced Instructions

Use a dilution system of known quality, proven with an known linear analyzer such as a FID.

Perform a zero and a span on the range desired. Verify that you have allowed plenty of time for the analyzer to stabilize.

Verify that the fullscale range setting is correct, and also the linearizer range settings are correct.

Flow a number of dilution samples for long enough to get stable readings, until you have enough data to generate the curve. This is normally between ten and sixteen points. Verify that you have given the analyzer time enough to stabilize - you are looking for an accuracy of reading of better than 0.1 % in order to generate a satisfactory curve 1 You may find it helpful to set the response time to a long value so that you have a good reading, or if you are using a computer for the data acquisition, make it do a statistical analysis on the signal to verify that you have no indication of a slope by the time you take the value.

Normalize the readings such that fullscale becomes equal to unity (divide the readings by the fullscale value). If your highest value gas is less than 100% of the fullscale, you must either change the fall scale value to that of the span gas or get a gas of the fullscale value. Trying to extrapolate to fullscale is not normally practical, and results in significant errors.

Using a least squares fit, calculate the polynomial coefficients. You may want to weight the errors so as to make the fit more accurate at the lower readings by making the error weight inversely proportional to that point's percent of range.

c. Details

The polynomial coefficients are stored in a series of array variables called LINAO_[l..4], LINA1_[I..4], LINA2_[1..4], LINA3_[1..4], LINIA4_ [1..4]. These are the four zeroth coefficients (element 1 corresponding to the zeroth coefficient for range 1, and so on). They may be found on the linearization coefficient screens, where they can be edited, but it is usually more convenient to use a PC to download them into the analyzer.

Since the analyzer normalizes its signal, such that 0 corresponds to the range low end and 1 corresponds to the range high end, the linearization curve is constrained to go through the points 0,0 and 1,1, meaning that the sum of the coefficients should be 1.0. In fact, because of the allowable errors, the sum must be between 0.98 and 1.02 if a 2% error is allowed.

The curve must be monotonic. If it isn't, the zero or span algorithm may fail, resulting in an offset to the zero or span point. This is equivalent to saying that the first differential of the polynomial has to be positive over the entire –0.05 to 1.1 range.

The linearization should be performed at a specific temperature, and this has to be the same as the base temperature for the temperature compensation algorithm. Normally, 25°C is chosen for this, and minor errors will have little effect.

If it is desired to achieve accuracies of 2% of point, and 1 % of range, whichever is less (above 10% of range), fig s which are quite practical in most cases, great care must be taken to verify that the dilution system employed, and the settling time allowed, are adequate. Errors of 0.1% of fullscale at the zero end will make it impossible to achieve this kind of result. You may have to wait several minutes for the zero reading to "get there", once you have put in a span gas.

It is essential that the gases used cover the entirety of the range. Don't try to extrapolate from an 80% gas to the 100% point, an error in your extrapolation will throw off the entire curve.

Network variables: LINA0_, LINA1_, LINA2_, LINA3_, LINA4_, LINSTAT, LINFORRANGE, LINRNGHI, LIN_OVER, LIN_UNDER

d. Troubleshooting

I use the self linearization screens, but nothing happens…

Version 2.2 software does not support self-linearization. You have to enter gases, take readings and figure out the coefficients externally.

I did a linearization, but my results don't check out with reference bottles…

Verify that you used a 100% gas, that the linearization ran-e matches or exceeds the fullscale range, that you have enabled the linearization at all and that you are using the correct set of coefficients (all of these are in the linearization setup screens under Expert controls). Verify that you have entered the coefficients correctly, and that their sum is close to 1.0.

If all of the above is OK, there is probably an error in your gas readings. Verify that the analyzer is correctly zeroed and spanned on the range you are using, and that you are using a long enough stabilization time. You may have to increase the analyzer's t90 time to get better signal to noise ratio.

Finally, you may have a problem with your dilution system, or your reference bottles. No matter how badly messed up the analyzer may be by this time, it should still read the same on the same gas. Make your blender produce the same concentration gas as a reference bottle, disable any linearizer, and read the two samples with the analyzer. If they don't read the same, something is wrong with either the dilution system or with the reference, and you will have to resolve this before you can resolve the linearity questions.

A common source of problems is the sample system in a CEMS installation. If you are losing concentration on the way down from the stack, due to leaks or water absorption or something, you may be unable to pass a linearity check when you introduce the reference gases at the probe. You will have to debug this. You may have lost concentration in a water trap, or you may have leaks. If the source adds ammonia to control NOx output, you may be condensing this in the sample cooler, and this will strip all NOx out of the sample.

Linearization: Well I tried all that, but I have to make it work anyway…

If all else fails, and you have to make the analyzer work without being able to resolve the real problem, you can use the tweak function described below. Remember that you are probably masking a real problem by doing so. Verify that the analyzer is really working correctly before resorting to this.

Some esoteric analyzer problems that can make it difficult to linearize include: FID - use of N_2 as the fuel diluent, and stratification at low hydrocarbon levels.

Saturation of the signal due to incorrect carbon content setting, sample pressure setting, or calibration gas value.

CLD - Inadequate ozone production, either caused by excessive sample flow, inadequate ozonator air flow, failure to use oxygen for higher than 1000 ppm concentration readings on a low range, or 2500 ppm on a high range unit, or a bad or tired ozonator lamp. Saturation of the signal caused by incorrect capillary setting or installation, and incorrect calibration gas values.

NDIR - Use of the incorrect cell spacer for the range you are working on, or incorrect settings of the temperature compensation factors.

All analyzers - Saturation of the analog signal path due to incorrect settings of gain resistors, or sample conditions, or specific parameters.

1-9 LINEARIZATION TOUCH-UP

NGA analyzers have two forms of linearization available. One method is to "tweak" them. This involves selecting up to three mid range values, and forcing the reading to correspond to the gas values at these points. The analyzer will then interpolate intermediate readings appropriately. This feature is useful when attempting to correlate the analyzer's performance against some standard gases of dubious accuracy, but where the gases must be believed. It can also be used to adjust the normal linearity adjustment for the particular idiosyncrasies of a gas divider, which itself may have linearity problems. In this case, perform the normal fourth order polynomial linearization, and then "tweak" the curve in using this tweak function. A preferable solution, incidentally, is to correct the gas divider or calibration gases.

a. Basic Instructions

Select the operating range desired.

Zero and span the analyzer in the normal way.

Select *Expert controls and setup*

Select *Analyzer module setup.*

Select *Gas measurement parameters...*

Select *Linearization functions...*

Select *Midpoint correction setup...*

You arrive at the setup for range 1, cycle through the other ranges by pressing "RANGE 2", "RANGE 3" and “RANGE 4" as desired.

Set *Correction:* to enabled.

Setpoint being measured: to point 1.

Flow the appropriate value of gas (typically 30% of scale).

Edit *Point 1 gas concentration*: to the named value on the bottle.

When the reading has stabilized, press “SET”.

Setpoint being measured: to point 2.

Flow the appropriate value of gas (typically 50% of scale).

When the reading has stabilized, press "SET” .

Setpoint being measured: to point 3.

Flow the appropriate value of gas (typically 75% of scale).

When the reading has stabilized, press "SET” .

Now do the same procedure for any other ranges you want to tweak.

b. Details

This algorithm applies a segmented straight-line approximation to the signal after the polynomial linearization has been done. It forces the reading through the points measured, and interpolates between the points on a straight line basis. You should only use this with care, to have to use it essentially admits that there is something wrong with the normal linearization setup, either a fault in the analyzer somehow or a fault in the test gas setup. The most usual reason for using this is to “correct" (actually, un-correct the analyzer) for inaccurate mid-point check gases in an EPA CEMS system. However if you are trying to linearize an analyzer to 2% of point at 2% of scale, this feature may save you when all else has failed.

Network variables: MID_GASA, MID_GASB, MIDPOINTA, MIDPOINTB, SPAN_THEN, TWEAK

c. Troubleshooting

The normal reason for failure with this procedure is an error in the setup. Verify you are editing the point that you have selected, or that you have selected the point you are editing. If you have messed up, go back and redo the points. Verify that the zero and span calibrations are correct. Also verify that you have selected the correct linearization curve, and that it is enabled. Verify that the analyzer is working correctly, for example that the ozonator lamp in a CLD.

1-10 RESPONSE TIME

The analyzer has a natural response time based on its gas passage design, and the response time of its sensor. However it is possible to add additional filtering to the signal, which will have the effect of increasing the response time while reducing the noise level.

The natural response time may be modified by changing the flow rate through the analyzer. This affects both the rise time and the delay time - the rise time is the time it takes from the beginning change in the output to the time that 90% of the final change has occurred, while the delay time is the time from the introduction of gas to the back of the analyzer to when that initial reading change occurs. The delay time will be reduced by increasing the flow rate, and the rise time may also be reduced in the same way, but only for flow sensitive analyzers such as the NDIR types. Note that increasing the flow may also change the response level, due to pressurization of the sample cell. The term “response time" is loose - sometimes it can refer to the rise time and sometimes to the overall response, rise time plus delay time. In the NGA it is used to refer to the rise time only.

In general, increasing the amount of filtering by editing the response time setting will first increase the order of the "Median" filter (this will also slightly increase the delay time), and then to increase the time constant of the third order infinite-impulse-response (IIR) software filter. The IIR filter is disabled for response times below about 0.5 seconds. Setting the response time to zero will completely disable all filtering.

You should normally set the response time for the longest possible value for your application.

The delay time should be set so as to delay the fastest responding analyzer in the system so that it responds at the same time as the slowest. The delay you need to be concerned with is the time from a sample gas change at the entry port to the time the reading just begins to move, not until it reaches its full change. You are then compensating for differences in sample path, as well as differences in analyzer performance.

The delay time adjustment was disabled in V2.2 of the PMD and NDIR analyzers, but enabled for V2.2.1 and later. Also on this screen is the LON update rate control. This sets the speed at which this particular analyzer updates its PVA variable -the primary or process variable, the main reading - over the LON. In almost all cases, setting this to 10 per second will be satisfactory. You can set it to ASAP, in which case it will update the PVA at up to 33 Hz, but doing so may make the system less responsive, particularly if you have several analyzers all on the LON together. The symptoms of excessive network traffic include difficulty getting PCs to update variables, and occasional lost menus - the system will seem to lock up, and only the left arrow key will work, then it will apparently come back to life again. They also include random failures generally in the network, such as I/O modules that do not respond to their analyzers. If this latter occurs, set the LON update time as above and then if the symptom does not go away immediately, rebind the I/O modules.

Network variables: AFT90_, AMDELAYTIME, LONPVUPDATE

a. Basic Instructions

Set the analyzer flow rates as desired.

Enter the *Main menu*.

Select *Expert setup and controls...*

Select *Analyzer module setup.*

Select *Gas measurement parameters...*

Select *delay/response time parameters...*

Edit the response time for each range as desired.

Edit the delay time as desired for the fastest analyzers in the system.

Edit the LON update rate for the desired rate, normally 10 per second.

b. Advanced Instructions

The menu paths as above.

Set the response time values for longer times on the lower ranges.

If there are apparent network collision problems, set the LON update rate to 1 per second.

For the most precise calibrations, set the response times to 20 or 30 seconds prior to a calibration, and then set them back to short times for operation.

c. Troubleshooting

Noisy analyzer signal…

The response time may be too short. Increase it until the noise level is satisfactory.

Poor system response to menu changes, and poor response to variable editing…

The LON update rate is too fast in one or more analyzers. Go through them all, setting the update rate to 10 per second from ASAP, or 1 per second. Via a PC, the variable to change is LONPVUPDATE, and it should be set to a value of 1 or 2.

One analyzer in a system responds faster than another on the same gas change…

Set the response time of the faster analyzer to the same as that of the slowest one. If there is still a problem, set the delay time of the faster analyzer so as to delay its signal compared with the slowest one. It can be hard to do this properly if you have very different response, times.

1-11 ANALYZER MODULE HISTORICAL DATA

Analyzer Modules contain varying amounts of historical data - values of parameters stored when the module was manufactured (or otherwise stored). These may be found in the diagnostic menus, normally either on a separate history menu or else shown alternately with the current data on the same menu.

The intention is to show how the analyzer was configured when it was tested, and therefore allow you to spot any differences that may be contributing to some performance shortfall.

It is possible to use this feature to store the current data in this way, if it is desirable to do so. Generally you should not do this unless you are sure that the analyzer is performing correctly, as you will overwrite the previous data and you will not be able to restore it.

It is also possible to store known good zero and span factors. In the screens showing the zero and span factors there are links to screens showing historical factors, and softkeys that store these, and also restore them into the current factors.

Network variables: AMVOLTSWAS, CONV_TEMPWAS, HIST2T_, HIST2V_, SPANWAS, ZEROWAS, WNXVOLTSWAS, SPAN_GOOD, ZERO_GOOD, CURR_WAS, PWAS, FLOW_WAS, TEMP_WAS

a. Basic Instructions

Enter the *Main menu…*

Enter *Technical level configuration*...

Enter *Service menus...*

Enter *Manufacturing data...*

Enter *Analyzer module data.*

Press "STORE", and after reading the caution screen, "STORE" again.

Press the "HOME" key to get back to the *Main menu*.

1-12 ANALYZER ALGORITHM

The Analog to digital converter is read 30 times a second. The value is stored as an integer in the 20 bit range.

There are 2 digital filters: A 7 point median filter followed by an IIR filter (controlled by the t90 time).

In the zero/span adjust section the raw signal (the output of the digital filters) is linearly converted to a scale based on the calibration coefficients (span factor and zero offset) using the following equation:

Output = SpanFactor * (Input -ZeroOffset)

If the output of the zero/span adjust is between -0.05 and 1.05 then the value is linearized. A forth order linearizer is used with the following formula:

$$Output = C0 + C1*Input + C2*input^2 + C3*Input^3 + C4*Input^4$$

The output of the linearizer (if used) or the zero/span adjust is input to the temperature compensation. The temperature compensation algorithms is as follows:

TempCompMultiplier = 1 + CaseTemperature + TempCompFactor

Output = input + TempCompMultiPlier

This feature is not normally used in the FID.

The output of the temperature compensation function is multiplied by CALRNGFU to generate the PVA output. The calibration routine (which is actually two routines a zero routine and a span routine) is used to adjust the span and zero offsets used by the zero/span adjust routine. It tries to adjust the factors so that when a 0 ppm gas is read a 0 will be output from the temperature compensation section and when a RNGHI ppm. gas is read, 1 will be output from the temperature compensation section. This is achieved using a successive approximation technique.

The values of the raw signal from the 20-bit ADC are typically 520,000 at zero, and somewhere under 900,000 at the highest fullscale range. The span value is quite variable and it depends on a series of factors as shown below.

Range fullscale values. In the case of the FID analyzer only, it sets its PGA gains and its preamplifier gains used based on a rather complicated algorithm. It does this in such a way as to verify that the maximum signal seen is less than the fullscale counts for a fullscale gas. The factors considered are: the range fullscale value; the response factor (methane or propane, etc.); the fuel type; the sample gas pressure; and the type of capillary. These gains are set for each range, but are not changed dynamically. Earlier than V2.3 CLDs adjusted their PGA gain based on the fullscale value, dividing the gain by 2 for every doubling of range above 100 ppm. Later CLDs and other analyzers do not use a PGA.

In the case of the FID, the pre-amplifier acts as a current-to-voltage converter, and its transfer ratio is selected from two alternatives by choosing either a 200 M or a 5 G feedback resistor. Following this there is a PGA which can select its gain from values of 1, 1/2, or 1/4. For methane and mixed fuel, the preamp changes gain at a fullscale range of 850 ppm. For methane and pure hydrogen, the equivalent value is 270 ppm. These values vary according to the other factors mentioned. It is not in general possible to say what scales are used in what ranges, but that information could be determined from a table.

You can display the main reading at a resolution of up to seven significant figures (on the platform). The PVA value is transmitted to a PC as a floating point value, also of about seven significant figures of resolution. The PC can display it according to its programming. This means that you could display the reading to hundredths of a ppm if the value of the reading is less than 99999.99 ppm. However, the noise level of around 0.1% of reading typically will make this of questionable value.

Network variables: RAW_SIGNAL, ZERO, SPAN, LINSTAT, LINA0_, LINA1_, LINA2_, LINA3_, LINA4_, CALRNGHI, BAROMETER, CAL_PRESS, CAL_PRESSURE, PVA, PVA-CEMS

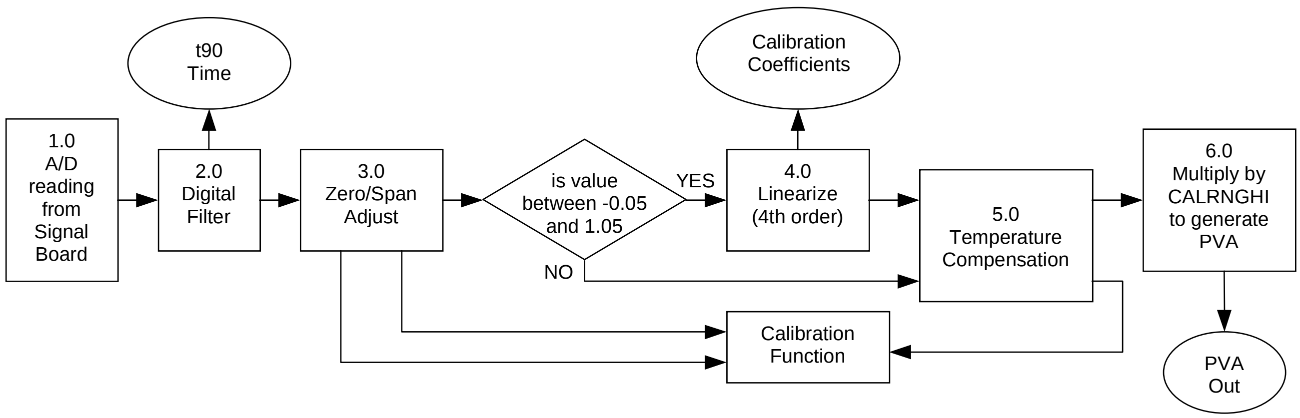

Figure 1-2. Analyzer Algorithm

1-13 SECURITY

You can enable security for each or all of the three main branches of the menus. In each case, you have to enter a five letter password in order to enter the appropriate section of the menus. Once you have entered the password, you will be able to enter or leave that section of the menus at will, unless you leave the instrument unused for a time out period, in which case you will have to re-enter security. If you make the passwords the same for each branch, entering one branch will disable security for all branches.

You can also set a time out for the menus themselves, after which the display will jump out of the menus. This in effect is another security device - it is practically impossible to figure out what to do in time if you set the time out to 10 seconds, thus it keeps people from making unauthorized adjustments.

Pressing the "LOCK" button on the main display screen will enable security immediately, cutting short the normal hold-open time.

a. Basic Instructions

Enter the Main menu…

Select Technical level configuration...

Select System setup...

Select Security codes...

Enable whichever set of codes you wish to use.

Select whichever security code you wish to configure.

Press the buttons in a suitable order. The code will be shown as a number.

Press the left arrow key when you are done.

Setup the other security codes as desired.

Press the left arrow key until you are in the System setup menu.

Select Front panel control...

Set the Drop out of menus after: line to a suitable time.

This line controls how long it will leave the menus showing after you have pressed a key in one.

b. Troubleshooting

Someone put in a password and now I'm locked out…

Call Rosemount Analytical Service and they will tell you a secret back door password. This will allow you to enter the *Technical level configuration* security screen, and then you can reset all the other passwords.

I put in passwords but I still don't have any security screens…

You have to enable security for each level you want it to work on. Do this in the screen immediately above the security password entry screens.

1-14 DATE AND TIME

The control module contains a real time clock which keeps accurate time despite power interruptions. It is normally more accurate than the clock in a PC. Every so often it updates the software clock in the other modules. A software clock is less accurate, and it loses its mind if the power fails. Such clocks are kept in the analyzer module computers, and also in the Autocalibration I/O modules.

Set the clock in the System setup menus under the Technical level configuration... menus.

See the Autocal module instruction manuals for details about setting up their timing.

Network variables: I_TIME, C_ TIME

a. Basic Instructions

Enter the *Main menu*.

Select *Technical level configuration*...

Select *System setup* ...

Select *Date and time ...*

Edit the time display format, and the hours, minutes, month day and year.

When all is satisfactory, press the "SET" button.

The *Current time:* line should now show the correct date and time.

Verify that the *network updating:* line is enabled.

1-15 SCREEN APPEARANCE

The appearance of the single analyzer display screen can be altered. You can select how many figures are displayed by the main reading, and you can select not only what the four auxiliary lines display, but also from which module they come, analyzer, I/O or Autocal.

a. Basic Instructions

Enter the *Main menu*.

Select *Expert controls and setup*

Select *System setup*...

Select *Main display configuration...*

Select *Display resolution...*

Choose the number of digits to be displayed altogether, and the number if any to be displayed after the decimal point.

Press the left arrow key.

Select *Auxiliary lines...*

Enable the number of auxiliary lines you want to show.

Select the source of each auxiliary line, following the menu instructions.

Press the left arrow key until you get back to the *Expert controls and setup* screen.

Select *Analyzer module setup.*

Select *Displayed physical parameters...*

Select the parameter to be displayed on each line. (This parameter will only be displayed if both this module is selected as the source for this line, and the line is enabled as above.)

Press the left arrow key twice, and select *Auxiliary module setup...*

Select the module you want, and then select *Displayed parameters...*

Select the parameters to be displayed from this module.

1-16 MANUFACTURING AND SERVICE DATA

The individual modules contain a menu that shows the manufacturing data appropriate to the module. It shows the serial number, the software revision, and other such data that is of use in quality assurance programs.

It can be found under *Technical configuration...*, under *Service menus...*

Also in this area are the service history menus. You can use these to record in service and last service dates, and you can also record service notes here if you want. The info screen for the control module shows the standard Rosemount Analytical service codes. Use these to save time editing letters.

You can also record security codes from this area. The menus are identical to those in *System setup*.

Network variables: AMSERNOTEA, AMSERNOTEB, AMSERNOTEC, AMSERNOTED, AMSERNOTEE, AMSERNOTEF, AMSERNOTEG, AMSERNOTEI, AMSERNOTEJ

1-17 ANALYZER STATUS

There are several kinds of status information reported by the analyzers. These include its alarm status, its operational status and its sampling status, its calibration activity and the validity of its output reading .

These are all reported over the network in the form of variables, and they are shown in various places in the menu structure.

a. Health (Alarm Status)

The analyzer continuously monitors the state of a whole series of internal parameters. It also monitors its operational parameters such as pressures and flows. The operational parameters may be assigned upper and lower limits, while the internal parameters have such limits fixed by the programming.

If a limit is exceeded, an alarm flag is set, and the alarm status variable is set to a level corresponding to the severity of the parameter. Most parameters cause a WARNING state to be set, but the internal parameters may cause a FAILURE state to be set. If any of the parameters is outside its Emits, this state will be set.

If you have allowed it to (by enabling alarm reporting in the technical setup section), a message will be displayed on the screen as well.

Otherwise you can show the alarm state by selecting "Health" to be reported in the auxiliary line selection under *Expert controls and setup*

You can set an I/O module to report this by setting up its alarm parameters to report the analyzer alarm state in the *Auxiliary module setup* under *Expert controls and setup*

Network variables: GENERALSTATE

b. Analyzer Operational Status

The analyzer may be in normal mode, in standby (meaning that it has not warmed up yet, or otherwise cannot take readings), or is in calibration. This state may also be reported in the auxiliary lines, and by the I/O module.

Network variables: OPSTATUS

c. Analyzer Sampling Status

An I/O module that controls the sample flow, such as an Autocal module or a sample stream selection module can tell the analyzer that it is not looking at the sample. This can also be reported like the other variables.

Network variables: PROCESS

d. Analyzer Calibration Activity

The analyzer reports when it is in the process of performing a zero or span. This is shown on the zero and span screens to tell you what it is currently doing. This information is also reported to an Autocal module as feedback so that the latter can tell when to go onto the next step.

Network variables: CALSTAT

e. Analyzer Calibration Status

The analyzer reports the status of its last calibration, together with its time and other data. This may be found on the "Results" menu under *Expert controls*, under *Expert controls and setup*

Network variables: CAL_ERR_MSG, CAL_RAWSIG, CAL_VALIDITY, CALDATE_Z, CALDATE_S

f. Analyzer Validity Status

The analyzer attempts to determine whether its readings may be regarded as valid or not. It looks at the operational state, and the health state (both must be normal), the sample flow (which must be above a minimum value), the sample and other pressures, its calibration state and whether it is being fed the sample or a not-from-process gas. It may also look another specific analyzer factors. If any of these are out of specification or clearly inappropriate, it reports its VALIDITY variable as INVALID. This may be seen on the auxiliary lines, and reported via the I/O module like the other status variables.

Network variables: VALIDITY

1-18 ANALYZER INTERNAL DATA STORAGE

Analyzers store up to 24 hours of averaged data in their volatile memory. It is stored as 96 fifteen-minute averages. You can select which two variables out of a list of about 20 are stored. The analyzer validity, and calibration status, as well as the time of each segment are stored.

This data can be retrieved using a computer interface. It is not available through the menus.

It is intended for certain CEMS monitoring requirements where data must be reported to a monitoring authority, and absence of data due to, for example a fault in the monitoring computer will cause significant monetary cost.

NOTE

The data is volatile!

If you lose power, the data is lost. However if the analyzer power stays on, the data remains despite network upsets and anything else that happens.

a. Basic Instructions

Select Technical level configuration...

Select Diagnostics menus...

Select Analyzer module diagnostics...

Select Trend display control...

Select the desired parameters to store.

Setup a computer with a suitable LON interface.

Using the DDE server program and an application such as Excel, use a macro or program to interrogate the analyzer.

It will take a few minutes to download all the data.

b. Details

The data is stored in an array inside the analyzer memory. The data may be retrieved by the use of two specific variables, DATA_INDEX and DATA_POINT.

You set DATA_INDEX to refer to a particular data point, wait for about one second, and then read DATA_POINT.

Both these variables are arrays, whose elements refer to specific things. See the variables appendix for details.

The Excel example spreadsheet called NGATREND.XLS shows how to do this in the Visual Basic for Applications language.

If the analyzer has not been powered for the full 24 hours, the unused sets of data will be filled with large negative numbers. This is so that it will be obvious that the data is not correct.

The analyzer puts the data into the appropriate time slot. If its internal clock is not corrected by a platform, this may be wrong. However the analyzer will store the time for each data point along with the data, so you can see which data is which. The data is retrieved point by point, so that you have to be aware when the day has rolled over.

Network variables: DATA_POINT, DATA_INDEX

c. Troubleshooting

I only get one data point…

You probably are not writing the DATA_INDEX correctly. Verify that this variable is indeed being written. Excel does not tell you if it has failed to poke a value. Common reasons for this include having the wrong network address, trying to poke a variable or a value, rather than a spreadsheet cell address, or a typo in the variable name.

You may also not be waiting long enough for the analyzer to respond. In the Excel example above, the macro writes DATA_INDEX, then reads DATA_POINT and does so repetitively until the index reported in this variable is the same as that requested.

I get lots of data, but it has a discontinuity in it…

The time rolls over after 24 hours. Each point is stored at a particular segment of memory, overwriting the point stored 24 hours earlier. So if you read the points from 1 to 96, somewhere the day will switch from today to 24 hours ago.

Use the reported time cell to sort the data so it is an appropriate order.

The data seems to be full of garbage…

The analyzer stores internal data in volatile memory. If there is loss of power, this memory is reset. When this happens, the internal storage is set to nonsense values, and the analyzer starts recording data in the area in the memory appropriate to the time of day, if it knows what that is from a network update. Only the section of memory that has been filled since the power failure will have any meaningful data in it.

1-19 SERIAL I/O MODULE

There is available in the platform a non-LON I/O module that can produce up to 8 channels of 12-bit analog outputs, as well as 3 alarm contacts and a serial (either RS232 or RS485) port.

a. Details

The serial I/O board is not a LON module like the other I/O modules. It communicates directly to the processor in the control module. As a result its menus are not like those in the single channel I/O modules.

Its analog outputs are arranged in groups of two. Each output is available as both a current and a voltage simultaneously, although you can only calibrate one of these at a time. Each output is isolated from the main analyzer and control module ground, but each pair has no isolation between themselves, they share a common ground with each other.

You can add up to three more pairs of analog output onto an serial I/O board. However you can only have one serial I/O board in a system.

You can add a serial interface module to the serial I/O board, configured either for RS232 or RS485. You can then select which interface protocol to use with this. See the interface section of this manual below for details.

You have to configure the serial I/O card manually, telling it what modules have been installed. Telling the computer the wrong thing will degrade the response time of the system, but will not cause a crash.

b. Troubleshooting

I configured the serial I/O module output but nothing happens…

Verify that you do in fact have an serial I/O card installed, remember that the menus are there regardless. Also verify that you have connected wires to the correct I/O board, not to a normal I/O card.

Also, verify you have edited *Module installed*: to YES.

I set the serial I/O module up for Modbus (or AK) and nothing happens…

Verify that you have the serial interface option installed. You have to do this by looking at the board.

Also verify that you have selected the correct module type under *Type of installed serial interface:*

How do I configure the relay outputs of the serial I/O module…

The relays are not configurable. They only work as described above.

If you want to have concentration alarms you need to use an analog I/O module.

1-20 NETWORK ISSUES

NGA analyzers operate over a digital network called the LON. All of the internal data is available over this network.

It is possible to access this information directly using appropriate hardware and software, but to do so requires a certain amount of software effort. To avoid this, and to accommodate users with investment in other protocols, several methods of retrieving this information and allowing control and configuration of the analyzers directly have been included.

a. LON Data

Data is sent over the LON as discrete packets called "Variables". These correspond with normal programming variables, except that they are available to anything on the LON capable of reading them.

There are also other packets of information used by the NGA system, but these are not accessible to non-NGA devices.

LON variables may be of four basic types, floating point, integer, enumerated or string. In addition, all but string variables may be packaged into arrays, with a maximum of seven floating point numbers per array, or ten integer or enumerated types per array.

Integer

A number between 0 and 65535, expressed as a 16-bit number. There can be up to 10 integer variables in an array.

Floating point

A four byte IEEE floating point number (in Motorola format). This is a number that can take a very wide range of values, but provides only about seven digits of precision. The analyzer main reading is expressed as a floating point number. There can be up to 7 floating point variables in an array.

Enumerated

An integer number whose value corresponds to a phrase. These are used to express one of several possibilities. A typical example is the variable that determines whether or not a linearizer is enabled: a value in the variable of 0 is translated as DISABLED, while a value of 1 is translated as ENABLED. There can be up to 10 enumerated variables packaged in an array.

String

A string variable contains up to 31 characters of ASCII. These are numbers which refer to the standard letters, numbers and odd symbols in the ASCII character set. There are in general no restrictions on the symbols contained in a string variable, except that the DDE server may not work correctly if analyzer TAG variables contain symbols other than the alphanumeric set. There are no string arrays.

b. LON Data Details

See Section 2 for details.

1-21 MODBUS

Modbus is a protocol developed by Gould Modicon, who provide documentation for it. The protocol is in the public domain. It operates over RS232 or RS485 links. It is a master - slave protocol - a master requests or writes information, and the slave responds. In the NGA case, the NGA control module is a slave.

In Modbus, all information is defined as existing in "registers", accessible by their address. These registers may contain integer, floating point (in our implementation) or string information. Registers are addressed by a scheme that determines first the analyzer module (or sub-node) with which it is desired to communicate, then the variable address within the analyzer. All NGA variables are available as registers. These may be read or written to, though output variable registers will ignore anything written into them.

The host may access individual registers, or may define a list of variables that can be addressed as one. This definition may be performed either as a Modbus command or via the control module.

A list of available variables and their corresponding registers is available from the Modbus connection directly as an ASCII file.

1-22 PC LON INTERFACE

It is possible to connect a PC to the LON. You can monitor variables, and you can write values into the configuration variables as desired.

It is possible to write software that uses Echelon libraries to directly interface with the LON, however this is not an undertaking for the faint of heart. If the performance limitations are acceptable, a better alternative is to use the DDE function in Windows to enable high level applications such as Excel or Labview to communicate with the analyzers.

Rosemount Analytical can supply a package of software that allows this functionality. This consists of a "DDE server" program, and some examples that show how to use it.

a. Performance

Windows allows a cycle time of about 65 micro seconds for the DDE protocol. This means that it is possible to get about 10 variable updates per second through the DDE server.

The DDE server is restricted to polling the network - that is to say it has to request a data update every time it wants one, rather than simply listening to the network the way the control module does. This also Emits the performance and may interfere with the operation of the control module menus (they will get slower and unresponsive eventually).

All Windows programs tend to be somewhat unstable, particularly if there are many entries and exits of Microsoft applications, due to the memory "leakage" problems afflicting them. It is as well to have someone check a PC for correct operation on a daily basis.

At this writing, Windows 95 operation has not been tested.

NOTE

It is not possible to write data into a platform control module from a PC, due to the control module's acting as a network manager.

It is also not possible to write configuration data into an I/O module, since its configuration variables are configured as output variables.

b. Basic Operation

A suitable LON hardware interface must be installed and its driver installed into the "CONFIG.SYS" file. For example, using the Echelon SLTA serial device, the driver LDVSLTA.SYS must be installed into CONFIG.SYS, with appropriate switch settings (/p1 /d1 /a is typical). See the Echelon documentation for details. Reboot the computer so it takes effect. You may have to use the memory management utilities until the DOS memory is adequate for the applications.

Install the Rosemount Analytical DDE server program by typing "SETUP" in the Run... prompt of the Windows program manager. It will be installed together with the example files into a new directory called NGASUITE.

Start the DDE server program. It will interrogate the network, and once it is done it will retire to an icon. You can open the icon and select "File", and then the network information, and see what nodes are found. The names and addresses of the nodes can be directly edited by double clicking on the appropriate field.

Verify that the TAG names do not contain periods or arithmetical signs such as "-“ or “/”. Edit them if they do.

Further help can be found in the accompanying documentation and in the "Help" screens built into the DDE server itself.

Open the desired Windows application and use its DDE functionality to transfer data to and from the DDE server.

c. Details

Variables are continuously updated by their source modules. If the module has been bound to another, they will be updated onto the network and sent to whichever nodes it has been bound to, if only the control module.

Certain LON devices can listen in to this traffic, but the DDE servers provided either by Echelon or Rosemount Analytical are not capable of doing this, they have to specifically request data. They also need to have a variable data base so as to be able to understand the data. This has to be provided externally to the Echelon server by the Rosemount Analytical MAKE_API program; the Rosemount Analytical server makes its own database automatically.

If analyzers are used with no control module, it is helpful to disable their autonomous outputting of data. They have normally been checked out with a control module, and therefore think that it is still there, and so they try to communicate with it. You can disable this by running the MAKE_API program with the switch "-c", i.e. MAKE_API -c. This will improve the performance of such networks.

The Rosemount Analytical DDE server program provides a number of features that are optimized for the NGA system, and thus is the preferred solution. In particular it reports the population and identity of modules on the network, allowing applications to configure themselves automatically and removing the need for user to understand what is happening.

The following is a brief explanation of how to use the Rosemount Analytical DDE server program.

DDE is a Windows feature that allows programs to communicate with each other. It is organized as a "conversation", with topics and data. You start a conversation, determine a topic and request or write (Poke in Visual Basic, or Excel) data.

d. Using Excel with the DDE Server

Basic DDE Points In Excel

Excel can either read variables directly into the spreadsheet using a formula, or it can read them by requesting the data in a macro. It can only write into a variable using a macro.

Macros in Excel (v5.0 or later) are written in a kind of Visual Basic (called VBA, Visual Basic for Applications). The examples given here are written in that language. Please see the Microsoft documentation for definitions of the terms used in the following paragraphs.

When reading a variable, the result is returned as an array of characters. If this is written into a cell in a worksheet, it is automatically turned into a number or string or whatever is appropriate - except for dates, which are helpfully translated into the date serial number. You can translate it back by formatting the cell as a date.

If you try to assign a DDE request into a VBA variable, unless you declare the variable to be of type variant, or declare it to be an array of strings, it will give you an error. If you want the variable to be a number, or a string, you have to convert it in some way. The easiest way is to write it into a worksheet cell, and then read it back. Otherwise you can use a function to do it, an example of which is

"LON-into-string0" in the excel spreadsheet examples.

The only way to write (or poke) a variable is to write a spreadsheet cell. You cannot write a value of a cell, or a variable. If there 'is an error in defining the cell, the poke function will fail and it will not tell you why. The cell must be formatted as text, you cannot write a number or a date.

Spreadsheet Cell Formula

=NGDDESRVInetvar!Node_name

VARIABLE_TAG

The TAG can be used as the node name, or the node number.

=NGDDESRVlnetvar!TAG

VARIABLE_TAG

The TAG MUST NOT contain spaces.

Using the node number:

=NGDDESRVInetvar!'"n"

VARIABLE_TAG

n is the node number. Note the " ' " before and after the address variable string.

To Get An Array Element

+NGDDESRVlnetvar!TAG

VARIABLE_TAG [n]

n is the array element

The DDE server does not check for out-of-bounds arrays.

Reading A Variable

Start a DDE conversation

Dim DDE_Channel as Integer

DDE_Channel = DDEInitiate(DDESRVR, netvar)

Setup to read a variable

Dim Variable-return as variant

Dim LON_Address, Analyzer_tag, Variable_name as string

Establish what ANALYZER_TAG and VARIABLE_NAME are here. The Chr(34) expression inserts a quote ("), used to handle the case where the TAG variable contains non-alphanumeric characters, such as #, &, +, or - . You can't write “” in an attempt to persuade VBA to insert a quote, you have to use the Chr(34) function. 34 is the ASCII decimal code for a quote.

LON_Address = Chr(34) & Analyzer_tag & Chr(34) & "" & Variable_name

Variable_return = DDERequest(DDE_Channel, LON_Address)

Write it into a spreadsheet cell

Worksheets(Worksheet).Cells(Row_number, Column_number).value=Variable_return

Worksheet, Row - number and Column= number are variables or expressions that determine which spreadsheet, and which address you are using.

Establishing Analyzers Present

The DDE server provides a list of the analyzers and their types present on the LON. This can be obtained by opening a conversation with the topic "Nodelist". Asking for "number" will tell you the number of nodes found, and asking for “get" will return a list of them and their types.

In a macro, open a DDE conversation with the expression

Dim DDE_Channel as Integer

DDE_Channel = DDEInitiate(NGDDESRV, nodelist)

Get the number of nodes present:

Dim Number_of_nodes as String

the return from the DDE server

Dim Integer_number_of_nodes as integer

the result we want.

Dim Variable_return as variant

(You don't need to do this twice if it has been defined before)

Variable_return = DDERequest(DDE_Channel, "number")

Number_of_nodes = LON_into_string(Variable_return)

LON_into_string is a function you can find in the demo spreadsheets. It converts the array returned by the DDE link into a string.

Integer_number_of_nodes = Right(Number_of_nodes, Len(Number_of_nodes) -1)

Number_of_nodes is a string "An", where n is the number of nodes. The above expression strips off the "A" from the front of this, and converts the "n" into an integer.

Now get the list of nodes

Dim Node_list_array as variant

Dim Node_list as string

Node_list_array = DDERequest(DDE_Channel, "get")

Node_list = LON_into_string(Node_list_array)

NODE_LIST will be a set of triplets, arranged as NODE_NUMBER, NODE_TYPE, and NODE_TAG. The series repeats for each node.

See the spreadsheet "NGCHECK.XLS" for an example of how to extract node names from this string.

Writing To A Variable

The only way to write to a variable is to use a macro expression.

Using the variables defined above, supposing that you want to write the contents of the cell defined by ROW_NUMBER, COLUMN_NUMBER to the variable LON_VAR:

Use the following format.

LON_Address = Chr(34) & Node_tag & Chr(34) & "" & LON_VAR

DDEPoke DDE_Channel, LON_Address, Worksheets(Worksheet).cells(Row_number, Column_number)

This will write the contents of cell; Row_number, Column_number in worksheet whose name is stored in the variable Worksheet, into the LON variable LON_VAR.

NOTE

The worksheet cell MUST be formatted as text! Also note the absence of parentheses.

1-23 AK

AK is a European automotive protocol. It runs on RS232 or RS485. It is structured as a series of ASCII strings that require a particular response. Analyzers made in the USA do not in general support the entire AK command set, however they do support a new command pair that allows reading and writing of any NGA variable.

a. AK Example Using The Windows Terminal Emulator

First, configure the platform to accept AK. Verify it has an "serial I/O" board with RS232 adapter plugged in, and under *Expert controls and setup*, select *Local //0 setup*. In this screen, set the *Module installed*: to Yes, and *Type of installed serial interface:* to RS232. (You may have to set the configuration parameters, but the default values are normally correct.)

In the terminal emulation program under Windows, set the function keys to have commands as follows:

Label "Reading" - command "^M^B_AKON K1^C”

Label "Flow" - command “^M^B_ASVC K1 S600 FLOW_IS1^C”

Label "Pressure" - command “^M^B_ASVC K1 S600 PRES_ IS1^C”

Put in other commands as you desire. In general, the line is:

^M^B_ASVC Kn S600 VAR_TAGm^C

n is the node number - "0" gets all the nodes

VAR_TAG is the tag of the variable

m is the array index (I based) of an array variable.

S600 refers to the non-standard AK service function number 600 used for this.

For zero and span commands, use ^M^B_**ESVC Kn S600 AMFN 1**^C to zero, and ^M^B_**ESVC Kn S600 AMFN 2**^C to span, with reset to 0 after a second or so of each command(^M^B_**ESVC Kn S600 AMFN** 0^C).

1-24 ALARM I/O MODULE GENERAL INFORMATION

Information about this module may be found in the Platform manual. However there are some more subtle points not covered there.

Version V2.2 and earlier I/O modules had general alarm functions, but were not capable of responding to specific analyzer conditions or of giving analyzers specific commands. Version 2.3 and later I/O modules are capable of both of these functions. They are controlled by a modification of the menu handling code in the V2.3 Platform Control module that is capable of putting values from analyzer variables into the I/O module menus, thus allowing the user to select analyzer specific options.

Network variables: AM_INPUT, DI_MSGE, ST1NAME, ST2NAME, STCONT

a. Setup Procedure

Binding To Analyzers

See Section 1-2b on page 1-2 Binding.

Setting Up Analog Output

The analog output is available either as a voltage or a current output. However only one is meaningful at a time, the other one will have incorrect readings even though it is physically present.

You can setup the output to track the analyzer ranges, to change the analyzer ranges automatically, or to report only one range despite what range the analyzer is on. You can also attach remote range control lines to the I/O module and it will control the analyzer's range. See Section 1-3 on page 1-7 for more details on the ramifications of this.

b. Details

The analog output module is a self contained computer that uses the Echelon Neuron chip as its processor. It gets data from the network, and it performs the necessary calculations to produce the analog output and the relay indications.

It updates its analog output at 100 micro seconds intervals. The output circuit uses a 16-bit DAC, producing a resolution of about 0.3 mV or 1 uA.

Because it communicates to the analyzer over the network, there are inherent delays involved. If the remote range change option is used, there will be a delay of about a half of a second before the output responds to the range change request.

The various diagnostic measurements are made of the actual parameter measured. They are not calculated based upon the desired result, they are a direct measurement of it, as close to the reality as possible.

Thus the output voltage is measured at the output circuit just before the EMC protection devices, and the relay states are measured by inspecting the state of the second relay contact.

The output current is measured as a voltage across the output terminals. It may be reported as a current by entering the load resistance in the diagnostic screen. However this is not a direct measurement of the current.

In any case, the voltage measurements do not have the resolution of the output circuits, and so should not be used to calibrate the latter.

1-25 AUTOCALIBRATION MODULES

There are two types of Autocal modules available, a single analyzer module and a four-analyzer module. The former provides greater flexibility when dealing with a single analyzer system, but the latter is more economical in multiple analyzer systems. The single channel module also provides an analog output that is identical to the one in the Analog Alarm I/O Module, but cannot automatically change ranges.

These modules are physically identical to the Analog Alarm I/O Module. The only difference is the software contained in the ROM.

a. Troubleshooting

I press Zero and the analyzer zeros off the sample…

The analyzer zero and span controls are not linked to the Autocalibration module. If you want to do an automatic calibration, enter the menus, enter *Expert controls and setup* and enter *Auxiliary module controls...,* select the *Autocalibration module* and press "START'". Simply to do an automatic zero you have to select the *Manual calibration* function in this screen, select *zero gas* and the *zero operation*, and press "START".

I set a start time but the module didn't do anything…

Verify the system clock is set correctly, and verify that the start day and time you chose is in the future from the time you set it. Then wait until that time.

I want to synchronize several analyzers to calibrate at once…

You should use the system Autocalibration module for this. You can only synchronize the zero start times between Autocalibration modules.

I put zero and span gases into the analyzer but the analyzers won't calibrate…

Verify that you have set them to calibrate, not QC check in both the zero and span gas valves, and also the general parameters. Verify that the gases are correct, and the analyzers are not trying to correct so much that their calibration limit checking stops them. Also verify that your dwell times are long enough that the zero and span readings are reached.

The analyzer does funny things on span, I can't figure it out…

If the analyzer changes range due to the Autocalibration module telling it to do so, the reading will possibly change, particularly if the ranges are not themselves all calibrated. Verify that all ranges are either calibrated or that the system is setup to work on one range only If this is the case, it is safest to set all ranges to be the same, then it won't matter if you have a range change.

b. Differences Between The System Autocalibration Module And The Single Autocalibration Module

The System Autocal Module is identical physically to the Single Autocal Module. However it does. not provide an analog output. It can zero up to four analyzer modules simultaneously, and span any of them on any range on each of its four span gas valves.

Set it up in the same way as for the single Autocalibration module, except that for each span valve you have to choose not only which analyzer but also which range to span on.

The module's menus refer to Analyzer 1, Analyzer 2, Analyzer 3 and Analyzer 4. There is a menu available which will let you tell which analyzer is which.

c. Use Of The System Autocalibration Module And The Single Autocalibration Module

Use the System Autocal Module when you want to synchronize calibrations of up to four analyzers in a system and you are using a common sample system for them all. Use the single Autocalibration module when you have just one analyzer, or when you have separate zero and span gas paths into multiple analyzers. In this case you can use multiple single Autocalibration modules in a system, and synchronize their operation. Finally you can use several single Autocalibration modules together with a system Autocalibration module and synchronize them all.

NOTE

The synchronization merely synchronizes the start time of the sequence, the subsequent sections are NOT synchronized.

1-26 SYNCHRONIZING AUTOCAL MODULES

Autocalibration modules can be synchronized by assigning them master, slave or independent status. A Master will force any slaves in the same system to start their calibration sequence when the master does. A Slave will not perform a calibration unless the Master tell it to. An Independent module will ignore a master, and simply work on its own internal timing.

a. Basic Instructions

Enter Expert controls and setup

Enter Auxiliary module setup...

Select the module.

Enter General parameters...

Select This module's control status:

Edit this to MASTER, SLAVE or INDEPENDENT.

SECTION 2
ANALYZER VARIABLES

2-1 INTRODUCTION

This section describes the NGA analyzer variables. This description is taken from the "CSV" files that are used to build the software for each NGA module, and where conflicts exist, the "CSV" file takes precedence.

The following variables are defined in the analyzer module and are also used by the I/0 module:

CALSTAT	PVACEMS
CONTROL	PVU
GAS	RNGHI
GENERALSTATE	RNGLO
I_TIME	SVCONT
IOHOLDCAL	SVNAME
MAXRANGE	TAG
MINRANGE	TIME_LEFT
OPSTATUS	VALIDITY
PROCESS	

AFT90

Direction	Bidirectional
Binding	AFT90
Type	4-element floating point
Value range	0.0-30
Units	Seconds
Description	Determines the filter time constant for the primary reading. This may be different for each range - element 1 applies to range 1 and so on.
Usage	Setting this to 0 removes 0 filtering. Setting it to less than about 1 second removes most of the median filtering, if the analyzer has any. Setting it higher will remove noise from the signal, but at the expense of response time. Those analyzers with inherently long response time, such as long cell IR analyzers, should use larger numbers. Otherwise, set this as large as is consistent with the response time you wish to obtain.
See also	LONPVUPDATE AMDELAYTIME

ALARM_LVL

Direction	Bidirectional
Binding	None
Type	Enumerated
Value range	ANY; WARNING; FAILURE; SAFETY FAILURE
Units	None
Description	Determines the level of alarm reported over the network.
Usage	The alarm task will report any alarms of equal or higher value than that selected. It is impossible to stop safety failure alarms from being reported, although currently these are only present in the FID analyzer. This variable may be superseded in releases later than 2.2.
See also	

AM_INPUT

Direction	Input
Binding	None
Type	Enumerated
Value range	Analyzer specific: FID - LIGHT_FLAME; CLD- NOX_MODE, OZONATOR_ON; Not present in NDIR or PMD modules.
Units	None
Description	Shows which functions can be controlled by an 1/0 Module's digital input
Usage	Used to select the operation of the 1/0 Module's digital input line. Its value appears on the 1/0 Modules' menus that control this function.
See also	ST1CONT

AMBC

Direction	Bidirectional
Binding	AMBC
Type	String
Value range	31 characters
Units	None
Description	Describes the analyzer physical configuration (e.g. bench type).
Usage	This is a descriptive variable. It should not be changed unless the analyzer hardware is changed.
See also	TAG AMSN GAS

AMDELAYTIME

Direction	Bidirectional
Binding	None
Type	Float
Value range	0-30
Units	Seconds
Description	Delays the primary reading by this amount
Usage	Used to delay the output of one analyzer with respect to another, so as to cause their responses to a gas change to be aligned in time. This is only useful for systems of analyzers.
See also	AFT90_

AMFN

Direction	Bidirectional
Binding	AMFN
Type	Integer
Value range	0 No operation I Zero on the gas currently present 2 Span on the gas currently present 4 FID light flame; WNOX dump drain valve 8 Analyzer specific function 16 Refresh all network variables over the network 32 Measure linearization gas 64 Calculate fourth order polynomial from stored gas data 127 Abort present operation 128 Measure linearization "tweak" gas More may be added in the future.
Units	None
Description	Initiates and aborts specific analyzer functions.
Usage	Set this to 0 before and after any other number - the analyzer responds to a change in this variable's value. Leave it on the desired value for a second before changing it back to 0. This variable is used by other modules on the network to initiate actions in the analyzer, and may also be used by PC programs to do the same thing.
See also	ACFN in autocal modules

AMHR

Direction	Bidirectional
Binding	AMHR
Type	String
Value range	31 characters
Units	None
Description	Describes the hardware revision level
Usage	Descriptive only, this is not currently in use. AMBC is usually used instead.
See also	AMSN TAG AMBC

AMLSDATE

Direction	Bidirectional
Binding	None
Type	String
Value range	31 characters
Units	None
Description	The last service date
Usage	Automatically loaded with the current date and time when the menus are entered for this analyzer.
See also	AMSERVDATE AMMFGDATE

AMMFGDATE

Direction	Bidirectional
Binding	AMMFGDATE
Type	String
Value range	31 characters
Units	None
Description	The manufacturing date
Usage	Set by the manufacturer when the module passes final test during the manufacturing process. This should not be changed lightly!
See also	AMSERVDATE AMMFGDATE

AMSERNOTEA, AMSERNOTEB, AMSERNOTEC etc. to AMSERNOTEJ.

Direction	Bidirectional
Binding	AMSERNOTEA, B etc.
Type	String
Value range	31 characters
Units	None
Description	Service notes
Usage	A set of string variables for the user to store service notes into. The info screens for the menus in which these variables are shown list the standard Rosemount Analytical service abbreviations.
See also	

AMSERVDATE

Direction	Bidirectional
Binding	None
Type	String
Value range	31 characters
Units	None
Description	The in-service date
Usage	Manually entered when the unit is put into service. This is optional.
See also	AMSERVDATE AMMFGDATE

AMSN

Direction	Bidirectional
Binding	AMSN
Type	String
Value range	31 characters
Units	None
Description	The module serial number.
Usage	Set by the manufacturer when the module passes final test during the manufacturing process. This should not be changed lightly! It should match the serial number on the analyzer case. If the analyzer computer board is exchanged, this value along with all others should be corrected.
See also	AMHR AMBC TAG

AMSR

Direction	Bidirectional
Binding	AMSR
Type	String
Value range	31 characters
Units	None
Description	The module software revision number.
Usage	Set by the software compilation process. This variable may be written to, but it is not stored in non-volatile memory, so its value will revert to the ROM value on a power cycle. In general, you can only use analyzers of a given revision level with control modules of the same or higher level revision, at least up to revision 3.0..
See also	AMHR AMBC TAG

AMVOLTSWAS

Direction	Output only
Binding	None
Type	4 to 6-element floating point array. See VOLTS-IS for details.
Value range	Nominal power supply values, plus or minus a volt or so.
Units	Volts
Description	Stored values of the power supply voltage array VOLTS-IS.
Usage	Stores the values of the power supply voltages at manufacturing check out time. Compare the present values to this in order to see what has changed. Only write into this if the electronic hardware has been changed. There is a special function in the manufacturing data screen which automatically stores this and other such variables.
See also	VOLTS_IS PRES_WAS FLOW_WAS TEMP_WAS ZERO_WAS SPANWAS PVWAS

AUTO_REIGNIT

Direction	Bidirectional
Binding	None
Type	Enumerated
Value range	DISABLED; ENABLED
Units	None
Description	FID only; controls the auto-re-ignition function
Usage	When enabled, allows the ignition function to attempt to ignite the flame a number of times if the first time fails. This does not allow the FID to re-ignite its flame if the flame goes out - for safety reasons this is a manual feature only.
See also	AUTOIGNITE

AUTOIGNITE

Direction	Bidirectional
Binding	None
Type	Enumerated
Value range	DISABLED; ENABLED
Units	None
Description	FID only; enables the autoignition function.
Usage	Enables the automatic ignition function. This allows the FID to go through the correct sequence of making the mixture richer, firing the glowplug, and determining whether a flame has ignited. If this variable is set to DISABLED, the user has to manually set the mixture and the glow plug firing.
See also	AUTO_REIGNIT

BAR_ENABLE

Direction	Bidirectional
Binding	BAR_ENABLE
Type	Enumerated
Value range	DISABLED; USE REMOTE READING; TRANSMIT LOCAL READING; USE LOCAL READING
Units	None
Description	Controls how the analyzer deals with BAROMETER
Usage	Selects whether the analyzer uses its internal pressure reading if any, or a network reading, or transmits its reading as BAROMETER. Only one analyzer in a system should transmit BAROMETER at once. If more than one do, BAROMETER win switch between the two values provided by the analyzers, producing an unstable PVA value.
See also	BAROMETER PVA

BAR_INTERNAL

Direction	Output
Binding	BAR_INTERNAL
Type	Floating point
Value range	1013 ± 3% except for NDIRs ± about 50%
Units	hPa
Description	NDIR or PMD only; internal measurement of the sample exhaust pressure.
Usage	Reported value of the internally measured pressure, as distinct from the network readable pressure BAROMETER. The analyzer uses BAR_INTERNAL if it is set to use its internal pressure measurement, BAROMETER if set to use the external one.
See also	BAROMETER BAR_ENABLE

BAROMETER

Direction	Bidirectional
Binding	BAROMETER
Type	Floating point
Value range	1013 ± 3% (except NDIR). The NDIR is capable of operating over a range of ±400%, as long as the pressure transducer circuit gain (PCOMP_GAIN) is set to 1
Units	hPa
Description	Contains the present absolute barometric pressure.
Usage	Transmitted by an analyzer which measures the pressure - as controlled by the BAR_ENABLE variable. Read by other analyzers which do not contain an absolute pressure transducer. Used to compensate PVA for pressure changes. Other analyzers use PRES_IS as the name of their pressure reporting variables, but these report gauge, not absolute pressures.
See also	BAR_ENABLE PVA BAR_INTERNAL PRESS_IS PCOMP_GAIN

BLOCK_THRESH

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	3-5
Units	Amps
Description	CLD only; minimum full-on FET current
Usage	Sets the minimum current allowed for successful sensor block heating.
See also	BLOK_SETP

BLOK_BIAS

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	50
Units	C
Description	CLD only; bias temperature for the sensor block temperature control algorithm.
Usage	Used in the sensor block temperature control FID algorithm. This value should not be adjusted.
See also	BLOK_IGAIN BLOK_PGAIN BLOK_SETP

BLOK_IGAIN

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0.003
Units	None
Description	CLD only; the integral "gain" for the sensor block temperature control algorithm.
Usage	Used in the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	BLOK_BIAS BLOK_PGAIN BLOK_SETP

BLOK_PGAIN

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0.2
Units	None
Description	CLD only; the proportional gain for the sensor block temperature control algorithm.
Usage	Used for the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	BLOK_BIAS BLOK_IGAIN BLOK_SETP

BLOK_SETP

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0-50
Units	Degrees C
Description	CLD only; the set point for the sensor block temperature control algorithm.
Usage	Used to ' determine the set point for the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	BLOK_IGAIN BLOK_PGAIN BLOK_BIAS

CAL_ERR_MSG

Direction	Output
Binding	CAL_ERR_MSG
Type	2-element enumerated array
Value range	CAL OK: USER ABORTED; ZERO TIMED OUT; SPAN TIMED OUT; ZERO OVER LIMIT; SPAN OVER LIMIT.
Units	None
Description	Results of last zero (element 1) or span (element 2) operation
Usage	Shows the results of a zero or span operation. If the value is greater than 0, some kind of failure occurred. ZERO (or SPAN) OVER I= means that the reading just before the zero or span operation was in error by an amount greater than that in CALFPC.
See also	CAL_VALIDITY CALFPC

CAL_PRESS

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	189-650
Units	hPa
Description	FID only; expected sample pressure during calibration.
Usage	Used to determine the gain settings, along with the fuel type, CARBON_ATOMS and the full scale range values. The actual value read in PRES_IS is not used in order to avoid hysteresis problems. If the wrong value is set, the gain may be wrong and the circuitry may saturate. This can be seen by examining the value of RAW SIGNAL during span, it should be less than 1,000,000. In general, the value of CAL_PRESS should be 189 (= 3 psig) for high range applications.
See also	CAL_PRESSURE

CAL_PRESSURE

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	189-650
Units	hPa
Description	FID only; actual sample pressure during calibration.
Usage	The actual sample pressure at calibration time. This is used together with the PRESS_IS first element or BAROMETER to compensate PVA for any sample pressure changes. This value should be within about 5% of CAL_PRESS for correct operation. Lower values are safe, higher values may saturate the amplifiers.
See also	CAL_PRESS

CAL_RAW_SIG

Direction	Output
Binding	None
Type	2-element floating point array
Value range	0 - 2^{20} (about 1 million) except CLD, 0 - 0 – 65535
Units	None
Description	Raw signal at last zero (element 1) or last span (element 2).
Usage	Shows the raw signal (ADC reading) during the last zero or span, but only if the zero or span was successful. These numbers should be reasonable based on the zero gas and span gas used, typically half of the full scale range for the zero, and between 20% and 80% of the rest of the range for the span. If the numbers are the same, it implies that the same gas was used for both operations, which would be an error.
See also	CAL_RNGHI

CAL_VALIDITY

Direction	Output
Binding	CAL_VALIDITY
Type	Enumerated type
Value range	None; 1; 2; 3; 4; and all combinations to 1 & 2 & 3 & 4
Units	None
Description	Ranges with valid zero and span calibrations
Usage	Shows which ranges were able to be both zeroed and spanned at the last calibration
See also	CAL_ERR_MSG

CALCHKLIMITS

Direction	Bidirectional
Binding	CALCHKLIMITS
Type	Enumerated type
Value range	DISABLED; ENABLED
Units	None
Description	Enables or disables calibration limit checking.
Usage	If enabled, will not allow a zero or span that requires more of a change (as a percentage of the current range) than is shown in CALFPC. If disabled, will allow zero or span to work no matter how much change in the calibration factors is made. If the current calibration is known to be good, enabling this will prevent subsequent calibration on grossly incorrect gases; if the current calibration is known to be bad for some reason, disabling this will allow a successful zero or span no matter how much of a change is required.
See also	CAL_ERR_MSG CAL_VALIDITY SPAN ZERO SPANGAS ZEROGAS

CALDATE_S

Direction	Output
Binding	None
Type	String
Value range	31 characters
Units	None
Description	Date of the last span
Usage	Shows the time and date of the last span. This requires that a control module be used with the analyzer so that its internal clock is updated, or alternatively a PC can be used to write into I_TIME.
See also	CALDATE_Z

CALDATE_Z

Direction	Output
Binding	None
Type	String
Value range	31 characters
Units	None
Description	Date of the last zero
Usage	Shows the time and date of the last zero. This requires that a control module be used with the analyzer so that its internal clock is updated, or alternatively a PC can be used to write into I_TIME.
See also	CALDATE_S

CALFAIL

Direction	Bidirectional
Binding	None
Type	Enumerated type
Value range	NO; YES
Units	None
Description	Enables calibration alarm reporting
Usage	If enabled, allows the analyzer to report a calibration failure as an alarm. In version 2.2 or earlier, this merely reports this fact to the control module, not to the 1/0 module for relay indication.
See also	CALCHKLIMITS CALFPC

CALFPC

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0 - 80; typically 5
Units	Percent
Description	Calibration error percentage
Usage	The percentage of range that constitutes a calibration failure. If the calibration gas is measured such that the difference between its measured value and its alleged value is greater than this as a percent of range, then the calibration will fail, if CALCHKLIMITS is set to enabled.
See also	CATCHLIMITS CALFPC

CALRANGES

Direction	Bidirectional
Binding	None
Type	Enumerated type
Value range	SEPARATELY; TOGETHER
Units	None
Description	Determines whether ranges are spanned together or separately.
Usage	If separately, a span command will cause a span on the current range only. If together, a span command will cause the analyzer to attempt to span on all ranges, unless it has to change hardware gains or unless the span gas concentration is greater than 10% higher than the range's upper limit. In these cases it will not calibrate the ranges it can't, but it will calibrate the others. In general it is best to calibrate ranges separately.
See also	CALCHKLIMITS SPANGAS

CALRESULT

Direction	Bidirectional
Binding	None
Type	2-element floating point array
Value range	0-100
Units	Percent
Description	Element 1 is calibration error for the last zero Element 2 is span error for the last span.
Usage	The difference between the zero gas reading and the alleged zero gas concentration expressed as a percentage of the current range (element 1) or the same for span gas (element 2). The value is always positive. If ranges have been spanned or zeroed together, the value for the current range is used.
See also	CALFPC

CALRNGHI

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Typically the same as the RNGHI array, between the minimum range value and the maximum.
Units	ppm
Description	Value of the range upper limits at the time the last span was performed.
Usage	Used as the multiplier in the PVA algorithm to convert the normalized, linearized value (of between 0 and 1) to engineering units. This is not the same as RNGHI -the current range upper limit array - because the span factor was chosen with the value of RNGHI during the last span, not whatever may have been done with it since.
See also	RNGHI

CALSTAT, CALSTATA, CALSTATB, CALSTATC, CALSTATD

Direction	Output
Binding	CALSTAT
Type	Enumerated type
Value range	READY; ZEROING - WAIT; SPANNlNG - WAIT.
Units	None
Description	Shows present calibration status
Usage	Used in analyzer and 1/0 module. *Analyzer:* Indicates that the analyzer is currently zeroing or spanning. Used by calibration modules or DAS programs to determine whether the analyzer has responded to a calibration command. Once the analyzer has finished its zero or span, this variable is reset to READY. *I/0 Module:* Indicates that the module is currently zeroing or spanning. Used to indicate the present status of this module's calibration cycle, based on how the analyzer has responded to a calibration command.
See also	AMFN

CALTIME

Direction	Bidirectional
Binding	None
Type	Integer
Value range	0-120
Units	Seconds
Description	The length of time over which the analyzer averages when it is doing a zero or span.
Usage	During a zero or span, the analyzer averages its readings over a period given by this variable. This gives a more accurate calibration than would be provided by a possibly short value of AFT90_. It also detects whether there is a statistically significant slope during this time, and if so it waits either until the slope has become insignificant, before zeroing or spanning, or until CALTIMEOUT, whatever is first.
See also	CALTIMEOUT

CALTIMEOUT

Direction	Bidirectional
Binding	None
Type	Integer
Value range	0-120
Units	Seconds
Description	The maximum time the analyzer will wait for stability during a zero or span.
Usage	See CALTIME. This variable limits the amount of time the analyzer will spend waiting for stability. If this time is exceeded, the analyzer will zero or span anyway, though if CALCHKLIMITS is enabled it may not complete the zero or span.
See also	CALCHKLIMITS CALTIME

CAP_FLOWRATE

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	50-200
Units	cc/min
Description	CLD only; the flow rate through the installed capillary
Usage	Used to determine the signal gains used for each range. The CLD output is directly proportional to the flow rate, and so changes in this require changes in gain to compensate.
See also	FLOW_FACTOR

CAPILLARY

Direction	Bidirectional
Binding	None
Type	Enumerated
Value range	2.5 cc/Min @ 5 psig; 10.0 cc/min @ 5 psig; 13.5 cc/Min @ 55 psig; 55.0 cc/min @ 5 psig; 13.5 cc/min @ 3 psig; 9.7 mL/min @ 3.5 psig (HFID)
Units	hPa
Description	FID only; capillary flow rate installed.
Usage	Describes the type of capillary installed. This should match the capillary, of course. It is used to determine the gain settings on each range, together with CAL_PRESS, CARBON_ATOMS, FUEL_TYPE and the fullscale ranges.
See also	

CARBON_ATOMS

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	1 – 8
Units	None
Description	FID only; gas response factor..
Usage	Used to determine the response of the analyzer to the calibration gas. FIDs essentially count the number of carbon atoms in the flame, and thus have a greater response to higher molecular weight hydrocarbons. The analyzer may be calibrated on a particular gas specie, and this variable must be set so as to avoid saturating the analog electronics if higher levels of high molecular weight gases are selected. For propane, the response factor is about 3.14, for methane it is 1.0.
See also	CAL_PRESS FUEL_TYPE

CASE_BIAS

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	50
Units	°C
Description	FID only; bias temperature for the case temperature control algorithm.
Usage	Used in the case temperature control PID algorithm. This value should not be adjusted. CASE_IGAIN
See also	CASE_PGAIN CASE_SETP

CASE_IGAIN

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0.003
Units	None
Description	FID only; the integral "gain" for the temperature control algorithm.
Usage	Used in the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	CASE_BIAS CASE_PGAIN CASE_SETP

CASE_MAX_TMP

Direction	Bidirectional
Binding	None
Type	Floating point variable
Value range	Specific to analyzer, typically 25 – 45
Units	°C
Description	NDIR, PMD; Lower trip point for case fan control.
Usage	The NDIR or PMD cooling fan has a duty cycle that extends between the lower trip point and the upper trip point. At the upper value, the duty cycle is 50%. It is possible to turn the fan completely ON or 50% ON by setting these variables so that the measured temperature is outside their range. This can help determine if any measured diurnal change is due to temperature changes or not.
See also	CASE_MIN_TMP

CASE_MIN_TMP

Direction	Bidirectional
Binding	None
Type	Floating point variable
Value range	Specific to analyzer, typically 25 – 45
Units	°C
Description	NDIR, PMD; Lower trip point for case fan control.
Usage	The NDIR or PMD cooling fan has a duty cycle that extends between the lower trip point and the upper trip point. At the former value, the duty cycle is 50%. It increases linearly until the higher trip point.
See also	CASE_MAX_TMP

CASE_PGAIN

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0.2
Units	None
Description	FID only; the proportional gain for the temperature control algorithm.
Usage	Used for the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	CASE_BIAS CASE_IGAIN CASE_SETP

CASE_SETP

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0-50
Units	°C
Description	FID only; the set point for the temperature control algorithm.
Usage	Used to determine the set point for the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	CASE_IGAIN CASE_PGAIN CASE_BIAS

CHOP_SPEED

Direction	Output
Binding	None
Type	Floating point variable
Value range	5 ± 0.1
Units	Hz
Description	NDIR only; Chopper speed.
Usage	The rotation rate of the NDIR chopper motor. This must be 5 Hz ± 0.1 Hz. Anything else indicates a physical problem.
See also	

CONTROL

Direction	Analyzer: bidirectional; 1/0 Module: input
Binding	CONTROL
Type	Enumerated
Value range	LOCAL; REMOTE; AUTO
Units	None
Description	Determines range selection source.
Usage	Used in the analyzer to bind to the same variable in the I/O modules, so that the latter may be controlled through the analyzer module's menus. LOCAL - only the control module (or PC interface) may change the range; REMOTE - the 1/0 module's digital inputs may change the range, though this can be overridden by the control module; AUTO - the 1/0 module's automatic range change algorithm is enabled. In this case if the user changes the range, the autorange change algorithm may well immediately change it back.
See also	CRANGE

CONV_BIAS

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	50
Units	°C
Description	CLD only; bias temperature for the converter temperature control algorithm.
Usage	Used in the converter temperature control PID algorithm. This value should not be adjusted.
See also	CONV_IGAIN CONV_PGAIN CONV_SETP

CONV_IGAIN

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0.003
Units	None
Description	CLD only; the integral "gain" for the converter temperature control algorithm.
Usage	Used in the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	CONV_BIAS CONV_PGAIN CONV_SETP

CONV_PGAIN

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0.2
Units	None
Description	CLD only; the proportional gain for the converter temperature control algorithm.
Usage	Used for the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	CONV_BIAS CONV_IGAIN CONV_SETP

CONV_SETP

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	250-450
Units	°C
Description	CLD only; the set point for the converter temperature control algorithm.
Usage	Used to determine the set point for the control algorithm. This value has been experimentally determined, and should be changed only if the converter is replaced with a new converter of different set point, or a converter efficiency test has shown a better setting.
See also	CONV_IGAIN CONV_PGAIN CONV_BIAS

CONV_TEMPWAS

Direction	Output
Binding	None
Type	Floating point
Value range	250-450
Units	°C
Description	CLD only; the converter temperature setting during the last NO or NOx setting.
Usage	Used to determine converter efficiency. When the operational mode is changed from NO to NOx, or vice versa, this variable is updated with the converter temperature in the last mode.
See also	CONV_IGAIN CONV_PGAIN CONV_BIAS

CRANGE

Direction	Bidirectional
Binding	CRANGE
Type	Enumerated
Value range	1; 2; 3; 4.
Units	None
Description	Determines current analyzer range.
Usage	The general range selection variable, set manually or automatically by 1/0 modules of various types. Note that this is an enumerated type - its value is one less than the range, i.e. a value of 0 refers to range 1, a value of 1 refers to range 2 etc.
See also	CONTROL

CRUDE_NOISE

Direction	Output
Binding	None
Type	Floating point
Value range	0 - 100, typically
Units	ppm
Description	Shows the current noise level
Usage	Calculated by the analyzer module, this shows the standard deviation of the signal, as long as a significant slope to the signal is not detected. In other words it is only meanignful when the signal is stable. It is expressed in ppm, as if it were a reading.
See also	PVA

CUR_SIG_GAIN

Direction	Output
Binding	None
Type	Integer
Value range	1-99
Units	Percent
Description	NDIR only; shows the current setting of the signal gain digital potentiometer.
Usage	Used to report this setting, as opposed to the variable that sets it.
See also	SIGNAL_GAIN

CURR_SENS

Direction	Output
Binding	None
Type	Floating point
Value range	0-5
Units	Amps
Description	NDIR only; measured source current.
Usage	Measures the current through the IR sources. This should be about 1 amp, more (about 1.24 amps) for long cell benches (such as low level CO) and less for short benches such as high level C02 (typically 0.85 amps). Excessive source current will stress the detector causing the response to jump unpredictably. A source current that is too low will reduce the sensitivity of the bench, increasing noise and drift. This is set at the factory, and should not be lightly adjusted.
See also	SOURCECURR

CURR_WAS

Direction	Output
Binding	None
Type	Floating point
Value range	0-5
Units	Amps
Description	NDIR only; historical source current.
Usage	Shows the value of source current at manufacturing check out time. This is automatically written by the manufacturing data storage function, and it should not be over-written.
See also	CURR_SENS

CURRENTINT

Direction	Output
Binding	None
Type	Enumerated
Value range	OFF; ON
Units	None
Description	Shows status of interference compensation for this range
Usage	Not used in version 2.2 or earlier. Version 2.2 analyzers do not have the interference compensation feature.
See also	

CURRENTLSTAT

Direction	Output
Binding	CURRENTLSTAT
Type	Enumerated
Value range	DISABLED; ENABLED – 1; ENABLED - 2; ENABLED - 3; ENABLED - 4.
Units	None
Description	Shows status of linearization for the current range.
Usage	Used for displaying the linearization status of the current range. It is possible to use any of the sets of linearization coefficients on a given range, as long as the upper limit of the range is within the limit of the linearizer range.
See also	LINSTAT LINFORRANGE

CURRENTMTHD

Direction	Output
Binding	CURRENTMTHD
Type	String
Value range	31 characters
Units	None
Description	Unused. Was to show the parameter set currently in use, but this function has not been implemented.
Usage	Not used in version 2.2 or earlier.
See also	

CURRENTRNGHI

Direction	Output
Binding	None
Type	Floating point
Value range	Same as RNGHI
Units	ppm
Description	The value of the upper limit point of the current range.
Usage	Used to show the current range's upper limit point on menus, rather than the entire array of range end points as would be shown by RNGHI. The analyzer copies the value of the appropriate element of RNGHI into this variable whenever CRANGE is changed.
See also	RNGHI CRANGE

CURRENTRNGLO

Direction	Output
Binding	None
Type	Floating point
Value range	Same as RNGLO, usually 0.
Units	ppm
Description	The value of the lower limit point of the current range.
Usage	Used to show the current range's lower limit point on menus, rather than the entire array of range end points as would be shown by RNGLO. The analyzer copies the value of the appropriate element of RNGLO into this variable whenever CRANGE is changed.
See also	RNGLO CRANGE

CURRENTRSPNS

Direction	Output
Binding	None
Type	Floating point
Value range	Same as AFT90_
Units	Seconds
Description	The value of the filter time constant setting of the current range.
Usage	Used to show the current range's time constant on menus, rather than the entire array of time constants as would be shown by AFT90_. The analyzer copies the value of the appropriate element of AFT90_ into this variable whenever CRANGE is changed.
See also	AFT90_ CRANGE

CURRENTSFAC

Direction	Output
Binding	None
Type	Floating point
Value range	Same as SPAN
Units	None
Description	The value of the span factor of the current range.
Usage	Used to show the current range's span factor on menus, rather than the entire array of span factors as would be shown by SPAN. The analyzer copies the value of the appropriate element of SPAN into this variable whenever CRANGE is changed.
See also	SPAN CRANGE CURRENTZFAC

CURRENTSPAN

Direction	Output
Binding	None
Type	Floating point
Value range	Same as SPANGAS
Units	ppm
Description	The value of the span gas for the current range.
Usage	Used to show the current range's span gas on menus, rather than the entire array of span gases as would be shown by SPANGAS. The analyzer copies the value of the appropriate element of SPANGAS into this variable whenever CRANGE is changed.
See also	SPANGAS CRANGE

CURRENTZERO

Direction	Output
Binding	None
Type	Floating point
Value range	Same as ZEROGAS
Units	ppm
Description	The value of the zero gas for the current range.
Usage	Used to show the current range's zero gas on menus, rather than the entire array of span gases as would be shown by ZEROGAS. The analyzer copies the value of the appropriate element of ZEROGAS into this variable whenever CRANGE is changed.
See also	ZEROGAS CRANGE

CURRENTZFAC

Direction	Output
Binding	None
Type	Floating point
Value range	Same as ZERO
Units	ppm
Description	The value of the zero factor for the current range.
Usage	Used to show the current range's zero factor on menus, rather than the entire array of zero factors as would be shown by ZERO. The analyzer copies the value of the appropriate element of ZERO into this variable whenever CRANGE is changed.
See also	ZERO CRANGE CURRENTSFAC

DATA_INDEX

Direction	Input
Binding	DATA_INDEX
Type	2-element integer array
Value range	Element 1: 0 - 96; element 2: 0 - 59, or up to 65535
Units	None
Description	Index into the locally stored data communicated in DATA_P0INT
Usage	The two elements have alternative meanings: if the second element has a value less than or equal to 59, the second element refers to the time in minutes, and the first to the time in hours - the time referring to the desired data point. If the value of the second element is greater than 59, the first element then is taken to refer to the index of the data point.
See also	DATA_POINT

DATA_POINT

Direction	Output
Binding	DATA_POINT
Type	7-element floating point array
Value range	See description below
Units	Depends on variables selected
Description	Contains the data for the particular 15 minute average segment selected by DATA_INDEX.
Usage	Set DATA_INDEX to the segment of stored data desired, then after about 1 second this variable will be loaded with the data appropriate for that segment. If no data is available for the particular segment, elements 0 and 5 will contain a large negative number. The elements are as follows: Primary variable (normally, but selected by TRENDCONT1) Day of month Hour Minute If > 9, calibration occurred; if 1 or 11, at least one invalid reading Secondary variable (from TRENDCONT2) The index where this data segment is stored, 0 - 95 Stored variables are selected by TRENDNAME, which shares data with TRENDCONT to tell the analyzer which variables to store.
See also	DATA_POINT TRENDNAME TRENDCONT

DEBUG

Direction	Output
Binding	None
Type	7-element floating point array, 7-element integer array
Value range	Undetermined
Units	None
Description	Debug variables used in software development
Usage	Used only for software development, Undetermined contents
See also	DEBUGI

DEBUGI

Direction	Output
Binding	None
Type	7-element floating point array, 7-element integer array
Value range	Undetermined
Units	None
Description	Debug variables used in software development
Usage	Used only for software development, Undetermined contents
See also	DEBUG

DET_SIG

Direction	Output
Binding	None
Type	Floating point
Value range	0-8.5
Units	Volts
Description	NDIR only; the detector signal, expressed in volts
Usage	In the NDIR analyzers, the detector signal must range between about 400mV at zero gas to a maximum of 8-5V at span gas. The span value should be at least 6V. The zero is set by the shutter adjustment, and the span by the source current adjustment and the SIGNAL_GAIN setting.
See also	SIGNAL_GAIN SOURCECURR

DI_MSGE

Direction	Input
Binding	DI_MSGE
Type	15 element enumerated array
Value range	N/A, OFF, ON
Units	None
Description	Shows the state of the digital input lines controlling the corresponding functions shown in AM_INPUT
Usage	Used to both show the state of these lines and to control the appropriate function in the analyzer.
See also	AM_INPUT

DIGDIAG

Direction	Output
Binding	None
Type	6-element enumerated array
Value range	OFF; ON
Units	None
Description	FID only; report various operational parameters. Elements are as follows: Status of a manual ignition request Status of the manual fuel override Status of the ignition command Status of the manual fuel enrichment Status of the flame Status of the purge air switch
Usage	Reports the present status of the above factors. Note that element 5 reports whether the flame is on or not.
See also	DIGDIAGA

DIGDIAGA

Direction	Output
Binding	None
Type	5-element enumerated array
Value range	OFF; ON
Units	None
Description	FID only; report various operational parameters. Status of the ignitor Status of the fuel solenoid valve Status of the purge control system Status of the fuel pressure Status of the fuel flow
Usage	Reports the present status of the above factors.
See also	DIGDIAG

DIOD_BLOK_SN

Direction	Bidirectional
Binding	None
Type	String
Value range	31 characters
Units	None
Description	CLD only; the serial number string for the combination of block and sensor
Usage	Records the block and sensor serial numbers
See also	AMSN

DUTY_COEFF

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0
Units	None
Description	CLD only; the temperature coefficient slope factor
Usage	Used to compensate the output for variations in ambient temperature. This temperature is measured by monitoring the block temperature controller's duty cycle, which varies as it keeps the block temperature constant.
See also	

FAN_MIN_DUTY

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0-100
Units	Percent
Description	NDIR and PMD only; minimum duty cycle for the case fan
Usage	The fan will not run if the duty cycle is set less than 50%, so this variable is used to make sure that the algorithm does not try to set the duty cycle too low at start up.
See also	

FID_MSGE

Direction	Output
Binding	None
Type	Enumerated
Value range	PARAMETERS NORMAL; FUEL PRESSURE TOO LOW; FUEL PRESSURE TOO HIGH; AIR PRESSURE TOO LOW; AIR PRESSURE TOO HIGH; SAMPLE PRESSURE TOO LOW; SAMPLE PRESSURE TOO HIGH; PURGE PRESSURE TOO LOW; PURGE PRESSURE TOO HIGH; FUEL SELECTION IN-VALID; PURGE SYSTEM FAILURE; IGNITION FAILED; OVEN TEMPERATURE TOO LOW; FLAME THERMISTOR FAILURE; SYSTEM PURGING... PLEASE WAIT.
Units	None
Description	FID only; reports the above list of states.
Usage	Reports the present status of the above factors
See also	DIGDIAG DIGDIAGA

FLAME_ON_TIM

Direction	Output
Binding	None
Type	String
Value range	31 characters
Units	None
Description	FID only; the length of time the flame has been on
Usage	Reports this time.
See also	

FLAME_STATUS

Direction	Output
Binding	None
Type	Enumerated
Value range	Ready; Enrich fuel; Light flame; Retry; FAILURE; Flame on
Units	None
Description	FID only; reports the state of the flame ignition cycle.
Usage	Reports the present status of the ignition cycle.
See also	DIGDIAG DIGDIAGA

FLOW_FACTOR

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	1; can vary from 0.25 to 4
Units	None
Description	CLD only; the capillary flow factor
Usage	Used as a multiplier for the CAP_FLOWRATE variable so that the output compensation for flow changes is correct
See also	CAP_FLOWRATE

FLOW_IS

Direction	Output
Binding	None
Type	NDIR, PMD, CLD: single floating point variable; FID: 3-element floating point variable
Value range	0-2000
Units	cc/min
Description	The sample flow through the analyzer bypass loop Sample flow (FID) Calculated burner air flow. Calculated burner fuel flow.
Usage	Shows the flow through the analyzer - except that the FID and CLD analyzers have a small additional sample flow through their measuring devices. If this flow is too low, the VALIDITY variable will be set to be invalid. The FID also calculates the burner fuel and air flows from the pressure measurements. Typical flow rates are between 200 and 1200 cc/min, with 1000 cc/min being optimum.
See also	VALIDITY

FLOW_WAS

Direction	Output
Binding	None
Type	3-element floating point variable
Value range	0-2000
Units	cc/min
Description	FID only; Sample flow at manufacturing test time Calculated burner air flow at manufacturing test time Calculated burner fuel flow at manufacturing test time
Usage	Shows the values of FLOW_IS taken during manufacturing test
See also	FLOW_IS

FUEL_FLOW

Direction	Bidirectional
Binding	None
Type	Enumerated
Value range	OFF; ON
Units	None
Description	FID only; controls fuel flow
Usage	Allows the user to shut off the fuel flow. This is the only way to shut off the flame through software
See also	DIGDIAGA

FUEL_TYPE

Direction	Bidirectional
Binding	None
Type	Enumerated
Value range	H_2-He; H_2-N_2; H_2
Units	None
Description	FID only; shows the fuel type in use
Usage	Set according to the physical assembly of this particular version of FM analyzer. It controls the signal gain, along with CARBON_ATOMS, CAL-PRESS and so on. Normally you should not change this.
See also	CARBON_ATOMS CAL_PRESS

FUELOVERIDE

Direction	Bidirectional
Binding	None
Type	Integer
Value range	0-120
Units	Seconds
Description	FID only; the duration of the air-fuel mixture enrichment before ignition
Usage	In automatic flame ignition, controls the length of time that the mixture is enriched before the glow plug is tamed on. In manual mode, the length of time the mixture is enriched, although the glow plug can be turned on at any time during this time.
See also	DIGDIAG

GAS

Direction	Analyzer: bidirectional; 1/0 module: input
Binding	GAS
Type	String
Value range	Up to 31 characters
Units	None
Description	The displayed gas name
Usage	Shows the name of the gas that the analyzer is currently measuring. This may be edited by the user, however in the case of the CLD analyzer, the analyzer will overwrite it with NO or NOx depending on its operational mode.
See also	TAG

GENERALSTATE

Direction	Analyzer: output; 1/0 Module: input
Binding	GENERALSTATE
Type	Enumerated
Value range	NORMAL; WARNING; FAILURE; SAFETY FAILURE
Units	None
Description	The alarm state of the analyzer module
Usage	This is set to the higher of any alarm states detected. It is used to determine the state of health of an analyzer module. If any of the measurement variables (FLOW_IS, PRES_IS and so on) are greater than their upper limits, or less than their lower limits, this variable is normally set to WARNING. Only the FID uses SAFETY FAILURE, it means that the purge system has failed in some way, and the analyzer has shut its fuel flow down.
See also	VALIDITY OPSTATUS

HEATER_BIAS

Direction	bidirectional
Binding	None
Type	Floating point
Value range	0-50
Units	°C
Description	NDIR, PMD only; the bias for the temperature control algorithm
Usage	Used to determine the starting value for the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	HEATER_IGAIN HEATER_PGAIN HEATER_SETP

HEATER_IGAIN

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0.003
Units	None
Description	NDIR, PMD only; the integral "gain" for the temperature control algorithm
Usage	Used in the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed
See also	HEATER_BIAS HEATER_PGAIN HEATER_SETP

HEATER_PGAIN

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0.2
Units	None
Description	NDIR, PMD only; the proportional gain for the temperature control algorithm
Usage	Used for the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	HEATER_BIAS HEATER_IGAIN HEATER_SETP

HEATER_SETP

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0-50
Units	°C
Description	NDIR, PMD only; the set point for the temperature control algorithm.
Usage	Used to determine the set point for the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	HEATER_IGAIN HEATER_PGAIN HEATER_BIAS

HIST2T_

Direction	Output
Binding	None
Type	3-element floating point array
Value range	Same as TEMP_IS for CLD
Units	°C
Description	CLD only; values of TEMP_IS at manufacturing check out time
Usage	Provides historical data on how the analyzer was set up during final check out
See also	TEMP_IS

HIST2V_

Direction	Output
Binding	None
Type	2-element floating point array
Value range	Same as PRESS_IS for CLD
Units	hPa
Description	CLD only; values of PRESS-IS at manufacturing check out time
Usage	Provides historical data on how the analyzer was set up during final check out
See also	PRESS_IS

I_TIME

Direction	Analyzer: bidirectional; I/0 module: input
Binding	TIME
Type	7-element integer array
Value range	Appropriate date and time values
Units	None
Description	Periodic time update variable Year Mouth Day Hour Minute Second Day of week -not implemented
Usage	Used to synchronize the internal clocks of analyzers and 1/0 modules with that of the control module. The CM updates this variable every few seconds, and if it is updated twice within 5 seconds, the analyzer or 1/0 module updates its internal clock to this time.
See also	

IGNITECYCLES

Direction	Bidirectional
Binding	None
Type	Integer
Value range	1-5
Units	None
Description	FID only; the number of ignition attempts allowed
Usage	Limits the number of ignition attempts during an automatic ignition cycle. If the flame has not ignited by this time, the algorithm will give up.
See also	

IGNOVERIDE

Direction	Bidirectional
Binding	None
Type	Integer
Value range	2-10
Units	none
Description	FID only; the duration of the glow plug current flow
Usage	The glow plug requires a current flow for a certain period in order for it to warm up enough to ignite the fuel. This variable sets that time. It is normally 3 seconds
See also	IGNITECYCLES

IOHOLDCAL

Direction	Analyzer: bidirectional; 1/0 module: output
Binding	IOHOLDCAL
Type	Enumerated
Value range	OFF; HOLD; CEMS
Units	None
Description	Allows the analyzer to control the track and hold operation of the 1/0 module when the analyzer module is in a calibration mode
Usage	OFF - the 1/0 module tracks the analyzer reading through a calibration event. HOLD - the 1/0 module holds the last reading when the analyzer PROCESS variable is anything other than 0. CEMS - forces the 1/0 module to track the PVACEMS reading rather than the PVA reading while PROCESS is greater than 0. *I/0 Module:* If set to DISABLED, the output will track the PVA reading during a calibration cycle. If set to ENABLED, the output will hold at its last value as soon as a calibration cycle is entered (or if the analyzer is manually told to do a zero or span). If set to CEMS, the output tracks PVACEMS (see this variable in the analyzer list) during a calibration cycle.
See also	PROCESS CALSTAT PVACEMS PVA IOMAINTHOLD

J13_IN

Direction	Output
Binding	None
Type	Floating point
Value range	-5 - +5
Units	Volts
Description	CLD only; values of J13 input
Usage	Unused. Shows the value of this input to the secondary ADC.
See also	

J6_IN

Direction	Output
Binding	None
Type	Floating point
Value range	-5 - +5
Units	Volts
Description	CLD only; values of J6 input
Usage	Unused. Shows the value of this input to the secondary ADC.
See also	

LASTSPAN

Direction	Output
Binding	None
Type	Floating point
Value range	0 - the analyzer PVA limit
Units	ppm
Description	The last span gas reading, using the ZERO factor from the subsequent zero operation.
Usage	Shows any interaction between zero and span operations. If the zero operation affects the span, this will show a change. It is most useful when tying to calibrate an analyzer with a non-zero zero gas.
See also	LASTZERO

LASTZERO

Direction	Output
Binding	None
Type	Floating point
Value range	0 - the analyzer PVA Emit
Units	ppm
Description	The last zero gas reading, using the SPAN factor from the subsequent span operation.
Usage	Shows any interaction between zero and span operations. If the span operation affects the zero, this will show a change. It is most useful when trying to calibrate an analyzer with a non-zero zero gas.
See also	LASTSPAN

LIN_CASETEMP

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0-70
Units	°C
Description	The temperature at which the linearizer curve was made.
Usage	Used for temperature compensation of analyzers. The signal should be adjusted for what it would be at the temperature that the analyzer was linearized, as the linearization curve is itself dependent upon temperature. This variable contains that value.
See also	Other LINxxxxx variables

LIN_ERROR

Direction	Output
Binding	None
Type	Floating point
Value range	0-100
Units	Percent
Description	Not used.
Usage	Not used.
See also	

LIN_GASESA

LIN_GASESB, LIN_GASESC

Direction	Bidirectional
Binding	LIN_GASESA, etc.
Type	7-element floating point (except LIN_GASESC, 6-element) array
Value range	-1 - 1,000,000 (-1 shows that no value has been entered)
Units	ppm
Description	Linearization function actual gas input value.
Usage	Used in the "Tweak' and self linearization functions to enter the actual gas concentrations.
See also	

LIN_MEASA

LIN_MEASB, LIN_MEASC.

Direction	Bidirectional
Binding	LIN_MEASSA, etc.
Type	7-element floating point (except LIN_MEASC, 6-element) array
Value range	0 - 1,000,000
Units	ppm
Description	Linearization function measured gas value.
Usage	Used in the "Tweak" and self linearization functions to store the measured gas concentrations corresponding to the actual concentrations in LIN_GASESA, etc.
See also	

LIN_ORDER

Direction	Output
Binding	LIN_ORDER
Type	Integer
Value range	1-4
Units	None
Description	Order of polynomial calculated by self linearization function.
Usage	Shows the order of polynomial calculated.
See also	

LIN_OVER

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	0 - 100; normally 10
Units	Percent
Description	The amount greater than the linearization range over which this curve is valid.
Usage	Linearization curves are valid only over a certain range given by LINRNGHI. However we allow a certain leeway above this point so that any sudden change of slope caused by disabling the linearizer does not cause odd effects in the PVA value. This LIN_OVER variable sets how much leeway there is in percent of the LINRNGHI value. Above this point the algorithm will provide a linear relationship between input and output, with a slope equal to the slope of the linearization curve at the LINRNGHI value.
See also	Other LINxxxxxxxx variable

LIN_RESULTA

LIN_RESULTB, LIN_RESULTC

Direction	Bidirectional
Binding	LIN_RESULTA, etc.
Type	7-element floating point (except LIN_RESULTC, 6-element) array
Value range	0 - 1,000,000
Units	ppm
Description	Linearization function measured gas value as linearized.
Usage	Used in the "Tweak" and self linearization functions to show the linearized measured gas concentrations corresponding to the actual concentrations in LIN_GASESA, etc.
See also	

LIN_UNDER

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	0 - 100; normally 5
Units	Percent
Description	The amount less than the linearization range over which this curve is valid.
Usage	LIN_OVER.and LIN_UNDER shows how far negative the signal can go before the input/output relationship becomes linear with slope equal to the slope at zero. It is expressed in percent of the linearization range given by LINRNGHI.
See also	Other LINxxxxxxxx variables

LIN_UNITS

Direction	Bidirectional
Binding	LIN_UNITS
Type	Enumerated
Value range	Percent of span gas, ppm
Units	None
Description	Allows the user to express the gas concentration as a percentage of the span gas or as an absolute value in ppm
Usage	Allows the user to dilute a span gas, and therefore to avoid having to re-enter all 20 gas values when he changes his span gas
See also	

LIN_VAR_ID

Direction	Bidirectional
Binding	LIN_UNITS
Type	Enumerated
Value range	Point 1 to Point 20
Units	None
Description	Allows the user to specify which gas sample he is entering
Usage	Controls the self-linearization measurement.
See also	

LINA0_

LINA1_, LINA2_, LINA3_, LINA4_

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Sum of each set of elements must be 1.0 ± 0.02.
Units	None
Description	Linearizer coefficients. Each element applies to the range given by that element number, so LINAO-1 is the zeroth coefficient for range 1.
Usage	NGA analyzers use a fourth order polynomial to linearize the normalized output of the sensors. The input range to the polynomial covers 0 - 1, and the output should cover that range as well. In general, the curve passes through the points (0,0) and (1.0,1.0), within the limits of acceptable error, usually 2%, i.e. ± 0.02 to 1.0 ± 0.02. These coefficients may be written to as desired, although Rosemount cannot guarantee linearization specifications if locally produced values are used. It is essential that the polynomial produced be monotonic over the range of 0 - 1, otherwise the calibration routines may fail.
See also	Other LINxxxxxxxx variables

LINFORRANGE

Direction	Bidirectional
Binding	None
Type	4-element enumerated array
Value range	1; 2; 3; 4
Units	None
Description	The linearizer coefficient set to be used for each range.
Usage	Element 1 contains the linearizer curve to be used for range 1, and so on. Curve I refers to the coefficient values stored in element 1 of each LINAn_ array
See also	Other LINxxxxxxxx variables

LINRNGHI

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Up to the analyzer maximum range value
Units	ppm
Description	The upper Emit for which the coefficient set corresponding to each element is valid.
Usage	Linearization curves are valid only over a certain range given by LINRNGHI. However we allow a certain leeway above this point so that any sudden change of slope caused by disabling the linearizer does not cause odd effects in the PVA value. The LIN_OVER variable sets how much leeway there is in percent of the LINRNGHI value. Above this point the algorithm will provide a linear relationship between input and output, with a slop equal to the slope of the linearization curve at the LINRNGHI value.
See also	Other LINxxxxxxxx variables

LINSTAT

Direction	Bidirectional
Binding	None
Type	4-element enumerated array
Value range	DISABLED; ENABLED
Units	None
Description	Determines whether the linearizer selected for the range corresponding to each element is enabled or not.
Usage	For example, if LINSTAT1 is set to ENABLED, the curve described in LINFORRANGE is used when the analyzer range is set to range 1. If disabled, no linearization curve is used on that range at all.
See also	Other LINxxxxxxxx variables

LONPVUPDATE

Direction	Bidirectional
Binding	LONPVUPDATE
Type	Enumerated
Value range	ASAP; 10 per second; 1 per second; normally 10 per second, though systems should be set to 1 per second.
Units	None
Description	The frequency with which the main reading variable PVA is updated over the network.
Usage	The network is capable of supporting about 250 variable updates per second. If this value is exceeded, collisions occur and the overall response becomes degraded. In this case, menus are not easily accessed, and the editing of variables does not appear to work reliably. PC software also becomes degraded. This can be ameliorated by reducing the update rate of the primary variable using LONPVUPDATE. The system response time is not directly affected, though of course the output will appear to step if the Once per second value is used.
See also	Other LINxxxxxxxx variables

MAXRANGE

Direction	Analyzer: bidirectional; 1/0 module: Input
Binding	MAXRANGE
Type	Floating point
Value range	0 - 1,000,000
Units	ppm
Description	The maximum range that the analyzer physics is capable of measuring.
Usage	This value is set in the manufacturing data screens, and is used to limit the range high end selection in the expert set up screens. This value should only be changed if the physics is changed so as to support the new value. This is an input to the 1/0 module for informational purposes only.
See also	MINRANGE RNGHI

MCHECKTIME

Direction	Output
Binding	None
Type	Integer
Value range	0-600
Units	Seconds
Description	NDIR only; the remaining time during the present phase of a modulation check.
Usage	Used to indicate how much longer any given phase of the modulation check will last.
See also	

MEAS_STAT

Direction	Bidirectional
Binding	MEAS_STAT
Type	Enumerated
Value range	READY; MEASURING; ABORTED; WRONG RANGE!; TIMED OUT
Units	None
Description	Reports what the analyzer is currently doing - or has done - in the self linearization process.
Usage	Used to give feedback to the user.
See also	

MEASUREPOINT

Direction	Bidirectional
Binding	MEASUREPOINT
Type	Enumerated
Value range	Point 1; Point 2; Point 3
Units	None
Description	Allows the user to specify which of the three piecewise linear approximation points he is dealing with.
Usage	The "Tweak" function allows the user to adjust up to three midscale points per range in order to make the linearization curve go exactly through particular standard gases.
See also	

METHODA

METHODB, METHODC, METHODD, METHODE

Direction	Bidirectional
Binding	None
Type	String
Value range	31 characters
Units	None
Description	Unused. Intended to be the description of the parameter sets.
Usage	Unused.
See also	

MID_GASA

MID_GASB

Direction	Bidirectional
Binding	MID_GASA, MID_GASB
Type	6-element floating point array
Value range	-1 - 1,000,000
Units	ppm
Description	Elements 1, 2 and 3 are the mid gas values as entered for range 1; the next three points are those for range 2, and so on.
Usage	Allows the user to enter the desired gas values for the three midrange points on each range. The "Tweak' function can then force the measured values to equal these, interpolating other points between them.
See also	

MIDPOINTA

MIDPOINTB

Direction	Bidirectional
Binding	MIDPOINTA, MIDPOINTB
Type	6-element floating point array
Value range	-1 - 1,000,000
Units	ppm
Description	Elements 1, 2 and 3 are the mid gas values as read for range 1; the next three points are those for range 2, and so on.
Usage	See MID_GASA, MID_GASB. These are the measured values for those gases, before they are forced to be equal to those values by the "Tweak" function.
See also	

MINRANGE

Direction	Analyzer: bidirectional; 1/0 module: input
Binding	MINRANGE
Type	Floating point
Value range	0 - MAXRANGE
Units	ppm
Description	The minimum range that the analyzer physics is capable of measuring.
Usage	This value is set in the manufacturing data screens, and is used to limit the range high end selection in the expert set up screens. This value should only be changed if the physics is changed so as to support the new value. It is determined by the noise level of the physics for a given response time. This is an input to the 1/0 module for informational purposes only.
See also	MAXRANGE RNGHI

MOD_TEST_INS

Direction	Output
Binding	None
Type	Enumerated
Value range	
Units	None
Description	NDIR only; messages and instructions for the modulation test screens.
Usage	Used to show the present status of the modulation test, and to give instructions as to what the user should do next. The MOD_TEST_xxx variables share data, they will always contain the same value, although the phrases to which this value refers are different for each variable.
See also	MOD_TEST_THN MOD_TEST_TXT MCHECKTIME

MOD_TEST_THN

Direction	Output
Binding	None
Type	Enumerated
Value range	
Units	None
Description	NDIR only; messages and instructions for the modulation test screens.
Usage	Used to show the present status of the modulation test, and to give instructions as to what the user should do next. The MOD_TEXT_xxx variables share data, they will always contain the same value, although the phrases to which this value refers are different for each variable.
See also	MOD_TEST_INS MOD_TEST_TXT MCHECKTIME

MOD_TEST_TXT

Direction	Output
Binding	None
Type	Enumerated
Value range	
Units	None
Description	NDIR only; messages and instructions for the modulation test screens.
Usage	Used to show the present status of the modulation test, and to give instructions as to what the user should do next. The MOD_TEST_xxx variables share data, they will always contain the same value, although the phrases to which this value refers are different for each variable.
See also	MOD_TEST_INS MOD_TEST_THN MCHECKTIME

NO_NOX

Direction	Bidirectional
Binding	NO_NOX
Type	Enumerated
Value range	NO; NOx
Units	None
Description	CLD only; controls state of NO/NOx toggle.
Usage	When in NOx mode, allows the sample to pass through the converter. When in NO mode, bypasses this. The variable GAS is set to whichever of setting is appropriate.
See also	GAS

NONNETVARS

Direction	Output
Binding	None
Type	String
Value range	31 characters
Units	None
Description	Non-volatile storage for various internal parameters.
Usage	This variable is used to store various internal parameters in EEPROM. It is not meaningful to anyone else. Trying to read it will crash the Echelon DDE server, as it does not contain ASCII characters necessarily.
See also	

NOSPANGAS

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Typically 80% of RNGHI
Units	ppm
Description	CLD only; contains the value of NO span gases, element 1 containing the span gas for range 1 etc.
Usage	During a span function, when in NO mode, the analyzer adjusts the value of SPAN for the selected range such that the value of PVA becomes equal to the value of the appropriate element of NOSPANGAS, to within 0.02% of the range value. This variable should be kept updated with the current value of the span gas as shown on the bottle label. If the bottle is of dubious quality, it may be desirable to compare its reading with that of a known good standard, and then mark the bottle and this variable accordingly.
See also	SPAN SPANWAS

NOXSPANGAS

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Typically 80% of RNGHI
Units	ppm
Description	CLD only; contains the value of NOX span gases, element 1 containing the span gas for range 1 etc.
Usage	During a span function, when in NOX mode, the analyzer adjusts the value of SPAN for the selected range such that the value of PVA becomes equal to the value of the appropriate element of NOSPANGAS, to within 0.02% of the range value. This variable should be kept updated with the current value of the span gas as shown on the bottle label. If the bottle is of dubious quality, it may be desirable to compare its reading with that of a known good standard, and then mark the bottle and this variable accordingly.
See also	SPAN SPANWAS

OPSTATUS

Direction	Analyzer: bidirectional; 1/0 module: input
Binding	OPSTATUS
Type	Enumerated
Value range	NORMAL; MAINTENANCE; STANDBY; CALIBRATION; QC CHECK.
Units	None
Description	The current operational status of the analyzer.
Usage	Used to indicate the status of the module, so as to generate the appropriate relay contact in the I/0 module. NORMAL - normal operation. MAINTENANCE - this analyzer's menus have been accessed. STANDBY - the temperature or other parameters are not at normal levels. CALIBRATION - the module is currently performing a zero, span or linearization function. QC CHECK - the variable PROCESS is set to a value greater than 0.
See also	GENERALSTATE CALSTAT PROCESS

OSC_TUNE

Direction	Output
Binding	None
Type	Floating point
Value range	0-100
Units	Volt s
Description	NDIR only; the output of the oscillator coil.
Usage	It is necessary to detune the oscillator coil to about 80% of its peak reading, on the higher frequency side of the peak. This allows the Luft detector to produce a linear output as the measured gas concentration changes. Read this value as you first turn the inductor core until you find the peak, then counter-clockwise past its peak until a value of 80% of the peak value is reached.
See also	SIGNAL_GAIN DET_SIG RAW_SIGNAL

OVEN_BIAS

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	50
Units	C
Description	HFID only; bias temperature for the oven temperature control algorithm.
Usage	Used in the oven temperature control PID algorithm. This value should not be adjusted.
See also	OVEN_IGAIN OVEN_PGAIN OVEN_SETP

OVEN_IGAIN

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0.003
Units	None
Description	HFID only; the integral "gain" for the oven temperature control algorithm.
Usage	Used in the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	OVEN_BIAS OVEN_PGAIN OVEN_SETP

OVEN_PGAIN

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0.2
Units	None
Description	HFID only; the proportional gain for the oven temperature control algorithm.
Usage	Used for the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	OVEN_BIAS OVEN_IGAIN OVEN_SETP

OVEN_SETP

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0-50
Units	°C
Description	HFID only; the set point for the oven temperature control algorithm.
Usage	Used to determine the set point for the control algorithm. This value has been experimentally determined, and should not under any circumstances be changed.
See also	OVEN_IGAIN OVEN_PGAIN OVEN_BIAS

OZON_SW

Direction	Output
Binding	None
Type	Enumerated
Value range	OFF; ON
Units	None
Description	The state of the ozonator pressure switch
Usage	There is a pressure switch in the CLD that detects the presence of ozonator air (or oxygen). The reaction that detects NO cannot occur in the absence of this.
See also	OZONATOR

OZONATOR

Direction	Bidirectional
Binding	None
Type	Enumerated
Value range	POWERED; UNPOWERED
Units	None
Description	CLD only; the state of the ozonator lamp
Usage	Shows the state of, and may be used to control the state of the ozonator lamp. This may be switched off to conserve its life, and also to conserve the life of the plumbing components around it in the absence of ozonator air or oxygen flow. If a technician is working on the unit, he should switch the lamp off so as to avoid both breathing ozone and burning his eyes with the ultra-violet light emitted by the lamp. Ozone is very harmful to lung tissue.
See also	OZON_SW

P_WAS

Direction	Output
Binding	None
Type	4-element floating point array
Value range	Depending on configuration..
Units	hPa
Description	FID only; manufacturing check out time values: Sample capillary pressure. Burner air pressure. Fuel supply pressure. Purge gas pressure.
Usage	Historical values of PRESS_IS. These show how the instrument was working when it was tested during the manufacturing process. These values are loaded automatically by the manufacturing data storage function.
See also	PRESS_IS

P2VFLL

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0 - 1000
Units	cc/min
Description	FID only; bypass sample flow lower limit
Usage	Used to generate a warning alarm if the bypass sample flow drops below the value set in this variable.
See also	FLOW_IS

PATH

PATHA, PATHB, PATHC, PATHD

Direction	Output
Binding	None
Type	Enumerated
Value range	
Units	None
Description	A set of variables that describe how to find commonly used places in the menu system.
Usage	These variables share data. Editing PATH causes the other variables to show their equivalent values, and thus a set of phrases that indicate how to find places in the menu system.
See also	TRENDCONT TRENDNAME SVCONT SVNAME

PCOMP_GAIN

Direction	Bidirectional
Binding	MAXRANGE
Type	Enumerated
Value range	1; 10; and 100
Units	None
Description	NDIR and PMD only; the gain setting of the pressure transducer programmable gain amplifier.
Usage	Allows the use of NDIR analyzers for hyperbaric applications by reducing the PGA gain for large pressure changes. When set to 100, the analyzer can compensate for pressure changes of the order of ± 4%; set to 10 the range is 40%, and set to 1 it is ± 400%. The former setting should be used for normal atmospheric conditions, while the latter is useful for hyprebaric applications. The latter setting is too coarse for good results over normal atmospheric pressure changes. If the setting is. indeed 100, the transducer hardware offset will have to be adjusted if the analyzer is used at altitudes higher than about 5000ft.
See also	PFACTOR BAROMETER

PELT_FINISH

Direction	Bidirectional
Binding	None
Type	Integer
Value range	2000 - 3000; default 2992
Units	None
Description	CLD only; the value for the DAC count controlling the Peltier device temperature.
Usage	Controls the end of the peltier cool down cycle. This variable only affects the initial cool down, editing it once the CLD is operational will not affect the current Peltier temperature. Do not adjust this variable!
See also	

PELT_OV

Direction	Output
Binding	None
Type	Enumerated
Value range	NORMAL; NORMAL; WARNING
Units	None
Description	CLD only; warning message for the peltier control algorithm menu
Usage	Used to show a problem with the Peltier cooler, the device used to cool the optical detector in the CLD.
See also	

PELT_SET

Direction	Output
Binding	None
Type	Integer
Value range	
Units	Volts
Description	CLD only; the voltage being put on the Peltier device
Usage	Shows the voltage with which the Peltier cooler is currently being driven.
See also	

PERCENT_MOD

Direction	Output
Binding	None
Type	Floating point
Value range	0-100
Units	Percent
Description	NDIR only; the modulation percentage resulting from the modulation check function.
Usage	The modulation check function allows the user to determine the amount of modulation, or change in light transmission, caused by the span gas. There is a sequence of events that are controlled by a menu in the NDIR analyzer. The result of this function is reported in this variable. Typical values should be between 10 and 30%.
See also	

PFACTOR

Direction	Bidirectional
Binding	None
Type	2-element floating point array
Value range	Element 1 - 1250; element 2 - 1.5
Units	None
Description	Offset and slope respectively for the pressure compensation algorithm.
Usage	Used to determine how the pressure compensation algorithm works.
See also	BAROMETER PCOMP_GAIN

PLIM

Direction	Bidirectional
Binding	None
Type	NDIR, PMD: 2 element floating point array; FED: 6-element array; CLD: 4-element array
Value range	0-1050
Units	hPa
Description	Sample pressure upper limit Sample pressure lower limit. Fuel pressure upper Emit (FID), Ozonator pressure upper limit (CLD) Fuel pressure lower limit (FED), Ozonator pressure lower limit (CLD) Burner air pressure upper limit. Burner air pressure lower limit.
Usage	These values are used by the alarm algorithm to generate warning alarms if the limits are exceeded by the pressure measurement, and if the alarms are enabled by ALARM_LVL
See also	ALARM_LVL BAROMETER PRESS_IS

PLIMA

Direction	Bidirectional
Binding	None
Type	2-element floating point array
Value range	0-1050
Units	hPa
Description	Purge air pressure upper Emit (FID only) Purge air pressure lower limit
Usage	These values are used by the alarm algorithm to generate warning alarms if the limits are exceeded by the pressure measurement, and if the alarms are enabled by ALARM_LVL
See also	ALARM_LVL BAROMETER PRESS_IS

PPU

Direction	Bidirectional
Binding	PPU
Type	Enumerated
Value range	hPa; psig.
Units	None
Description	Selects the units for pressure variable display for this analyzer.
Usage	The NGA control module displays any variable with units defined as PPU in the pressure units selected through the variable PPU. The pressure is still transmitted in hPa (the SI unit), but it is interpreted as hPa or as psig as PPU is selected. It is important to note that the pressure value itself is not changed, it is merely displayed differently.
See also	PTU PVU

PRESS_COEFF

Direction	Bidirectional
Binding	PRESS_COEFF
Type	4-element floating point array.
Value range	-3000 to +3000
Units	hPa
Description	NDIR only; pressure compensation offset values for each range
Usage	For hyperbaric applications, the NDIR pressure compensation algorithm needs an offset term to work satisfactorily over the wide pressure variations required. This term varies for different ranges and different background gases, and is experimentally determined.
See also	PFACTOR_

PRESS_IS

Direction	Output
Binding	None
Type	4-element floating point array; 5-element in HFID
Value range	0-1050
Units	hPa
Description	Sample pressure (FID only). Burner air pressure. Fuel pressure. Purge air pressure. Carrier gas pressure (FID only).
Usage	Shows the present levels of these pressures.
See also	ALARM_LVL BAROMETER PRESS_WAS PLIM PLIMA

PRESS_THERE

Direction	Output
Binding	None
Type	Enumerated
Value range	ABSENT; PRESENT
Units	None
Description	NDIR and PMD only; indicates the presence or absence of a pressure transducer.
Usage	Indicates whether using pressure compensation is likely to work or not!
See also	PFACTOR_

PROCESS

Direction	Analyzer: input, 1/0 modules: Input to AIO, output from ACAL and SCAL
Binding	PROCESS
Type	Enumerated
Value range	NORMAL; NOT FROM PROCESS; etc.
Units	None
Description	Tells the analyzer that another module is not allowing the measurement sample to flow for some reason
Usage	Shows the analyzer that its measurement is invalid, because it is not measuring process gas. For example, a sample system controller may be flowing a calibration gas, or purging a system with air or nitrogen.
See also	VALIDITY

PTU

Direction	Bidirectional
Binding	PTU
Type	Enumerated
Value range	°C; °F
Units	None
Description	Selects the units for temperature variable display for this analyzer.
Usage	The NGA control module displays any variable with units defined as PTU, in the temperature units selected through the variable PTU. The temperature is still transmitted in 'C (the SI unit), but it is interpreted as 'C or as 'F as PTU is selected. It is important to note that the value itself is not changed, it is merely displayed differently.
See also	PPU PVU

PURGE_IS_TOO

Direction	Output
Binding	None
Type	Floating point
Value range	0-2
Units	None
Description	FID only; alarm message variable
Usage	Used to show an alarm message. If the purge air pressure is too low, the value of this variable is set to 0 causing the alarm message “PURGE_IS_TOO LOW" to appear on the control module screen. Conversely if the pressure is too high, the value of this variable is set to 2 causing the message "PURGE_IS_TOO HIGH” to appear on the screen.
See also	ALARM_LVL

PVA

Direction	Output
Binding	PVA
Type	Floating point
Value range	0 - 1,000,000 typically, no hard limits though.
Units	ppm
Description	The primary variable - the main gas measurement from the analyzer.
Usage	PVA is the main reading from the analyzer. It is always transmitted in units of ppm. It is generated by a complicated algorithm described in other documents. Its output update rate may be controlled by LONPVUPDATE. It can be delayed in time in order to align the outputs from multiple analyzers all looking, at the same sample gas, using AMDELAYTIME. Its response time can be controlled (within the physical limits of the measurement) by AFT90_. If the analyzer considers that its reading is invalid for some reason, PVA is still reported but the variable VALIDITY is set to invalid. If the analyzer is in a mode other than normal, the variable OPSTATUS will be set to some value other than zero, but again PVA is still reported. This is true even of analyzers that cannot perform a measurement, such as a MID with no flame.
See also	VALIDITY OPSTATUS PVACEMS

PVACEMS

Direction	Analyzer: output; 1/0 module: input
Binding	PVACEMS
Type	Floating point
Value range	0 - 1,000,000 typically, no hard limits though.
Units	ppm
Description	A copy of the primary variable (PVA), but with prior calibration factors applied.
Usage	During a calibration sequence, while PROCESS is set to something other than 0 by the calibration module, PVACEMS reports the value of PVA using the values of the calibration factors that were in use before the current calibration cycle. This allows an 1/0 module or DAS to record the drift experienced by the analyzer since the last calibration. PVA is reported as well, but with the latest calibration factors applied. The effect is that any span gas is reported through PVACEMS as if no zero calibration had just been done, thus showing the total error in the span gas reading. As soon as PROCESS goes back to 0, at the end of the calibration cycle, PVACEMS is no longer updated, and its value becomes meaningless.
See also	PVA PROCESS

PVU

Direction	Analyzer: bidirectional; 1/0 module: input
Binding	PVU
Type	Enumerated
Value range	ppm; ppb; %
Units	None
Description	Selects the units for all variables with values relating to the main reading for this analyzer.
Usage	The NGA control module displays any variable with units defined as PVU, in the units selected through the variable PVU. The value is still transmitted in ppm, but it is interpreted as ppm, ppb or as percent as PVU is selected. It is important to note that the value itself is not changed, it is merely displayed differently. The 1/0 module copies this value so the control module can do the same thing with 1/0 menus.
See also	PPU PTU

PWAS

Direction	Output
Binding	None
Type	2-element floating point array
Value range	Both elements between 0 and 100.
Units	None
Description	NDIR only: Oscillator tune at manufacturing time. Percent modulation at manufacturing time.
Usage	Historical values of OSC_TUNE and PERCENT_MOD respectively. These show how the instrument was working when it was tested during the manufacturing process. These values are loaded automatically by the manufacturing data storage function.
See also	OSC_TUNE PERCENT_MOD

PWASA

Direction	Output
Binding	None
Type	Integer
Value range	Between 0 and 100
Units	None
Description	NDIR only; Signal gain setting at manufacturing time.
Usage	Historical values of SIGNAL-GAIN. This show how the instrument was working when it was tested during the manufacturing process. This value is loaded automatically by the manufacturing data storage function.
See also	SIGNAL_GAIN

PWM_CUR_IS

Direction	Output
Binding	None
Type	2-element floating point array except FID, 3-elements
Value range	Both elements between 0 and 5000.
Units	mA
Description	Heater Current (NDIR, FID), Block heater current (CLD) Fan Current (NDIR, FID), Converter heater current (CLD) Air FET Current (FID)
Usage	Shows the current through the control FET for these devices. Used as a diagnostic tool.
See also	

PWM_DUTY

Direction	Output
Binding	None
Type	NDIR, PMD, HFID: 2-element floating point array; FU): single floating point; CLD: 3-element floating point.
Value range	Both elements between 0 and 100
Units	None
Description	Fan FET duty cycle (NDIR, PMD), Temperature controller duty cycle (FID, HFID), Fan duty cycle (CLD). Heater FET duty cycle (NDIR, PMD), Oven controller duty cycle (HFID), Converter duty cycle (CLD). Detector cooler (Peltier) duty cycle (CLD).
Usage	Shows the duty cycle of the control algorithm for these devices.
See also	

RAW_SIGNAL

Direction	Output
Binding	None
Type	Floating point
Value range	Between 0 and 220; typically around 550,000
Units	None
Description	The signal from the ADC, filtered by AFT90_ and the median filter if any.
Usage	The raw signal from the physical hardware, although filtered. Used to determine whether the signal is making sense or not, since the user may have calibrated the analyzer incorrectly. Analyzers with 20-bit ADC's have a typical value on zero gas around 500,000, whereas the 16-bit ADC in the CLD has an output on zero gas of around 32,000. A span gas of value close to the MAXRANGE should give a RAW_SIGNAL of about 800,000 to 1,000,000. Anything else indicates some kind of problem. At the least, the span gas should give a value significantly different from the zero gas value, if it does not, there is probably an error in the choice of gases, or the analyzer physics is inoperable, as for example in the case of a FID whose flame is out.
See also	DET_SIG

REF_DUTY_CYC

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	Typically 0.2785
Units	None
Description	CLD only; the temperature compensation offset term
Usage	The CLD uses the duty cycle of the sensor block controller to determine the temperature of the analyzer as a whole. This is used to compensate the PVA value. This variable is used to provide the offset term in this compensation.
See also	

RNGHI

Direction	Analyzer: bidirectional; I/0 module: input
Binding	RNGHI
Type	4-element floating point array
Value range	Between 0 and MAXRANGE
Units	ppm
Description	The upper range end points, element 1 being the upper end point for range 1 etc.
Usage	The range definition, together with RNGLO. RNGHI cannot be edited higher than MAXRANGE or lower than MINRANGE using the control module, and should not be made so through a PC either. It is possible to set the higher ranges of lower value than the lower ranges, but doing so will confuse any auto-range change algorithm. The resolution of the analyzer is not directly affected by the choice of range in most cases, except for the FED which changes a range resistor between certain settings. However the output resolution is affected, as is the operation of a. linearizer algorithm.
See also	RNGLO MAXRANGE MINRANGE

RNGLO

Direction	Analyzer: bidirectional; 1/0 module: input
Binding	RNGLO
Type	4-element floating point array
Value range	Between 0 and RNGHI
Units	ppm
Description	The lower range end points, element 1 being the lower end point for range 1 etc.
Usage	The range definition, together with RNGHI. RNGLO cannot be edited higher than the equivalent element in RNGHI using the control module, and should not be made so through a PC either. RNGLO is normally set to 0, but it is possible to operate the analyzer on a "Suppressed range" by setting RNGLO to a higher value. Note that the analyzer accuracy, noise and drift specification are based on ranges with a low end point of zero. It is still best to zero the analyzer on a zero gas if possible, but again it is possible to use a non-zero gas, as long as the user is prepared to iterate between zeros and spans as required.
See also	RNGHI

SELFTEST

Direction	Output
Binding	None
Type	FID: 1 O-element enumerated array; HFID: 11 -element enumerated array
Value range	Pass; Fail
Units	None
Description	EEPROM test result (FID only) EPROM test result RAM test result Power supply test result Network test result 20-bit ADC test result 12-bit ADC test result Power supply board test result Safety board test result Case temperature test result Oven / sample temperature test.
Usage	The results of the self test when the FID or HFID is powered or started up.
See also	GENERALSTATE

SENSOR_OFFS

Direction	Bidirectional
Binding	None
Type	Integer
Value range	0 - 4096; default 1000 (CLD)
Units	None
Description	CLD: the value for the DAC count providing the hardware sensor offset voltage. NDIR and PMD: defines the analog offset in the signal circuitry. Not used as an adjustment.
Usage	CLD: Used to provide an offset for the analog circuitry. This value is not changed in operation. NDIR and PMD: An offset in the analog circuitry. This is not used, and should not be altered.
See also	

SIGNAL_GAIN

Direction	FID: Output; CLD: bidirectional.
Binding	None
Type	FID: 2-element enumerated array; CLD: integer
Value range	FID: LOW; MEDIUM; HIGH; CLD: 1 - 64
Units	None
Description	NDIR only; determines the analog signal gain Signal gain of final resistor divider chain (FID). Signal gain of preamplifier (FID). CLD only: signal gain of PGA.
Usage	FID only; these are set by a combination of CARBON_ATOMS, CAL_PRESS, CALRNGHI, FUEL_TYPE according to a set of criteria. These values are designed so that the analog circuitry does not saturate whatever combination of conditions are used. CLD only; set by the current full scale range. Its values decrease by a factor of 2 from the highest value (64) at 100 ppm to 1. Used to set the signal level in the NDIR analyzer. This value should be set such that the value of DET_SIG on the highest range span gas is about 7 volts. It is a feature of the digitally programmed potentiometer used that its internal EEPROM can get corrupted under some circumstances. If this should happen, as shown by the symptom that the value of DET_SIG is too low no matter what the gas is, or this variable's setting, the pot can be reset by first noting the present value of SIGNAL_GAIN, then setting it to zero, then to 99, then to zero , and then back to its original value. CARBON_ATOMS
See also	CAL_PRESS CALRNGHI FUEL_TYPEDET_SIG RAW_SIGNAL

SOURCECURR

Direction	Bidirectional
Binding	None
Type	Integer
Value range	0-99
Units	None
Description	NDIR only; determines the source current potentiometer setting.
Usage	Used to set the source current in the NDIR analyzer. This value should be set such that the value of CURR_SENS is as set up originally, typically about 1A. Long bench IRs require a higher setting, and short bench IRs require a lower setting. See CURR_SENS for more information.
See also	CURR_SENS

SPAN

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Each element typically around 0.0005, depending on range and analyzer.
Units	None
Description	The span coefficient array, element 1 being the value of the span coefficient for range 1.
Usage	The multiplicative factor that converts the raw signal minus the zero offset to the normalized value between 0 and 1 for use in the linearizing function. This value is set by the span function in the analyzer, though it may be overwritten by the user, or copied over from the SPAN_WAS or SPAN_GOOD values. It may be copied into SPAN_WAS or SPAN_GOOD by functions in the analyzer menus.
See also	SPAN_GOOD SPAN_WAS ZERO

SPAN_COMP

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	Around 0
Units	None
Description	NDIR and PMD only; determines the temperature compensation slope coefficient.
Usage	Used to set the temperature compensation in the NDIR and PMD analyzer. This is experimentally determined by first compensating the zero offset with ZERO_COMP, and then running span gases through the analyzer while varying the temperature. It is essential that the analyzer be linearized correctly beforehand. If the user is not in a position to do this experiment, this value should not be adjusted
See also	ZERO_COMP

SPAN_GOOD

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Each element typically around 0.0005, depending on range and analyzer.
Units	None
Description	A known good value of the span factor SPAN.
Usage	The user can copy a known good set of span coefficients into this variable, and then if desired copy them back into SPAN. It is a good way of insuring against accidental invalid calibrations.
See also	SPAN SPANWAS

SPAN_THEN

Direction	Output
Binding	None
Type	4-element floating point array
Value range	Equal to the span gas value when the unit was linearized
Units	ppm
Description	The value of the span gases when the unit was linearized.
Usage	Used for the temperature compensation scheme, this value is recorded by the analyzer so as to allow it to compensate correctly.
See also	SPANGAS

SPANGAS

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Typically 80% of RNGHI
Units	ppm
Description	Contains the value of span gases, element 1 containing the span gas for range 1 etc.
Usage	During a span function, the analyzer adjusts the value of SPAN for the selected range such that the value of PVA becomes equal to the value of the appropriate element of SPANGAS, to within 0.02% of the range value. This variable should be kept updated with the current value of the span gas as shown on the bottle label. If the bottle is of dubious quality, it may be desirable to compare its reading with that of a known good standard, and then mark the bottle and this variable accordingly.
See also	SPAN SPANWAS

SPANWAS

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Each element typically around 0.0005, depending on range and analyzer.
Units	None
Description	The value of the span factor SPAN at manufacturing checkout time.
Usage	The check out personnel copy a known good set of span coefficients into this variable, and then if desired the user can copy them back into SPAN.
See also	SPAN SPAN_GOOD

ST1NAME

Direction	Analyzer input
Binding	None
Type	Single element enumeration
Value range	NORMAL, MAINTENANCE REQUEST, FAILURE, CAL IN PROGRESS, ZERO IN PROGRESS, SPAN IN PROGRESS, ZERO FAILED, SPAN FAILED, RANGE OVERFLOW. RANGE UNDERFLOW, FLOW TOO LOW, FLOW TOO HIGH, INVALID SELECTION, RANGE 1, RANGE 2, RANGE 3, RANGE 4
Units	None
Description	Each bit of the first and second element of STCONT shows the state of the corresponding alarm named in this variable; These are standard alarms supported by each analyzer. MAINTENANCE REQUEST means that GENERALSTATE is greater than 0; FAILURE that it is equal to' FAILURE. RANGE OVERFLOW means that the reading is greater than the CURENTRNGHI value, RANGE UNDERFLOW that it is less than the RNGHI value of the range below the present one. INVALID SELECTION is not shown on the display.
Usage	Used to allow the 1/0 Module to select which specific alarm to assign to which relay. These values are shown on the 1/0 module alarm selection menu.
See also	ST2NAME ST3NAME ST4NAME STCONT

ST2NAME

Direction	Analyzer input
Binding	None
Type	Single element enumeration
Value range	Analyzer specific: FID - FLAME OUT, PURGE FAILURE; CLD - OZONATOR OFF, NO MODE, NOx MODE; others INVALID SELECTION.
Units	None
Description	Each bit of the third and fourth elements of STCONT shows the state of the corresponding alarm named in this variable; these are specific alarms for each analyzer type.
Usage	Used to allow the 1/0 Module to select which specific alarm to assign to which relay. These values are shown on the 1/0 module alarm selection menu. INVALID SELECTION is not shown on the menus.
See also	ST1NAME ST3NAME ST4NAME STCONT

ST3NAME

Direction	Analyzer input
Binding	None
Type	Single element enumeration
Value range	INVALID SELECTION in all single channel analyzers. Same as ST1NA2v1E in MLT analyzers.
Units	None
Description	Provided to allow compatibility with MLT analyzers.
Usage	Not used in analyzers covered by this document. INVALID SELECTION is not shown on the menus. The fifth and sixth elements of STCONT apply to this variable.
See also	ST1NAME ST2NAME ST4NAME STCONT

ST4NAME

Direction	Analyzer input
Binding	None
Type	Single element enumeration
Value range	INVALID SELECTION in all single channel analyzers. Same as ST1NAME in MLT analyzers.
Units	None
Description	Provided to allow compatibility with MLT analyzers.
Usage	Not used in analyzers covered by this document. INVALID SELECTION is not shown on the menus. The seventh and eighth elements of STCONT apply to this variable.
See also	ST1NAME ST2NAME ST3NAME STCONT

STCONT

Direction	Analyzer output and 1/0 module output
Binding	STCONT
Type	8-element integer array
Value range	Bit field variables; odd elements are 16 bits, even elements use only the last 4 bits
Units	None
Description	Each bit of the first element shows the state of the corresponding alarm named in ST1NAME; the odd elements show the first 16 elements of ST1NAME, the even show the last four. Similarly for the remaining pairs with ST2NAME etc.
Usage	Used to show the state of the specific analyzer alarms listed in ST1NAME, ST2NAME and so on.
See also	ST1NAME

SVCONT

Direction	Analyzer and 1/0 module: output
Binding	None
Type	4-element enumerated array
Value range	A list of variable names, each element having the same list.
Units	None
Description	Contains the variable names for the control module to use in the secondary variable display.
Usage	The variable SVNAME shares data with this variable. When a selection is made in SVNAME, it causes the control module to use the contents of the equivalent enumeration in SVCONT as the value to be displayed on the auxiliary line of the single analyzer display screen. Element 1 is displayed on line 1, and so on. The description in SVNAME is used as the text description on the variable line on the same screen.
See also	SVNAME

SVFLL

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	0 - about 200
Units	cc/min
Description	The sample bypass flow rate lower limit
Usage	Used in the alarm system to provide the lower limit for the flow alarm. When the flow-rate given in FLOW_IS drops below this value, the variable VALIDITY is set to invalid.
See also	SVFUL FLOW_IS

SVFUL

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	600-1200
Units	cc/min
Description	The sample bypass flow rate upper limit
Usage	Used in the alarm system to provide the upper limit for the flow alarm.
See also	SVFLL FLOW_IS

SVNAME

Direction	Analyzer and 1/0 module: output
Binding	None
Type	4-element enumerated array
Value range	A list of variable descriptions, each element having the same list.
Units	None
Description	Contains the descriptions of the variables that the control module will use in the secondary variable display, as well as the means of selecting the variables in the first place.
Usage	The variable SVCONT shares data with this variable. When a selection is made in SVNAME, it causes the control module to use the contents of the equivalent enumeration in SVCONT as the value to be displayed on the auxiliary line of the single analyzer display screen. Element 1 is displayed on line 1, and so on. The description in SVNAME is used as the text description on the variable line on the same screen.
See also	SVCONT

SW_DIAG1A

SW_DIAG1B, SW_DIAG1C, SW_DIAG1D, SW_DIAG2A, SW_DIAG2B, SW_DIAG2C, SW_DIAG2D

Direction	Output
Binding	None
Type	String
Value range	31 characters
Units	None
Description	Software error reporting variables.
Usage	Contain a series of strings reporting any software error detected by the internal diagnostic function. Only the first error in a series will be reported. The values may be reset to blank by editing SW_RESET to 1 (Reset).
See also	SW_RESET

SW_RESET

Direction	Bidirectional
Binding	None
Type	Enumerated
Value range	Report; Reset
Units	None
Description	Resets the software error reporting variables.
Usage	If an error has occurred, the software error reporting variables will contain the error. They can be reset by editing this variable to the value 1, or "Reset".
See also	SW_DIAG1A etc.

TAG

Direction	Analyzer: bidirectional; 1/0 module: output
Binding	ANALTAG
Type	String
Value range	31 characters
Units	None
Description	Analyzer, AIO, and ACAL: user tag for the module.
Usage	This is the tag for the module. It appears on the top line of every menu applying to that analyzer. It appears as the selection on all the menus that allow the user to enter the 1/0 module menus. It is also used to select the module during the binding process. It may be changed as desired via the menus.
See also	AMSN AMTAG KOTAG

TARGETMETHOD

Direction	Bidirectional
Binding	None
Type	String
Value range	31 characters
Units	None
Description	Unused.
Usage	This was supposed to be the desired parameter set into which to copy the current parameter set. This feature has not been implemented in version 2.2, and in fact has been overtaken by the PC interface developments. No internal use is made of this variable.
See also	METHODA etc.

TEMP_IS

Direction	Output
Binding	None
Type	NDIR and PMD: 2-element floating point array; FID and CLD: 3-element floating point array; HFID: 5-element floating point array
Value range	See below.
Units	C
Description	Internal temperature measurements. Case temperature (NDIR, PMD, FID), Converter temperature (CLD). Detector temperature (NDIR, PMD), Flame temperature (FID), Sensor block temperature (CLD). Peltier device temperature (CLD), Preamp temperature (FID). Sample temperature (HFID). Oven temperature (HFID).
Usage	Real time temperature measurements. The meaning varies with each analyzer, see above. In the NDIR and PMD the detector temperature is critical, at 61.5°C. In the CLD, the converter is set to an optimum temperature based on a converter efficiency test, typically about 350°C. The sensor block in the CLD is critical at 51.5°C, and the Peltier temperature is also critical at 0°C. The FID flame temperature has to be above 115°C for the flame to be considered to be on, and the preamp temperature is less critical, although it is normally about 55°C.
See also	TEMP_WAS

TEMP_WAS

Direction	Output
Binding	None
Type	NDIR and PMD: 2-element floating point array; FID and CLD: 3-element floating-z point array; HFID: 5-element floating point array
Value range	See below.
Units	C
Description	Historical value of internal temperature measurements: Case temperature (NDIR, PMD, FID), Converter temperature (CLD) Detector temperature (NDIR, PMD), Flame temperature (CLD). Peltier device temperature (CLD), Preamp temperature FID). Sample temperature (HFID). Oven temperature (HFID).
Usage	These are the values of the internal temperature readings at manufacturing check out time.
See also	TEMP_IS

TEMPCOMP

Direction	Bidirectional
Binding	None
Type	Enumerated
Value range	DISABLED; ENABLED
Units	None
Description	CLD only; selects whether the temperature compensation is enabled or not
Usage	If enabled, the CLD uses the sensor block temperature controller duty cycle to determine the ambient temperature. The temperature compensation algorithm uses this to adjust the output for temperature changes.
See also	

TIME_LEFT

Direction	Analyzer and 1/0 module: output
Binding	None
Type	NDIR, PMD, I/0 module: Integer; FID: 3-element integer
Value range	0 - 300 or so; 0 - 999 in I/0 module
Units	Seconds
Description	The time remaining in a function. General use (FID only). Number of ignition tries in the present sequence. Timer for the air purge. ACAL, SCAL only; shows the time left in the current procedure.
Usage	***Analyzer:*** Used to show how much time remains for the present function. In the case of the FID, element two counts how many ignition tries so far (unsuccessful if greater than 1); element 3 times the purge air. This is stopped if DIGDIAGA element 3 is set, i.e., the purge is successful. ***I/O module***: Shows the time left until time out for the current section of a calibration cycle. This either refers to the time until a fixed event, such as the remaining time on a zero gas soak before the analyzers are told to zero themselves, or the time left until a time out occurs, such as while waiting for an analyzer to zero itself, this value will count down from 999. At the end of this time the procedure will abort if the analyzer has not reported a successful calibration. Otherwise the procedure will move on as soon as the analyzer has reported a successful calibration, whatever the value of this variable.
See also	

TLIMA

Direction	Bidirectional
Binding	None
Type	2-element floating point array (6-element in the FID and CLD)
Value range	User selectable, depending on application
Units	°C
Description	Internal temperature measurement limits: Case temperature upper limit (NDIR, PMD, FID), Converter temperature (CLD). Case temperature lower limit (NDIR, PMD, FID), Converter temperature (CLD). Flame temperature upper limit (FID), Sensor block temperature (CLD). Flame temperature lower limit (FID), Sensor block temperature (CLD). Sensor block temperature upper limit (CLD), Preamp temperature (FID). Sensor block temperature lower limit (CLD), Preamp temperature (FID).
Usage	Limits on the temperature measurements. If transgressed, the alarm system Will issue warning alarms.
See also	TEMP_WAS

TLIMB

Direction	Bidirectional
Binding	None
Type	NDIR: 2-element floating point array, HFID: 4-element floating point array.
Value range	User selectable, depending on application
Units	C
Description	Internal temperature measurement limits: NDIR: Detector temperature upper limit. Detector temperature lower limit. HFID: Oven temperature upper limit. Oven temperature lower limit. Sample temperature upper limit. Sample temperature lower limit.
Usage	Limits on the temperature measurements. If transgressed, the alarm system will issue warning alarms.
See also	TLIMA

TRENDCONT

Direction	Bidirectional
Binding	None
Type	2-element enumerated array.
Value range	A list of analyzer variables
Units	None
Description	Lists possible analyzer variables whose 15 minute averages may be stored in the internal storage buffer.
Usage	This variable shares data with TRENDVAR. TRENDVAR contains enumerations whose phrases describe the variables whose names are referred to by the enumerations in TRENDCONT. In the menu system, the user selects an element in TRENDVAR and the system tells the software in the analyzer to store the data in the variable pointed to by TRENCONT.
See also	TRENDVAR

TRENDTIME

Direction	Bidirectional
Binding	None
Type	Integer
Value range	0-240
Units	Hours
Description	Length of time over which TRENDCONT and TRENDVAR are stored.
Usage	Not used. If implemented, will control the length of time over which the internal storage will run. In version 2.2 or earlier, this is fixed at 24 hours.
See also	TRENDVAR

TRENDVAR

Direction	Bidirectional
Binding	None
Type	2-element enumerated array.
Value range	A list of analyzer variable descriptions
Units	None
Description	Lists possible analyzer variables whose 15 minute averages may be stored in the internal storage buffer.
Usage	This variable shares data with TRENDCONT. TRENDVAR contains enumerations whose phrases describe the variables whose names are referred to by the enumerations in TRENDCONT. In the menu system, the user selects an element in TRENDVAR and the system tells the software in the analyzer to store the data in the variable pointed to by TRENCONT.
See also	TRENDCONT

TRENDTIMEOUT

Direction	Bidirectional
Binding	None
Type	Enumerated
Value range	DISABLED; ENABLED
Units	None
Description	Disables the control module time out function when the analyzer trend display is on the screen. Not used.
Usage	Not used in version 2.2 or earlier, as graphic screens are not implemented in these versions.
See also	TRENDVAR

TWEAK

Direction	Bidirectional
Binding	None
Type	4-element enumerated array
Value range	DISABLED; ENABLED
Units	None
Description	Determines whether the tweak correction is enabled on each range.
Usage	When enabled, the "Tweak' function will add additional linearization to the signal so as to force the reading to go through the mid point gas values exactly.
See also	MIDPOINTA etc. MID_GASA etc.

VALIDITY

Direction	Analyzer: output; 1/0 module: input
Binding	VALIDITY
Type	Enumerated
Value range	VALID; INVALID; NOT FROM PROCESS
Units	None
Description	Describes the validity of the PVA variable.
Usage	Reports the PVA invalid if any of the following are true: Flow below limits Invalid calibration on this range Flame out (FID only) Ozonator switch off (CLD only) PROCESS variable reported anything but 0 (i.e. not from process).
See also	OPSTATUS GENERALSTATE PVA

VOLTS_IS

Direction	Output
Binding	None
Type	5-element (6-element in FED, CLD) floating point array
Value range	Nominal voltage ± about 2V
Units	Volts
Description	Reports internal power supply voltages: +15 V -15 V + 5 V; +10 V FID +24 V; polarizing voltage (~95 V) FID +12 V; not on FID On HFID, 10 V reference. +10 V CLD only
Usage	Reports internal power supply voltages. Note that a significant error in the +5 V supply will not be reported as it will stop the computer from working.
See also	AMVOLTSWAS

ZERO

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Around 500,000 except CLD, 32,000
Units	None
Description	Zero offset. Element 1 refers to the zero offset for range 1, etc.
Usage	Contains the zero offsets used in the main PVA calculation. During zero calibration, these are adjusted such that the value of PVA resulting is within 0.02% of the full scale range value of the appropriate element of ZEROGAS. If CALCHCKLIMITS is set to enabled, this will fail if the change required is greater than the percentage of the full scale value given in CALFAIL. The value of ZERO should be the same as the value of RAW-SIGNAL while zero gas is flowing, and a zero may be effected by simply copying the value of RAW-SIGNAL into the appropriate element of ZERO.
See also	SPAN_GOOD ZEROGAS ZERO_WAS

ZERO_COMP

Direction	Bidirectional
Binding	None
Type	Floating point
Value range	Around 0
Units	None
Description	NDIR and PMD only; determines the temperature compensation for the offset coefficient.
Usage	Used to set the zero temperature compensation in the NDIR and PMD analyzers.
See also	SPAN_COMP

ZERO_GOOD

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Around 500,000 except CLD, 32,000
Units	None
Description	User stored known good value of zero offsets.
Usage	Once a known good zero calibration has been achieved, the values of the zero offsets involved may be stored by the user in this array. Another function will automatically copy them back to the operational values (ZERO) if desired.
See also	SPAN_GOOD ZERO ZERO_WAS

ZERO_WAS

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Around 500,000 except CLD, 32,000
Units	None
Description	Manufacturing checkout time stored known good value of zero offsets.
Usage	Once a known good zero calibration has been achieved, the values of the zero offsets involved are stored by manufacturing check out in this array. There is a function that will automatically copy them back to the operational values (ZERO) if desired.
See also	SPANWAS ZERO ZERO_GOOD

ZEROGAS

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Normally 0
Units	ppm
Description	Zero gas. Element 1 refers to the zero gas for range 1, etc.
Usage	During zero calibration, the elements of ZERO are adjusted such that the value of PVA resulting is within 0.02% of the full scale range value of the appropriate element of ZEROGAS. If CALCHCKLIMITS is set to enabled, this will fail if the change required is greater than the percentage of the full scale value given in CALFAIL. The value of ZERO should be the same as the value of RAW_SIGNAL while zero gas is flowing, and a zero may be effected by simply copying the value of RAW_SIGNAL into the appropriate element of ZERO.
See also	SPANGAS ZERO

ZERORNGS

Direction	Bidirectional
Binding	None
Type	Enumerated
Value range	SEPARATELY; TOGETHER
Units	None
Description	Determines whether to zero each range separately or do them all at once.
Usage	If set to SEPARATELY, when a zero operation is performed, only the current range will be zeroed. If set to TOGETHER, the analyzer will attempt to zero each range, one after the other, assuming that the gas contains the concentration shown in each element of ZEROGAS. If these are different, this will fail, unless CALCHKLIMITS is set to DISABLED, in which case it will zero all ranges anyway. If the preamp gain has to be changed between ranges, the analyzer will not zero any range for which it has to change the gain. If it fails to zero any range, it will set CALRESULT such that any failed ranges are uncalibrated. In this case it will leave the original zero factor unchanged.
See also	ZERO CALRANGES

SECTION 3
I/O MODULES VARIABLES

3-1 INTRODUCTION

1/0 modules that are built around the Neuron 3150 microprocessor can only support input and output variables, unlike the analyzer modules which can also support Bidirectional ones. Output variables can be updated by the control module via its menus, but not by a PC program using the Echelon DDE server. The latter can only change input variables.

This section describes 1/0 Module variables. This description is taken from the "CSV" files that are used. to build the software for each NGA module, and where conflicts exist, the "CSV' file takes precedence. In this file the acronyms AIO, ACAL and SCAL refer to the analog output/ three alarm module, the single analyzer autocalibration module and the system autocalibration module respectively.

These variables are defined in the analyzer section and can be used in the 1/0 module:

CALSTAT	PVACEMS
CONTROL	PVU
GAS	RNGHI
GENERALSTATE	RNGLO
I_TIME	SVCONT
IOHOLDCAL	SVNAME
MAXRANGE	TAG
MINRANGE	TIME_LEFT
OPSTATUS	VALIDITY
PROCESS	

ACFN

Direction	Input
Binding	ACFN
Type	Integer
Value range	0 NO operation; 1 Start an autocalibration cycle; 2 Start a manual calibration cycle 127 Abort present cycle.
Units	None
Description	ACAL; SCAL only; a control variable for the autocal modules.
Usage	May be used to initiate a manual cycle as programmed, a full autocalibration cycle or to abort a current cycle.
See also	AMFN in the analyzer list

ALLVL

Direction	output
Binding	None
Type	6-element floating point
Value range	Elements 1, 3, 5 - 0 - 1,000,000; elements 2, 4, 6 - 0 - 100
Units	Elements 1, 3, 5 - 0 - ppm; elements 2, 4, 6 - percent
Description	Absolute alarm level for relay I (AIO only). Percent of range alarm level for relay 1. Absolute alarm level for relay 2. Percent of range alarm level for relay 2. Absolute alarm level for relay 3. Percent of range alarm level for relay 3.
Usage	Sets the concentration alarm levels for the three possible relays. These may be expressed as an absolute level or as a percentage of the current range. GENPARMA control this choice.
See also	GENPARMA ALOP ALTYPE ALVAR

ALOP

Direction	output
Binding	None
Type	3-element enumerated array
Value range	Fail-safe; Non-fail-safe
Units	None
Description	AIO only; Fail-safe/Non-fail-safe choice for concentration alarms. Element I refers to relay I etc.
Usage	Applies to concentration alarms only. If fail-safe is chosen, the relay will be powered when it is not in alarm mode, and un-powered when it is in alarm. This means that a power failure will produce an alarm, and therefore that the initial condition of the module until all binding and set up has been accomplished will be in alarm. If Non-fail-safe is chosen, the relay is only powered when an alarm condition is detected. All alarms other than concentration alarms are always failsafe.
See also	ALLVL ALTYPE

ALTYPE

Direction	Output
Binding	None
Type	3-element enumerated array
Value range	All elements; HIGH; HIGH-HIGH; LOW; LOW-LOW; Disabled
Units	None
Description	Describes the operation of the appropriate concentration alarm. Each element applies to its respective relay.
Usage	A "HIGH" alarm will go into its alarm state if the concentration exceeds a preset level. "HIGH-HIGH" is the same, but implies a higher alarm level than that of the "FEGIT' alarm. A "LOW" alarm will go into its alarm state if the concentration drops below a preset level, and a "LOW-LOW" is the same but implying a lower alarm level than a "LOW" alarm. "Disabled" keeps the relay in its non-alarmed state no matter what the concentration.
See also	ALLVL ALOP

ALVAR

Direction	output
Binding	None
Type	3-element enumerated array
Value range	VALIDITY; AM Warning; AM Failure; Sys. Failure; Control Status; Concentration; Analyzer alarm 1; Analyzer alarm 2; Analyzer alarm 3; Analyzer alarm 4; Analyzer alarm 5; Analyzer alarm 6; Analyzer alarm 7; Analyzer alarm 8; Analyzer alarm 9; Analyzer alarm 10.
Units	None
Description	AIO only; determines the functionality of each relay.
Usage	VALIDITY makes the relay respond to the VALIDITY variable, it will alarm if VALIDITY becomes anything greater than 0; AM Warning makes the relay respond to the GENERALSTATE variable, it will alarm if GENTERALSTATE is equal to "WARNING" (1); AM Failure makes the relay respond to the GENERALSTATE variable, it will alarm if GENERALSTATE is equal to "FAILURE" or "SAFETY FAELLTRE" (2 or 3); Sys. Failure makes the relay respond to SYSTEMSTATE, it will alarm if SYSTEMSTATE becomes greater than 0; Control Status makes the relay respond to the CONTROL variable, it will change state if CONTROL changes between the values of 0 or 2, and I - i.e. it responds to remote versus local or automatic control; Concentration makes the relay respond to the value of PVA, the gas concentration, as determined by the concentration variables such as ALLVL, ALTYPE etc.; Analyzer alarm I etc. Are not used in version 2.2.
See also	ALLVL ALTYPE

AM_ALARM

Direction	Input
Binding	None
Type	10-element enumerated array
Value range	OFF; ON
Units	None
Description	An array of alarm reporting elements.
Usage	Analyzers supporting this feature can generate specific alarms that are assigned to various elements of this array. If enabled through ALVAR, the 1/0 will cause its appropriate relay to respond to any of these. No 2.2 analyzer supports this feature.
See also	ALVAR

AMFAIL

Direction	output
Binding	None
Type	Enumerated
Value range	ZERO; FULLSCALE; LAST VALUE
Units	None
Description	AIO, ACAL only; describes what the analog output will do if the PVA is not updated for more than 10 seconds.
Usage	If the analyzer dies, or for some reason the PVA variable is not updated, the analog output may be forced to zero (or 4 mA), to full scale (5V or 20mA), or to hold at its last value. This should be chosen based on the results of such a failure.
See also	

AMFNO

Direction	Output
Binding	AMFN
Type	Integer
Value range	See AMFN in Section 2, Analyzer Module Variables
Units	None
Description	Controls analyzer operation
Usage	Binds to the AMFNT variable in the analyzer. Used to control various functions in the analyzer.
See also	AMFN (Section 2)

AMFNOA

Direction	Output
Binding	AMFN
Type	Integer
Value range	See AMFN in Section 2, Analyzer Module Variables
Units	None
Description	ACAL. SCAL only; controls analyzer operation
Usage	Binds to the AMFN variable in the analyzer. Used to control various functions in the analyzer. In the SCAL this is bound to the analyzer number 1.
See also	AMFN (Section 2)

AMFNOB

Direction	Output
Binding	AMFN
Type	Integer
Value range	See AMFN in Section 2, Analyzer Module Variables
Units	None
Description	SCAL only; controls analyzer operation
Usage	Binds to the ANIFN variable in the analyzer. Used to control various functions in the analyzer. This is bound to analyzer number 2.
See also	AMFN (Section 2)

AMFNOC

Direction	Output
Binding	AMFN
Type	Integer
Value range	See AMFN in Section 2, Analyzer Module Variables
Units	None
Description	SCAL only; controls analyzer operation
Usage	Binds to the ANIFN variable in the analyzer. Used to control various functions in the analyzer. This is bound to analyzer number 3.
See also	AMFN (Section 2)

AMFNOD

Direction	Output
Binding	AMFN
Type	Integer
Value range	See AMFN in Section 2, Analyzer Module Variables
Units	None
Description	SCAL only; controls analyzer operation
Usage	Binds to the ANIFN variable in the analyzer. Used to control various functions in the analyzer. This is bound to analyzer number 4.
See also	AMFN (Section 2)

AMS_SPANNED

Direction	output
Binding	None
Type	6-element enumerated array
Value range	None; 1; 2; 3; 4; 1&2; 1&3; 1&4; 2&3; 2&4; 3&4; 1&2&3; 1&2&4; 2&3&4; 1&2&3&4
Units	None
Description	SCAL only; controls analyzer operation on particular functions. The analyzer(s) affected by the zero gas valve function. The analyzer(s) affected by the span gas valve 1 function. The analyzer(s) affected by the span gas valve 2 function. The analyzer(s) affected by the span gas valve 3 function. The analyzer(s) affected by the span gas valve 4 function. The analyzer(s) affected by the manual function.
Usage	Controls which analyzers do what in the various parts of the system autocal autocalibration and manual calibration functions.
See also	

ANALOGOUTPUT

Direction	output
Binding	None
Type	Floating point
Value range	-20 to + 22
Units	Either V or mA, depending on ANOPUNITS.
Description	AIO and ACAL only; the present output value of the analog output circuit.
Usage	Shows the voltage or current output, for display on the control module.
See also	ANOPUNITS RNG1EI

C_TIME

Direction	output
Binding	None
Type	7-element integer array
Value range	0 - 60, 0 - 24, 0 - 31 depending c, on the element
Units	Days, hours and minutes
Description	ACAL and SCAL only; times and dates to initiate calibration cycles, and the time and date the last one occurred; The hour of day to initiate the next calibration cycle. The minute in the hour to initiate the next calibration cycle. The day of the month to initiate the next calibration cycle. The hour of day that the last calibration cycle occurred. The minutes in the hour that the last calibration cycle occurred. The day of the month that the last calibration cycle occurred. The month in which the last calibration cycle occurred.
Usage	The first three elements control the starting time of the next calibration cycle calibrations will occur at intervals after this as set by TIME-PERIOD. The last four elements show when the last cycle actually occurred, and completed. Setting the first three elements to zero will disable the repetitive calibration cycles.
See also	TIME_PERIOD CAL_DRIFTA CAL_DRIFTB CAL_DRIFTC CAL_DRIFTD

CAL_

Direction	Output
Binding	None
Type	4-element floating point array
Value range	-10 to + 10
Units	None
Description	AIO and ACAL only. Voltage offset output calibration factor. Voltage gain output calibration factor. Current offset output calibration factor. Current gain output calibration factor.
Usage	Sets the calibration of the output circuitry. Set the desired output units (voltage or current), then use TESTMODE to set the operation of the software, and then IODIAG to set the desired output current or voltage, and use this variable to make the output match what is expected. It is often necessary to iterate between settings of offset and gain a few times to get a perfect calibration.
See also	TESTMODE IODIAG

CAL_DRIFTA

Direction	Output
Binding	None
Type	5-element floating point array
Value range	same as analyzer calibration gas, ±5% or so. A calibration failure is indicated by a very large negative number of about 9 E-12 or so, much less than zero.
Units	ppm
Description	SCAL only; Shows the appropriate analyzer reading just prior to calibration on the various gas cycles. Analyzer 1's reading just prior to the zero calibration. Analyzer 1's reading just prior to the span gas 1 calibration. Analyzer 1's reading just prior to the span gas 2 calibration. Analyzer 1's reading just prior to the span gas 3 calibration. Analyzer 1's reading just prior to the span gas 4 calibration.
Usage	Allows a DAS to track the calibration drift of the analyzer. These values are updated after the calibration cycle is. complete. If the cycle does not complete, the incomplete values will be represented by the very large negative number.
See also	CAL_DRIFTB CAL_DRIFTC CAL_DRIFTD

CAL_DRIFTB

Direction	output
Binding	None
Type	5-element floating point array
Value range	Same as analyzer calibration gas, ±5% or so. A calibration failure is indicated by a very large negative number of about 9 E-12 or so, much less than zero.
Units	ppm
Description	SCAL only; shows the appropriate analyzer reading just prior to calibration on the various gas cycles. Analyzer 2's reading just prior to the zero calibration. Analyzer 2's reading just prior to the span gas 1 calibration. Analyzer 2's reading just prior to the span gas 2 calibration. Analyzer 2's reading just prior to the span gas 3 calibration. Analyzer 2's reading just prior to the span gas 4 calibration.
Usage	Allows a DAS to track the calibration drift of the analyzer. These values are updated after the calibration cycle is complete. If the cycle does not complete, the incomplete values will be represented by the very large negative number.
See also	CAL_DRIFTA CAL_DRIFTC CAL_DRIFTD

CAL_DRIFTC

Direction	output
Binding	None
Type	5-element floating point array
Value range	Same as analyzer calibration gas, ±5% or so. A calibration failure is indicated by a very large negative number of about 9 E-12 or so, much less than zero.
Units	PPM
Description	SCAL only; shows the appropriate analyzer reading just prior to calibration on the various gas cycles. Analyzer 3's reading just prior to the zero calibration. Analyzer 3's reading just prior to the span gas 1 calibration. Analyzer 3s reading just prior to the span gas 2 calibration. Analyzer 3's reading just prior to the span gas 3 calibration. Analyzer 3's reading just prior to the span gas 4 calibration.
Usage	Allows a DAS to track the calibration drift of the analyzer. These values are updated after the calibration cycle is complete. If the cycle does hot complete, the incomplete values will be represented by the very large negative number.
See also	CAL_DRIFTA CAL_DRIFTB CAL_DRIFTD

CAL_DRIFTD

Direction	output
Binding	None
Type	5-element floating point array
Value range	Same as analyzer calibration gas, +5% or so. A calibration failure is indicated by a very large negative number of about 9 E-12 or so, much less than zero.
Units	PPM
Description	SCAL only; shows the appropriate analyzer reading just prior to calibration on the various gas cycles. Analyzer 4's reading just prior to the zero calibration. Analyzer 4's reading just prior to the span gas 1 calibration. Analyzer 4's reading just prior to the span gas 2 calibration. Analyzer 4's reading just prior to the span gas 3 calibration. Analyzer 4's reading just prior to the span gas 4 calibration.
Usage	Allows a DAS to track the calibration drift of the analyzer. These values are updated after the calibration cycle is complete. If the cycle does not complete, the incomplete values will be represented by the very large negative number.
See also	CAL_DRIFTA CAL_DRIFTB CAL_DRIFTC

CAL_MODE

Direction	output
Binding	None
Type	2-element enumerated array
Value range	LOCAL; REMOTE; EXTERNAL
Units	None
Description	AIO and ACAL only. Calibration mode for automatic calibration; Calibration mode for manual calibration.
Usage	Controls which set of timing parameters controls the calibration algorithm, the "Local" set or the "remote" set, or allows this to be chosen by the digital input lines when in REMOTE mode. This is to support EPA system calibration requirements whereby calibration gas has to be introduced at the extractive probe (so called "REMOTE" mode), or for diagnostic purposes - as it saves on calibration gas - the gas is introduced locally to the analyzers.
See also	DWELL

CAL_NOWI

Direction	Input
Binding	CAL_NOW
Type	Enumerated
Value range	Wait; Cal now.
Units	None
Description	AIO and ACAL only; initiates a calibration cycle, if the module is in SLAVE mode.
Usage	This variable is bound to CAL_NOWO. It allows a system of autocal modules to synchronize the start of a calibration cycle. One of them is put into MASTER mode, and it updates CAL_NOWO when its time comes, based on CAL_TIME. The others are in SLAVE mode, and they wait until their CAL_NOWI variables are updated by the master to the "Cal now" state. They then initiate a calibration of their own. Note that the timing of the entire cycle is dependent upon the analyzers themselves, so although the zero gas will be put on the analyzers at the same time, they may not track each other through the cycle.
See also	CAL_NOWO MSTR_SLV

CAL_NOWO

Direction	Input
Binding	CAL_NOWO
Type	Enumerated
Value range	Wait; Cal now.
Units	None
Description	AIO and ACAL only; initiates a calibration cycle in other modules themselves in SLAVE mode.
Usage	This variable is bound to CAL_NOWI. It allows a system of autocal modules to synchronize the start of a calibration cycle. One of them is put into MASTER mode, and it updates CAL_NOWO when its time comes, based on CAL_TIME. The others are in SLAVE mode, and they wait until their CAL_NOWI variables are updated by the master to the "Cal now" state. They then initiate a calibration of their own. Note that the timing of the entire cycle is dependent upon the analyzers themselves, so although the zero gas will be put on the analyzers at the same time, they may not track each other through the cycle.
See also	CAL_NOWI MSTR_SLV

CAL_OR_QC

Direction	Output
Binding	None
Type	2-element enumerated array
Value range	CAL; CHECK
Units	None
Description	AIO and ACAL only; Determines whether the module causes the analyzer to zero or span, or simply measure the calibration gases without any calibration. Element 1 determines this for the autocalibration function Element 2 determines this for the manual calibration function.
Usage	This is a global variable that affects the entire auto- or manual Calibration sequence. If set to CAL, the sequence will follow its programming (which may include a check, rather than a calibration on one or more gases). If set to CHECK, the sequence will run but without any calibration, no matter how the programming has been set up.
See also	AMS_SPANNED

CALSTATA

Direction	Input
Binding	CALSTAT
Type	Enumerated type
Value range	READY; ZEROING - WAIT; SPANNING - WAIT.
Units	None
Description	SCAL only; shows present calibration status of associated analyzer.
Usage	Bound to the CALSTAT of analyzer 1, this shows analyzer 1's current calibration status, and is used by the SCAL module as a signal as to what part of its sequence to do next. For example, it updates AMFNO with a value meaning "'Do a zero", and then monitors CALSTATA(B, C or D) to see if the analyzer has both received the message and is doing a zero. Once it has done, and CALSTAT is back to normal again, it goes on to the span step. If the analyzer does not update CALSTAT with its zeroing message, the SCAL module realizes that the analyzer zero has failed, and it will abort the calibration cycle at this point.
See also	CALSTATA CALSTATB CALSTATC CALSTATD

CALSTATB

Direction	Input
Binding	CALSTAT
Type	Enumerated type
Value range	READY; ZEROING - WAIT; SPANNING - WAIT,
Units	None
Description	SCAL only; shows present calibration status of associated analyzer.
Usage	Bound to the CALSTAT of analyzer 2, this shows analyzer 2's current calibration status, and is used by the SCAL module as a signal as to what part of its sequence to do next. For example, it updates AMFNO with a value meaning "Do a zero", and then monitors CALSTATA(B, C or D) to see if the analyzer has both received the message and is doing a zero. Once it has done, and CALSTAT is back to normal again, it goes on to the span step. If the analyzer does not update CALSTAT with its zeroing message, the SCAL module realizes that the analyzer zero has failed, and it will abort the calibration cycle at this point.
See also	CALSTATA CALSTATB CALSTATC CALSTATD

CALSTATC

Direction	Input
Binding	CALSTAT
Type	Enumerated type
Value range	READY; ZEROING - WAIT; SPANNING - WAIT.
Units	None
Description	SCAL only; shows present calibration status of associated analyzer.
Usage	Bound to the CALSTAT of analyzer 3, this shows analyzer 3's current calibration status, and is used by the S CAL module as a signal as to what part of its sequence to do next. For example, it updates AMFNO with a value meaning 'Do a zero", and then monitors CALSTATA(B, C or D) to see if the analyzer has both received the message and is doing a zero. Once it has done, and CALSTAT is back to normal again, it goes on to the span step. If the analyzer does not update CALSTAT with its zeroing message, the SCAL module realizes that the analyzer zero has failed, and it will abort the calibration cycle at this point.
See also	CALSTATA CALSTATB CALSTATC CALSTATD

CALSTATD

Direction	Input
Binding	CALSTAT
Type	Enumerated type
Value range	READY; ZEROING - WAIT; SPANNING - WAIT.
Units	None
Description	SCAL only; shows present calibration status of associated analyzer.
Usage	Bound to the CALSTAT of analyzer 4, this shows analyzer 4's current calibration status, and is used by the SCAL module as a signal as to what part of its sequence to do next. For example, it updates AMFNO with a value meaning "Do a zero", and then monitors CALSTATA(B, C or D) to see if the analyzer has both received the message and is doing a zero. Once it has done, and CALSTAT is back to normal again, it goes on to the span step. If the analyzer does not update CALSTAT with its zeroing message, the S CAL module realizes that the analyzer zero has failed, and it will abort the calibration cycle at this point.
See also	CALSTATA CALSTATB CALSTATC CALSTATD

CONC_ALARM

Direction	output
Binding	None
Type	Enumerated
Value range	None; HIGH ALARM; HIGH HIGH ALARM; LOW ALARM; LOW LOW ALARM.
Units	None
Description	Reports any concentration alarm detected.
Usage	This reports the any concentration alarm that has caused the appropriate relay to change state. If there are two or more alarms, the more extreme of them will be reported, e.g. if the module has two HIGH alarms and a HIGH-HIGH alarm, and all three are in alarm, this variable will report a HIGH-HIGH alarm. Otherwise it will report the latest alarm that occurred (if there are overlapping high and low alarms).
See also	ALLVL ALVAR ALTYPE

CRANGEI

CRANGEI, CRANGEIA, CRANGEIB, CRANGEIC, CRANGEID

Direction	Input
Binding	CRANGE
Type	Enumerated
Value range	1; 2; 3; 4.
Units	None
Description	Tells the 1/0 module what the analyzer current range is. SCAL only uses CRANGEIA etc. to bind to each of its analyzer modules.
Usage	The general range selection variable, set manually or automatically by 1/0 modules of various types. Note that this is an enumerated type - its value is one less than the range, i.e. a value of 0 refers to range 1, a value of 1 refers to range 2 etc.
See also	CRANGEO CRANGE (in Section 2)

CRANGEO

CRANGEO, CRANGEOA, CRANGEOB, CRANGEOC, CRANGEOD

Direction	Output
Binding	CRANGE
Type	Enumerated
Value range	1; 2; 3; 4.
Units	None
Description	Determines current analyzer range. SCAL only uses CRANGEOA etc. to bind to each of its analyzer modules.
Usage	Bound to CRANGE in the analyzer, this is used to control the analyzer range, as opposed to CRANGEI which tells the 1/0 module what the analyzer thinks its range is.
See also	CRANGEI CRANGE (in Section 2)

DWELL

Direction	output
Binding	None
Type	Integer
Value range	1-300
Units	Seconds
Description	ACAL and SCAL only; dwell times for the calibration cycles. The local zero gas dwell time. The local span gas dwell time. The local sample purge dwell time. The remote zero gas dwell time. The remote span gas dwell time. The remote sample purge dwell time.
Usage	The zero gas dwell time is the time the calibration module allows zero gas to flow before telling the analyzer(s) to perform a zero. The analyzer will then wait until it detects a stable signal, or its time out is up, before doing a zero. The span gas dwell time is the equivalent waiting time before the calibration module tells the analyzer to span, and the sample dwell time is the time after spanning is complete before the sample can be expected to have purged the span gas and the PVA value of the analyzer has come to a realistic reading. In general the zero time must be longer than the span time, normally by about a factor of 2, and the sample time may be the same as or somewhat less than the span time. These times are dependent partially on the sample system delays, and partially on the inherent analyzer response times. The dwell times should be a minimum of ten times the nominal analyzer response time; the latter is defined as the time to a 90% reading, and in calibration it is essential that the analyzer comes to a 99.9% reading for 0. 1 % span or zero accuracy.
See also	CALSTAT

GAS_SELECT

Direction	Output
Binding	None
Type	3-element enumerated array
Value range	Sample; SPAN 1; SPAN 2; SPAN 3; SPAN 4; ZERO.
Units	None
Description	ACAL, SCAL only; selects or shows a particular gas. The current gas selected by the calibration algorithm. The gas that the user wants to have selected by the manual calibration algorithm. The gas selected for a solenoid valve test in the diagnostic menus.
Usage	These are used in various places in the menu system. Element 1 shows the user what is happening, element 2 is used by the user to control the manual calibration, and element 3 is used by the user to directly control the operation of an output relay (and thus presumably the gas controlled by that relay).
See also	

GENPARMA

Direction	Output
Binding	None
Type	Enumerated
Value range	Percent; Absolute
Units	None
Description	Determines whether any concentration alarm responds to an absolute value or a percent of the current range.
Usage	If set to "Percent' ', any concentration alarm will respond to ALLVL element 2, 4 or 6, where the value in that variable is multiplied (as a percentage) with RNGHI for the current range. If set to "Absolute", any concentration alarm will respond to ALLVL element 1, 3 or 5, directly comparing PVA against this value.
See also	ALLVL

GENPARMB

Direction	output
Binding	None
Type	Enumerated
Value range	0;1;2;5;10;15;20;30
Units	Percent
Description	AIO only; determines the hysteresis in the concentration alarm setting.
Usage	If the alarm set point is set to 100, and it is a high alarm, the relay will chance state as the concentration level (PVA) reaches 100. If the concentration then drops back again, it will have to drop by the percentage given in this variable before the relay changes state again.
See also	ALLVL RNGHI

GENPARMC

Direction	output
Binding	None
Type	Enumerated
Value range	0; 0.1; 0.5; 1; 2; 5; 10; 30
Units	Seconds
Description	AIO only; determines the delay before activation of any concentration alarm.
Usage	Setting this variable to a value other than zero will cause a delay in the activation of a concentration alarm. This avoids spurious alarms in a noisy system where short term spikes do not indicate an alarm situation. This my be particularly useful in cases of extreme electrical interference, where spurious glitches cannot be prevented from upsetting the measurement.
See also	ALLVL RNGHI

ILINE

Direction	Output
Binding	None
Type	7-element enumerated array
Value range	OFF; ON
Units	None
Description	Shows the present state of the digital input lines to the 1/0 module. Elements 1 through 6 show the input lines 1 through 6. Element 7 shows the presence of the "GM" jumper, a jumper that connects the output relays in a way that
Usage	This is used primarily as a diagnostic indication. It shows the presence or absence of a voltage on the digital input lines. It may also be used to read the state of these lines for general purpose uses, by making a PC poll this variable. In this case the 1/0 module acts as an input port for the LON. The lines are used for the following functions: Initiates a zero calibration in both ACAL and SCAL Initiates a span operation both ACAL and SCAL Initiates a complete zero and span calibration in both ACAL and SCAL The LSB for the range to be calibrated on ACAL, it selects local or remote calibration on the SCAL The MSB for the range to be calibrated on the ACAL only, it. has no function on the SCAL. Has no function.
See also	ILINE_CNTRL

ILINE_CNTRL

Direction	Output
Binding	None
Type	Enumerated
Value range	DISABLED; ENABLED
Units	None
Description	ACAL, SCAL only; determines whether the digital input lines can control the calibration function.
Usage	If enabled, this allows the digital input lines to the 1/0 module to control the calibration function.
See also	ILINE

IODIAG

Direction	Output
Binding	None
Type	6-element enumerated array
Value range	Various
Units	Elements 1 and 3 - V; elements 2, 4 and 6 - mA; element 5 - Ohms.
Description	A10 and ACAL only; shows the operation of the analog output circuitry. What the module is intending to put out as volts. What the module is intending to put out as mA. The measured output voltage.. The measured voltage on the current output terminals. The current circuit load resistance as entered by the user. The calculated output current based on elements 4 and 5.
Usage	Used as a diagnostic tool to determine how the analog output circuitry is doing. Note that the precision of the output DAC (16 bits, a resolution of about 0.2mV) is significantly greater than the measuring circuit (12 bits, a resolution of no less than 5 mV), so this is only a rough test of the quality of the output.
See also	

IOLIM

Direction	output
Binding	None
Type	5-element floating point array
Value range	-20 to +20
Units	Elements 1 -3, mA; elements 4 and 5, V.
Description	AID and ACAL only. The lower limit for the 0mA output. The lower limit for the 4mA output. The upper limit for the 20mA output. The lower limit for the 0V output. The upper limit for the 5V output.
Usage	These are used to set the limits beyond which the output current or voltage will not go, no matter what the value of PVA they are trying to track. For example, if the value of PVA goes negative for some reason, the 4mA output will go below 4 mA. It may be desirable to refuse to allow it to go below 3mA, thus keeping a 0mA output as an indication of a fault in the I/0 module.
See also	ANALOGOUTPUT

IOMAINTHOLD

Direction	Output
Binding	IOMAINTHOLD
Type	Enumerated
Value range	DISABLED; ENABLED
Units	None
Description	Determines how the I/0 module reacts to the value of OPSTATUS being 1, indicating that the analyzer's menus are being accessed and thus that the analyzer in maintenance.
Usage	If set to DISABLED, the output will track the PVA reading during maintenance. If set to ENABLED, the output will hold at its last value as soon as the menus are entered.
See also	IOHOLDCAL

IOVOLTS

Direction	Output
Binding	None
Type	3-element floating point array.
Value range	Nominal power supply values, plus or minus a volt or so.
Units	Volts
Description	The present value of the +15 V power supply. The present value of the -15 V power supply. The present value of the +5 V power supply.
Usage	The present power supply voltages. Of course you will be lucky to read this variable if the third element is significantly different from 5V as it would stop the Neuron chip from working: if it is different it probably indicates that the ADC or its reference voltage is faulty.
See also	IOVOLTSWAS

IOVOLTSWAS

Direction	output
Binding	None
Type	3-element floating point array.
Value range	Nominal power supply values, plus or minus a volt or so.
Units	Volts
Description	Stored values of the power supply voltage array IOVOLTS.
Usage	Stores the values of the power supply voltages at manufacturing check out time. Compare the present values to this in order to see what has changed. Only write into this if the electronic hardware has been changed. There is a special function in the manufacturing data screen which automatically stores this and other such variables.
See also	IOVOLTS

K0TAG

Direction	Output
Binding	None
Type	String
Value range	29 characters
Units	None
Description	SCAL only; module tag (as distinct from the subnode tags)
Usage	The tag for the base subnode. This has to be present for networking reasons.
See also	K1TAG

K1TAG

K1TAG, K2TAG, K3TAG, and K4TAG

Direction	Output
Binding	None
Type	String
Value range	31 characters
Units	None
Description	SCAL only; subnode tags (as distinct from the module base tag)
Usage	The tags that select subnodes in the SCAL module. These are used to select which subnode to bind to which analyzer. The tags are generated automatically from the base tag in SUBNODE_BASE.
See also	K0TAG TAG SUBNODE_BASE

MISC_INT

Direction	Output
Binding	None
Type	3-element integer array
Value range	1 - 255 except element 3, 0-7.
Units	None
Description	ACAL and SCAL only; miscellaneous integer values. How many zeros are done before a complete calibration. How many zeros have been done since the last complete calibration. The slot identification.
Usage	When the ACAL or SCAL modules are set to perform periodic calibrations, they can be told to do some number of zero calibrations and only occasionally to do a complete zero and span calibration. Most analyzers are more stable on span than on zero, and span gases are normally more expensive, so this is practical for applications other than EPA compliance. The first element determines how many zeros to do before a complete calibration. The second element shows how many such zeros it has done. The third element is the same as SLOTPOSITION on the AIO module
See also	SLOTPOSITION

OP

Direction	Output
Binding	None
Type	2-element floating point array
Value range	-10 to +22
Units	None
Description	AIO, ACAL only The desired output for voltage calibration. The desired output for current calibration.
Usage	When TESTMODE is set to "MST", the 1/0 module puts out what it thinks is the this value of voltage or current, depending on the setting of RNG1EL The user can then use CAL- to calibrate the output.
See also	TESTMODE CAL_

OP_RANGE

Direction	output
Binding	None
Type	Enumerated
Value range	Analyzer; Fixed on 1; Fixed on 2; Fixed on 3; Fixed on 4.
Units	None
Description	AIO, ACAL only; determines how the analog output responds when the analyzer range is changed.
Usage	When this variable is set to "Analyzer", if CRANGEI or CRANGEO is changed, the output will track the new range, that is to say the output will be the same percentage of its scale as the PVA is percentage of its current range. If this variable is set to "Fixed on n" where n is I through 4, the output will be scaled to that range only, no matter what range the analyzer is on. If the analyzer has different linearizer coefficients for each range, or changes its gain between ranges, the analog output may change value when a range is changed as it tracks the new value of PVA calculated by the analyzer.
See also	PVA

PVIA

Direction	Input
Binding	PVA
Type	Floating point
Value range	0 - 1,000,000 typically, no hard limits though.
Units	ppm
Description	The primary variable input- the main gas measurement from the analyzer. In the SCAL this is the input for subnode 1.
Usage	PVA is the main reading from the analyzer. It is bound to the input variable PVIA in the 1/0 modules. PVA is always transmitted in units of ppm. It is generated by a complicated algorithm described in other documents. Its output update rate may be controlled by LONPVUPDATE. It can be delayed in time in order to align the outputs from multiple analyzers all looking at the same sample gas, using AMDELAYTIME. Its response time can be controlled (within the physical limits of the measurement) by AFT90_. If the analyzer considers that its reading is invalid for some reason, PVA is still reported but the variable VALIDITY is set to invalid. If the analyzer is in a mode other than normal, the variable OPSTATUS will be set to some value other than zero, but again PVA is still reported. This is true even of analyzers that cannot perform a measurement, such as a FID with no flame.
See also	VALIDITY OPSTATUS PVACEMS PVIB PVIC PVID

PVIB

Direction	Input
Binding	PVA
Type	Floating point
Value range	0 - 1,000,000 typically, no hard limits though.
Units	ppm
Description	SCAL only; The primary variable input- the main gas measurement from the analyzer 2.
Usage	Equivalent to PVIA for subnode 2, bound to analyzer 2 in the SCAL.
See also	VALIDITY OPSTATUS PVACEMS PVIA PVIC PVID

PVIC

Direction	Input
Binding	PVA
Type	Floating point
Value range	0 - 1,000,000 typically, no hard limits though.
Units	ppm
Description	SCAL only; The primary variable input- the main gas measurement from the analyzer 3.
Usage	Equivalent to PVIA for subnode 4, bound to analyzer 3 in the SCAL.
See also	VALIDITY OPSTATUS PVACEMS PVIA PVIB PVID

PVID

Direction	Input
Binding	PVA
Type	Floating point
Value range	0 - 1,000,000 typically, no hard limits though.
Units	ppm
Description	SCAL only; The primary variable input- the main gas measurement from the analyzer 4.
Usage	Equivalent to PVIA for subnode 4, bound to analyzer 4 in the SCAL.
See also	VALIDITY OPSTATUS PVACEMS PVIA PVIB PVIC

RANGE_SVA_

Direction	Output
Binding	None
Type	4-element enumerated array
Value range	1; 2; 3; 4; Default
Units	None
Description	ACAL and SCAL only; Ranges used during span or QC check for analyzer 1. The range used on span gas valve 1. The range used on span gas valve 2. The range used on span gas valve 3. The range used on span gas valve 4.
Usage	On each span gas, the range used on each analyzer can be selected. Default means that the range that is currently in use in the analyzer is unchanged.
See also	RANGE_SVB_ RANGE_SVC_ RANGE_SVD_

RANGE_SVB_

Direction	Output
Binding	None
Type	4-element enumerated array
Value range	1; 2; 3; 4; Default
Units	None
Description	SCAL only; Ranges used during span or QC check for analyzer 2. The range used on span gas valve 1. The range used on span gas valve 2. The range used on span gas valve 3. The range used on span gas valve 4.
Usage	On each span gas, the range used on each analyzer can be selected. Default means that the range that is currently in use in the analyzer is unchanged.
See also	RANGE_SVA_ RANGE_SVC_ RANGE_SVD_

RANGE_SVC_

Direction	Output
Binding	None
Type	4-element enumerated array
Value range	1; 2; 3; 4; Default
Units	None
Description	SCAL only; Ranges used during span or QC check for analyzer 3. The range used on span gas valve 1. The range used on span gas valve 2. The range used on span gas valve 3. The range used on span gas valve 4.
Usage	On each span gas, the range used on each analyzer can be selected. Default means that the range that is currently in use in the analyzer is unchanged.
See also	RANGE_SVA_ RANGE_SVB_ RANGE_SVD_

RANGE_SVD_

Direction	Output
Binding	None
Type	4-element enumerated array
Value range	1; 2; 3; 4; Default
Units	None
Description	SCAL only; Ranges used during span or QC check for analyzer 4. The range used on span gas valve 1. The range used on span gas valve 2. The range used on span gas valve 3. The range used on span gas valve 4.
Usage	On each span gas, the range used on each analyzer can be selected. Default means that the range that is currently in use in the analyzer is unchanged.
See also	RANGE_SVA_ RANGE_SVB_ RANGE_SVC_

RMEASURE

Direction	output
Binding	None
Type	7-element enumerated array
Value range	OFF; ON
Units	None
Description	Shows the present state of each relay power.
Usage	Each element shows whether the associated relay is powered or not. This is used for diagnostic purposes to detect frozen relays.
See also	ILINE RSTATUS

RNG1EI

Direction	output
Binding	None
Type	Enumerated
Value range	0-5V; 0-20mA; 4-2OmA.
Units	None
Description	AIO, ACAL only; selects the analog output mode.
Usage	The analog output circuit produces both voltage and current at once, but only one has meaning. The output is scaled according to the setting of this variable. If it is set to 0-5V, the voltage output will cover a range of 0-5V when the input varies between RNGLO and RNGHI on that range. This output is calibrated with the variable CAL-, and the algorithm uses the appropriate elements of CAL depending on the setting of RNG1EI.
See also	PPU PTU

RNGPAR

Direction	output
Binding	None
Type	4-element integer array
Value range	0 -100 except element 4, 0 - 300
Units	None
Description	AIO, ACAL only. The percent of range for the auto-range change algorithm to change down. The percent of range to change up. The initial range change time delay. The range change toggle hold-off time delay.
Usage	Used to control the automatic range change algorithm. Elements 1 and 2 refer to percentages of the next range down. Element 3 delays the range change so as to avoid nuisance changes on short term spikes, and element 4 is further insurance against range toggling.
See also	

RSTATUS

Direction	Output
Binding	None
Type	7-element enumerated array
Value range	OFF; ON; AUTO
Units	None
Description	Shows the desired state of each relay power.
Usage	If TESTMODE element 2 is set to TEST, each element of RSTATUS determines whether the associated relay is powered or not. If set to AUTO the relay is powered or not depending on the state of its operating algorithm, if set to OFF or ON the relay is forced into that state.
See also	ILINE RSTATUS

SLOTPOSITION

Direction	Output
Binding	None
Type	Integer
Value range	0-7
Units	None
Description	AIO only; shows the present position in the backplane of the 1/0 module
Usage	The NGA control module backplane is encoded with an arrangement of ground connections that determine the slot position of the 1/0 module. The 1/0 module circuitry detects this encoding and reports the position in this variable. Earlier examples of the 1/0 module did not support this feature in hardware, in which case the value of this variable will be 0 no matter where they are put.
See also	MISC_INT

SUBNODE_BASE

Direction	Output
Binding	None
Type	String
Value range	29 characters.
Units	None
Description	SCAL only; provides the base for the tags for each subnode.
Usage	The subnode tags are expected to be something like "System autocal for analyzer 1". The program adds the space and the number for each tag, so you could edit this variable to "SCAL" and then the subnode tags would be "SCAL 1", SCAL 2" etc. For this reason the length of the string in this variable is truncated to 29, making it pointless to enter more letters than that!
See also	K1TAG K2TAG K3TAG K4TAG

SYSTEMSTATE

Direction	Input
Binding	SYSTEMSTATE
Type	Enumerated
Value range	Normal; WARNING; FAILURE; SAFETY FAILURE
Units	None
Description	AIO only; shows the present state of the entire system.
Usage	This variable is set by the control module to be the highest state of any of its analyzers' GENERALSTATE variable. It is used by the 1/0 module to provide a system level failure indication, as selected by ALVAR.
See also	GENERALSTATE ALVAR

TAGA

Direction	Input
Binding	None
Type	String
Value range	31 characters
Units	None
Description	SCAL only; shows the AMTAG belonging to analyzer 1.
Usage	Allows the menus for the SCAL module to identify which analyzer is regarded as analyzer 1.
See also	AMTAG (in Section 2) TAGB TAGC TAGD

TAGB

Direction	Input
Binding	None
Type	String
Value range	3 1 characters
Units	None
Description	SCAL only; shows the AMTAG belonging to analyzer 2.
Usage	Allows the menus for the SCAL module to identify which analyzer is regarded as analyzer 2.
See also	AMTAG (in Section 2) TAGA TAGC TAGD

TAGC

Direction	Input
Binding	None
Type	String
Value range	31 characters
Units	None
Description	SCAL only; shows the AMTAG belonging to analyzer 3.
Usage	Allows the menus for the S CAL module to identify which analyzer is regarded as analyzer 3.
See also	AMTAG (in Section 2) TAGA TAGB TAGD

TAGD

Direction	Input
Binding	None
Type	String
Value range	3 1 characters
Units	None
Description	SCAL only; shows the AMTAG belonging to analyzer 4.
Usage	Allows the menus for the SCAL module to identify which analyzer is regarded as analyzer 4.
See also	AMTAG (in Section 2) TAGA TAGB TAGC

TESTMODE

Direction	Output
Binding	None
Type	2-element enumerated array
Value range	AUTO; TEST
Units	None
Description	Controls the 1/0 algorithm to allow direct user modification of output devices, The relay control. The analog output control.
Usage	Setting either element to TEST causes the various variables that can directly set the output to be operational. The module will reset the variable to AUTO after 1 minute.
See also	RSTATUS CAL_ OP

TIME_PERIOD

Direction	Output
Binding	None
Type	Integer
Value range	1-255
Units	Hours
Description	ACAL, SCAL only; determines the period between calibration cycles.
Usage	This variable determines the time between calibration cycles. The normal setting is 24. More frequent calibrations will reduce analyzer error due to drift but will use more calibration gases and will increase the time spent not measuring the process.
See also	

VAL_HOLD

Direction	output
Binding	None
Type	Enumerated
Value range	DISABLED; ENABLED
Units	None
Description	AIO, ACAL only; determines whether the output will hold while VALIDITY is anything other than Normal.
Usage	If this variable is enabled, the analog output will hold at its last value while VALIDITY is other than VALID.
See also	IOMAINTHOLD IOHOLDCAL

ZEROGAS

Direction	Bidirectional
Binding	None
Type	4-element floating point array
Value range	Normally 0.
Units	ppm
Description	Zero gas. Element I refers to the zero gas for range 1, etc.
Usage	During zero calibration, the elements of ZERO are adjusted such that the value of PVA resulting is within 0.02% of the full scale range value of the appropriate element of ZEROGAS. If CALCHCKLIMITS is set to enabled, this will fail if the change required is greater than the percentage of the full scale value given in CALFAIL. The value of ZERO should be the same as the value of RAW - SIGNAL while zero gas is flowing, and a zero may be effected by simply copying the value of RAW-SIGNAL into the appropriate element of ZERO.
See also	SPANGAS ZERO

ZERORNGS

Direction	Bidirectional
Binding	None
Type	Enumerated
Value range	SEPARATELY; TOGETHER
Units	None
Description	Determines whether to zero each range separately or do them all at once.
Usage	If set to SEPARATELY, when a zero operation is performed, only the current range will be zeroed. If set to TOGETHER, the analyzer will attempt to zero each range, one after the other, assuming that the gas contains the concentration shown in each element of ZEROGAS. If these are different, this will fail, unless CALCHKLIMITS is set to DISABLED, in which case it will zero all ranges anyway. If the preamp gain has to be changed between ranges, the analyzer will not zero any range for which it has to change the gain. If it fails to zero any range, it will set CALRESULT such that any failed ranges are uncalibrated. In this case it will leave the original zero factor unchanged.
See also	ZERO CALRANGES

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