

deroQUAL

Series 900 & 905
Transmitter/ Controller

User Guide



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1. Description

The Aeroqual **Series 900 Transmitter/Controller** is designed to measure and control gas concentrations, and to communicate with a variety of hardware systems. The **Series 905** also measures Temperature and Relative Humidity and transmits this using a RS485 output.

The Series 900/905 Transmitter/Controller can operate as a relay controller with user defined setpoints, a 4-20 mA gas transmitter and it can communicate via RS485 on a network. PC Networking & Data logging Software is available as an option. Please contact your distributor if you require this for further information.

1.1 Components Supplied

- Series 900 or 905 base unit (transmitter / controller)
- Gas Sensor Head (installed)
- User guide & Configuration Software CD

Please check that all these components have been supplied and contact your dealer or Aeroqual on email at: sales@aeroqual.com if any of the components are missing.

1.2 Components not supplied but required

- 12VDC 1A power supply
- RS485/USB converter
- PC for configuring the monitor.
- Multi-strand twisted pair cables for connections

Replacements

Replacement batteries, sensor heads and other accessories can be purchased separately.

Note:

All sensors deteriorate over time. It will be necessary to replace your sensor head with either a new or refurbished head. This must be done on a scheduled basis or when the %sensor aging+or sensor failure+diagnostic appears. Bump tests, zero and span calibration can be performed under specified conditions with appropriate tools.

2. Configuration

The Series 900/905 alarm and 4-20 mA output scale settings can be modified using a computer and the S900 Configuration Program supplied or using a R900 purpose made hand held communication tool.

To configure the S900/S905 by computer you will need an RS232/RS485 or USB/RS485 converter. There are many RS232/RS485 converters on the market. Only certain brands will function well with Aeroqual's products. Aeroqual can supply a converter (R51) suitable for configuring a single monitor (it is not suitable for a S900 network). Converters which have been tested by Aeroqual can be purchased from Aeroqual or its distributors. Contact Aeroqual for more information.

2.1 Using a USB to RS485 converter

Computer requirements

CD-ROM Drive

RS232 port

Windows 95 or later.

45 Mb hard drive space spare

Additional components required:

- 12V power supply

- RS232/RS485 or

USB/RS485 converter

- RS485 wired S900/S905

Recommended supplier: Moxa(www.moxa.com)

Note: Aeroqual S900 series monitors communicate via a 2 wire RS485. The converter must be configured to RS485 2W using software supplied with the converter.

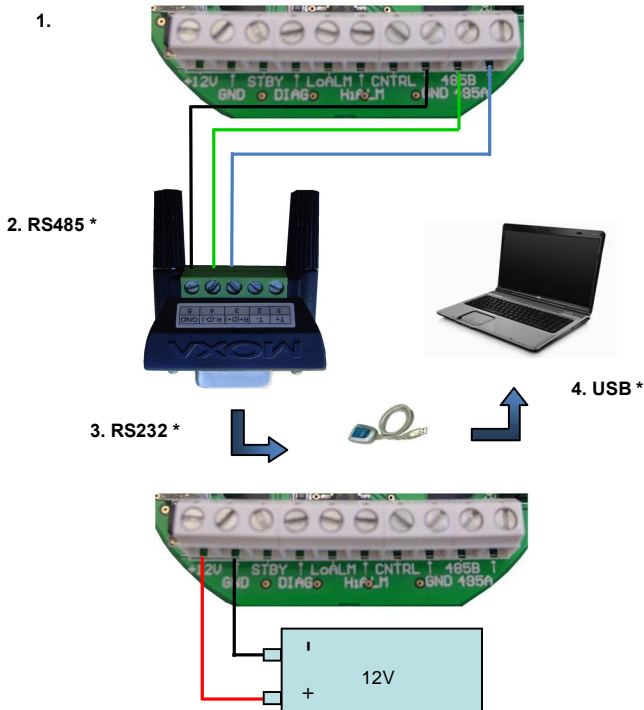
Installation instructions for version 1.5.0.0 of the Moxa UPort1150 driver:

Configure a Moxa UPort 1150 for RS485-2 wire mode as follows:

1. Install software from the CD provided with Moxa UPort 1150
2. Attach Moxa UPort 1150 USB device to USB port
3. Once the drivers have been installed for the device, open up the device manager (found under control panel/system/device manager (Windows Vista), OR Control panel/system/hardware/device manager (Windows XP)
4. Right-click on the UPort 1150 item and select properties
5. Expand the %Multi-port serial adapters+item
6. Click on the "Ports Configuration" tab
7. Select the appropriate COM port
8. Click on the button labeled %Port Setting+
9. Under heading %Interface+, select the %RS-485 2W+entry from the drop down list
10. Click OK in this window and in the original window opened from the Device Manager in step 5

2.2 Procedure for S900/S905 configuration:

- 1) Plug in and install the USB or RS232 to RS485 converter into your computer.
- 2) Connect the Series 900/905 RS485 port leads to the converter
- 3) Install the Aeroqual Series 900/905 Configuration Program on the computer if not already installed.
- 4) Power up the Series 900/905 unit.
- 5) Run the Aeroqual Series 900/905 Configuration Program.
- 6) Select Unit by entering the ID of the S900/905 you wish to modify (and click on "Download" to download the unit's current values).
- 7) Modify settings
- 8) Click Upload to upload the settings to the S900/905 unit.
- 9) Click Exit
- 10) Power down the S900/905 and install.



Port ID

Click on %Port+ menu and select %Change port ID+ to change ID to your requirement in the range 1 to 255. Caution: if you are setting up a network please ensure each unit has a unique ID otherwise there will be conflicts and data loss.

Alarms

High alarm and low alarm setpoints can be set by clicking on the appropriate window and entering the required activation setpoint. Please note: High alarm setpoint must be greater than low alarm setpoint. The low Alarm trigger determines whether low alarm is activated by being above or below the setpoint

S900 Configuration 1.4

System Port

Configure Settings

Port ID:

High alarm (ppm):

Low alarm (ppm):

Low alarm trigger:

- Above setpoint
- Below setpoint

Alarms:

- Enable
- Disable

Control high (ppm):

Control low (ppm):

4-20 mA output scale

- Sensor default 0 to ppm
- User defined 0 to ppm

Download Upload

Exit

Click mouse on the button to select. The Alarms can be enabled or disabled by clicking on the button alongside Enable or Disable, respectively.

Control

The control output is triggered according to the band set by the Control high and Control low values. Control high must be greater than Control low. The action of this output is designed to enable control of an ozone generator. The Control output will be "on" when the concentration is rising in the range from below Control low until it hits Control high when it turns off. It remains off until the concentration falls below Control low.

4-20 mA output scale

This sets the gas concentration scale that corresponds to 4 -20 mA. Each sensor head type has a default setting but the user can modify this by clicking the user define button and entering the required value that corresponds to 20 mA.

(NOTE: The LED display is calibrated for the default settings only and will not operate correctly if the default range is altered . if you are in any way uncertain of this, please seek technical assistance from Aeroqual.)

Upload

Clicking this button uploads the settings to the S900/905.

Download

Clicking this button downloads the settings from the S900 or S905. Use this function to check the settings are correct.

3. Operation

3.1 Description of Outputs

DIAG

This output is designed to enable detection of sensor faults. This is normally floating but is set to GND when the sensor fails. Thus it can be considered a "switch" which is closed when the sensor fails. This can be used to activate an alarm or relay and can also be monitored with a PLC. The output is an open collector current sink. The maximum rating of the transistor output is 24VDC at 150mA.

LoALM

This is set to GND when low alarm is activated. It is floating at other times. Use the Configuration Program to set the Lo alarm set point. The output can be used to drive an alarm relay or similar. The alarm can be set to trigger above or below the set point using the configuration software. The output is an open collector current sink. The maximum rating of the transistor output is 24VDC at 150mA. Should you connect a relay coil or any other inductive load to the transistor outputs, a back EMF suppression diode must be fitted across the load.

HiALM

This is set to GND when high alarm is activated. It is floating at other times. Use the Configuration Program to set the Hi alarm set point. The output can be used to drive an alarm relay or similar. The output is an open collector current sink. The maximum rating of the transistor output is 24VDC at 150mA. Should you connect a relay coil or any other inductive load to the transistor outputs, a back EMF suppression diode must be fitted across the load.

CNTRL

This is set to GND when the gas concentration is rising in the range from below Control low set point to the Control high set point at which stage, it is set to floating. It remains floating until the concentration falls below the Control low set point at which point, it is reset to ground. Use the Configuration Program to set the Control set points. This output can be used to control, for example, a gas generator or vent in a process operation. The output is an open collector current sink. The maximum rating of the transistor output is 24VDC at 150mA. Should you connect a relay coil or any other inductive load to the transistor outputs, a back EMF suppression diode must be fitted across the load.

STBY

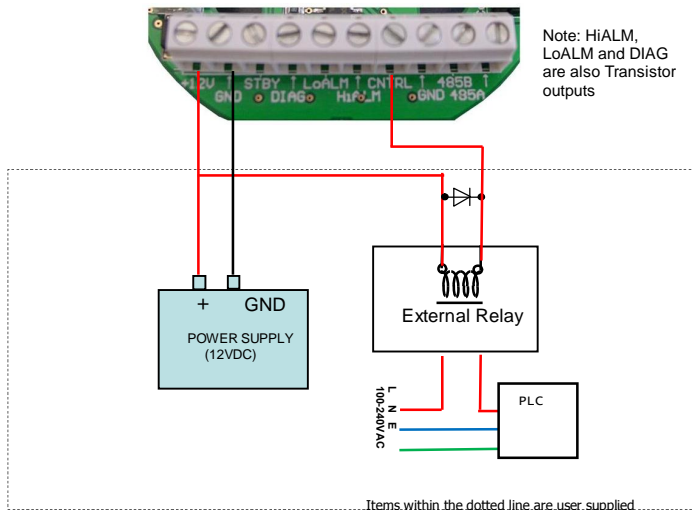
STBY is a hardware toggle switch. If it is briefly pulsed (about 50ms) to GND it puts the sensor head into Standby mode and the S900 into Sleep mode. If pulsed again to GND it will return to normal operation. This can be used to protect the sensor during process room cleaning and/or to reduce power and extend sensor life when the sensor is not needed.

3.2 Operation as a relay controller

The S900/S905 can be used as a simple relay controller using the alarm or control outputs which are open collector current sinks. They are set to ground when activated according to their setpoints. The setpoints can be configured by computer using the supplied Configuration program or using a R900 programmer (see Aeroqual for more information). It is recommended that the DIAG output is always used to alert a sensor fault condition.

Procedure

1. Connect 12V power supply
2. Connect alert relay/alarm to DIAG output screw connector if required
3. Connect relay ground toggle to STDBY pin on the screw connector if required.
4. Connect control relay to CNTL output on the screw connector if required.
5. Connect relays to LoALM and/or HiALM alarm outputs on the screw connector if required
6. Power on and test response.



3.3 Operation as a 4-20 mA transmitter

The Series 900/905 can be connected to a PLC or current sensing device via the 4-20 mA output to provide concentration information. The output is linearly proportional to concentration. The full scale (20 mA) value is factory set but can also be user configured with the Configuration software supplied. If the sensor fails the output will be 20 mA. It is also recommended that the DIAG (diagnostic) output be used to monitor for fault conditions.

The 4-20 mA output loop is opto-isolated from the Series 900/905 unit and it is recommended that it be powered by a separate power supply with a voltage in the range 12-24 V applied with the correct polarity as labeled. This will produce the most reliable connection method. If opto-isolation is not important then the 4-20 mA loop may be powered by the same power supply as the unit.

LED display models are designed to operate in conjunction with the 4-20mA circuit and the loop needs to be powered correctly for the display to function correctly.

Procedure

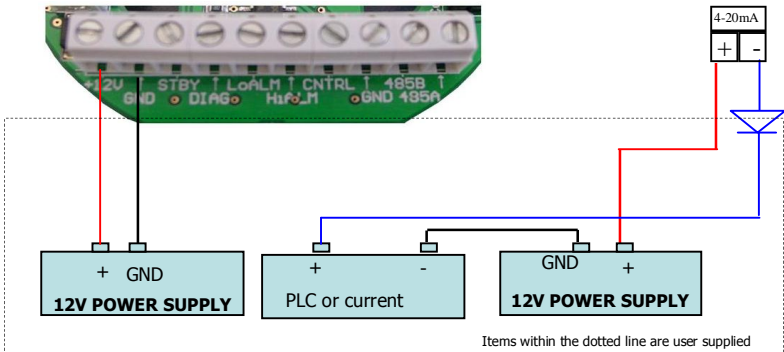
1. Connect the 4-20 mA loop on the screw connector to the power supply and current measuring device (eg PLC) ensuring the polarity is correct. Please refer to the diagrams below.

Caution: if the polarity is incorrect the 4-20 mA output may be permanently damaged

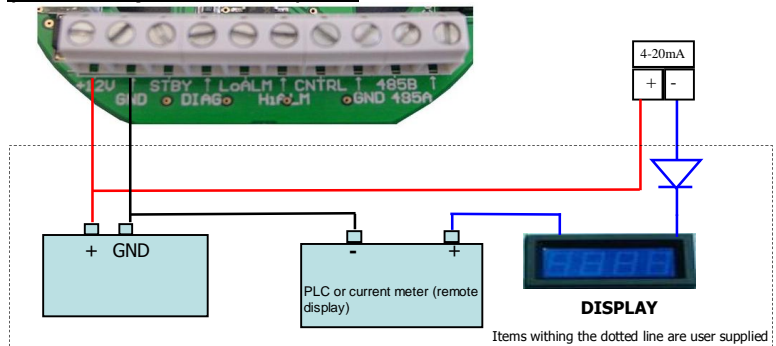
2. Power on the S900/905 and PLC
3. Check the PLC or current sensing device to ensure data is present.

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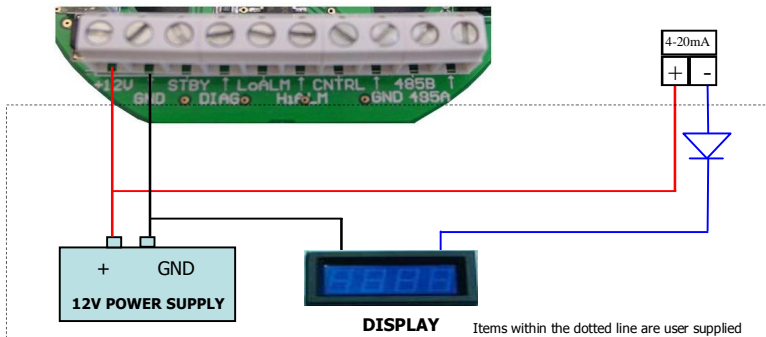
4-20 mA wiring diagram for Loop (with opto-isolation) 12V



4-20 mA wiring diagram for Loop and external Display (without opto-isolation) 12V



Operating external LED Display if 4-20 mA loop is not being used 12V



3.4 Operation as a RS485 Transmitter

The Series 900/905 unit can communicate over a RS485 bus. Each monitor has an ID which can be user set via the Configuration software and up to 255 units networked together. Aeroqual supplies a Configuration program to configure the S900/S905 over the RS485. Aeroqual can also supply Networking software to set up a RS485 network of S900/S905 units linked to a computer.

Connecting via RS485

1. Connect a 12 vDC power supply to the power input on the PCB screw connector. (12V DC option available)
2. Use twisted pair cable to connect the RS485 lines on the screw connector to the RS485 hub, bus or converter .
3. Power up the monitor and run the communication software on your computer or PLC

Network Settings

If the S900/S905 is to be used as part of aaisy chained+RS485 network, a number of settings need to be adjusted.

1. Jumper settings

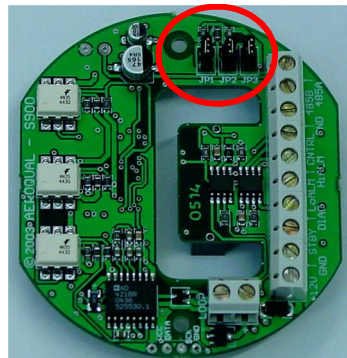
The termination resistors need to be set correctly to ensure the network communication is stable. The jumpers JP1, JP2, JP3 are to install termination resistors on the RS485 communication lines. Remove the jumpers J1, J2, J3 for all S900/905 units in a chain except the last S900/905 unit in the network chain. If there is only one unit then set the jumpers in place.

2. Accessing Jumpers

To access these jumpers remove the sensor head and then remove the mounting screws. Then lift out the mounting plate and PCB assembly.

3. ID Settings

Monitors on the network require unique IDs so they can be distinguished on the RS485 network. The ID of the unit is factory set as 1 and therefore it will need to be changed. Use the Configuration program to change the IDs (see the section on Configuring the monitor).



4. S900/S905 Specification

Power	12VDC, 800mA regulated
Outputs	4-20 mA (opto-isolated) internal or external loop power 12 to 24V High alarm Low alarm Control Diagnostics
Inputs	Standby toggle
Communication	RS485
Jumpers	J1, J2, J3 termination resistors
Ingress Protection	IP20 equivalent
Connectors	Screw
ID	1 (Default) User configurable from 1 to 255
2 x Alarm setpoints	User configurable
Control setpoint	User configurable
RS485 protocol	Aeroqual proprietary protocol
Casing	Polycarbonate . ABS Blended Material
Mounting	Screw fixture
Operating temperature	-5 °C to 50 °C
Operating relative humidity	0 to 95% non-condensating
<u>S905 only</u>	
Temperature sensor	Range -40 to 120 °C, Accuracy ± 0.5 °C
Relative Humidity sensor	Range 0 to 100%, Accuracy $\pm 2\%$

5. Gas Measurement Guidelines

The following information is presented to help users operate their **Aeroqual S900/905 Transmitter/Controller** in the most effective and efficient manner.

5.1 Installation Guide

The **S900/905** should be installed at a location that is free from contaminants that might affect the performance of the sensor head. Please contact technical@aeroqual.com for assistance with specific chemicals that you believe may adversely affect the supplied sensor. In general the S900/905 should **never** be exposed to:

- steam, fumes, water or chemical spray
- aggressive solvents
- high condensing humidity
- cooking vapors/aromas
- paint fumes
- high levels of dust

5.2. Permanent Controller Placement

The **S900/905** has been designed to measure the ambient gas concentration.

For indoor local area monitoring attach the controller to an inert surface. For leak detection mount the unit as close as possible to potential gas leaks.

Ensure that the controller is protected from excessive water splashing, dust, vibration, excessive heat or cold, excessive swings in humidity and gas concentrations outside the range of the specific sensor head.

5.3 Technical Support:

If you require technical support in the setup or operation of you Series 900, please contact Aeroqual:

Aeroqual Limited

109 Valley Road, Mt Eden, Auckland 1024, New Zealand

Phone: +64 9 623 3013

Fax: +64 9 623 3012

Email: technical@aeroqual.com

6. Troubleshooting

Fault Description	Possible cause	Remedy
No power	Lead connection broken Power supply failure S900/905 damaged	Reconnect power lead Replace 12V power supply Replace unit
RS485 communications unstable	RS485/RS232 adaptor faulty Connections broken ID incorrect Noise on cable Sensor head not fitted correctly	Reconfigure/replace adaptor Reconnect leads Check ID use shielded twisted pair cable Insert head correctly
4-20 mA output failure	30V input exceeded	Replace S900/905
Network unstable	ID conflict Noise on leads Jumpers set incorrectly S900/905 units too close together	Modify IDs so that no S900/905 units share the same ID use shielded twisted pair cable Set jumpers correctly The leads between S900/905 units should be a minimum of 30 cm in length.
Display shows -1	over-range (>20 mA) reverse loop current	Loop polarity is incorrect. Reverse this. Incorrect loop polarity can cause irreversible damage to the S900/S900. Reduce loop current.
Display shows 1	over-range loop current (>20 mA)	Reduce loop current
Display shows -.125	4-20 mA Loop not powered	Power loop. The display requires the loop to be powered to read correctly

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Display oscillates between min and max	Sensor head not fitted correctly	Insert sensor head correctly
Sensor failure when new sensor	Insufficient warm-up Air contaminated Sensor damaged	Run the sensor for 24-48 hours Move the sensor to cleaner environment and check reading Replace sensor
Sensor showing high baseline reading under zero gas conditions	Background gas level higher than normal Interferent gas present Sensor zero drift Sensor damaged Flow incorrect	Move sensor to clean air and recheck baseline Move sensor to clean air and recheck baseline Re zero sensor in a clean, stable background Replace sensor Measure sample flow and compare with specification. If incorrect check for leaks a
Sensor showing higher than expected reading in the presence of sensor gas	Zero calibration incorrect Span calibration incorrect Sensor correct Interferent gas present Sensor calibration lost Flow incorrect	Zero calibrate sensor Span calibrate sensor Check calibration of gas generator. Move sensor to clean air and check reading upon exposure to known gas concentration Replace /refurbish sensor Measure sample flow and compare with specification. If incorrect check for leaks

<p>Sensor showing lower than expected reading in the presence of sensor gas</p>	<p>Zero calibration incorrect</p> <p>Span calibration incorrect</p> <p>Sensor correct</p> <p>Sensor inlet contaminated</p> <p>Interferent gas present</p> <p>Gas reactive and decomposing before detection</p> <p>Sensor calibration lost</p>	<p>Zero calibrate sensor</p> <p>Span calibrate sensor</p> <p>Check calibration of gas generator.</p> <p>Clean sensor inlet filter and mesh</p> <p>Move sensor to clean air and check reading upon exposure to known gas concentration</p> <p>Move the monitor closer to the source of the gas</p> <p>Replace /refurbish sensor</p>
<p>Sensor output noisy</p>	<p>S900/905 power supply unregulated</p> <p>Local air flow too high</p> <p>Environmental conditions fluctuating</p>	<p>Install regulated power supply</p> <p>Reduce air flow</p> <p>Reduce fluctuations</p>

7. Diagnostics

The S900/905 has inbuilt diagnostics to detect sensor faults. If the sensor fails it can be easily replaced by simply removing and installing a new one (see sensor manual for details). The failed sensor can be sent back to Aeroqual for refurbishment or disposal.

Table of fault condition diagnostics

Fault description	DIAG output	4-20 mA output	RS485 output
No fault	floating	valid gas reading	valid gas reading Status1 = 0x00
Sensor failed fault	GND	20 mA	last valid gas reading Status1=0x01
Sensor aging fault	GND	20 mA	last valid gas reading Status1=0x02
Sensor not fitted correctly	GND	Oscillates between 4 and 20 mA	no reply

8. Appendix

8.1 Copyright

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8.2 Compliance

1. The Aeroqual Series 900/905 Transmitter/Controller complies with EN 50082-1: 1997
2. The Aeroqual Series 900/905 Transmitter/Controller complies with EN 50081-1: 1992
3. The Aeroqual Series 900/905 Transmitter/Controller complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
 - (i) these devices may not cause harmful interference, and
 - (ii) these devices must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules



8.3 Warranty

Aeroqual warrants this product to be free from defects in material and workmanship at the time of its original purchase by a consumer, and for a subsequent period as stated in the following table:

Products	Warranty Period
Series 900/905 Transmitter/ Controller	One year from the date of purchase
Sensor heads – all gases	Six months from the date of purchase
Other Accessories	One year from the date of purchase

This warranty is expressly limited to the original owner who purchases the equipment directly from Aeroqual or from an authorized Aeroqual dealer.

What we will do

If, during the warranty period, this product fails to operate under normal use and service, due to improper materials or workmanship, Aeroqual subsidiaries, authorized distributors or authorized service partners will, at their option, either repair or replace the product in accordance with the terms and conditions stipulated herein.

8.4 Conditions

The warranty is valid only if the original receipt issued to the original purchaser by the dealer, specifying the date of purchase, is presented with the product to be repaired or replaced. Aeroqual reserves the right to refuse warranty service if this information has been removed or changed after the original purchase of the product from the dealer.

If Aeroqual repairs or replaces the product, the repaired or replaced product shall be warranted for the remaining time of the original warranty period or for ninety (90) days from the date of repair, whichever is longer. Repair or replacement may be via functionally equivalent reconditioned units. Replaced faulty parts or components will become the property of Aeroqual.

This warranty does not cover any failure of the product due to normal wear and tear, damage, misuse, including but not limited to use in any other than the normal and customary manner, in accordance with Aeroqual's user guide for use, faulty installation, calibration and maintenance of the product, accident, modification or adjustment, events beyond human control, improper ventilation and damage resulting from liquid or corrosion.

This warranty does not cover product failures due to repairs, modifications or improper service performed by a non-Aeroqual authorized service workshop or opening of the product by non-Aeroqual authorized persons.

The warranty does not cover product failures which have been caused by use of non-Aeroqual original accessories.

Tampering with any part of the product will void the warranty.

Damage to the sensors can occur through exposure to certain sensor poisons such as silicones, tetraethyl lead, paints and adhesives. Use of Aeroqual sensors in these environments containing these materials may (at the discretion of Aeroqual) void the warranty on the sensor head. Exposure to gas concentrations outside of the design range of a specific Aeroqual sensor head can adversely affect the calibration of that sensor head and will also void this warranty as it applies to the replacement of sensor heads.

Aeroqual makes no other express warranties, whether written or oral, other than contained within this printed limited warranty. To the fullest extent allowable by law all warranties implied by law, including without limitation the implied warranties of merchantability and fitness for a particular purpose, are expressly excluded, and in no event shall Aeroqual be liable for incidental or consequential damages of any nature whatsoever, however they arise, from the purchase or use of the product, and including but not limited to lost profits or business loss.

Some countries restrict or do not allow the exclusion or limitation of incidental or consequential damage, or limitation of the duration of implied warranties, so the preceding limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights, which may vary from country to country.

8.5 Series 900 & 905 RS485 Communication Protocol

Protocol Version 1.5 Date: 01-02-2005

The network communication is in master-slave mode, which means that a PC or other device will be the network master. All information is requested by the network master. Otherwise no information is sent out by the S900/S905 network units.

Section 1. General description of the communication commands (for command details and data representations please refer section 4):

01. Information request command to S900/S905. The basic format is a 5 bytes data stream:

BASE, COMMAND, NETWORK_ID, OTHERS, CHECKSUM

- * BASE - information request data stream header
- * COMMAND - 1 byte network unit action command
- * NETWORK_ID - 1 byte S900/S905 network ID.
- * OTHERS - may be used to extend functions later, it can be left as empty for now
- * CHECKSUM - makes the data stream total sum byte value to zero.

02. S900/S905 unit basic reply command format will be a 15 bytes stream (see Section 2 for details):

SENSOR, COMMAND, NETWORK_ID, DATA1(4 bytes), DATA2(4 bytes), RESERVED, STATUS1, STATUS2, CHECKSUM

Section 2. S900/S905 Network ID specified commands. These commands generate a response by a specified S900/S905 unit. Every command needs a corresponding reply.

01. Gas Data request command. The command asks for the gas data that a specific S900/S905 unit currently holds. The S900/S905 unit responds with a gas value. The gas data validity depends on the DATA_UNVALID bit of STATUS1 flag (please see Section 4 for details).

Command: BASE, GAS_CONC_DATA, NETWORK_ID, EMPTY, CHECKSUM

Reply: SENSOR, GAS_CONC_DATA, NETWORK_ID, DATA1, TEMP, RH, RESERVED, STATUS1, STATUS2, CHECKSUM

- * DATA1 - 4 bytes IEEE754 floating point data, measured gas value, if DATA_UNVALID bit of STATUS1 flag is 1 then it will be last byte measured value, otherwise it's new measured value.
- * TEMP - 2 bytes int value, its actual value equals the int value divided by 10 (TEMP/10) for its real temperature value of S905 unit
- * RH - 2 bytes int value, its actual value equals the int value divided by 10 (RH/10) for its real relative humidity value of S905 unit
- * for S900 the field TEMP and RH will be always zero for firmware version 1.5 and later.
- * However, for S905 firmware version 1.4 and earlier can't use this command to

02. Standby command. The S900/S905 unit will set its sensor head to standby state. The S900/S905 will set STANDBY bit of STATUS2 to 1 indicating it is in standby mode. When the standby state has been terminated, it will reset STANDBY bit of STATUS2 to 0.

Command: BASE, STANDBY, NETWORK_ID, EMPTY, CHECKSUM
Reply: SENSOR, STANDBY, NETWORK_ID, DATA1, DATA2, RESERVED, STATUS1, STATUS2, CHECKSUM

* DATA1 and DATA2 - no meanings.

The reply just confirms that it performed action, to find it check status bit.

03. Specific S900/S905 reset command. The command will reset the S900/S905 at any time.

Command: BASE, RESET, NETWORK_ID, EMPTY, CHECKSUM
Reply: SENSOR, RESET, NETWORK_ID, DATA1, DATA2, RESERVED, STATUS1, STATUS2, CHECKSUM

* DATA1 and DATA2 - no meanings.

* RESET - 1 byte reset command, see section 4 for details.

04. Specific S900/S905 unit connected sensor head version number request command and reply. PC or other devices can request sensor head version information through S900/S905 unit.

Command: BASE, SENSOR_VERSION, NETWORK_ID, EMPTY, CHECKSUM
Reply: SENSOR, SENSOR_VERSION, NETWORK_ID, VERSION_NUM, DISPLAY_TYPE, NAME_LENGTH, SENSOR_NAME, RESERVED, CHECKSUM

* VERSION_NUM - 1 byte, the version number of sensor head plugged in the S900/S905 unit. Real version number is the value divided by 10.

* DISPLAY_TYPE - 1 byte, the decimal value display type, different gas sensor head are different, see sensor head specifications for details

* NAME_LENGTH - 1 byte, the sensor head name length.

* SENSOR_NAME - 7 bytes max, valid length depends on NAME_LENGTH value, the sensor head name ASCII code that connected to S900/S905 unit,

05. Modify S900/S905 unit network ID command, that can change current S900/S905 unit network ID.

Command: BASE, CHANGE_NETWORK_ID, OLD_ID, NEW_ID, CHECKSUM
Reply: SENSOR, CHANGE_NETWORK_ID, NEW_ID, DATA1, DATA2, RESERVED, STATUS1, STATUS2, CHECKSUM

* CHANGE_NETWORK_ID - 1 byte command, see section 4 for details.

* OLD_ID - the S900/S905 unit old network ID, 1 byte

* NEW_ID - the S900/S905 unit new network ID, 1 byte

06. Specific S900/S905 connected sensor gas unit ppm to mg/m3 convert factor and analogue current max output scale factor value request command.

Command: BASE, FACTOR_REQUEST, NETWORK_ID, EMPTY, CHECKSUM

Reply: SENSOR, FACTOR_REQUEST, NETWORK_ID, DATA1, DATA2, RESERVED, STATUS1, STATUS2, CHECKSUM

* DATA1 - 4 bytes, gas unit ppm to mg/m3 convert factor floating point value
* DATA2 - 4 bytes, default S900/S905 4-20mA current output max scale factor floating point value. See sensor head spec for details.

07. Specified S900/S905 unit configure settings upload command, which set the S900/S905 unit alarm 1, alarm 2, defined output scale and alarm enable settings. Total 25 bytes data stream.

Command: BASE, PARAMETERS_UPLOAD, NETWORK_ID, EMPTY, CHECKSUM

Parameters: BASE, PARAMETERS_UPLOAD, NETWORK_ID, ALARM1, ALARM2, DEFINED_SCALE, CONTROL_HIGH, CONTROL_LOW, ALARM_STATUS, CHECKSUM

Reply: SENSOR, PARAMETERS_UPLOAD, DATA1, DATA2, RESERVED, STATUS1, STATUS2, CHECKSUM

*ALARM1 - 4 bytes alarm level 1 set point value, see section 4 for its data representation

*ALARM2 - 4 bytes alarm level 2 set point value, see section 4 for its data representation

*DEFINED_SCALE - 4 bytes user defined max output scale value.

*CONTROL_HIGH - 4 bytes control high set point value see section 4 for its data representation

*CONTROL_LOW - 4 bytes control low set point value see section 4 for its data representation

*ALARM_STATUS - 1 byte alarm state settings, see section 4 for details

*Reply just used for confirm uploading successfully

08. Specific S900/S905 unit configure settings download command, total 25 bytes stream.

Command: BASE, PARAMETERS_DOWNLOAD, NETWORK_ID, EMPTY, CHECKSUM

Reply: SENSOR, PARAMETERS_DOWNLOAD, NETWORK_ID, ALARM1, ALARM2, DEFINED_SCALE, CONTROL_HIGH, CONTROL_LOW, ALARM_STATUS, CHECKSUM

*ALARM1 - 4 bytes alarm 1 set point value, see section 4 for its data representation

*ALARM2 - 4 bytes alarm 2 set point value, see section 4 for its data representation

*DEFINED_SCALE - 4 bytes user defined max output current output value

*CONTROL_HIGH - 4 bytes control high set point value see section 4 for its data representation

*CONTROL_LOW - 4 bytes control low set point value see section 4 for its data representation

* ALARM_STATUS - 1 byte alarm state settings, see section 4 for details

09. Specific S900/S905 base unit version number request command and reply. PC or other devices can request the base unit version information.

Command: BASE, BASE_VERSION, NETWORK_ID, EMPTY, CHECKSUM

Reply: SENSOR, BASE_VERSION, NETWORK_ID, VERSION_NUM, SENSOR_COUNT, RESERVED, RESERVED, RESERVED, RESERVED, RESERVED, RESERVED, RESERVED, RESERVED, RESERVED, CHECKSUM

* VERSION_NUM - 1 byte, the version number of the S900/S905 unit

* SENSOR_COUNT - 1 byte, actually used to specify its S900 or S905, if it's 0x01, that is S900 no temperature and humidity sensor connected, if it's 0x03, that is S905 there is a temperature and humidity sensor connected.

10. Temperature and relative humidity data request command (S905 only). The command asks for the temperature and humidity data that a specific S905 unit currently holds. The S905 unit responds with two values respectively.

Command: BASE, TEMP_RH_DATA, NETWORK_ID, EMPTY, CHECKSUM

Reply: SENSOR, TEMP_RH_DATA, NETWORK_ID, TEMP, RH, RESERVED, STATUS1, STATUS2, CHECKSUM

* TEMP - 4 bytes IEEE754 floating point data, measured temperature value of S905 unit,

* RH - 4 bytes IEEE754 floating point data, measured relative humidity value of S905 unit

* for S900 the command will be no reply at all.

Section 3. Broadcast commands are a set of special commands of the network system. Every unit that receives the commands on the network performs the action. They are not ID specific, BROADCAST command indicator can be considered as NETWORK_ID. These commands send out by network master and that don't need reply at all.

* BROADCAST is a 1 byte special S900/S905 ID that is zero *

01. Broadcast S900/S905 standing by command, this command will set all sensor head that connected to the network go to stand by state. The command generates no reply. To check whether a 900/905 unit has performed the command, the network master should check STATUS2's STAND_BY bit.

BASE, STANDBY, BROADCAST, EMPTY, CHECKSUM

BROADCAST - 1 byte broad cast indicator, see section 4 for its value

02. Broadcast S900/S905 reset command; it will reset whole network sensor heads connected to. The command generates no reply. To check whether a 900/905 unit has performed the command, the network master should check STATUS2's STAND_BY bit.

BASE, RESET, BROADCAST, EMPTY, CHECKSUM

* BROADCAST - 1 byte broadcast indicator, see section 4 for its value

Section 4. Protocol commands value and descriptions:

BASE = 0x55 command header used for network master to S900/S905
 SENSOR = 0xAA reply header used for S900/S905 to network master
 STANDBY = 0xFD command used to set sensor head standing by mode
 RESET= 0x07 command to reset sensor head to normal working state
 GAS_CONC_DATA = 0x10 command to request/report measured gas concentration value
 TEMP_RH_DATA = 0x20 command to request temperature and humidity values
 BASE_VERSION = 0xF9 command to request/report S900/S905 base unit version number
 SENSOR_VERSION = 0xFB command to request/report sensor head version number
 FACTOR_REQUEST = 0x2A command to request/report sensor head concentration ppm to mg/m3 conversion factor and max current output scale factor
 BROADCAST= 0x00 broadcast command indicator, like a special S900/S905 ID reserved for information broadcast
 PARAMETERS_UPLOAD = 0x19 command to upload configure settings to S900/S905
 PARAMETERS_DOWNLOAD = 0x18 command to download configure settings from S900/S905
 EMPTY= 0x00 no meanings at all, reserved space
 RESERVED can be any value, no meanings at all
 CHECKSUM data stream check sum used to verify the command data stream information lost or noise. It makes the data stream total byte sum to zero.
 NETWORK_ID range: 0x00 -- 0xFF,
 0x00 is reserved for broadcast command.
 0x01 will be the default ID when S900/S905 been programmed.
 STATUS1 (1 Byte) SensorStatus0 b0 \ b1=0, b0=0, sensor is normal,
 SensorStatus1 b1 / b1=0, b0=1, sensor failure no gas reporting
 b1=1, b0=0, means sensor aging, (for low Ozone sensor only)
 FAN_STATUS b2 reserved
 UNIT_UNSTABLE_FLAG b3 = 1 sensor head is at setting up stage not stable yet
 RESERVED b4 reserved
 RESERVED b5 reserved

SensorResetFlag	b6 = 1	sensor head is doing reset
DATA_UNVALID	b7 = 1	the data is not valid data, maybe last reported reading
STATUS2 (1 byte)		not used now, reserved for further developing
RESERVED	b0	reserved
RESERVED	b1	reserved
RESERVED	b2	reserved
RESERVED	b3	reserved
STANDBY	b4 = 1	sensor head in stand by mode
sensor head in normal working mode	b4 = 0	
RESERVED	b5	reserved
RESERVED	b6	reserved
RESERVED	b7	reserved
ALARM_STATUS (1 byte)		used for alarm status setting
Alarm_Enable	b0 = 0	S900/S905 alarm enabled, b0 = 1, S900/S905 alarm disabled
Alarm2_Triger	b1 = 0	S900/S905 alarm 2 triggered when reading exceed alarm 2
alarm 2	b1 = 1	S900/S905 alarm 2 rigged when reading below alarm 2
Define_Ouput_Scale	b2 = 0	use sensor head default current output value
value	b2 = 1	user defined current output value
RESERVED	b3	reserved
RESERVED	b4	reserved
RESERVED	b5	reserved
RESERVED	b6	reserved
RESERVED	b7	reserved

The following data values use IEEE754 32 bits floating point little endian representation.

These data are: DATA1, DATA2, ALARM1, ALARM2, DEFINED_SCALE, CONTROL_HIGH, CONTROL_LOW etc.

Section 5. Data transfer mechanism

Floating point data (4 bytes) send sequence is low byte first, high byte last, such as section 4's data DATA1, ALARM1, ALARM2 etc.

2. Broadcast command - when network master broadcasts a command to RS485 bus, every unit connected to the bus has to perform the action immediately without reply. Whether the command has been performed or not can be tested using a specific sensor command to poll an individual unit. If some sensor heads do not perform the action the network master needs to rebroadcast the command again.

3. Specific unit sensor measured gas concentration request. Once a sensor head measures a new concentration it will set STATUS1 b7 to zero indicating the value is valid. However, when the new data has been sent out the STATUS1 b7 DATA_UNVALID bit will set to 1 indicating the data not valid.

DATA_UNVALID	b7 = 1	the data is not valid data, maybe last reported reading
STATUS2 (1 byte)		not used now, reserved for further developing
RESERVED	b0	reserved

4. Timing issue (VERY IMPOTANT): The master request command frequency can't be less than 1 second per command, otherwise, the network will be unstable.

Section 6. RS485 communication port settings:

Baud rate: 4800
Data bits: 8
Stop bits: 1
Parity: none
Flow control: none

* OLD_ID - the S940/S945 unit old network ID, 1 byte

* NEW_ID - the S940/S945 unit new network ID, 1 byte

06. Specific S940/S945 connected sensor gas unit ppm to mg/m3 convert factor and analogue current max output scale factor value request command.

Command: BASE, FACTOR_REQUEST, NETWORK_ID, EMPTY, CHECKSUM

Reply: SENSOR, FACTOR_REQUEST, NETWORK_ID, DATA1, DATA2, RESERVED, STATUS1, STATUS2, CHECKSUM

* DATA1 - 4 bytes, gas unit ppm to mg/m3 convert factor floating point value

* DATA2 - 4 bytes, default S940/S945 4-20mA current output max scale factor floating point value. See sensor head spec for details.

07. Specified S940/S945 unit configure settings upload command, which set the S940/S945 unit alarm 1, alarm 2, defined output scale and alarm enable settings. Total 25 bytes data stream.

Command: BASE, PARAMETERS_UPLOAD, NETWORK_ID, EMPTY, CHECKSUM

Parameters: BASE, PARAMETERS_UPLOAD, NETWORK_ID, ALARM1, ALARM2, DEFINED_SCALE, CONTROL_HIGH, CONTROL_LOW, ALARM_STATUS, CHECKSUM

Reply: SENSOR, PARAMETERS_UPLOAD, DATA1, DATA2, RESERVED, STATUS1, STATUS2, CHECKSUM

*ALARM1 - 4 bytes alarm level 1 set point value, see section 4 for its data representation

*ALARM2 - 4 bytes alarm level 2 set point value, see section 4 for its data representation

*DEFINED_SCALE - 4 bytes user defined max output scale value.

*CONTROL_HIGH - 4 bytes control high set point value see section 4 for its data representation

*CONTROL_LOW - 4 bytes control low set point value see section 4 for its data representation

*ALARM_STATUS - 1 byte alarm state settings, see section 4 for details

*Reply just used to confirm uploading successfully

08. Specific S940/S945 unit configure settings download command, total 25 bytes stream.

Command: BASE, PARAMETERS_DOWNLOAD, NETWORK_ID, EMPTY, CHECKSUM

Reply: SENSOR, PARAMETERS_DOWNLOAD, NETWORK_ID, ALARM1, ALARM2, DEFINED_SCALE, CONTROL_HIGH, CONTROL_LOW, ALARM_STATUS, CHECKSUM

*ALARM1 - 4 bytes alarm 1 set point value, see section 4 for its data representation

*ALARM2 - 4 bytes alarm 2 set point value, see section 4 for its data representation

*DEFINED_SCALE - 4 bytes user defined max output current output value

*CONTROL_HIGH - 4 bytes control high set point value see section 4 for its data representation

*CONTROL_LOW - 4 bytes control low set point value see section 4 for its data representation

*ALARM_STATUS - 1 byte alarm state settings, see section 4 for details

09. Specific S940/S945 base unit version number request command and reply. PC or other devices can request the base unit version information.

Command: BASE, BASE_VERSION, NETWORK_ID, EMPTY, CHECKSUM

Reply: SENSOR, BASE_VERSION, NETWORK_ID, VERSION_NUM, SENSOR_COUNT, RESERVED, RESERVED, RESERVED, RESERVED, RESERVED, RESERVED, RESERVED, RESERVED, RESERVED, CHECKSUM

* VERSION_NUM - 1 byte, the version number of the S940/S945 unit

* SENSOR_COUNT - 1 byte, actually used to specify its S940 or S945, if it's 0x01, that is S940 no temperature and humidity sensor connected, if it's 0x03, that is S945 there is a temperature and humidity sensor connected.

10. Temperature and relative humidity data request command (S945 only). The command asks for the temperature and humidity data that a specific S945 unit currently holds. The S945 unit responds with two values respectively.

Command: BASE, TEMP_RH_DATA, NETWORK_ID, EMPTY, CHECKSUM

Reply: SENSOR, TEMP_RH_DATA, NETWORK_ID, TEMP, RH, RESERVED.

STATUS1, STATUS2, CHECKSUM

* TEMP - 4 bytes IEEE754 floating point data, measured temperature value of S945 unit,

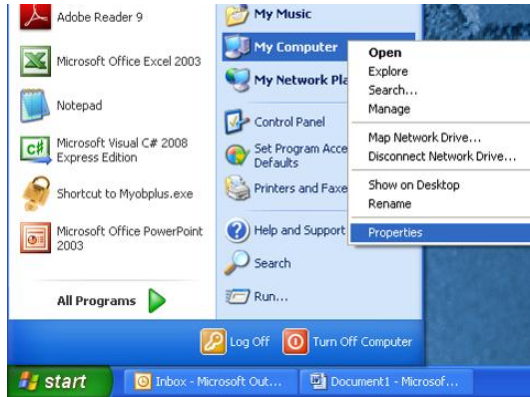
* RH - 4 bytes IEEE754 floating point data, measured relative humidity value of S945 unit

* for S940 the command will be no reply at all.

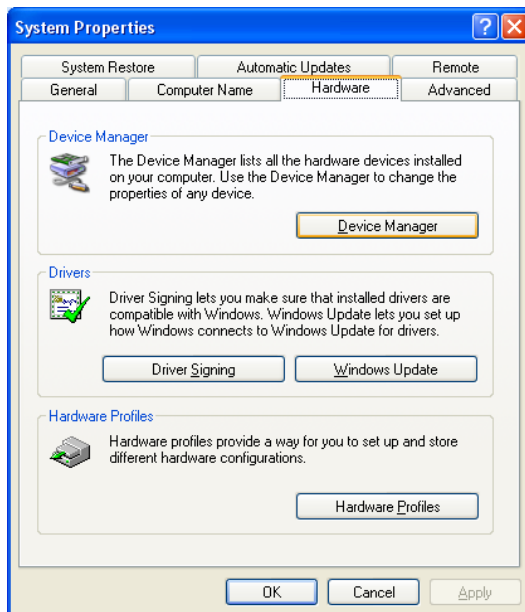
8.7 Technical Note:

R52 Serial to USB Adaptor COM Port Setup

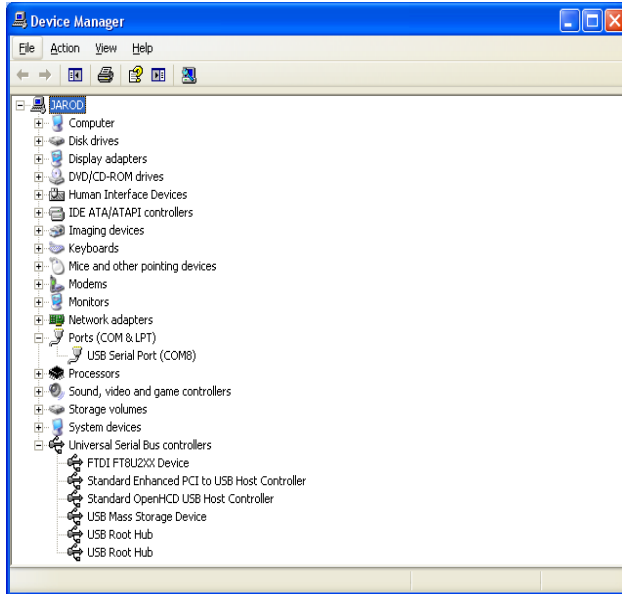
1. Right-click on My Computer.
Select Properties.



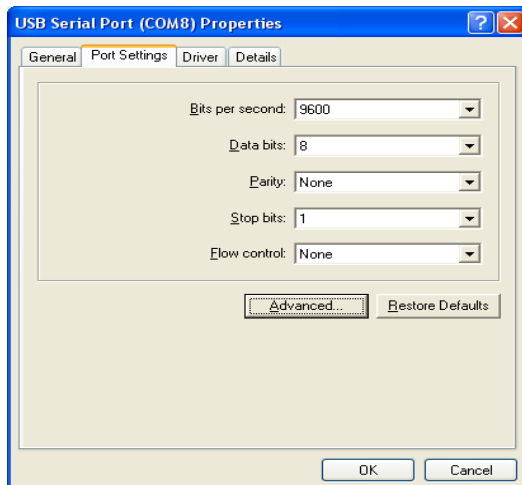
2. Select the Hardware tab,
click on Device Manager.



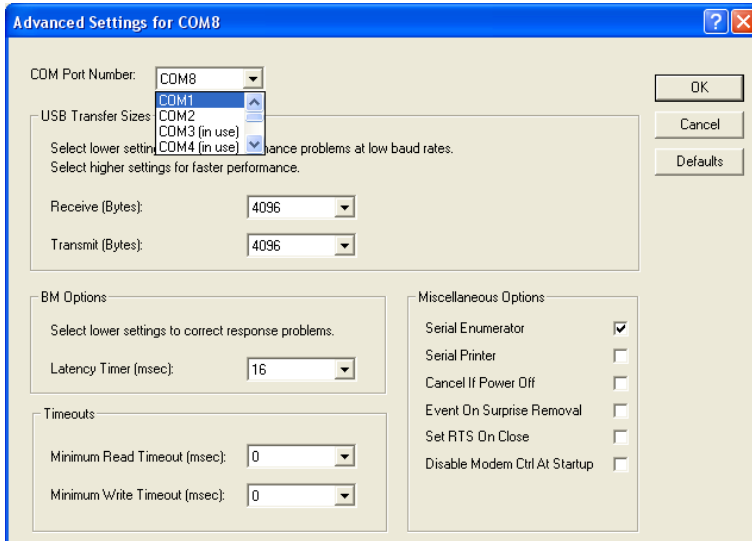
3. Plug in the USB to Serial cable and expand the *Ports (COM & LPT)* node and the *Universal Serial Bus* controllers node. You should have a *USB Serial Port* present under *Ports*, and a *FTDI FT8U2XX Device* present under *Universal Serial Bus controllers* **OR** you should have *USB Serial Port* present under *Ports*, and a *USB Serial Controller* present under *Universal Serial Bus controllers*.



4. Select the **Advanced** button under the **Port Settings** tab.

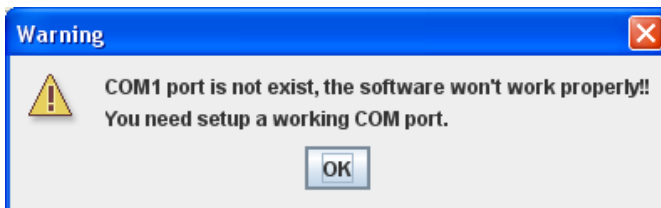


5. Select the port number to be a port you choose. For example COM1 providing COM1 is not in use. **In this example the COM port is COM8.**

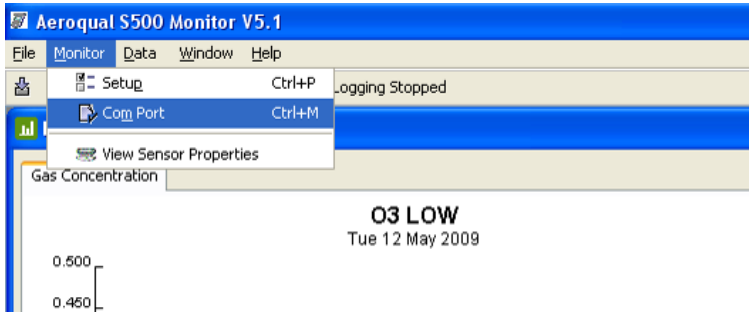


6. Start Aeroqual S900 v2.5 monitoring software.

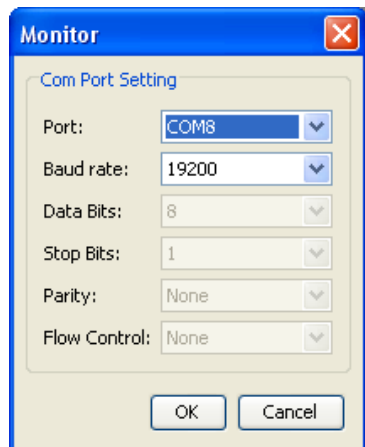
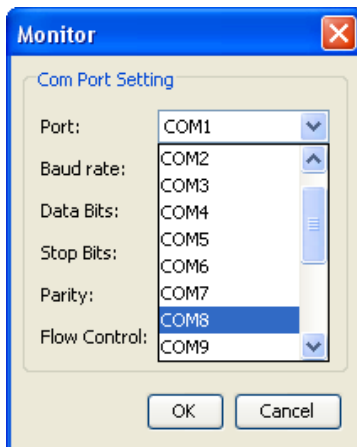
7. Click OK. Aeroqual S900 v2.5 monitoring software starts.



8. Select Monitor a Com Port.



9. Choose the COM port which you have got configured. **In this example I am using COM8.**



Your system should be configured and working correctly.