MODEL 330 AND 331 HYDROGEN SULFIDE ANALYZER

MODBUS COMMUNICATIONS GUIDE

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Overview

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. The main reasons for the extensive use of Modbus over other communications protocols are:

1. It is openly published and royalty-free
2. Relatively easy industrial network to deploy
3. It moves raw bits or words without placing many restrictions on vendors

Modbus allows for communication between many devices connected to the same network, for example a system that measures temperature and humidity and communicates the results to a computer. Modbus is often used to connect a supervisory computer with a remote terminal unit (RTU) in supervisory control and data acquisition (SCADA) systems.

Versions of the Modbus protocol exist for serial port and for Ethernet and other networks that support the Internet protocol suite.

Most Modbus devices communicate over a serial EIA-485 physical layer[1].

For serial connections, two variants exist, with different representations of numerical data and slightly different protocol details. Modbus RTU is a compact, binary representation of the data. Modbus ASCII is human readable, and more verbose. Both of these variants use serial communication. The RTU format follows the commands/data with a cyclic redundancy check checksum, while the ASCII format uses a longitudinal redundancy check checksum. Nodes configured for the RTU variant will not communicate with nodes set for ASCII, and the reverse.

For connections over TCP/IP (e.g. Ethernet), the more recent variant Modbus/TCP exists. It does not require a checksum calculation.

Data model and function calls are identical for all three communication protocols; only the encapsulation is different.

Each device intended to communicate using Modbus is given a unique address. In serial networks only the node assigned as the Master may initiate a command, but on Ethernet, any device can send out a Modbus command, although usually only one master device does so. A Modbus command contains the Modbus address of the device it is intended for. Only the intended device will act on the command, even though other devices might receive it (an exception is specific broadcast-able commands sent to node 0 which are acted upon but not acknowledged). All Modbus commands contain checking information, ensuring that a command arrives undamaged. The basic Modbus commands can instruct an RTU to change a value in one of its registers, control or read an I/O port;as well as commanding the device to send back one or more values contained in its registers.

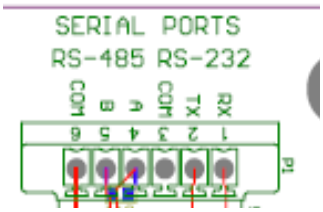
Almost all implementations have variations from the official standard. Different varieties may not communicate correctly between different suppliers equipment. Some of the most common variations are:

- Data Types
    - Floating Point IEEE
    - 32 bit integer
    - 8 bit data
    - mixed data types
    - bit fields in integers
    - multipliers to change data to/from integer. 10, 100, 1000, 256 ...
- Protocol extensions

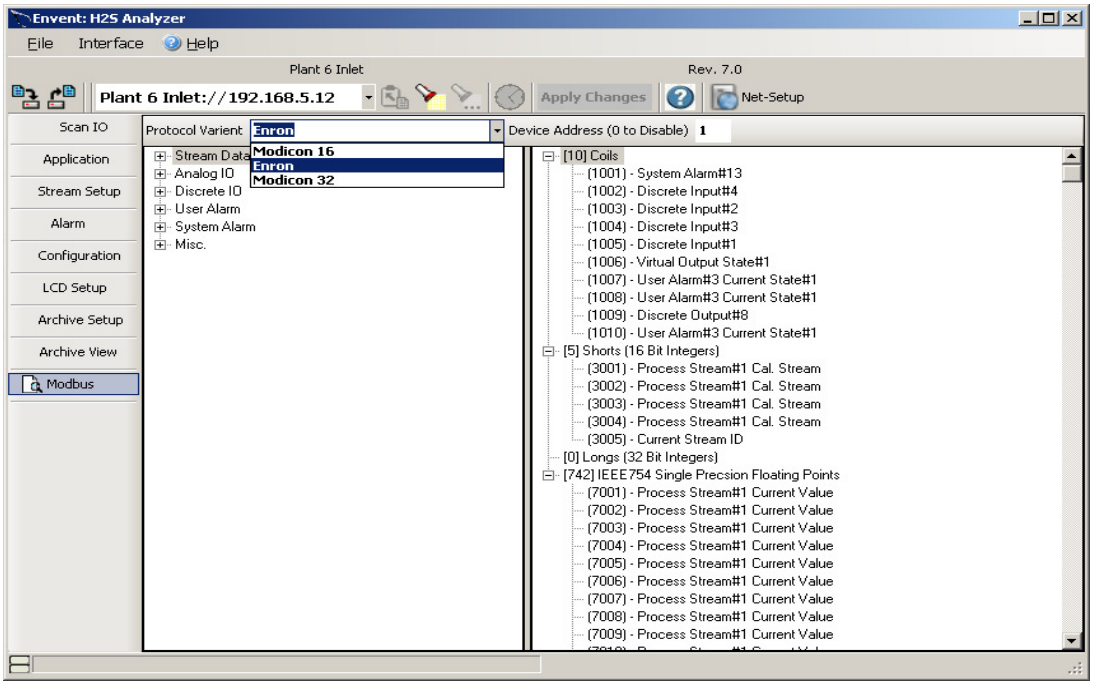
- 16 bit slave addresses
- 32 bit data size (1 address = 32 bits of data returned.)
- word swapped data

(Wikipedia)

The standard Models 330 and 331 hydrogen sulfide analyzers provide two serial communications ports. A RS232 port is normally used to configure the analyzer. The two wire RS485 communications port is available for communication to a local RTU or a remote monitoring station.



The communication ports operate at 9600 N 8 1 (no parity, 1 stop bit) using RTU protocol (ASCII protocol is not supported). Modicon 16, Modicon 32 and Modicon Enron (Daniel) variants of the Modbus protocol are selected from a drop down menu. A device address must be selected to allow more than one device to communicate on a single RS485 communication link.



To add an item to the Modbus register list, locate the desired parameter in the *Protocol Variant* column and drag it into the appropriate register area. Binary data ie. switch or relay status are normally configured as coils. Stream data such as the current analyzer reading are normally configured as single precision floats (Modbus Enron protocol). To move a register item, highlight it then press Ctrl and the up arrow. To delete an item, highlight it and press delete. To configure the Modbus list to conform to the register list of legacy equipment it may be necessary to move

the required Modbus registers to a higher address in the register list. This can be done by inserting any parameter (Process Stream1 Current Value for instance) into the register list multiple times to move the required parameter into the legacy address. This has no adverse effect on the analyzer operation.

RS232 is an electrical standard for exchange of serial data between two devices. It is subject to signal degradation in noisy electrical environments and is specified for a maximum wire length of 50 feet. RS232 does not support multiple end devices on the same communications link. Three wire shielded cable is required for RS232 communications (Belden 8723 or equivalent).

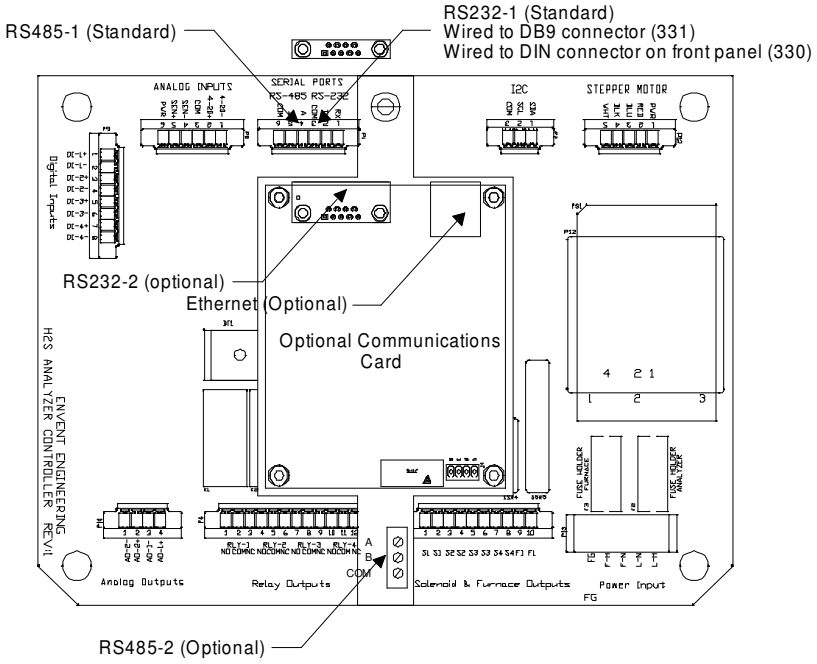
RS485 is also an electrical standard for exchange of serial data between two devices. It is specified for a maximum wire length of 4000 feet at 9600 BPS. RS485 supports up to 128 end devices on the same communications link. Three wire shielded cable is required for RS232 communications (Belden 8723 or equivalent). Please note that although it is called 2 wire RS485, three wires are required (A, B and signal common) otherwise damage to the devices may occur.

Note: Both the communication ports are capable of analyzer configuration or Modbus communication. No changes are required to the analyzer.

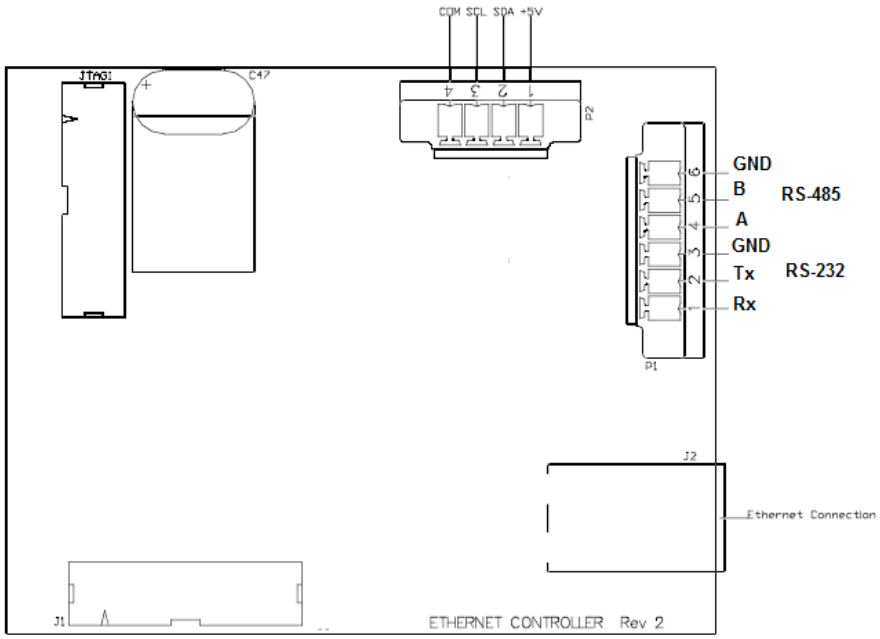
Optional Communications Card

A communications board is available as an option for both the model 330 and 331 analyzers. This board adds an additional RS232 and an additional RS485 communications port (a total of two each). An Ethernet port is also provided that will support both configuration and Modbus communications (simultaneously if desired). The Ethernet port supports Modbus/TCP as well as standard Modbus.

Original (Red Card)



Second Gen (Green Card)



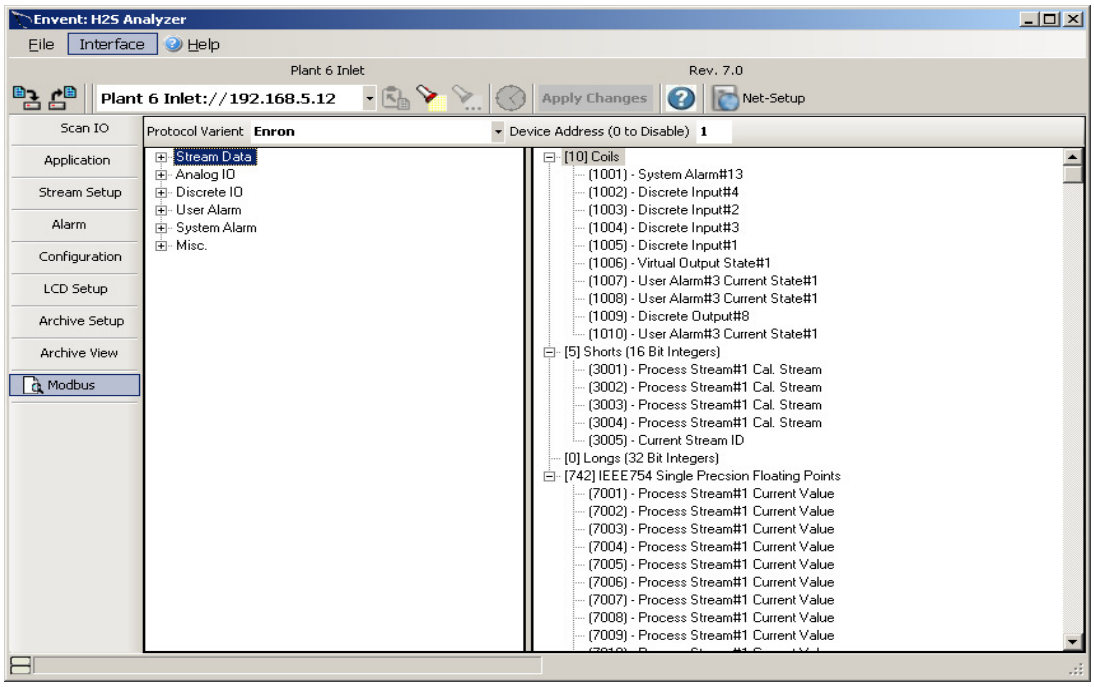
Communications Card Ethernet Port Setup

Step 1) Ensure there is an Ethernet cable plugged into the networking card RJ45 connector with the other end connected to the networking services router on the site.

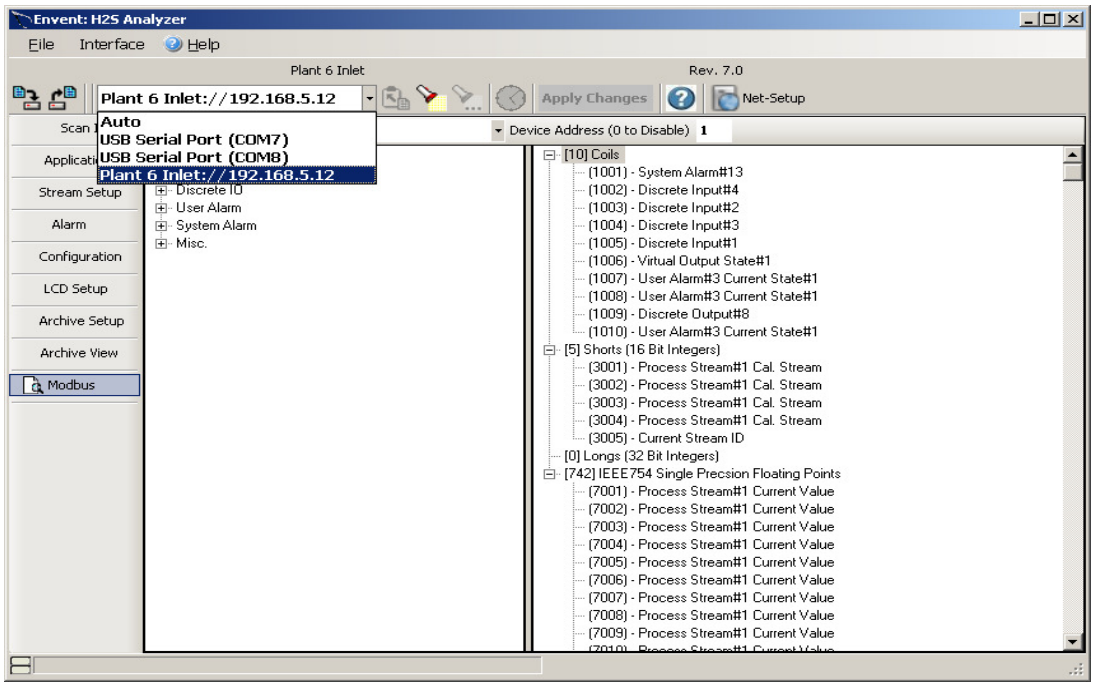
Step 2) Apply power to the analyzer and wait for the Green LED on the networking card to start blinking. (Indicates connection to the network)

Step 3) Select the ‘Clear network device list’ from the “Interface” menu option.

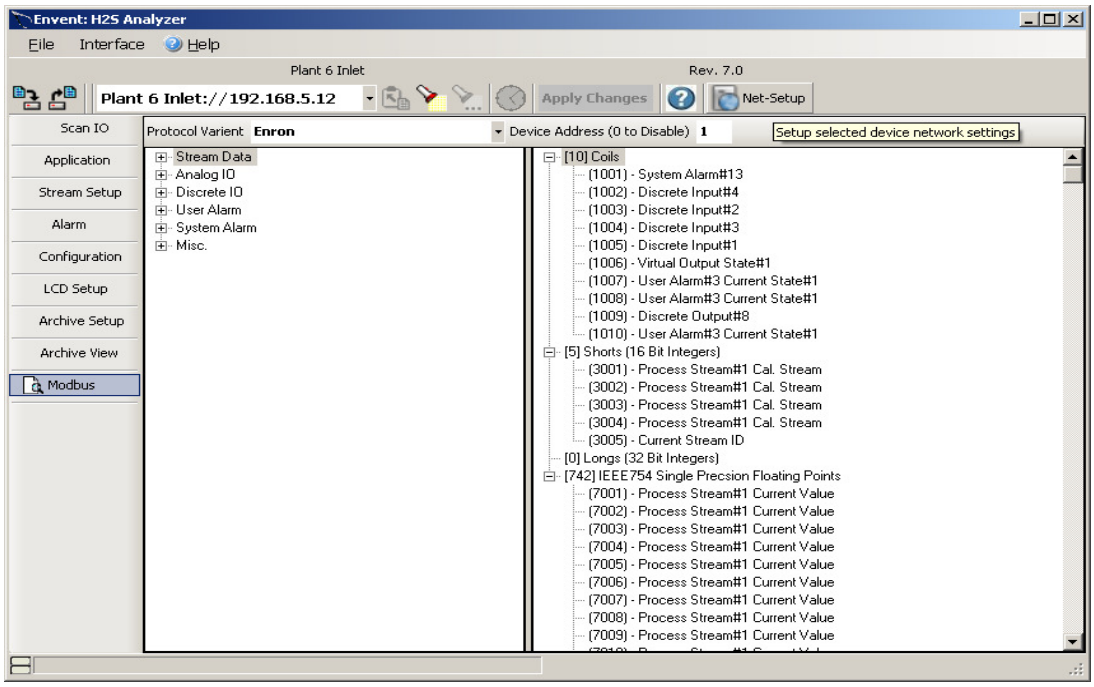
Step 4) Select the ‘Scan network for devices’ from the “Interface” menu option and wait for approximately 10 seconds while the software detects the analyzers connected to the network.



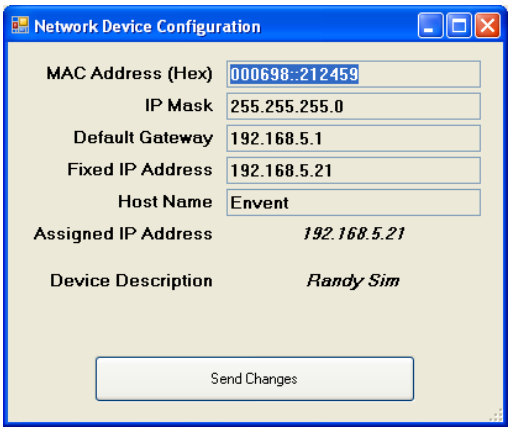
From the list of communications options in the toolbar, there should appear one or more listings with a '://' sequence in the name. This indicates a network connection. Select the option that describes the device you are connecting to.



Once a network device is selected from the list of communications options a new button will appear on the right hand side of the UI labeled 'Net-Setup', press this button to view the networking card options.



The Network Device Configuration dialog allows the network card to adopt addressing options to fit the device into the network.



1) MAC Address – This is a unique ID for the network card set at the factory and should never be modified or the device may cease to function properly (only made available here for device recovery purposes.)
2) IP Mask – Network specific, ask your network administrator for the proper value
3) Default Gateway - Network specific, ask your network administrator for the proper value
4) Fixed IP Address – If left as all zeros (000.000.000.000) the network card assumes there is no fixed address and will look for a DHCP server on the network from which to acquire an address, else the card will open up a port and monitor the specific address for all network communications.
5) Host Name – This is the Network Domain Name that should be assigned
6) Assigned IP Address – If there is a valid fixed address this field should echo that address, else this field will indicate which address has been assigned by the DHCP server.

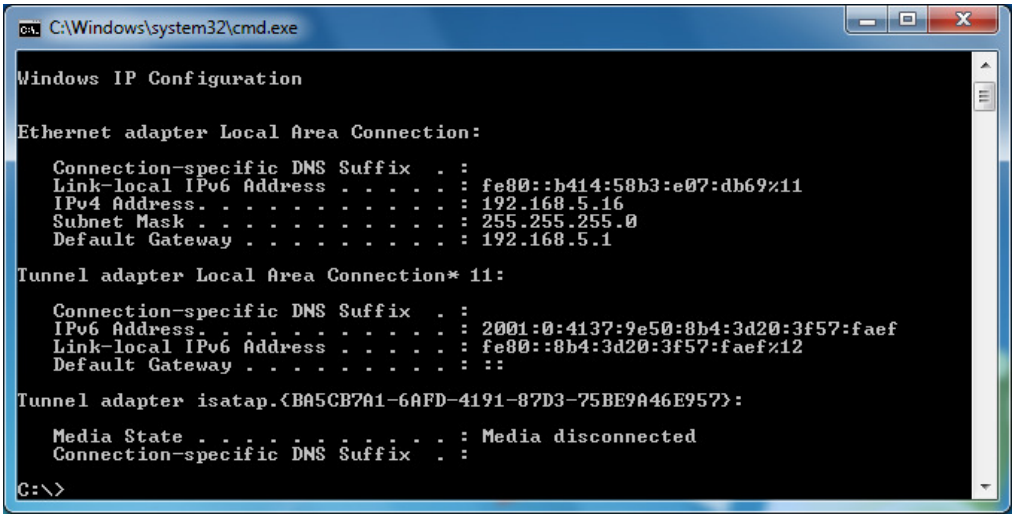
7) Device Description – All Envent H2S analyzers have a naming capability and this field represents the name assigned to the device. This is also used in the 'Communications Options' box in the toolbar to aid in differentiating more than 1 device in a single network.

Manually assigning a fixed IP address to the Communications Card

The communications card is shipped from the factory with the IP address left as all zeros (000.000.000.000). The network card assumes there is no fixed address and will look for a DHCP server on the network from which to acquire an address.

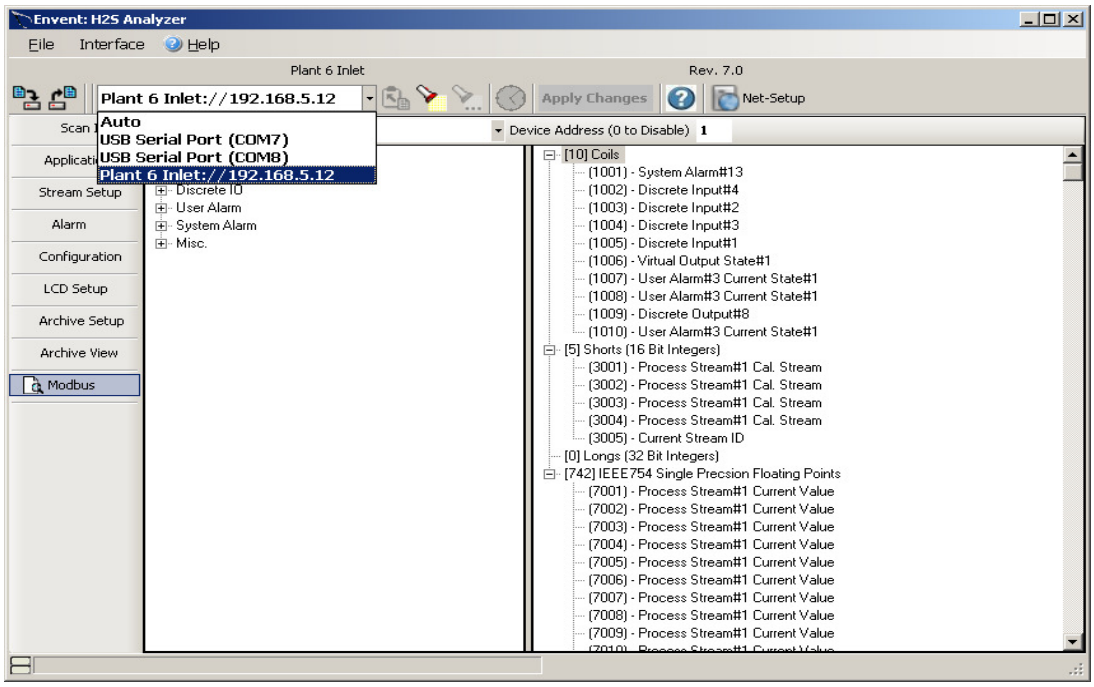
If the analyzer can not be connected to a router supporting DHCP the IP address can be configured to a fixed address with a laptop by performing the following procedure.

1. Disable your wireless card
2. Connect a standard network cable from the laptop to the communication card
3. Check that the led indicator next to the RJ45 network connector on the laptop illuminates. Any recent laptop will support network communication using a standard networking cable. Very old laptops may require a "crossover network cable" which is available from any office supply store.
4. From the Windows *Start* Icon, select run, type cmd. This will bring up a DOS box.
5. Type ipconfig, and confirm a valid IP address has been assigned.

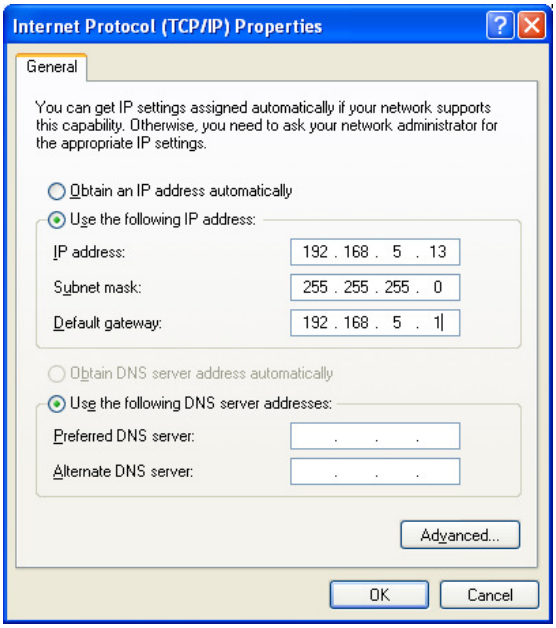


6. If a valid IP has not been assigned *Media State.....Media disconnected* will be displayed. In this case restart the computer. This indicates that your require a crossover cable.

7. Start the EventH2S program
8. From the *Interface Menu* select *Clear Network Device List*
9. From the *Interface Menu* select *Scan Network For Devices*



12. Note the IP address assigned to the analyzer
13. From *Control Panel , select* *Local Area Connection*
14. Right click, then select *Properties*
15. Select Internet Protocol (TCP/IP)
16. Select *Properties*
17. Select *Use the following IP Address*
18. Enter an IP address one or two addresses above the analyzer
19. Select *OK*



20. You can now connect directly to the analyzer using the Envent H2S software. The IP Address can be fixed as described previously
21. You should set the laptop back to *Obtain IP Address Automatically* when you are done

Typical Standard Modbus Register List

Input Coils	
Registry Number	**Data Field**
10001	Discrete Input 1
10002	Discrete Input 1
10003	Discrete Input 2
10004	Discrete Input 2
10005	Discrete Input 3
10006	Discrete Input 3
10007	Discrete Input 4
10008	Discrete Input 4

Output Register (16 bit)	
Registry Number	**Data Field**
40001	Process Stream 1 Current Value
40002	Process Stream 1 Current Value
40003	Process Stream 2 Current Value
40004	Process Stream 2 Current Value
40005	Analog Input Current # 1
40006	Analog Input Current # 1
40007	Analog Input Current # 2
40008	Analog Input Current # 2
40009	RRA Current Value
40010	RRA Current Value
40011	Analysis Time
40012	Analysis Time
40013	mv at Sample Start
40014	mv at Sample Start
40015	mv at Sample End
40016	mv at Sample End
40017	Time at Sample Start
40018	Time at Sample Start
40019	Time at Sample End
40020	Time at Sample End
40021	System Date
40022	System Date
40023	Board Temperature
40024	Board Temperature
40025	Cal Gain 1
40026	Cal Gain 1
40027	Cal Gain 2
40028	Cal Gain 2

Output Registry (32 bit)	
Registry Number	**Data Field**
40029	Process Stream 1 Current Value
40031	Process Stream 1 Current Value
40033	Process Stream 2 Current Value
40035	Process Stream 2 Current Value
40037	Analog Input Current # 1
40039	Analog Input Current # 1
40041	Analog Input Current # 2
40043	Analog Input Current # 2
40045	RRA Current Value
40047	RRA Current Value
40049	Analysis Time
40051	Analysis Time
40053	mv at Sample Start
40055	mv at Sample Start
40057	mv at Sample End
40059	mv at Sample End
40061	Time at Sample Start
40063	Time at Sample Start
40065	Time at Sample End
40067	Time at Sample End
40069	System Date
40071	System Date
40073	Board Temperature
40075	Board Temperature
40077	Cal Gain 1
40079	Cal Gain 1
40081	Cal Gain 2
40083	Cal Gain 2

Output Registry (Floats)	
Registry Number	**Data Field**
40085	Process Stream 1 Current Value
40087	Process Stream 1 Current Value
40089	Process Stream 2 Current Value
40091	Process Stream 2 Current Value
40093	Analog Input Current # 1
40095	Analog Input Current # 1
40097	Analog Input Current # 2
40099	Analog Input Current # 2
40101	RRA Current Value
40103	RRA Current Value
40105	Analysis Time
40107	Analysis Time
40109	mv at Sample Start
40111	mv at Sample Start
40113	mv at Sample End
40115	mv at Sample End
40117	Time at Sample Start
40119	Time at Sample Start
40121	Time at Sample End
40123	Time at Sample End
40125	System Date
40127	System Date
40129	Board Temperature
40131	Board Temperature
40133	Cal Gain 1
40135	Cal Gain 1
40137	Cal Gain 2
40139	Cal Gain 2

Output Coils	
Registry Number	**Data Field**
00000	Discrete Output 1
00001	Discrete Output 1
00002	Discrete Output 2
00003	Discrete Output 2
00004	Discrete Output 3
00005	Discrete Output 3
00006	Discrete Output 4
00007	Discrete Output 4
00008	Discrete Output 5
00009	Discrete Output 5
00010	Discrete Output 6
00011	Discrete Output 6
00012	Discrete Output 7
00013	Discrete Output 7
00014	Discrete Output 8
00015	Discrete Output 8
00016	User Alarm 1 State 1
00017	User Alarm 1 State 1
00018	User Alarm 1 State 2
00019	User Alarm 1 State 2
00020	User Alarm 1 State 3
00021	User Alarm 1 State 3
00022	User Alarm 1 State 4
00023	User Alarm 1 State 4
00024	User Alarm 2 State 1
00025	User Alarm 2 State 1
00026	User Alarm 2 State 2
00027	User Alarm 2 State 2
00028	User Alarm 2 State 3
00029	User Alarm 2 State 3
00030	User Alarm 2 State 4
00031	User Alarm 2 State 4
00032	User Alarm 3 State 1
00033	User Alarm 3 State 1
00034	User Alarm 3 State 2
00035	User Alarm 3 State 2
00036	User Alarm 3 State 3
00037	User Alarm 3 State 3
00038	User Alarm 3 State 4
00039	User Alarm 3 State 4
00040	User Alarm 4 State 1
00041	User Alarm 4 State 1
00042	User Alarm 4 State 2
00043	User Alarm 4 State 2
00044	User Alarm 4 State 3
00045	User Alarm 4 State 3
00046	User Alarm 4 State 4
00047	User Alarm 4 State 4
00048	User Alarm 5 State 1
00049	User Alarm 5 State 1
00050	User Alarm 5 State 2
00051	User Alarm 5 State 2
00052	User Alarm 5 State 3
00053	User Alarm 5 State 3
00054	User Alarm 5 State 4
00055	User Alarm 5 State 4
00056	User Alarm 6 State 1
00057	User Alarm 6 State 1
00058	User Alarm 6 State 2
00059	User Alarm 6 State 2
00060	User Alarm 6 State 3
00061	User Alarm 6 State 3
00062	User Alarm 6 State 4
00063	User Alarm 6 State 4
00064	User Alarm 7 State 1
00065	User Alarm 7 State 1
00066	User Alarm 7 State 2
00067	User Alarm 7 State 2
00068	User Alarm 7 State 3
00069	User Alarm 7 State 3
00070	User Alarm 7 State 4
00071	User Alarm 7 State 4
00072	User Alarm 8 State 1
00073	User Alarm 8 State 1
00074	User Alarm 8 State 2
00075	User Alarm 8 State 2
00076	User Alarm 8 State 3
00077	User Alarm 8 State 3
00078	User Alarm 8 State 4
00079	User Alarm 8 State 4
00080	Virtual Output State 1
00081	Virtual Output State 1
00082	Virtual Output State 2
00083	Virtual Output State 2
00084	Virtual Output State 3
00085	Virtual Output State 3
00086	Virtual Output State 4
00087	Virtual Output State 4