Products	Solutions	Services

Description of device parameters
HC 12 Firmware

Endress+Hauser [EH]

People for Process Automation
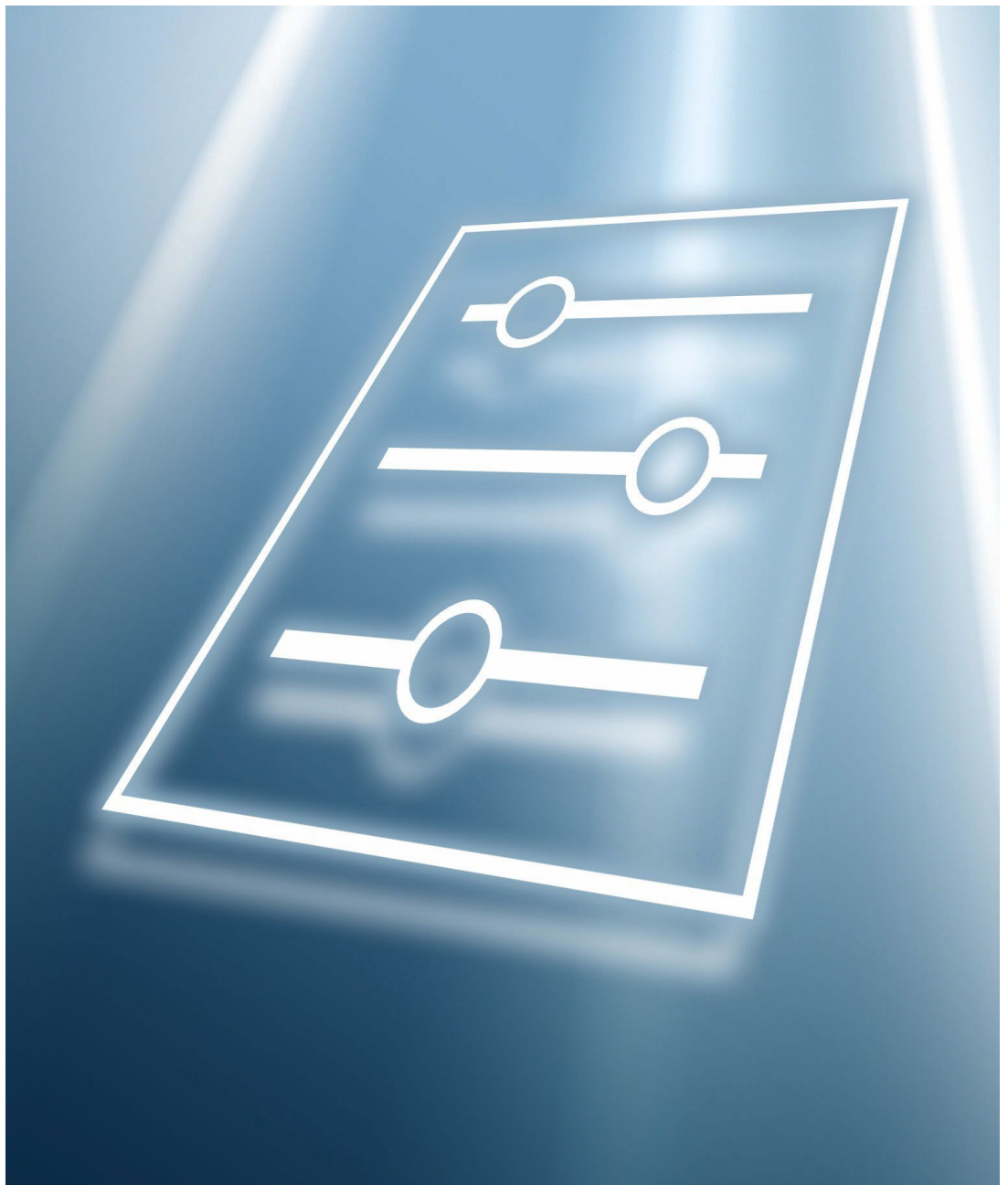
Product/Firmware Matrix

Product Model	HC 12 Firmware	FS Firmware	NS Firmware
SS2100, SS2100a, SS2100i-1, SS2100i-2	Not Used	Used for differential analyzers	Used for non-differential analyzers
2-Pack/3-Pack	Used on right-side analyzer electronics	Used on left-side analyzer electronics	Not used
SS1000, SS500, SS500e, SS500XP, SS2000, SS2000e, SS2000XP, SS3000, SS3000e	Used	Not used	Not used

Table of Contents

1   About this document

1.1 Warnings

Structure of Information	Meaning
⚠ **WARNING** Causes (/consequences) If necessary, consequences of noncompliance (if applicable) ▸ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation can result in a fatal or serious injury.
⚠ **CAUTION** Causes (/consequences) If necessary, consequences of noncompliance (if applicable) ▸ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or more serious injuries.
NOTICE Cause/situation If necessary, consequences of noncompliance (if applicable) ▸ Action/note	This symbol alerts you to situations which may result in damage to property.

1.2 Symbols on the device

Symbol	Meaning
⚠ (Laser Radiation)	The Laser Radiation symbol is used to alert the user to the danger of exposure to hazardous visible laser radiation when using the TDLAS Gas Analyzer.
⚠ (High Voltage)	The High Voltage symbol that alerts people to the presence of electric potential large enough to cause injury or damage. In certain industries, high voltage refers to voltage above a certain threshold. Equipment and conductors that carry high voltage warrant special safety requirements and procedures.
ETL Intertek	The ETL Listed Mark provides proof of product compliance with North American safety standards. Authorities Having Jurisdiction (AHJ) and code officials across the US and Canada accept the ETL Listed Mark as proof of product compliance to published industry standards.
WEEE	The WEEE symbol indicates that the product should not be discarded as unsorted waste but must be sent to separate collection facilities for recovery and recycling.
CE	The CE Marking indicates conformity with health, safety, and environmental protection standards for products sold within the European economic area (EEA).

1.3 U.S. export compliance

The policy of Endress+Hauser is strict compliance with U.S. export control laws as detailed in the website of the Bureau of Industry and Security at the U.S. Department of Commerce.

1.4 Document function

The document is part of the Operating Instructions and serves as a reference for parameters, providing a detailed explanation of each individual parameter of the operating menu.

1.4.1 Target group

The document is aimed at specialists who work with the device over the entire life cycle and perform specific configurations. It is used to perform tasks that require detailed knowledge of the function of the device:

- Commissioning measurements under difficult conditions
- Optimal adaptation of the measurement to difficult conditions
- Detailed configuration of the communication interface
- Error diagnostics in difficult cases

2 Introduction

This Endress+Hauser analyzer was shipped with Endress+Hauser's HC12 Firmware. This firmware version provides users with the features and functions to operate the tunable diode laser (TDL) analyzer.

This manual was designed to provide the user with an overview of the HC12 firmware functionality. The information contained in this manual is divided into the following sections:

- Operations
- Serial Communication
- Firmware Troubleshooting

2.1 Who should read this manual

This manual should be read and referenced by anyone operating or having direct contact with the analyzer.

General note icons

Instructional icons are provided in this manual to alert the user of important information and valuable tips. The following symbols and associated information can be found throughout the manual.

	General notes and important information concerning the installation and operation of the analyzer.
	Failure to follow all directions may result in malfunction of the analyzer.
	INVISIBLE LASER RADIATION - Avoid exposure to beam. Class 3b Radiation Product. Refer servicing to the manufacturer-qualified personnel.
	Maximum voltage and current specifications for the fuse closest to label.

2.2 Conventions used in this manual

In addition to the symbols and instructional information, this electronic manual is created with "hot links" to enable the user to quickly navigate between different sections within the manual. and to other manuals. These links are

identified by a pointing finger cursor   when rolling over the text. Simply click on the link to navigate to the associated reference.

2.2.1 Manufacturer address

Endress+Hauser
11027 Arrow Route
Rancho Cucamonga, CA 91730
United States
www.endress.com

3   Operating the analyzer

The analyzer is designed to be a stationary measuring device. It should be securely mounted during normal operation.

The laser housing labels on the flanges of the sample cell warn about exposure to laser radiation inside. Never open the sample cell unless directed to do so by a service representative and the analyzer power is turned off.

*The optical head has a seal and "**WARNING**" sticker to prevent inadvertent tampering with the device. Do not attempt to compromise the seal of the optical head assembly. Doing so will result in loss of device sensitivity and inaccurate measurement data. Repairs can then only be performed by the factory and are not covered under warranty.*

3.1   Firmware version

Each Endress+Hauser analyzer operates based on a single version of firmware. The firmware version for each analyzer is listed in the calibration certificate that accompanies each analyzer, and displays on system start-up. The operation instructions provided in this chapter are intended for the HC12 firmware version.

3.2   Powering up the analyzer

After mounting the analyzer, connecting the power wires, connecting the gas lines, connecting the (optional) output signal wires and checking for leaks, you are ready to power up the analyzer.

Refer to the Operating Instruction for your analyzer to locate fuses. If you need to replace a fuse, use only the same type and rating of fuse as the original.

3.2.1   To power up the analyzer

1. Using the switch or designated circuit breaker, apply power to the analyzer.
2. The analyzer goes through an initialization period counting down from 14 while showing the firmware version and release date (where "xxxx" is the release date).

```
Initializing...
                14
HC12              v2.51-xxxx
```
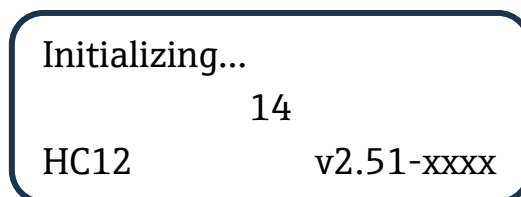
3. After initialization, the LCD displays the **Normal Mode** screen with four lines (the third of which is blank for single-channel units). An example is shown below.

The measurements displayed are:
- **ANA**: Refers to the concentration in the sample cell (in units) selected in **Mode 2**.
- **P**: Pressure in the sample cell (in units) selected in **Mode 2**.

```
<NORMAL MODE>
ANA : 4.046 ppmv
P : 954.4mb        T : 76.1F
```
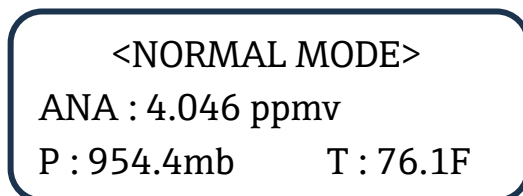
- **T**: Temperature in the sample cell (in units) selected in **Mode 2**.
4. Enable **Peak Tracking** following the procedure outlined in *To change parameters in Mode 2 or Mode 3* → 🖹**.**
5. Continuous updates of the measurement parameters displaying on the LCD indicate that the analyzer is operating normally.

3.3 Powering down the analyzer

It may be necessary to power down the analyzer for problem solving or maintenance reasons. An approved switch or circuit breaker rated for 15 amps should have been installed and clearly marked as the disconnecting device for the analyzer.

3.3.1 To power down the analyzer

1. Switch off the power to the analyzer using the switch or circuit breaker designated as the disconnection device for the equipment. Refer to the analyzer Operating Instruction.
2. If the analyzer is going to be shut down for a short period of time for routine maintenance, isolate the analyzer from the sample conditioning system (SCS). Refer to the SCS Operating Instruction or the analyzer Operating Instruction.
3. If the analyzer is going to be shut down for a long period of time, follow the procedure for isolating the process sample tap for long-term shutdown in the SCS operating instruction, analyzer operating instruction, or contact Endress+Hauser's Service. It is recommended to also disconnect the power completely from the analyzer to prevent potential damage from lightning strikes.

3.4 Operating the analyzer from the keypad

The keypad enables the operator to modify measurement units, adjust operational parameters, and perform diagnostics. During normal operation, the LCD continuously displays the measured components' concentration, sample cell temperatures, and sample cell pressures.

The Endress+Hauser keypad is shown in Figure 1. To activate any functions on the keypad, press the mode key **#** (Mode) followed by a number on the keypad to specify an action.

CSA-certified products include the SS2100, 2-Pack, 3-Pack, SS500/SS2000/SS300, SS500e/SS2000e/SS3000e, SS500XP/SS2000XP.
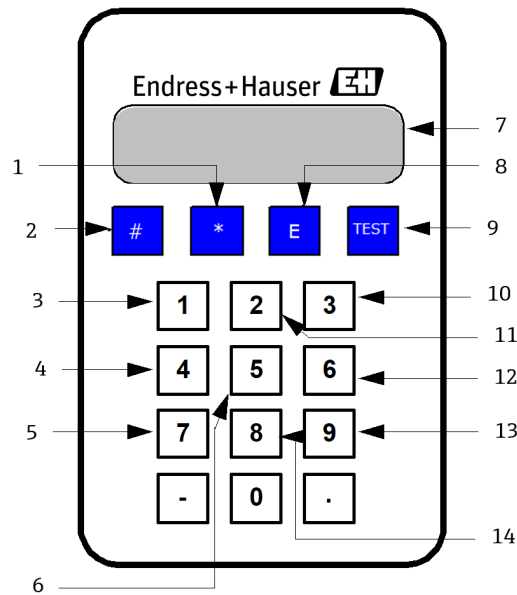
Figure 2. *Keypad for CSA-certified analyzers*

1	Enter key
2	Mode key
3	Main measurement
4	Diagnostics parameters analyzer A
5	Validation measurement analyzer A
6	Diagnostics parameters analyzer B
7	LCD (Display)
8	Exponent Value
9	Scroll Direction
10	Change parameters analyzer B
11	Change Parameters analyzer A
12	Export Diagnostic Data
13	Validation Results
14	Validation Measurement Analyzer B

When you press the **#** key, the words MODE displays on the LCD. At this point, the analyzer waits for you to press a second key.

*You must press the **#** key before pressing a number or function key to trigger a response from the keypad.*

Mode 2 and **Mode 3** set the parameters in the system. In this mode, the ***** key functions as the "ENTER" key. The analyzer saves the displayed parameter value when you press this key. Always press ***** after entering a value on the keypad (unless the entry was made in error).

If you do make an error, press the ***** key followed by the **TEST** key, and then the ***** key to return to the parameter and enter the correct value.

3.5 Modes defined

Use the keypad to access the following modes by pressing the key **#** key first followed by a number (**1**, **2**, **3**, **4**, **5**, **6**, **7**, or **8**) to activate a mode. The following section explains each mode and the corresponding information that displays on the LCD.

> *When the **#** key is pressed, measurement will be suspended until the new mode is established. The only modes that produce measurements are **Mode 1**, **Mode 6**, **Mode 7** or **Mode 8**.*

3.5.1 Mode 1: (Normal mode)

Mode 1 continuously displays updated measurements. Press the **#** key followed by the **1** key. Depending on the analyzer being used, the screen on this page or the screen on the next page will be shown.

#	1

```
        <NORMAL MODE>
ANA : 4.046 ppmv
P : 954.4mb        T : 76.1F
```

OR

#	1

```
        <NORMAL MODE>
ANA : 4.046 ppmv
ANA : 8.133 ppmv
P : 954.4mb  T : 76.1F
```

The measurements displayed are:

- **ANA**: Particular analyte concentration measured in the sample cell in units selected in **Mode 2** or **Mode 3** (for SS3000 analyzers only), e.g., H_2O, CO_2, etc.

- **P**: Pressure in the sample cell in units selected in **Mode 2**.

- **T**: Temperature in the sample cell in units selected in **Mode 2**.

> *If any warnings or alarms are active, then they will appear on line 1 in place of <NORMAL MODE>. If more than one warning or alarm is active, then those messages will automatically scroll through the active list.*

3.5.2   Mode 2: (Set parameter mode-analyzer A)

Mode 2 enables the user to view and change measurement parameters for Analyzer A (CH A). Press the **#** key followed by the **2** key.
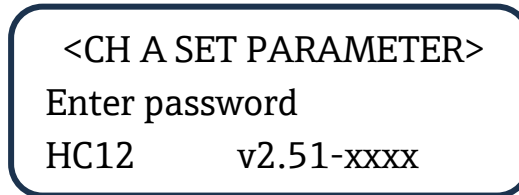
#		2

```
<CH A SET PARAMETER>
Enter password
HC12        v2.51-xxxx
```

*While in this mode the analyzer suspends measurement until you return to **Mode 1**, **Mode 6**, **Mode 7**, or **Mode 8**.*

The LCD prompts for a numeric password. Enter the user password (**3142**) on the keypad, then press the ***** key to enter the number. The following is displayed on the LCD.

```
<CH A SET PARAMETER>
Main Matrix
0
0:A 1:B 2:C 3 :D
```
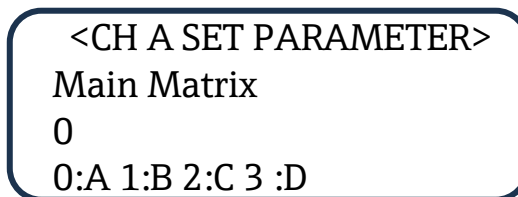
Follow the procedure under *To change parameters in Mode 2 or Mode 3* → 📖 for viewing and changing any of the parameters.

3.5.3   Mode 3: (Set parameter mode-analyzer B)

Mode 3 enables the user to view and change measurement parameters for Analyzer B (CH B). Press the **#** key followed by the **3** key.

#		2

```
<CH B SET PARAMETER>

Please Wait...
```
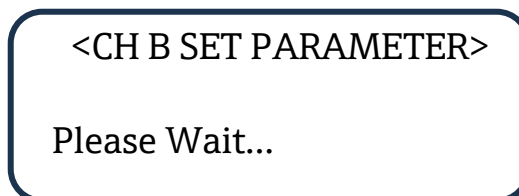
A "Please wait" screen will display briefly as the following screen for CH B is queried.
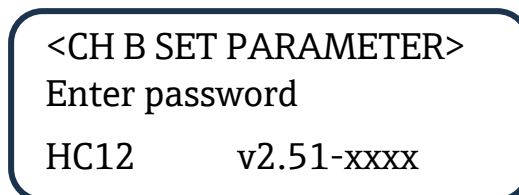
```
<CH B SET PARAMETER>
Enter password
HC12        v2.51-xxxx
```

> While in this mode the analyzer suspends measurement until you return to **Mode 1**, **Mode 6**, **Mode 7,** or **Mode 8**.

The LCD prompts for a numeric password. Enter the user password (**3142**) on the keypad, then press the ***** key to enter the number. The following is displayed on the LCD.

```
  <CH B SET PARAMETER>
Main Matrix
0
0:A 1:B 2:C 3 :D
```

Follow the procedure under *To change parameters in Mode 2 or Mode 3 →* 📖 for viewing and changing any of the parameters.

3.5.4   Mode 4: (Diagnostic parameters – analyzer A)

Displays system diagnostic data for Analyzer A (CH A). These values may be useful when troubleshooting the system. Press the **#** key followed by the **4** key.

```
  #              4
```

```
PP2F: 8190   PkDf: 34.00
Powr: 2538 PkDI: 34.00
PK :176 374
Zero: -24
```

> While in this mode the analyzer suspends measurement until you return to **Mode 1**, **Mode 6**, **Mode 7,** or **Mode 8**.

The Analyzer A (CH A) diagnostic parameters displayed are:

- **PP2F**: Shows the magnitude of the concentration signal found at the index value.
- **Powr**: Shows the magnitude of the DC laser power in the measurement cell. A number below 200 will trigger a **Power Fail Error** (see *Faults/Alarms →* 📖) indicating that either the optics need to be cleaned or there is an alignment problem. A user controlled **Low Power Warning** value can be set as a predictive diagnostic to prevent this error from occurring.
- **PK**: Shows the location of the two peaks. The first peak, Peak 1, shows the index where the concentration signal was found. The second peak, Peak 2, shows the index where the methane signal was found (for H_2O analyzers) or shows the same index as Peak 2 (for CO_2 analyzers). Peaks 1 and 2 will be around 190 and 410 for an H_2O analyzer, or both peaks will be around 290 for a CO_2 analyzer.
- **Indx**: Shows the index where the concentration signal was found.
- **Zero**: Shows the detected signal with the laser turned off.
- **PkDf**: Shows the factory set default midpoint.

- **PkDl**: Shows the current midpoint the analyzer is using.

3.5.5   Mode 5: (Diagnostic parameters – Analyzer B)

Displays system diagnostic data for Analyzer B (CH B). These values may be useful when troubleshooting the system. Press the **#** key followed by the **5** key.

#	+	5

#	+	5

```
<DIAGNOSTICS FOR CHB>

Please wait...
```
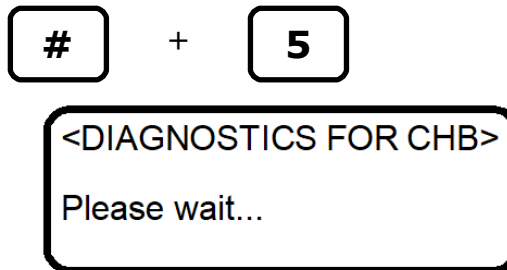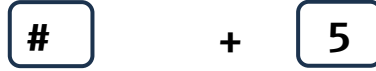
A "Please wait" screen will display briefly as the diagnostic data for CH B is queried.
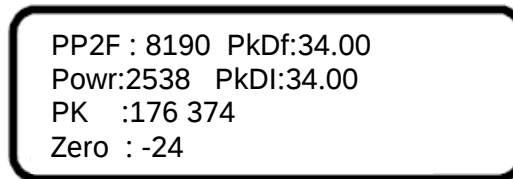
```
PP2F : 8190  PkDf:34.00
Powr:2538   PkDI:34.00
PK    :176 374
Zero  : -24
```

*While in this mode the analyzer suspends measurement until you return to **Mode 1**, **Mode 6**, **Mode 7,** or **Mode 8**.*

**The Analyzer B (CH B) diagnostic parameters displayed are:**

- **PP2F**: Shows the magnitude of the concentration signal found at the index value.

- **Powr**: Shows the magnitude of the DC laser power in the measurement cell. A number below 200 will trigger a **Power Fail Error** (see *Faults/Alarms* → 🗎) indicating that either the optics need to be cleaned or there is an alignment problem. A user controlled **Low Power Warning** value can be set as a predictive diagnostic to prevent this error from occurring.

- **PK**: Shows the location of the two peaks. The first peak, Peak 1, shows the index where the concentration signal was found. The second peak, Peak 2, shows the index where the methane signal was found (for H_2O analyzers) or shows the same index as Peak 2 (for CO_2 analyzers). Peaks 1 and 2 will be around 190 and 410 for an H_2O analyzer, or both peaks will be around 290 for a CO_2 analyzer.

- **Indx**: Shows the index where the concentration signal was found.

- **Zero**: Shows the detected signal with the laser turned off.

- **PkDf**: Shows the factory set default midpoint.

- **PkDl**: Shows the current midpoint the analyzer is using.

- **T**: Shows the CH B temperature in the sample cell.

- **P**: Shows the CH B pressure in the sample cell.

3.5.6 Mode 6: (Diagnostic data download)

Used to transfer diagnostic data to the serial port and read the individual data points of both the **DC** and **2f** spectra that the instrument analyzes to calculate the gas concentration. Viewing these data can be helpful in diagnosing problems with the analyzer. Press **#** key followed by the **6** key.

$$\boxed{\#} \quad + \quad \boxed{6}$$

```
<DUMP SPECTRUM MODE>

INDEX: 0
```
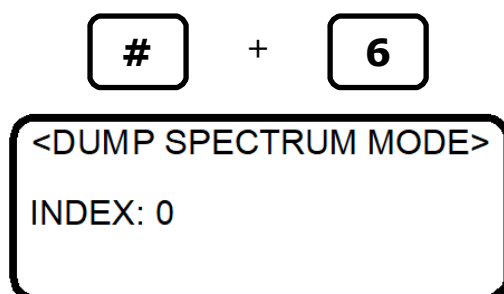
The parameter settings and data points, along with intermediate calculation results, are output to the serial port(s) whenever **Mode 6** is selected.

For example, in an SS3000 analyzer, there are two serial ports; one for Analyzer A and one for Analyzer B. When **Mode 6** is selected, the diagnostic data is output from both ports at the same time.

3.5.7 Mode 7: (Validation measurement – analyzer A)

Mode 7 is used to set the system for validation measurement for Analyzer A (CH A). The settings for this mode are controlled by the Validation Matrix parameter. Press the **#** key followed by the **7** key.
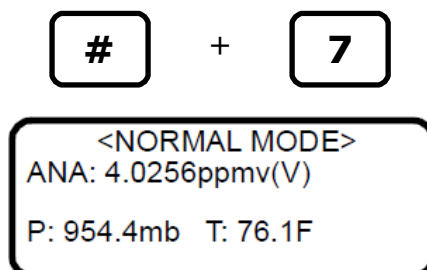
$$\boxed{\#} \quad + \quad \boxed{7}$$

```
       <NORMAL MODE>
ANA: 4.0256ppmv(V)

P: 954.4mb   T: 76.1F
```

The measurements displayed are:

- **ANA**: Particular analyte concentration measured in the sample cell in units selected in **Mode 2** (e.g., H_2O, CO_2, etc.).

- **P**: Pressure in the sample cell in units selected in **Mode 2**.

- **T**: Temperature in the sample cell in units selected in **Mode 2**.

While the system is in validation mode, (V) will display to the right of the analyte type on the LCD. Refer to *Validating the Analyzer* → 🗎 for instructions on performing a manual validation measurement.

3.5.8 Mode 8: (Validation measurement - analyzer B)

Mode 8 is used to set the system for validation measurement for Analyzer B (CH B). The settings for this mode are controlled by the **Validation Matrix** parameter. Press the **#** key followed by the **8** key.
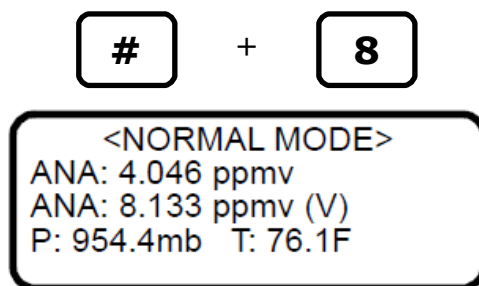
The measurements displayed are:

- **ANA**: Particular analyte concentration measured in the sample cell in units selected in **Mode 2** and **Mode 3,** e.g., H_2O, CO_2, etc.

- **P**: Pressure in the sample cell in units selected in **Mode 2**.

- **T**: Temperature in the sample cell in units selected in **Mode 2**.

While the system is in validation mode, (V) will display to the right of the third line on the LCD. Refer to *Validating the Analyzer* → 🕮 for instructions on performing a manual validation measurement.

3.6 Configuring the analyzer at start-up

Endress+Hauser analyzers are pre-programmed at the factory with most parameters set to default values, which are suitable for most applications. There are a few parameters that should be set by the end user. Endress+Hauser recommends checking all the parameters at start-up.

3.6.1 Parameter setting/checking procedure

1. After the analyzer has started up, press **Mode 2** (**#2**) and enter password **3142.**
2. Press the ***** key repeatedly to scroll through the parameters and verify the settings.

The firmware default parameter settings are reflected in the table in *Changing measurement and control parameters* → 🕮. Your analyzer may be configured using application specific defaults that vary from those listed below, but which are necessary for proper operation. These parameters will be noted. Refer to *Service* → 🕮 before changing any annotated parameters in the steps that follow.

1. **Main Matrix** default = 0 (Matrix A), the normal default value suitable for most applications.

⚠️ *Contact Service before making any changes to this parameter. Refer to Service → 🕮.*

If Main Matrix is set to 1, 2 or 3 as received from the factory, please refer to the calibration certificate supplied with the analyzer. The calibration certificate will indicate what additional matrices are calibrated in the analyzer and their corresponding gas compositions. Select the matrix that best matches the background gas composition of the process.

On some systems, more than one calibration is needed to handle multiple analyte ranges or background variations. Up to four calibration matrices can be loaded into the analyzer, each using a letter designation A, B, C or D that are set using the **Main Matrix** and **Validation Matrix** parameters. All analyzers using the HC12 firmware and Table 1 or Table 2 calibration (SS1000, SS500/SS2000/SS3000, SS500e/2000e/3000e, and the H_2O or CO_2 channels of the SS2100 2-packs and 3-packs analyzers) are shipped with Matrix A calibrated for 100% methane background. This calibration is appropriate for all process streams with background gas compositions conforming to the Table as listed below.

Component Name	Component Abbreviation	Allowable Component Range
Methane	C1	90-100%
Ethane	C2	0-7%
Propane	C3	0-2%
Butanes	C4	0-1%
Pentanes	C5	0-0.2%
Hexanes and Heavier	C6+	0-0.2%
Carbon Dioxide	CO_2	0-3%
Nitrogen and other Inerts	N_2	0-10%
Hydrogen Sulfide	H_2S	0-300 ppmv
Water	H_2O	0-5000 ppmv [1]

[1]For H_2S measurements up to 50 ppmv, water content must be 5000 ppmv. For H_2S measurements >50 ppmv, water content must be <2%.

This calibration is suitable for the vast majority of interstate pipeline natural gas streams. Matrix A is also used by default for validation of the analyzers, using a cylinder standard of the analyte (H_2O or CO_2) in a background of pure methane.

Other streams that do not meet the background gas compositions in the table above, but do meet the limits listed in the table below will have their calibration in Matrix B. Any additional calibrations to match other stream compositions will be in Matrices C and D. Any additional calibrations must fall within the same table as the main process calibration (Matrix B).

Component Name	Component Abbreviation	Allowable Component Range
Methane	C1	50-100%
Ethane	C2	0-20%
Propane	C3	0-15%
Butanes	C4	0-5%
Pentanes	C5	0-2%
Carbon Dioxide	CO_2	0-20%
Hexanes and Heavier	C6+	0-2%
Nitrogen and other Inerts	N_2	0-20%
Hydrogen Sulfide	H_2S	0-5%

The Main Matrix parameter sets the active calibration matrix when **Mode 1** is pressed.

2. **Validation Matrix** default = 0 (normal default setting)
Validation gases are normally the analyte (H_2O or CO_2) in a background of pure methane. Refer to the calibration certificate to confirm that Matrix A has a background gas of pure methane.

Contact Service before making any changes to this parameter.
Refer to *Service* → 🖺.

Validation Matrix parameter sets the calibration matrix that is used when **#**(Mode) **7** (for Analyzer A) or **#**(Mode) **8** (for Analyzer B) is pressed.

3. **S Factor** default = 1

Contact Service before making any changes to this parameter.
Refer to *Service* → 🖺.

Refer to *Adjusting Analyzer Reading to Match Specific Standard(s)* → 🖺 for details on setting S Factor.

4. **S factor offset** default = 0

Contact Service before making any changes to this parameter.
Refer to *Service* → 🖺

Refer to *Adjusting Analyzer Reading to Match Specific Standard(s)* → 🖺 for details on setting S Factor Offset.

5. **# Spectrum Average** default = 4

> Contact Service before making any changes to this parameter.
> Refer to *Service* → 🖹.

For most applications the default value is correct. Refer to *# Spectrum Average* → 🖹 for more detail.

6. **Logger Rate** default = 4

> Contact Service before making any changes to this parameter.
> Refer to *Service* → 🖹.

For most applications the default value is correct. Refer to *Logger Rate* → 🖹 for more detail.

7. **Peak Tracking** set = 1 (P1) or 3 (Auto) depending on application.

> Peak Tracking may be turned off at the factory prior to shipment to prevent the peak tracking algorithm from shifting the spectrum during initial power-up of the unit. Once the unit is installed in the field, the Peak Tracking should be turned on and left on at all times.

8. **DO Alarm Delay** default = 0

For most applications the default value is correct. Refer to *DO Alarm Delay* → 🖹 for more detail.

9. **Low Power Warning** default = 200
Laser Power is a measurement of the total laser light intensity at the detector, and decreases if the mirror(s) in the sample cell becomes contaminated with liquids or solids.

> Contact Service before making any changes to this parameter.
> Refer to *Service* → 🖹.

At the default setting, the **Low Power Warning** will be triggered when the power drops to 200. Below 200 power, the measurement may not be reliable and cell mirrors should be cleaned immediately. Refer to **"Cleaning the Mirrors"** in the Hardware Installation and Maintenance Manual or the Sample Conditioning System (SCS) Overview Manual. Set the **Low Power Warning** to a higher value, but less than the power measurement in **Mode 4** so that the analyzer will provide an earlier indication of mirror contamination. For example, if the power is set to 1500 in **Mode 4**, set the **Low Power Warning** = 1000 so that if contamination

from the sample begins to decrease the laser power, the analyzer will provide a Low Power Warning earlier and mirror cleaning can be delayed until a more convenient time rather than being done urgently.

> The Low Power Warning displays on the LCD of the analyzer only, and does not trigger the 4-20 mA alarm.

10. **DO Alarm Setup** default = 0
    For most applications the default value is correct. Refer to *DO Alarm Setup*→ 📄 for more detail.
11. **Alarm Setpoint(ppmv)** default = 430
    Adjust to comply with stated user operation guidelines. Refer to *Alarm Setpoint(ppmv)* → 📄 for more detail.
12. **4-20 mA Alarm Action** default = 0
    For most applications, Endress+Hauser recommends setting this value to 1 (High). That is, on common fault alarm, the 4-20mA current loop drives to 20 mA and emulates a full-scale measurement. Refer to *4-20 mA Alarm Action* → 📄 for more detail.
13. **4-20 mA % Test** default = 101
    Refer to *4-20 mA % Test* → 📄 for details on testing and calibrating the 4-20 mA current loop. This parameter must be set to 101 to disable the 4-20 mA Test mode and allow normal measurements.
14. **4 mA Value** default = 0
    For most applications the value will be set at the low range of the analyzer. Refer to *4 mA Value* → 📄 for more detail.
15. **20 mA Value** default = 422
    For most applications the value will be set at the maximum range. Refer to *20 mA Value* → 📄 for more detail.
16. **Temperature Unit** default = 0
    Set the Temperature measurement unit to the end user's preference, ᵒC or ᵒF. Refer to *Temperature Unit* → 📄 for more information.
17. **Pressure Unit** default = 0
    Set the Pressure measurement unit to the end user's preference, mBar, Torr, kPa, or psi. Refer to *Pressure Unit* → 📄 for more information.
18. **Concentration Unit** default = 0
    Set the Concentration Unit to the end user's preference. Refer to *Concentration Unit* → 📄 for details.
19. **Concentration Unit Convert** default = 0
    For most applications the default value is correct. Refer to *Concen Unit Convert* → 📄 for more detail.
20. **Pipeline Pressure** default = 0
    For most applications the default value is correct. Refer to *Pipeline Pressure* → 📄 for more detail.
21. **4-20 mA Val Action** default = 0
    For most applications the default value is correct. Refer to *4-20 mA Val Action* → 📄 for more detail.
22. **Modbus Address** default = 0
    If Modbus communication is to be used, enter a legal Modbus address (1 – 250). Refer to *Modbus Address* → 📄 for more detail.
23. **Modbus Mode** default = 0
    If Modbus communication is to be used, enter 1 for Gould Modbus protocol, 2 for Daniel Modbus protocol. Refer to *Modbus Mode* → 📄 for more detail.
24. **User Password** default = 3142
    The user may change the user level password if desired.

3.7 Changing measurement and control parameters

In **Mode 2**, all of the pertinent measurement and control parameters can be viewed and changed. Refer to the Table for a list of parameters and value ranges. The parameters are listed in the order viewed during **Mode 2** operation.

Parameter	Setting	Function

Main matrix	0, 1, 2, 3 Default = 0	Sets the calibration matrix (A, B, C, D) that is used when **Mode 1** is pressed.
Validation matrix	0, 1, 2, 3 Default = 0	Sets the calibration matrix (A, B, C, D) that is used when **Mode 7** (CH A) or Mode 8 (CH B) is pressed.
S factor	-99 – 99 Default = 1	Analyzer response adjustment to match calibration standard in the field.
S factor offset	-999999 – 999999 Default = 0	Analyzer offset adjustment to match calibration standard in the field.
Stream compensation	0 or 1 Default = 0	Sets the concentration compensation for the background stream.
# spectrum average	1 – 240 Default = 4	Sets the number of scans averaged for each measurement.
Logger rate	1 – 300 Default = 4	Sets the number of measurements to include in the running average.
Peak tracking	0, 1, 2, 3, 4 Default = 0	Sets peak tracking capability to off, peak 1, peak 2, auto or reset.
DO alarm setup	0 – 9 or 100 – 109 Default = 0	Sets the functionality of the secondary digital output, if applicable.
DO alarm delay	0 – 30000 Default = 0	Sets the number of consecutive readings concentration must be above setpoint before triggering a **High Concentration Alarm**.
Alarm setpoint(ppmv)	0 – 999999 Default = 430	Sets the threshold for the **High** (or **Low**) **Concentration Alarm**.
Low power warning	200 – 4999 Default = 200	Sets the DC power level below which the analyzer will issue a **Low Power Warning**.
4-20 mA % test	0 – 101 Default = 101	Sets the 4-20 mA output to a percentage of full scale.
4-20 mA alarm action	0, 1, 2 or 3 Default = 0	Sets the current loop state upon alarm condition.
4 mA value	-999999 - 999999 Default = 0	Sets the ppmv or dew point value that will correspond to 4 mA.
20 mA value	-999999 - 999999 Default = 422	Sets the ppmv or dew point value that will correspond to 20 mA.
4-20 mA Val action	0 or 1 Default = 0	Sets the behavior of the analog output when the analyzer is in Validation Measurement Mode.
Temperature unit	0 or 1 Default = 0	Sets the display unit for temperature.
Pressure unit	0, 1, 2, or 3 Default = 0	Sets the display unit for pressure.

Concentration unit	0 - 3 or 10 - 13 Default = 0	Sets the display unit for concentration.
Concen unit convert	0 - 999999 Default = 0	Sets a custom conversion multiplier for the Concentration Unit. Zero uses the default conversion.
Pipeline pressure	0 – 999999 Default = 0	Sets pipeline pressure used to calculate dew point.
Modbus address	0 – 250 Default = 1	Sets Modbus address for the analyzer.
Modbus mode	0, 1, or 2 Default = 0	Sets type of Modbus protocol.
Analyzer ID	0 – 2147483647 Default = 0	Customer definable value for analyzer ID.
Sample ID	0 – 2147483647 Default = 0	Customer definable value for sample ID.
Component ID	0 – 2147483647 Default = 0	Customer definable value for component (analyte) ID.
User password	0 – 9999 Default = 3142	Sets Level 1 access password.

To change parameters in Mode 2 or Mode 3

1. Press the **#** key followed by the **2 (Mode 2) or 3 (Mode 3)** key.
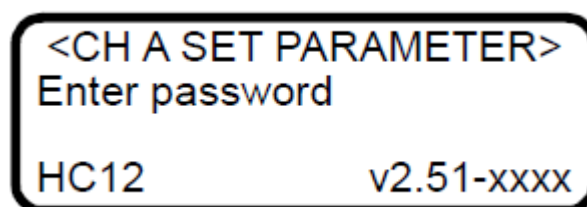
The LCD prompts for a numeric password.

2. Enter the user password (**3142**) on the keypad, then press the * key to enter the number. The following displays on the LCD.
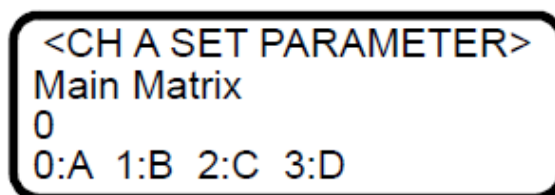
3. Starting with the first parameter, enter a new value and/or press the ***** key to store the value and cycle to the next parameter.

4. When finished changing or viewing the measurement and control parameters, press the **#** key followed by the **1** key to return to **Mode 1** and normal operation.

3.8 Measurement and control parameters defined

The following section defines the measurement and control parameters set in the system. The parameters are shown in alphabetical order for easy reference. Refer to the Table in section 3.7 to review the parameter order listed during **Mode 2** or **Mode 3** configuration.

3.8.1 # Spectrum average

The **# Spectrum Average** parameter sets the number of scans that the analyzer averages when determining concentration. Averaging over multiple scans lowers noise in the measurement, but inherently increases response time. Each scan adds about 0.25 seconds to the response time. For example, if # **Spectrum Average** is set to "4," an updated concentration value will be calculated about once every second.

```
<CH A SET PARAMETER>
# Spectrum Average
16
Enter a value
```

3.8.2 4-20 mA alarm action

The **4-20 mA Alarm Action** parameter determines the current loop state upon an alarm condition. Enter **0** (low) for the current loop to assume a low state (4 mA), **1** (high) for the current loop to assume a high state (20 mA), 2 (track and hold) for the current loop to hold the last valid measurement value, or 3 (no control) for the current loop to continue to track the concentration value upon an alarm condition.

```
<CH A SET PARAMETER>
4-20 mA Alarm Action
0
0:L  1:H  2:T&H  3:None
```

3.8.3 4-20 mA % test

The **4-20 mA % Test** parameter enables control of the current loop output for testing and calibration purposes. The value entered represents a percent of scale value where zero equals 4 mA and full scale equals 20 mA. Thus, the current loop output, i, is given by $i = R(20 \text{ mA} - 4 \text{ mA}) + 4 \text{ mA}$, where R is the **4-20 mA % Test** parameter value. Entering **101** turns off the control of the current loop and returns to the current loop output tracking the concentration value.

```
<CH A SET PARAMETER>
4-20 mA % Test
101
Enter a % (101=Off)
```

After setting the desired value, press # **Mode** and **1** to initiate control of the current loop to the value entered.

3.8.4 4-20 mA val action

The **4-20 mA Val Action** parameter sets the behavior of the analog output signal while the analyzer is in Validation Measurement Mode. If **0** is chosen, the analog output will stay at the last known value while the analyzer is in

Validation Measurement Mode. If **1** is chosen, the analyzer will update the analog output with the Validation Measurement Mode values.

```
<SET PARAMETER MODE>
4-20mA Val Action
0
0:Hold 1:Measure
```

3.8.5   4 mA value

The **4 mA Value** parameter sets the concentration value (in ppmv or dew-point temperature [in temperature units selected with the **Temperature Unit** parameter]) that corresponds to 4 mA on the current loop output. Typically this will be 0.000. To set the analyzer for dew point on the current loop output refer to *Concentration unit* → 🖹

```
<CH A SET PARAMETER>
4 mA Value
0.00000
ppmv or DewPoint F/C
```

3.8.6   20 mA value

The **20 mA Value** parameter sets the concentration value (in ppmv or dew-point temperature units selected with the **Temperature Unit** parameter) that corresponds to 20 mA on the current loop output. Typically this will be the full-scale value for which the analyzer was calibrated. To set the analyzer for dew point on the current loop output refer to *Concentration unit* → 🖹

```
<CH A SET PARAMETER>
20 mA Value
100.000
ppmv or DewPoint F/C
```

3.8.7   Alarm Setpoint(ppmv)

The **Alarm Setpoint(ppmv)** parameter sets the threshold for the **High** (or **Low**) **Concentration Alarm**. This parameters is used in two ways. First, it is used to control the concentration over threshold bit in the Modbus alarm flag 45001. If the concentration is over this set point, then the bit is "On"; otherwise it is "Off". Second, it is used when the **DO Alarm Setup** parameter is set to **1** (101) for a **High Concentration Alarm** or **2** (102) for a **Low Concentration Alarm**. For a **High Concentration Alarm DO** this parameter serves as the high threshold and for a **Low Concentration Alarm DO** this parameters serves as the low threshold.

```
<CH A SET PARAMETER>
Alarm Setpoint(ppmv)
430
Enter a value
```

3.8.8   Analyzer ID

The **Analyzer ID** parameter assigns a numeric identification to the data enabling SCADA or DCS systems to associate data with a particular analyzer.

```
 <CH A SET PARAMETER>
Analyzer ID
0
Enter a value
```

3.8.9   Component ID

The **Component ID** parameter assigns a numeric identification to the data enabling SCADA or DCS systems to associate the data with a particular analyte/component.

```
 <CH A SET PARAMETER>
Component ID
0
Enter a value
```

3.8.10 Concen Unit Convert

The **Concen Unit Convert** parameter allows a custom conversion multiplier to be used instead of the analyzer default conversion for the Concentration Unit. On moisture systems, this custom conversion does not apply if Dew Point is chosen as the Concentration Unit.

```
 <CH A SET PARAMETER>
Concen Unit Convert
0.000
0:Off >0:Multiplier
```

3.8.11 Concentration unit

The **Concentration Unit** parameter designates the display units for the measured concentration. For moisture analyzers (H_2O):

- **0** for ppmv
- **1** for lb/MMscf
- **2** for dew point
- **3** for mg/Nm3

```
 <CH A SET PARAMETER>
Concentration Unit
0
0:ppmv  1:lb  2:DP  3:mg
```

If dew point is required to be output on the analog output signal, then add a 1 in front of the desired **Concentration Unit**. For example, the **Concentration Unit** setting of 2 will give dew point on the LCD, but the analog output will be ppmv. If dew point is required on both the LCD and the analog output, then set Concentration Unit to **12**. If dew point

is only required on the analog output and ppmv is required on the LCD, then use a setting of **10**. Also, if dew point is used, the **Pipeline Pressure** parameter must be set.

For non-moisture analyzers (CO_2/H_2S):

- **0** for ppmv

- **1** for %

- **2** for mg/Nm3

```
 <CH A SET PARAMETER>
Concentration Unit
0
0:ppmv 1:% 2:mg
```

3.8.12 DO Alarm Delay

The **DO Alarm Delay** parameter sets the number of measurements to delay the **High Concentration Alarm** before it becomes active.

```
 <CH A SET PARAMETER>
DO Alarm Delay
4
Enter a value
```

3.8.13 DO Alarm Setup

The **DO Alarm Setup** parameter sets the functionality of the secondary digital output.

```
 <CH A SET PARAMETER>
DO Alarm Setup
1
Enter a value
```

Enter the value corresponding to the desired functionality according to the table below.

	Setting	Functionality
Normally	0	Always Activated
	1	High Concentration Alarm
	2	Low Concentration Alarm
	3	Power Fail Error

	4	PT Fail Error
	5	Spectrum Fail Error
	6	Null Fail Error
	7	Track Fail Error
	8	Low Power Warning
	9	Stream Comp Warning
Normally De-energized	100	Always Deactivated
	101	High Concentration Alarm
	102	Low Concentration Alarm
	103	Power Fail Error
	104	PT Fail Error
	105	Spectrum Fail Error
	106	Null Fail Error
	107	Track Fail Error
	108	Low Power Warning
	109	Stream Comp Warning

Option 0 is intended to be used as a power failure alarm for the analyzer for AC or DC power only. If selected while the analyzer is on, the relay will also be on. If the analyzer loses power, the relay will turn off.

Logger rate

For applications where an external data logger is employed, use the logging rate to set the number of measurements to include in the running average. The display and the current loop output will each have a value representing the running average of the concentration over a number of measurements equal to **Logger Rate**.

```
<CH A SET PARAMETER>
Logger Rate
4
Enter a value
```

3.8.14 Low Power Warning

The **Low Power Warning** parameter sets the level at which the analyzer will issue a Low Power Warning. A number below 200 will trigger a **Power Fail Error** (refer to *Faults/Alarms* →▤) indicating that either the optics need to be cleaned or there is an alignment problem. This parameter can be set higher than the **Power Fail Error** level as a predictive diagnostic to prevent this error from occurring.

```
<CH A SET PARAMETER>
Low Power Warning
200
Enter a value
```
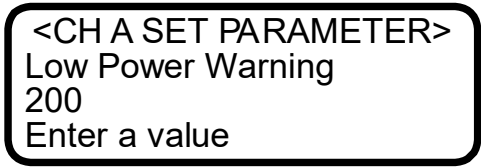
3.8.15 Main Matrix

On some systems, more than one calibration is needed to handle multiple analyte ranges or background variations. Up to four calibrations matrices can be loaded into the analyzer each using a letter designation (A, B, C or D). The **Main Matrix** parameter sets the active calibration matrix when **Mode 1** is pressed.

```
<CH A SET PARAMETER>
Main Matrix
0
0:A  1:B  2:C  3:D
```
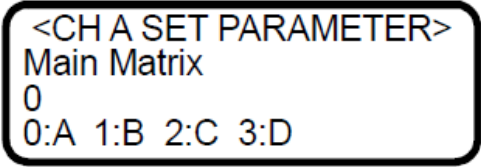
3.8.16 Modbus address

The **Modbus Address** parameter sets the analyzer address for when the analyzer is used as a Modbus device. Addresses from 1 to 250 can be used.

```
<CH A SET PARAMETER>
Modbus Address
1
Enter a value(1-250)
```
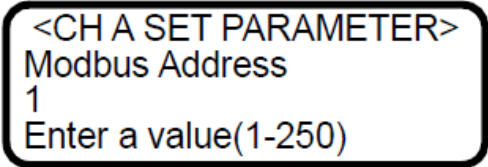
3.8.17 Modbus mode

The **Modbus Mode** parameter sets the communications protocol for the RS-232 port. There are three choices: **0** for turning the Modbus capabilities off and defaulting to generic serial output as described in *Receiving Serial Data (Customer Port Output)* → ▤; **1** for enabling the analyzer to respond to Gould Modbus RTU function codes 3, 6 and 16; and **2** for enabling the analyzer to respond to Daniel Modbus RTU function codes 3, 6 and 16.

```
<CH A SET PARAMETER>
Modbus Mode
0
0:Off  1:GMR  2:DMR
```
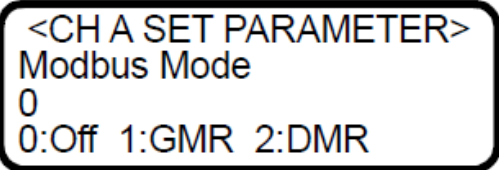
3.8.18 Peak tracking

The **Peak Tracking** function is a software utility that continuously adjusts the laser current to keep the absorption peak of the measured component at the center of the scan. There are five choices: **0** for no peak tracking, **1** for peak tracking on peak **1**, **2** for peak tracking on peak **2**, **3** (default) for automatic peak tracking on peak 1 or peak 2, or **4** to reset the peak tracking function. In most cases, the peak tracking should be left "on" (i.e., **Peak Tracking** set to **1** for CO_2 or **3** for H_2O).

```
<CH A SET PARAMETER>
Peak Tracking
1
0Off 1P1 2P2 3Auto 4Rest
```

3.8.19 Pipeline pressure

The **Pipeline Pressure** parameter sets the pipeline pressure used for the current dew point calculation in units defined by the **Pressure Unit** parameter.

```
<CH A SET PARAMETER>
Pipeline Pressure
0
Enter a value
```

3.8.20 Pressure unit

The **Pressure Unit** parameter designates the display units for the measured absolute pressure in the cell. There are four choices: **0** for millibar, **1** for Torr, **2** for kPa, and **3** for psia.

```
<CH A SET PARAMETER>
Pressure Unit

0:mb 1:Torr 2:kPa 3:psi
```

3.8.21 Sample ID

The **Sample ID** parameter assigns a numeric identification to the data enabling SCADA or DCS systems to associate the data with a particular sample point.

```
<CH A SET PARAMETER>
Sample ID
0
Enter a value
```

3.8.22 S Factor

The **S Factor** parameter is a user definable value that enables adjustment (without affecting the factory calibration) of the analyzer response (or slope) in the field. Refer to *Adjusting analyzer reading to match specific standard(s) → 🖺*.

```
 <CH A SET PARAMETER>
 S Factor
 1.00000
 Enter a value
```

3.8.23 S Factor Offset

The **S Factor Offset** parameter is a user definable value that enables adjustment (without affecting the factory calibration) of the analyzer offset in the field. Refer to *Adjusting analyzer reading to match specific standard(s) → 🖺*.

```
 <CH A SET PARAMETER>
 S Factor Offset
 0.00000
 Enter a value (ppmv)
```

3.8.24 Stream Compensation

In some cases it may be desirable to compensate the concentration reading for the background stream. This can be done by enabling this parameter, choosing the correct/closest calibration from the Main Matrix parameter, and updating the stored background stream in the analyzer with current values. Choosing the correct/closest calibration matrix is an important step in this process as each background stream compensation will be different for each calibration matrix. Refer to *Configuring the analyzer at start-up → 🖺* or the calibration certificate provided with the analyzer for the proper **Main Matrix** parameter setting.

These values are only available through Modbus and include:

- Methane
- Ethane
- Propane
- Butane
- Carbon Dioxide
- H_2S
- N_2

Refer to *Modbus Communications Protocol* → 🖺 for further information on how to use these values.

```
<CH A SET PARAMETER>
Stream Compensation
0
0:Disable  1:Enable
```

3.8.25 Temperature unit

The **Temperature Unit** parameter designates the display units for the measured cell temperature. There are two choices: **0** for degrees Celsius and **1** for Fahrenheit. The default value is the standard unit of measurement in the region the analyzer is being used.

```
<CH A SET PARAMETER>
Temperature Unit
0
0:C  1:F
```

3.8.26 User Password

The **User Password** parameter sets the Level 1 access password. The default password is **3142**.

```
<CH A SET PARAMETER>
User Password
3142
Enter password
```

3.8.27 Validation Matrix

On some systems, more than one calibration is needed to handle multiple analyte ranges or background variations. Up to four calibrations matrices can be loaded into the analyzer each using a letter designation (A, B, C or D). The **Validation Matrix** parameter sets the active calibration matrix that is used when **Mode 7** or **Mode 8** is pressed.

```
<CH A SET PARAMETER>
Validation Matrix
0
0:A  1:B  2:C  3:D
```

3.9 Adjusting analyzer reading to match specific standard(s)

In some instances, the user may wish to adjust the analyzer reading to match the concentration (or concentrations) of a specific standard (or standards). The **S Factor** and **S Factor Offset** parameters are used to adjust the analyzer output in the field without affecting the factory calibration. Both parameters are used when samples from two different concentration standards are available, whereas only the **S Factor Offset** parameter is used when a non-zero gas sample from only one concentration standard is available.

The value of the **S Factor** parameter, *S*, is determined by

$$S = \frac{C_2 - C_1}{A_2 - A_1},$$

where C_1 is the certified concentration of standard No. 1, C_2 is the certified concentration of standard No. 2, A_1 is the measured concentration (analyzer reading) of standard No. 1, and A_2 is the measured concentration (analyzer reading) of standard No. 2.

The **S Factor Offset** parameter, *O*, is determined by

$$O = C_1 - (S \cdot A_1),$$

where *S = 1* when a sample from only one concentration standard is available.

3.9.1.1 To adjust the analyzer reading:

1. Validate the analyzer using one or two concentration standards (refer to *Validating the analyzer* → 🖹).

> *Endress+Hauser recommends validating the analyzer using only the analyte/component mixed in the validation gas specified on the analyzer calibration report. Bottles of test gas with certified concentrations of approximately 20% and 80% of full scale are recommended for a two point validation. For a single point validation, a bottle with a certified concentration of approximately 50% of full scale should be used.*

> *When procuring a gas standard, make sure the background gas is that specified or a mix that closely resembles the contents of the process stream and have the gas standard certified to better than the specified precision of the analyzer, if possible.*

2. Calculate the **S Factor** and/or **S Factor Offset** parameter(s) using the equations above.
3. Follow the procedure under *To change parameters in Mode 2 or Mode 3* → 🖹 to enter the new values.
4. Confirm the new values by re-measuring the bottle(s) of test gas.

3.10 Scaling and calibrating the current loop signal

> *The 4-20 mA current loop function is available through optional hardware. Refer to Service → 🖹.*

The 4-20 mA current loop signal is most conveniently scaled and calibrated at the receiving end (RTU, flow computer, etc.).

> *The 4-20 mA current loop is factory set as the source unless otherwise specified. Refer to Service → 🖹.*

To scale the receiver's output, the analyzer's current loop output is set to 4 mA and 20 mA and the receiver is adjusted to read "0" and "Full Scale," respectively.

3.10.1 To scale the current loop signal

1. Make sure the current loop to be adjusted is connected and the receiver is set for the 4-20 mA board to source the current. Refer to the Operating Instruction for instruction and safety information.

2. Set the current loop output to 4 mA board by setting the **4-20 mA % Test** parameter to zero (See To change parameters in Mode 2 or Mode 3 → 🗏).

3. Adjust the receiver calibration control to read the appropriate value. The current loop output of 4 mA corresponds to the concentration value set in **AO 4 mA Value** parameter.

4. Set the current loop output to 20 mA by setting the **4-20 mA % Test** parameter to 100.

5. Adjust the receiver calibration control to read for the appropriate value. The current loop output of 20 mA corresponds to the concentration value set in **20 mA Value** parameter.

6. If desired, repeat by setting the **4-20 mA % Test** parameter, *R*, to any value between 0 and 100 and confirm that the output, *i*, agrees with $i = R(20\ \text{mA} - 4\ \text{mA}) + 4\ \text{mA}$.

7. When finished, reset the **4-20 mA % Test** parameter to 101.

3.11 Warnings

Warning messages appear on the front panel LCD and can be selected as part of the **DO Alarm Setup** parameter; however, they are not output as part of the **General Fault Alarm**. If more than one warning or system fault message is active, the analyzer will automatically scroll through the active list. All warnings are automatically controlled meaning when the warning occurs it will be displayed/output and when the warning condition clears it will automatically be cleared. Warnings may include one or more of the following:

*   **Low Power Warning**: This warning occurs when the DC signal drops below the level set by the **Low Power Warning** parameter. It is typically used as a predictive diagnostic for the **Power Fail Error**.

*   **Stream Comp Warning**: This warning occurs when the Stream Compensation is enabled and one of the following occurs.

*   The calibrated stream composition total is below 95% or above 105% (Stream Compensation Status = 2).

*   The user stream composition total is below 95% or above 105%. (Stream Compensation Status = 3).

Typically this warning is a result of a parameter setup issue and when it occurs the Stream Compensation calculation is bypassed. Refer to the Stream Compensation Status value that can be viewed from the diagnostic serial data output string to determine the cause of the warning. If the Stream Compensation status value is 2, refer to *Service* → 🗏 for further assistance. Otherwise, correct the cause as indicated.

> Dual channel analyzers have the same warning messages for both Analyzer A (CH A) and Analyzer B (CH B) as indicated above except the CH B warnings will have "B" appended to the end of the warning message.

> Refer to Appendix A for recommendations and solutions to common problems resulting in a warning.

3.12 Faults/Alarms

System faults appear on the front panel LCD and can be selected as part of the **DO Alarm Setup** parameter. The **General Fault Alarm** is triggered by system faults that cause the current loop to respond according to the **4-20 mA Alarm Action** parameter setting. If more than one warning or system fault message is active, the analyzer will automatically scroll through the active list.

3.12.1 System faults

All system faults are automatically controlled, which means a system fault will be displayed or output after it occurs in the analyzer and automatically cleared when the analyzer clears it. System faults include one or more of the following:

• **Power Fail Error**: This fault occurs when the DC signal becomes too weak, typically less than 200, for a reliable measurement typically as a result of mirror contamination.

• **Null Fail Error**: This fault occurs if the detector signal value is out of the range of -50 to +50 when the laser is turned off.

• **Spectrum Fail Error**: This fault occurs when the system is unable to adequately find a peak within a certain range (150 - 230 for H_2O and 200 - 370 for CO_2), typically as a result of DC signal saturation in the absence of absorbing gas in the measurement cell, too much noise in the signal or an unexpected gas mixture in the measurement cell.

• **PT Fail Error**: This fault occurs when the pressure and/or temperature in the measurement cell exceeds the specified minimum or maximum operating levels.

• **Track Fail Error**: This fault occurs when the peak tracking function is out of range (**PkDf** [factory set midpoint] and **PkDl** [peak track midpoint] differ by more than 4 counts).

> SS3000 analyzers have the same system fault messages for both Analyzer A (CH A) and Analyzer B (CH B) as indicated above except that the CH B system faults will display "B" appended to the end of the system fault message.

Refer to Appendix A for recommendations and solutions to common problems resulting in a system fault.

3.12.2 User alarms

User alarms are generated based on measurement readings and their relation to **Mode 2** parameter settings. They do not appear on the front panel LCD, but can be selected as part of the **DO Alarm Setup** parameter. User alarms are also not output as part of the **General Fault Alarm**. All user alarms are automatically controlled, so if selected as part of the **DO Alarm Setup** parameter, user alarms will be output after they occur and automatically cleared when the condition in the analyzer clears. User alarms include the following:

- **High Concentration Alarm**: This user alarm occurs when the measured concentration is above the concentration limit set with the **Alarm Setpoint(ppmv)** parameter and the **DO Alarm Setup** parameter is set to 1 or 101. (see *High Alarm Setpoint* → 🖺).
- **Low Concentration Alarm**: This user alarm occurs when the measured concentration is below the concentration limit set with the **Alarm Setpoint(ppmv)** parameter and the **DO Alarm Setup** parameter is set to 2 or 102. (see *Low Alarm Setpoint* → 🖺).

3.13 Validating the analyzer

Validation of the analyzer using an appropriate gas standard can be done manually on systems equipped with a check gas or validation gas port.

3.13.1 To validate manually (if applicable)

1.   Connect a bottle of validation gas to the check gas or validation gas port (at the specified supply pressure).

2.   Press **#**(Mode) **7** or **#**(Mode) **8** to set the validation measurement mode.

> When the validation mode is enabled through **Mode 7** or **Mode 8**, "(V)" will be displayed to the right of the designated analyte type on the LCD.

3. Close the upstream measurement cell isolation valve.

4. Open the check gas or validation gas shut-off valve.

5. Adjust the sample flow meter metering valve to the specified flow for the measurement cell.

> The adjustment setpoints of the analyzer flow meters and pressure regulators will be interactive and may require readjustment multiple times until the final setpoints are obtained.

> The analyzer system has been designed for the sample flow rate specified. A lower than specified sample flow rate may adversely affect system performance. Contact Service if you are unable to attain the specified sample flow rate, refer to *Service* → 🖺.

6. Make a measurement after the gas flows for approximately five minutes or when the values on the LCD settles.

7. After validation, press **#**(Mode) **1** to return to normal mode.

8. Close the check gas or validation gas shut-off valve.

9. Open the upstream measurement cell isolation valve.

10. Adjust the sample flow meter metering valve to the specified flow for the measurement cell, and to return to normal operation.

> Endress+Hauser recommends validating the analyzer using only the analyte mixed in the validation gas specified on the analyzer calibration report. Bottles of test gas with certified concentrations of approximately 20% and 80% of full scale are recommended for two point validation. For single point validation, a bottle with a certified concentration of approximately 50% of full scale should be used.

> When procuring a gas standard, make sure the background gas is that specified or a mix that closely resembles the contents of the process stream and have the gas standard certified to better than the specified precision of the analyzer, if possible.

3.14 Calibrating the analyzer

Calibrating the analyzer is typically <u>not</u> required under normal circumstances. Endress+Hauser calibrates each analyzer to a National Institute of Standards and Technology (NIST) traceable standard before shipping the unit to the end user. Because Endress+Hauser analyzers use a non-contact form of measurement, they are relatively insensitive to contamination, are quite rugged and virtually maintenance free ensuring years of reliable service.

4   Serial port communications

4.1   Receiving serial data (RS-232 Output)

When the **Modbus Mode** parameter is set to **0**, the analyzer is configured to transfer a string of data from the analyzer to a serial device via the RS-232 port. The receiving device is typically a computer running HyperTerminal, a program included with Microsoft® Windows®, that enables serial communication and the viewing, capturing and storage of serial port data and messages. Contact Service if your computer does not have HyperTerminal, for additional options, refer to *Service → 🖺*.

4.1.1   To launch HyperTerminal

1. On your Windows desktop, click **Start** followed by **Run** (usually located in the lower right side of the Start Menu).
2. Type **Hypertrm.exe** and hit **Return** to launch HyperTerminal.

For faster access to HyperTerminal, save a HyperTerminal shortcut to the desktop.

3. Once HyperTerminal is activated, the **Connection Description** window appears, as shown in Figure 4. Type in a **Filename** (where the terminal session settings will be stored for future recall) and click on any icon. Click OK.
4. The **Connect To** window appears prompting for a connection, as shown in Figure 5. Click the **Menu Arrow** under **Connect Using** to view the choices.
5. Click on the appropriate port to which your analyzer is connected (COM1, COM2, COM3, etc.) as established under "Connecting the Output Signals" referenced in the Operating Instruction.
6. Click **OK**.
7. Once the port is chosen, the **COM Properties** window appears. Make sure the COM properties for the port selected reflect those shown in Figure 6 (9600 baud, 8 data bits, 1 stop bit, no parity, and no flow control).
8. Click **OK** to establish the connection.

Once connected, the data will start streaming through the HyperTerminal Window as shown in Figure 7.
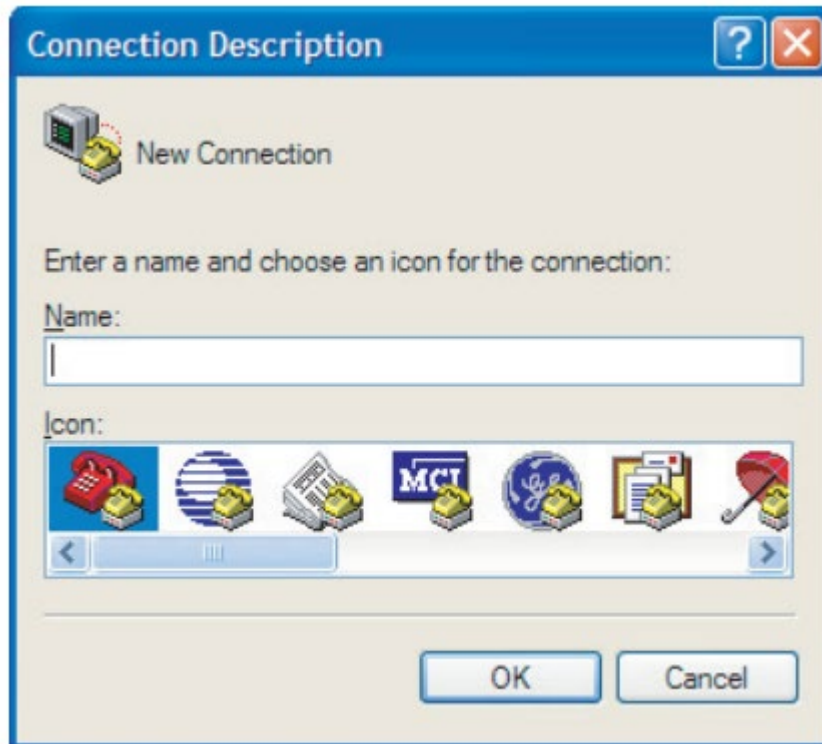
Figure 3. *Connection description window*
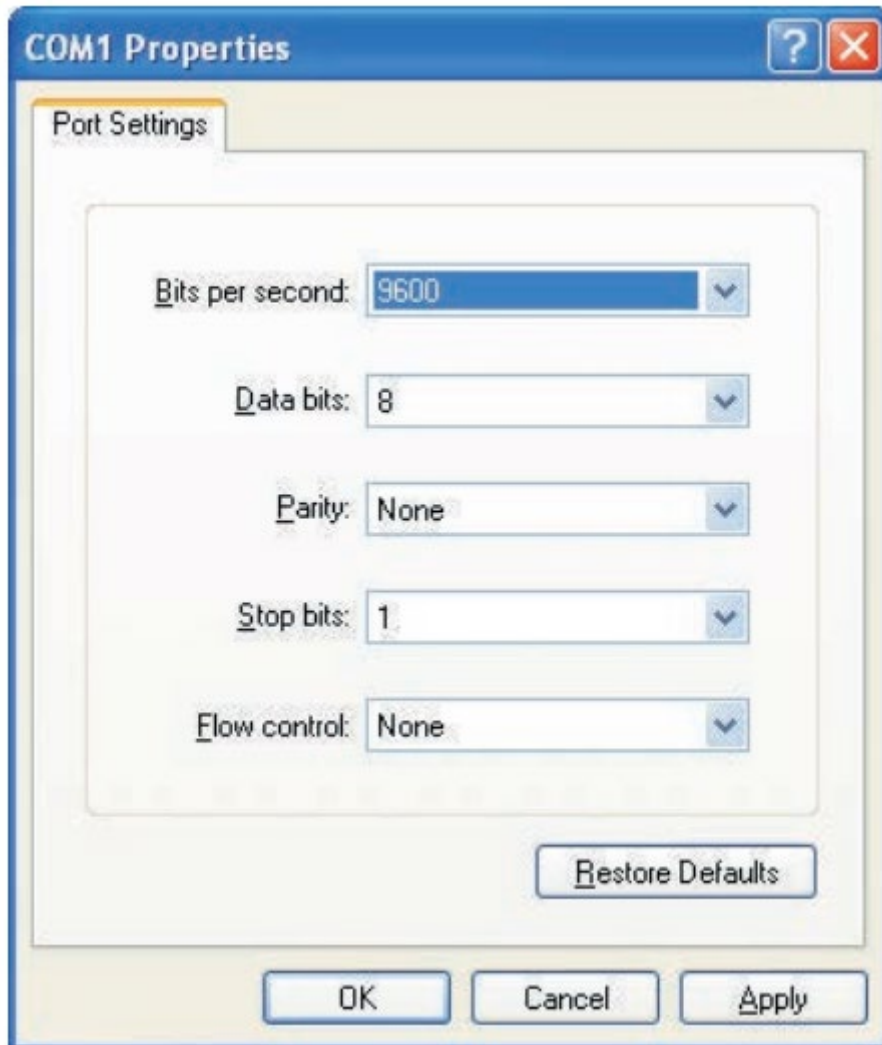

Figure 4. *Connect to window*
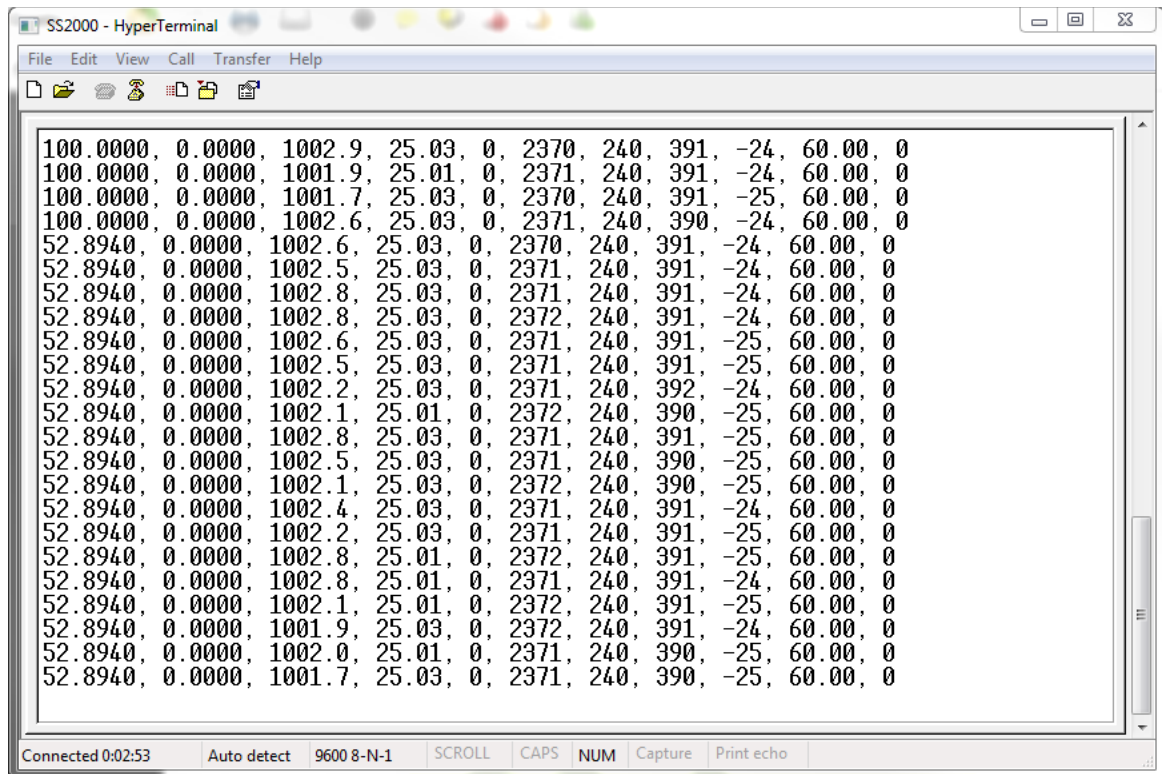
Figure 5. *COM properties window*

Figure 6. *HyperTerminal window with streaming data*

The data string is comma and space delimited with a carriage return at the end of the line and includes:

- **Concentration CH A: Analyte concentration of Analyzer A (user selected units).**
- **Concentration CH B: Analyte concentration of Analyzer B (user selected units).**
- **Pressure**: Cell pressure (user selected units).
- **Temperature**: Cell temperature (user selected units).
- **PP2F**: Magnitude of concentration signal (counts).
- **Powr**: DC signal at absorption peak (counts).
- **Peak 1**: Position of absorption peak in scan used for concentration and peak tracking, in certain situations.
- **Peak 2**: Position of secondary peak in scan used for peak tracking in certain situations, typically the methane peak.
- **Zero**: Detected signal with laser turned off (counts).
- **PkDl**: Present midpoint value (mA).
- **Stream Compensation Status**: Status of the stream compensation calculation is as follows:
  - 0 = Stream Compensation is disabled.
  - 1 = Stream Compensation is enabled and operating correctly.
  - 2 = Calibrated stream composition total is below 95% or above 05%.
 - 3 = User stream composition total is below 95% or above 105%.

> *The number of seconds between each line of data output should be the **# Spectrum Average** number set in **Mode 2** or **Mode 3** divided by 4.*

4.1.2 To capture and save data from the serial port

1. To save the data from the serial port, use the **Transfer/Capture Text** function and enter the **Filename** to where you would like to store the captured data.
2. To stop the capture of the serial data, click on **Transfer/Capture Text/Stop**.

4.1.3 To read diagnostic data with HyperTerminal

1. Before entering **Mode 6**, make sure the serial port on the computer used for serial communication is connected to the analyzer and the output stream is showing on the screen as described in *To launch HyperTerminal* → 🖺.
2. To save the data from the serial port, use the **Transfer/Capture Text** function and enter the **Filename** to where you would like to store the captured data.
3. Once capturing is in place, enter **Mode 6** by pressing **#** key followed by the 6 key.

<div align="center">

+ **6**

```
<DUMP SPECTRUM MODE>

Stats and Setting
```

</div>
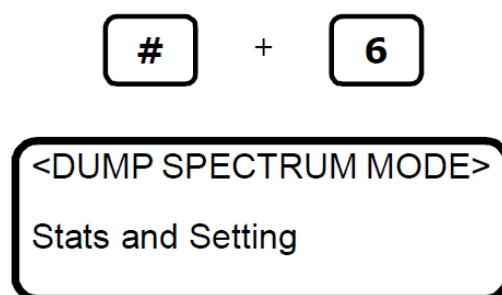
First, the firmware and analyzer configuration are output along with the current parameter settings. This data is output only once. Next, the DC and 2f spectrum data are output followed by the computational statistics.

<div align="center">

+ **6**

```
<DUMP SPECTRUM MODE>

Index: 0
```

</div>
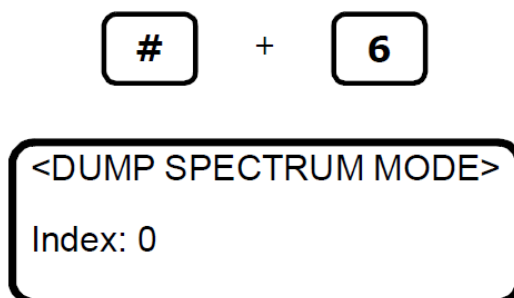
The index shown on the LCD display counts by 50's from 0 to 511 in a few seconds. The analyzer will continue to dump **Mode 6** data until instructed to stop. The screen above will repeat itself for each data dump. Once sufficient data has been captured, press the MODE key at any time to discontinue. When the analyzer completes the current dump, the following screen displays:

<div align="center">

```
            MODE
```

</div>
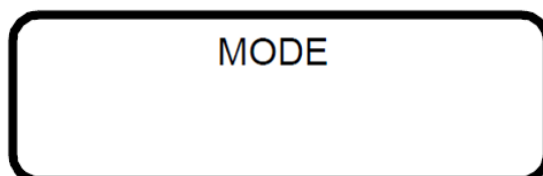
4. Press the **#** key followed by the **1** key to return to **Mode 1**.
5. Once normal operation resumes, allow appropriate time for data streaming, then stop the capture of the serial data. To stop the capture of the serial data, click on **Transfer/Capture Text/Stop**.

The resulting data files contain the downloaded data as shown in Figure 8.

```
Current Mode: Main Stream
Current File: 0 (0:A 1:B 2:C 3:D)

Settings
Midpoint: 60.0000
Ramp amplitude: 35.0000
Imod: 8.000
Phase: 300
Rcalb: (A)4.000000E+01 (B)4.000000E+01 (C)4.000000E+01 (D)4.000000E+01
Zero Offset (ppmv): (A)0.000000E+00 (B)0.000000E+00 (C)0.000000E+00 (D)0.000000E+00
P a1 Coeff: (A)1.000E+00 (B)1.000E+00 (C)1.000E+00 (D)1.000E+00
P a2 Coeff: (A)0.000E+00 (B)0.000E+00 (C)0.000E+00 (D)0.000E+00
P a3 Coeff: (A)0.000E+00 (B)0.000E+00 (C)0.000E+00 (D)0.000E+00
P a4 Coeff: (A)0.000E+00 (B)0.000E+00 (C)0.000E+00 (D)0.000E+00
NL a0 Coeff: (A)0.00000E+00 (B)0.00000E+00 (C)0.00000E+00 (D)0.00000E+00
NL a1 Coeff: (A)1.00000E+00 (B)1.00000E+00 (C)1.00000E+00 (D)1.00000E+00
NL a2 Coeff: (A)0.00000E+00 (B)0.00000E+00 (C)0.00000E+00 (D)0.00000E+00
NL a3 Coeff: (A)0.00000E+00 (B)0.00000E+00 (C)0.00000E+00 (D)0.00000E+00
Nonlinear Boundary: (A)1000000 (B)1000000 (C)1000000 (D)1000000
NL b0 Coeff: (A)0.00000E+00 (B)0.00000E+00 (C)0.00000E+00 (D)0.00000E+00
NL b1 Coeff: (A)1.00000E+00 (B)1.00000E+00 (C)1.00000E+00 (D)1.00000E+00
NL b2 Coeff: (A)0.00000E+00 (B)0.00000E+00 (C)0.00000E+00 (D)0.00000E+00
NL b3 Coeff: (A)0.00000E+00 (B)0.00000E+00 (C)0.00000E+00 (D)0.00000E+00
Main Matrix: 0
Validation Matrix: 0
S Factor: 1.00000
S Factor Offset: 0.00000
Stream Compensation: 0
# Spectrum Average: 4
Logger Rate: 4
Xleftvmr: 240
Xrightvmr: 340
Peak Tracking: 0
Peak Index Location: 290
mA Index Scale: 0.06835938
Peak Track Num Avgs: 60
Peak Track Range Min: 3
Peak Track Range Max: 70
Peak Track Conc Min: 10
Peak Track Conc Max: 95
Peak Track Temp Min: -20
Peak Track Temp Max: 60
```

Figure 7. *Sample Mode 6 data output*

```
Min Range (ppmv): 0.000
Max Range (ppmv): 422.00
Min Pressure (mbar): 700
Max Pressure (mbar): 1700
Null Fail Range Min: -50
Null Fail Range Max: 50
DO Alarm Setup: 0
DO Alarm Delay: 0
Alarm Setpoint(ppmv): 430.0
Low Power Warning: 200
4-20mA % Test: 101
4-20mA Alarm Action: 0
4 mA Value: 0.000
20 mA Value: 422.000
4-20 mA Val Action: 0
Temperature Unit: 0
Pressure Unit: 0
Concentration Unit: 0
Concen Unit Convert: 0.000
Pipeline Pressure: 0.00
Modbus Address: 1
Modbus Mode: 0
User Analyzer ID: 0
User Sample ID: 0
User Component ID: 0
Serial Number: 100000000


Constants
Null Point: 6



SpectraSensors HardHat
Idx      DC      AC
0        3453    0
1        3465    6
2        3084    9
3        2239    10
4        1457    10
5        864     10
6        461     8
7        215     7
8        79      5
9        8       4
10       -18     3
11       -25     1
12       -22     0
13       11      3
14       85      46
15       148     113
16       204     210
17       255     330
18       298     464
19       329     603
20       351     741
21       368     874
22       380     1000
23       390     1116
24       398     1222
25       405     1318
...
```

Figure 8. *Sample Mode 6 data output (continued)*

Refer to *Viewing diagnostic data with Microsoft Excel* → 🕮 below for instructions to import the stored data file into a spreadsheet program such as Microsoft Excel® to plot the data.

4.2 Viewing diagnostic data with Microsoft Excel

A spreadsheet program such as Microsoft Excel can import the data collected in the **Mode 6** data dump for viewing and plotting.

4.2.1 To import the data file into Excel

1. In Excel, click **Open** and choose the name of the spectrum file saved while in **Mode 6**. Be sure to select **All Files (*.*)** under **Files of type:** while searching, as shown in Figure 9.
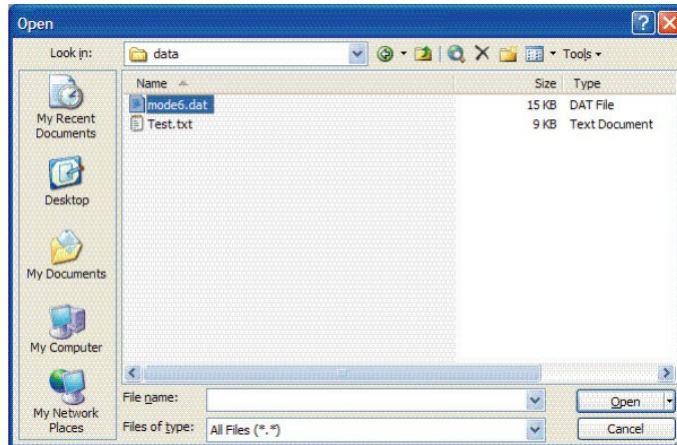

Figure 9. *HyperTerminal window with streaming data*

2. The **Text Import Wizard** should open. Choose the **Delimited** option and click **Next**, as shown in Figure 10.
3. Under **Delimiters**, choose the **Tab** and **Comma** options, check the **Treat Consecutive Delimiters as One** box, as shown in Figure 10, and then click **Finish** to display the spreadsheet. The first few lines look like the normal serial output data received before the **Mode 6** command was entered. Look for the three columns of numbers at the bottom of the file, as shown in Figure 12.
4. Click on the upper left cell with the "Idx" header, as shown in Figure 11. Hold the **Shift** key down while pressing the **Control** key followed by the **Right Arrow** key to highlight the third column. Hold the **Shift** and **Control** key down again and press the **Down Arrow** key to highlight all 512 rows.
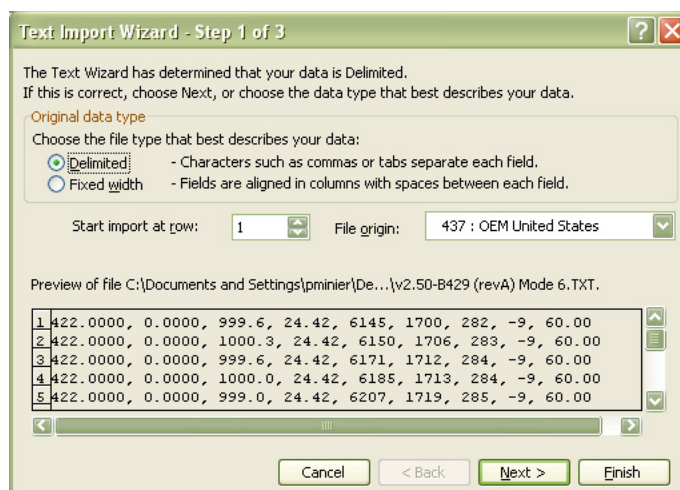

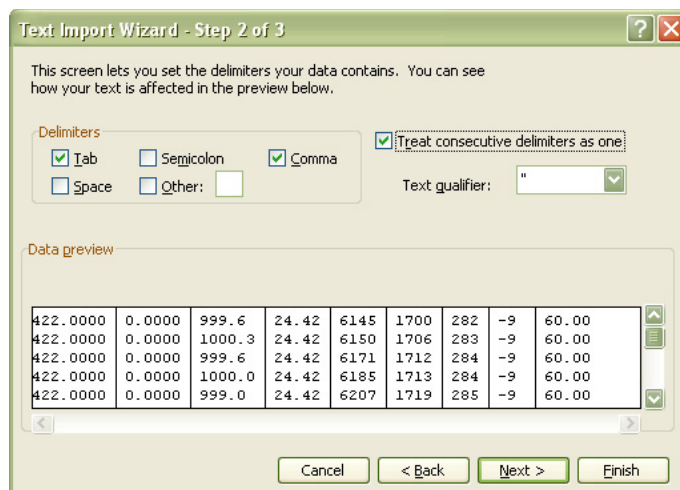Figure 10. *Setting data type in Text Import Wizard*

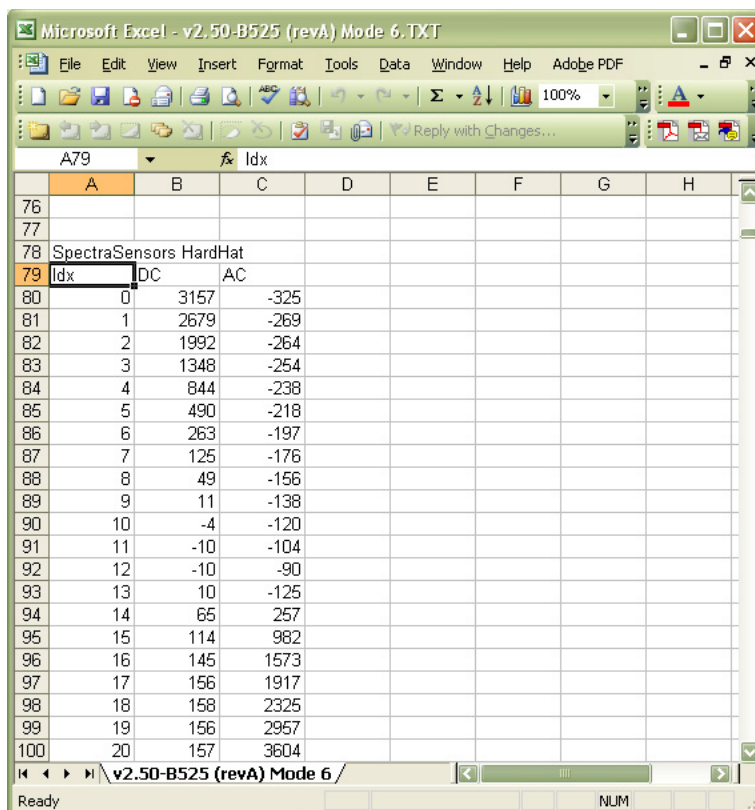*Figure 11. Setting Tab and Comma as delimiters*

Figure 12. Highlighting imported data for plotting in Excel

5. Click the **Chart Wizard** button on the **Task Bar**. The **Chart Wizard** should open, as shown in Figure 13.
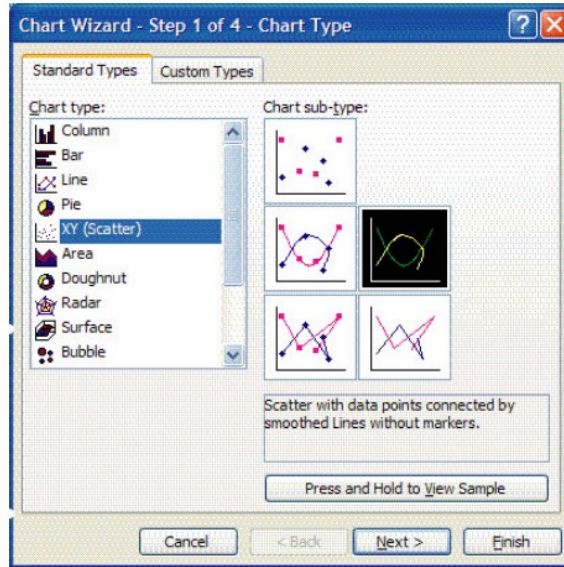
Figure 13. Chart Wizard – Step 1 window

6. Choose the **X-Y (Scatter)** chart type and the **Smoothed Lines Without Markers** sub-type. Click **Finish** to display a graph of the spectrum, as shown in Figure 13.

    If the $2f$ curve appears flat, double-click on it to get to the **Format Data Series Window**. Select the **Axis** tab, and select **Plot Series on Secondary Axis**, as show in in figure 14. Click **OK** to rescale the plot.
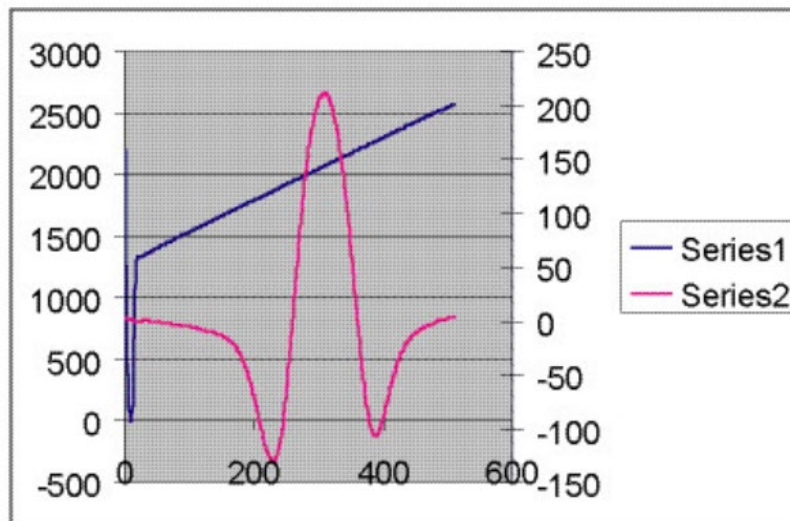

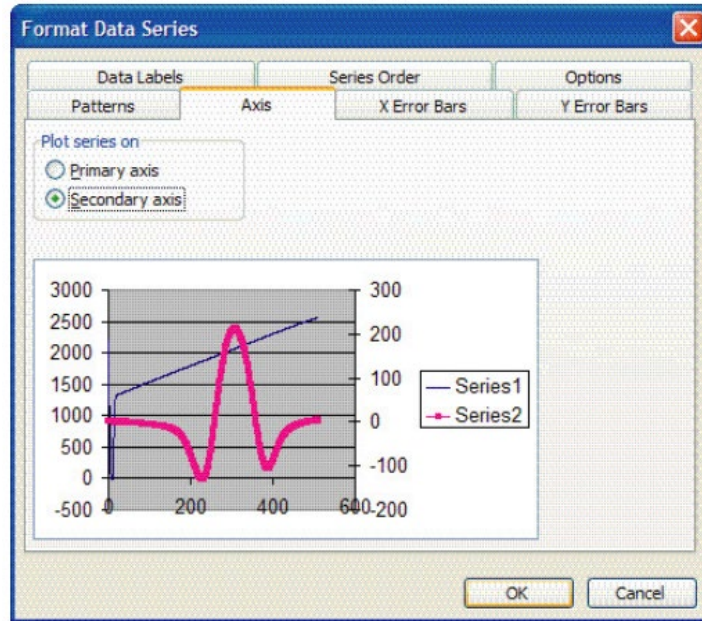
Figure 14. Data file plot in Excel

Figure 15. Format data series window

4.3 Modbus Communications Protocol

Modbus is a serial communications protocol published by Modicon in 1979 for use with its programmable logic controllers (PLCs). It has become a de facto standard communications protocol in industry, and is now the most commonly available means of connecting industrial electronic devices. Modbus is used extensively in lieu of other communications protocols because it is openly published and royalty-free, relatively easy to deploy, and capable of moving raw bits or words without placing many restrictions on vendors.

Modbus enables communication between many devices connected to the same network, for example, a supervisory computer with a remote terminal unit (RTU) in supervisory control and data acquisition (SCADA) systems.

The Endress+Hauser analyzer acts as a server in a client/server(s) network of devices. It can receive queries from a client and send responses back using either Gould Modbus RTU protocol or Daniel Extended Modbus RTU protocol.

4.3.1 Framing/protocol

The transmission mode used to communicate is either Gould Modbus RTU or Daniel Modbus RTU with port parameters 9600 (baud rate), 8 (data bits), 1 (stop bit), no (parity), and none (flow control/handshake).

The Modbus option is determined by the user via a front-panel configuration Modbus Mode parameter as follows:

- Set Modbus Mode = **0** to disable Modbus mode and to enable the Generic Serial mode.
- Set Modbus Mode = **1** to enable Gould Modbus RTU mode.
- Set Modbus Mode = **2** to enable Daniel Modbus RTU mode.

The generic serial output is disabled if either Gould or Daniel Modbus is selected.

4.3.2 Functions

Available functions are 0x03 (read holding registers), 0x06 (write to a single register), 0x10 (write to multiple registers), and 0x2B (read device identification).

4.3.3 Addressing

The analyzer's Modbus client node address can be in the range of 0-250 with the default being 1. All analyzers will respond to an address of 0, so this address can be used to interrogate a single unit when its address is unknown or to determine its address.

See the Table for register definitions for both Gould and Daniel Modbus modes. Be aware that for Gould Modbus the table follows the convention of identifying the register with an offset of 40001. Therefore, the actual value transmitted in the starting register field of the command is the listed register value minus 40001, e.g., register 47001 is addressed as 7000.

4.3.4 Reading/writing in Daniel Modbus Mode

Daniel Modbus supports three types of registers: short integer, long integer and floating point. Each "short integer" register is two bytes in length and will contain an integer value. Each "long integer" register is four bytes in length and will contain an integer value and each "floating point" register is four bytes in length and will contain a floating point value.

4.3.5 Reading/writing in Gould Modbus Mode

Gould Modbus supports three types of variable data, short integer, long integer and floating point, but all registers are addressed as word (two byte) registers. A "short integer" value is contained in one register whereas a "long integer" or "floating point" value requires two contiguous registers. The registers are defined as Read or Read/Write.

Use caution when writing to registers as changing the value of a writable register may affect the calibration of the analyzer.

An appropriate password must be downloaded to the password register prior to writing to most registers. The User Level 1 (L1) user password **3142** will allow access to those registers which have been pre-defined as user configurable. Other writable registers can only be downloaded or changed by Endress+Hauser support personnel using a User Level 2 (L2) password.

4.3.6 Endianness

Endianness, often referred to as byte order, is the ordering of individually addressable sub-units (words, bytes, or even bits) within a longer data word. Byte orders with the most versus least significant byte first are called big-endian and little-endian, respectively. In Endress+Hauser analyzers, all bytes are stores big-endian. Thus, for floating point and long-integer data types, the byte order will look like:

HighWord-HighByte	HighWord-LowByte	LowWord-HighByte	LowWord-LowByte

Note that floating point values follow the IEEE Standard for Floating-Point Arithmetic (IEEE 754-2008).

4.3.7 To enable Modbus communications

1. Confirm that the serial cable has been properly connected. See Connecting the output signals in the Operating Instruction.
2. Power up the analyzer (see *Powering up the analyzer→ 🖹*).
3. Press the **#** key followed by the **2** key for Analyzer A (CH A) or the **#** key followed by the **3** key for Analyzer B (CH B). In the following displays, program entry for CH A is used.

```
<CH A SET PARAMETER>
Enter password

HC12            2.51-xxxx
```

The LCD prompts for a numeric password. Enter the user password (**3142**) on the keypad, then press the ***** key plus **2** to enter **Mode 2** (Set Parameter Mode - CH A) or **3** to enter **Mode 3** (Set Parameter Mode 3 – CH B). The following displays on the LCD.

```
<CH A SET PARAMETER>
Main Matrix
0
0:A  1:B  2:C  3:D
```

4. Press the ***** key repeatedly until the **Modbus Address** parameter is displayed.

```
<CH A SET PARAMETER>
Modbus Address
1
Enter a value(1-250)
```

5. Enter the desired **Modbus Address** and press the ***** key to store the value and cycle to the **Modbus Mode** parameter.

```
<CH A SET PARAMETER>
Modbus Mode
0
0:Off  1:GMR  2:DMR
```

6. Enter the desired **Modbus Mode** and press the ***** key to store the value.

7. Press the **#** key followed by the **1** key to return to **Mode 1**. The analyzer is now ready to receive Modbus queries.

Parameter	Daniel Reg.	Gould Reg.	Data Type	Action	Min.	Max.
Concentration	7001	47001	Float	Read	-	-
Temperature	7002	47003	Float	Read	-	-
Pressure	7003	47005	Float	Read	-	-
Supply Voltage (DC)	7004	47007	Float	Read	-	-
PkDI (Current Midpoint)	7005	47009	Float	Read	-	-
Concentration (ppmv)	7006	47011	Float	Read	-	-
Temperature (deg C)	7007	47013	Float	Read	-	-

Pressure (mb)	7008	47015	Float	Read	-	-
Firmware Version	7057	47113	Float	Read	-	-
S Factor	7101	47201	Float	R/W L1[1]	-99	99
S Factor Offset (ppmv)	7102	47203	Float	R/W L1[1]	-999999	999999
Alarm Setpoint (ppmv, lb or %)	7103	47205	Float	R/W L1[1]	0	999999
Pipeline Pressure (mb)	7104	47207	Float	R/W L1[1]	0	999999
4 mA Value (ppmv or dew point)	7105	47209	Float	R/W L1[1]	0	999999
20 mA Value (ppmv or dew point)	7106	47211	Float	R/W L1[1]	0	999999
Concen Unit Convert	7107	47213	Float	R/W L1[1]	0	999999
Methane [A]	7301	47601	Float	R/W L1[1]	0	1
Ethane [A]	7302	47602	Float	R/W L1[1]	0	1
Propane [A]	7303	47603	Float	R/W L1[1]	0	1
Butane [A]	7304	47604	Float	R/W L1[1]	0	1
Carbon Dioxide [A]	7305	47605	Float	R/W L1[1]	0	1
H_2S [A]	7306	47611	Float	R/W L1[1]	0	1
N_2 [A]	7307	47613	Float	R/W L1[1]	0	1
Methane [B]	7308	47615	Float	R/W L1[1]	0	1
Ethane [B]	7309	47617	Float	R/W L1[1]	0	1
Propane [B]	7310	47619	Float	R/W L1[1]	0	1
Butane [B]	7311	47621	Float	R/W L1[1]	0	1
Carbon Dioxide [B]	7312	47623	Float	R/W L1[1]	0	1
H_2S [B]	7313	47625	Float	R/W L1[1]	0	1
N_2 [B]	7314	47627	Float	R/W L1[1]	0	1
Methane [C]	7315	47629	Float	R/W L1[1]	0	1
Ethane [C]	7316	47631	Float	R/W L1[1]	0	1
Propane [C]	7317	47633	Float	R/W L1[1]	0	1
Butane [C]	7318	47635	Float	R/W L1[1]	0	1
Carbon Dioxide [C]	7319	47637	Float	R/W L1[1]	0	1
H_2S [C]	7320	47639	Float	R/W L1[1]	0	1
N_2 [C]	7321	47641	Float	R/W L1[1]	0	1
Methane [D]	7322	47643	Float	R/W L1[1]	0	1
Ethane [D]	7323	47645	Float	R/W L1[1]	0	1
Propane [D]	7324	47647	Float	R/W L1[1]	0	1
Butane [D]	7325	47649	Float	R/W L1[1]	0	1
Carbon Dioxide [D]	7326	47651	Float	R/W L1[1]	0	1

H$_2$S [D]	7327	47653	Float	R/W L1[1]	0	1
N$_2$ [D]	7328	47655	Float	R/W L1[1]	0	1
Alarm Flags	5001	45001	Long	Read	0	0
Status Flags	5002	45003	Long	Read	0	0
Analyzer ID	5101	45201	Long	R/W L1[1]	0	2.0E9
Sample ID	5102	45203	Long	R/W L1[1]	0	2.0E9
Component ID	5103	45205	Long	R/W L1[1]	0	2.0E9
PP2f	3001	43001	Integer	Read	0	0
Power	3002	43002	Integer	Read	0	0
Peak Index 1	3003	43003	Integer	Read	0	0
Zero	3004	43004	Integer	Read	0	0
Peak Index 2	3005	43005	Integer	Read	0	0
Stream Compensation Status	3006	43006	Integer	Read	0	0
# Spectrum Average	3201	43201	Integer	R/W L1[1]	1	240
Logger Rate	3202	43202	Integer	R/W L1[1]	1	300
Peak Tracking	3203	43203	Integer	R/W L1[1]	0	4
4-20 mA Alarm Action	3204	43204	Integer	R/W L1[1]	0	3
Temperature Unit	3205	43205	Integer	R/W L1[1]	0	1
Pressure Unit	3206	43206	Integer	R/W L1[1]	0	3
Concentration Unit	3207	43207	Integer	R/W L1[1]	0	13 H$_2$O/ 2 non-H$_2$O
Modbus Device Address	3208	43208	Integer	R/W L1[1]	0	250
Modbus Mode	3209	43209	Integer	R/W L1[1]	0	2
DO Alarm Setup	3210	43210	Integer	R/W L1[1]	0	109
4-20 mA % Test	3211	43211	Integer	R/W L1[1]	0	101
Low Power Warning	3212	43212	Integer	R/W L1[1]	200	4999
User Password	3213	43213	Integer	R/W L1[1]	0	9999
DO Alarm Delay	3214	43214	Integer	R/W L1[1]	0	30000
Main Matrix	3215	43215	Integer	R/W L1[1]	0	3
Validation Matrix	3216	43216	Integer	R/W L1[1]	0	3
4-20 mA Val Action	3217	43217	Integer	R/W L1[1]	0	1
Validation On	3219	43219	Integer	R/W L1[1]	0	1
Password	4999	44999	Integer	R/W L0	0	9999

[1]*Write privilege requires User Level 1 (L1) password to be downloaded to the Password register.*

4.3.7.1 Modbus accessible parameter definitions

The following definitions refer to the Modbus accessible parameters listed in the Modbus register map table. These parameters are shown in alphabetical order for ease of reference.

- **# Spectrum Average:** Number of scans averaged for each measurement.
- **20 mA Value (ppmv or dew point):** Controls the high range of the 4-20 mA output.
- **4 mA Value (ppmv or dew point):** Controls the low range of the 4-20 mA output.
- **4-20 mA % Test:** User set relative output of 4-20 mA current loop.
- **4-20 mA Alarm Action:** Sets 4-20 mA signal reaction to alarm condition.
- **4-20 mA Val Action:** For custom configurations. When **Mode 7** (CH A) or **Mode 8** (CH B) is pressed, the analyzer will either hold the last known value for the analog output or update the analog output with the validation measurements.
- **Alarm Flags:** Long integer register identifying the status of each individual alarm in the analyzer as follows:
    - Bit 0 = 1, general fault condition exists
    - Bit 1 = 1, Null Fail Error condition exists
    - Bit 2 = 1, Spectrum Fail Error condition exists
    - Bit 3 = 1, PT Fail condition exists
    - Bit 4 = 1, Power Fail Error condition exists
    - Bit 5 = 1, Track Fail Error condition exists
    - Bit 6 = 1, Concentration is over user defined limit
    - Bit 7 = 1, Power Warning condition exists
    - Bit 8 = 1, Stream Compensation Warning
- **Alarm Setpoint:** Sets the threshold for the **High** (or **Low**) **Concentration Alarm**.
- **Analyzer ID:** User defined numeric analyzer ID.
- **Butane [A/B/C/D]:** Stream compensation background stream value for the calibration matrix.
- **Carbon Dioxide [A/B/C/D]:** Stream compensation background stream value for the calibration matrix.
- **Component ID:** User defined numeric component ID.
- **Concen Unit Convert:** If set to 0, the default conversion factor for **Concentration Unit** is used, but if set to a value, this will be the value used for the conversion factor (multiplier) that is used.
- **Concentration:** Current live concentration in selected engineering units for CH A or CH B, depending on the serial data connection.
- **Concentration (ppmv):** Current live concentration in ppmv for CH A or CH B, depending on the serial data connection.
- **Concentration Unit:** Sets the concentration measurement units.
- **DO Alarm Setup:** Sets function of the secondary digital output.
- **DO Alarm Delay:** Sets the number of consecutive readings concentration must be above setpoint before triggering a **High Concentration Alarm.**
- **Ethane [A/B/C/D]:** Stream compensation background stream value for the calibration matrix.
- Firmware Version: Firmware version running in the analyzer.
- **H$_2$S [A/B/C/D]:** Stream compensation background stream value for the calibration matrix.
- **Logger Rate:** Running average of the concentration reading.
- **Low Power Warning:** Sets the level at which the analyzer will issue a Low Power Warning.
- **Main Matrix:** Picks the current calibration matrix that is used when Mode 1 is pressed and when parameters are changed. Up to four calibrations can be saved.
- **Methane [A/B/C/D]:** Stream compensation background stream value for the calibration matrix.
- **Modbus Address:** User assigned numeric address identifying analyzer to Modbus host system.
- **Modbus Mode:** Sets the Modbus communication protocol type.
- **N$_2$ [A/B/C/D]:** Stream compensation background stream value for the calibration matrix.
- **Password:** Password required to change register settings. In the above table those registers denoted as R/W L1 can be modified if the User Level 1 password is downloaded to this register.
- **Peak Index 1:** Position of the absorption peak along scan.
- **Peak Index 2:** Position of the secondary peak used for peak tracking if enabled.
- **Peak Tracking:** Turns peak tracking on and off.
- **Pipeline Pressure:** Sets the pressure used in calculating dew point in mb.
- **PkDl (Current Midpoint):** The current midpoint value being used in the analyzer when peak tracking is turned on.
- **Power (counts):** Laser power detected at the absorption peak.
- **PP2F (counts):** Value of the concentration signal.
- **Pressure:** Current live pressure reading of the gas sample in selected engineering units atmospheric.
- **Pressure (mb):** Current live pressure reading of the gas sample in mb.
- **Propane [A/B/C/D]:** Stream compensation background stream value for the calibration matrix.
- **Pressure Unit:** Sets the pressure measurement units.

- **S Factor:** Slope adjustment enabling the analyzer to be tuned to match a specific calibration standard without affecting the factory calibration.
- **S Factor Offset:** Offset adjustment enabling the analyzer to be tuned to match a specific calibration standard without affecting the factory calibration.
- **Sample ID:** User defined numeric sample ID.
- **Status Flags:** Shows the current measurement stream
- (process = 1, validation = 2) corresponding to the concentration value.
- **Stream Compensation:** Enables or disables the stream compensation feature.
- **Stream Compensation Status:** Status of the stream composition calculation as follows:
    - **0** = Stream compensation is disabled
    - **1** = Stream compensation is enabled and operating correctly
    - **2** = The calibrated stream composition total is below 95% or above 105%
    - **3** = The user stream composition total is below 95% or above 105%
- **Supply Voltage:** The current live supply voltage to the analyzer board.
- **Temperature:** Current live temperature of the gas sample in selected engineering units.
- **Temperature (deg C):** Current live temperature of the gas sample in degrees Celsius.
- **Temperature Unit:** Sets the temperature measurement units.
- **User Password:** Sets Level 1 custom user password.
- **Validation Matrix:** Picks the current calibration matrix that is used when Mode 7 (CH A) or Mode 8 (CH B) is pressed.
- **Validation On:** Controls the calibration matrix used to calculate the concentration value. Setting to 0 uses the Main Matrix, similar to pressing **Mode 1**. Setting to **1** uses the Validation Matrix, similar to pressing **Mode 7** (CH A) or **Mode 8** (CH B).
- **Zero (counts):** Detected signal level with laser off.

5   Appendix A: Troubleshooting

Class 3B invisible laser radiation when open. Avoid exposure to the beam. Never open the sample cell unless directed to do so by the factory service representative and the analyzer power is turned off.

The optical head has a seal and "WARNING" sticker to prevent inadvertent tampering with the device. Do not attempt to compromise the seal of the optical head assembly. Doing so will result in loss of device sensitivity and inaccurate measurement data. Repairs can then only be performed by the factory and are not covered under warranty.

This section presents recommendations and solutions This section presents recommendations and solutions to common problems related to firmware operation of the analyzer. Contact Service if your analyzer does not appear to be hampered by one of these related problems. Refer to *Service* → 🖺.

5.1 Peak tracking reset procedure

The analyzer's software is equipped with a peak tracking function that keeps the laser scan centered on the absorption peak. Under some circumstances, the peak tracking function can get lost and lock onto the wrong peak. If the difference between **PkDf** and **PkDl** is more than 4, or **Track Fail** error is displayed, the peak tracking function should be reset.

5.1.1 To check the PkDf and PkDl values

1. Press the **#** key followed by the **4** key to enter **Mode 4** for Analyzer A (CH A) or **Mode 5** for Analyzer B (CH B).

```
PP2F:8190   PkDf:34.00
Powr:2538   PkDl:34.00
Pk: 175  374
Zero: -24
```

2. Compare the values for **PkDf** and **PkDl**. If the difference is more than 4, reset the peak tracking function.

5.1.2 To reset Peak Tracking

1. Press the **#** key followed by the **2** key for CH A or the **3** key for CH B. The LCD will prompt for a numeric password.

```
<CH A SET PARAMETER>
Enter password

HC12              v2.51-xxxx
```

2. Enter the user password (**3142**) on the keypad, then press the ***** key to enter **Mode 2** (Set Parameter Mode).

3. Press the ***** key to cycle through the screens until the **Peak Tracking** parameter appears.

```
<CH A SET PARAMETER>
Peak Tracking
1
0Off1P12P23Auto4Rest
```

4. Press **4** (RESET) followed by the ***** key. The peak tracking function will cycle off then on and reset.

5. Press the mode key **#** followed by **1** to return to **Mode 1** (Normal Mode).

5.2 Instrument Problems

Refer to Table A–1 below before contacting Service if the analyzer does not appear to be hampered by hardware issues, refer to the Operating Instruction for your analyzer. To contact Service, refer to *Service* → 🗎.

Symptom	Response
Power Fail Error	Press **# 6** to capture diagnostic data and send the file to Endress+Hauser.
PT Fail Error	Refer to the Operating Instruction, Troubleshooting section, for your analyzer.
Front panel display is not lit and no characters appear	Refer to the Operating Instruction, Troubleshooting section, for your analyzer.
Strange characters appear on front panel display	Refer to the Operating Instruction, Troubleshooting section, for your analyzer.
Pressing keys on front panel do not have specified effect	Refer to the Operating Instruction, Troubleshooting section, for your analyzer.
Current loop is stuck at 4 mA or 20 mA	Check the display for error message. If alarm has been triggered, reset the alarm.
	Refer to the Operating Instruction, Troubleshooting section, for your analyzer.
Reading seems to always be high by a fixed amount	Capture diagnostic data and send the file to Endress+Hauser (see *To read diagnostic data with HyperTerminal* → 🗎).

Reading seems to always be high by a fixed percentage	Capture diagnostic data and send the file to Endress+Hauser (see *To read diagnostic data with HyperTerminal* → 🖺).
	Check that Peak Tracking is enabled (see To change parameters in Mode 2 or Mode 3 → 🖺).
Reading displays 0.0 or seems relatively low	Capture diagnostic data and send the file to Endress+Hauser (see *To read diagnostic data with HyperTerminal* → 🖺).
Reading is erratic or seems incorrect	Capture diagnostic data and send the file to Endress+Hauser (see *To read diagnostic data with HyperTerminal* → 🖺).
Reading goes to "0"	Gas concentration is equal to zero.
Reading goes to full scale	If **4-20 mA Alarm Action** is set to **1**, look on display for an error message (see To change parameters in Mode 2 or Mode 3 → 🖺).
	Gas concentration is greater than or equal to full scale value.
Serial output is displaying garbled data	Make sure the computer COM port is set for 9600 baud, 8 data bits, 1 stop bit, no parity, and no flow control.
Serial output is providing no data	Make sure the analyzer is operating in **Mode 1** and readings are being displayed on the LCD.
	Make sure the computer COM port is set for 9600 baud, 8 data bits, 1 stop bit, no parity, and no flow control.
	Be sure no other programs are using the COM port selected.
	Make sure the connections are good. Verify the correct pin connections with an ohmmeter.
	Make sure to select the correct COM port into which the cable is plugged.

LCD does not update and unit is locked up for more than 5 minutes	Switch off power to the analyzer, wait 30 seconds, and then switch power back on.

5.3 Service

For Service, refer to our website for the list of local sales channels in your area (https://www.endress.com/contact).

5.4 Disclaimers

Endress+Hauser accepts no responsibility for consequential damages arising from the use of this equipment. Liability is limited to replacement and/or repair of defective components.

This manual contains information protected by copyright. No part of this guide may be photocopied or reproduced in any form without prior written consent from Endress+Hauser.

www.addresses.endress.com

Endress+Hauser

People for Process Automation