aeroQUAL

Series 940 & 945
Ozone-Transmitter/Controller

User Guide

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Series 940 - OZONE TRANSMITTER

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Contents

Foreword

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09.03.05

Aeroqual Limited
6/192 Victoria Street West, Auckland, New Zealand
phone   +64 9 307 0441
fax   +64 9 307 0443
email technical@aeroqual.com
web   www.aeroqual.com

WARNING

- *Do not* expose the monitor to very high levels of ozone
- *Do not* place the sensor head in an ozone stream – the monitor is designed to measure ambient levels of ozone and uses *'active sampling'* to achieve this.
- *Do not* switch the monitor on before reading the User Guide.

For Your Safety

Read these simple guidelines. Ignoring these guidelines may be hazardous.

- USE SENSIBLY
  Use only as per this user guide.

- USE AEROQUAL APPROVED SERVICE
  Only approved service personnel must work on this product.

- ACCESSORIES
  Use only approved accessories. Do not connect incompatible products.

- CONNECTING TO OTHER DEVICES
  When connecting to any other device, read the appropriate user guide for detailed safety instructions. Do not connect incompatible products.

- HAZARDOUS ENVIRONMENTS
  Do not use the Ozone Controller in or near volatile fuel or chemicals.

- HEALTH AND SAFETY IN THE WORKPLACE
  The Aeroqual Series of Controllers are used to monitor ozone concentrations. Aeroqual does not guarantee user safety. In hazardous environments, an appropriate Health and Safety plan should be in place.

Components Supplied

Series 940 Ozone Transmitter / Controller

The following components are supplied with the Series 940 Ozone Transmitter / Controller:

- Series 940 base unit (transmitter /controller)
- Ozone sensor head (installed)
- User guide & Configuration Software CD
- Enclosure mounting brackets
- 2 x Male cord connectors (8-pin & 5-pin)

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.

Components not supplied

You will also require the following components (not supplied):

- 24V 1A power supply
- RS485/RS232 converter
- PC with Configuration software installed
- Multi-strand shielded twisted pair cables for connections

Sensor Head Types

1. **The High Concentration Ozone Sensor Head** is designed to measure ozone concentrations from 0.00 to 20.00 ppm and is accurate to within ±10% between 0.20 ppm and 2.00 ppm and ±15% between 2.00ppm and 20.00ppm. The T90 response time (i.e. the time to reach 90% of the actual ozone concentration) of the high concentration sensor head is 40 seconds. *Exposure of this sensor head to ozone concentrations higher than 20.00 ppm may affect the calibration.*

2. **The Low Concentration Ozone Sensor Head** is designed to measure ozone concentrations from 0.000 to 0.500 ppm with an accuracy of ±0.008 ppm from 0 to 0.100 ppm and ±10% from 0.100 to 0.500 ppm and has a resolution of 0.001 ppm. The T90 response time (i.e. the time to reach 90% of the actual ozone concentration) of the low concentration sensor head is 55 seconds.

Exposure of this sensor head to ozone concentrations higher than 0.500 ppm may affect the calibration.

3. The sensor head is calibrated prior to delivery and does not normally need to be re-calibrated during its life.

About Your Transmitter / Controller

The Aeroqual **Series 940 Ozone Transmitter / Controller** is designed to measure and control ozone concentrations, and to communicate to a variety of hardware systems.

The Series 940 Transmitter /Controller can operate in a "stand alone" mode using the default factory settings. The default settings can be user-modified using the supplied configuration software.

The Series 940 unit can operate as part of an analogue or digital network for measurement or control purposes. It can also support distributed control functions, and internet-based information systems.

Measure and Transmit

The Series 940 provides a 4-20 mA signal that is linearly proportional to the ozone concentration. The full scale value is dependent on the sensor head type. The unit automatically recognises the sensor head type and sets the default full scale range. The output scale can be user set – see section on user modified settings (an example of a default factory setting is shown below).
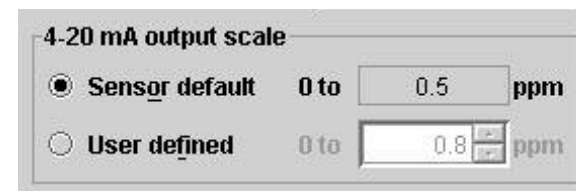
The ozone concentration can also be determined using the RS485 communication system. See the section on Network Systems on page 14.

Local Control and Alarm

The unit can be used as a control device (to maintain the ambient ozone concentration between user defined levels) and as a simple switching device (signalling alarms, relays or equipment on or off). The Series 940 and 945 output settings are factory set – see section on User Modified Settings on page 11.

Additional Features

Diagnostics Hardware Switch: The Series 940 and 945 units come with built-in diagnostics which inform the user if the sensor is not operating correctly. The same information can be obtained using the RS485 communication system. See the section on Network Systems.

Standby Hardware Switch: The Series 940 and 945 units come with a hardware toggle switch which puts the sensor into or out of standby mode.

Digital Communication Systems (Multi-Sensor Networks)

The Series 940 and 945 is designed to operate as part of a network system with computer-based systems or PLC controllers.

A full range of measurement and control functionality is offered for digital systems.

Each unit can be given a unique ID (required for digital networking systems) – see section on User Modified Settings on page 11.

The set-up for digital network communications requires termination resistors on the RS485 communication lines to be correctly set – see section on Installation, Wiring and Operation.

The Network Systems section provides details about connecting the Series 940 and 945 to a computer or PLC, and the Series 940 and 945 command protocols.

Guidelines on How to Measure Ozone

The following information is presented to help users operate their **Aeroqual S940 Ozone Transmitter/Controller** in the most effective and efficient manner.

General

- Ozone is heavier than air and tends to sink. Thus detection of leaks from ozone generating equipment should be performed at the most appropriate position.
- Ozone will react and decompose on surfaces such as walls, furniture etc.
- Smell is not a reliable test for the presence or concentration of ozone as the odour threshold varies widely from person to person and is affected by local ambient conditions.

Installation Guide

The **S940** 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 S940 should **never** be exposed to:
- steam, fumes, water or chemical spray,
- solvents or alcohols
- high condensing humidity
- cooking vapors/aromas
- paint fumes
- high levels of dust
- constant high air flows

Permanent Controller Placement
- The **S940** has been designed to measure the ambient concentration of ozone. The controller must not be placed directly in an ozone stream.
- For indoor local area monitoring attach the controller to an inert surface such with the inlet unobstructed.
- For leak detection mount the unit near the ozone equipment.
- Ensure that the controller is protected from excessive water splashing, dust, vibration, excessive heat or cold, high concentrations of ozone and excessive swings in humidity.

Warm up

- It is recommended that the sensor head for the Series 940 transmitter/controller is run for up to 24 hours prior to use as a control or alarm function if it has been switched off for more than 7 days. This will remove any surface contamination that may influence the accuracy of the measured ozone concentration.

False Readings

- The Aeroqual S940 has been designed to respond selectively to ozone, however other oxidizing gases such as chlorine and nitrogen dioxide can generate false readings if they are at high concentrations. High concentrations of hydrocarbon gases such as vapours of alcohol, oils and solvents can reduce and mask the concentration of ozone.
- Ozone will react with and decompose on organic substances. *The presence of human beings may reduce the local ozone concentration.*

Calibration

- The sensor head is calibrated prior to delivery.
- The Aeroqual Ozone Transmitter/Controller has been designed so that it does not normally require re-calibration for the life of the sensor head.
- Environmental conditions such as dust, high humidity, vibration, chemicals and heat or cold as well as high concentrations of ozone may degrade the sensor performance and shorten the sensor life. Please ask your local dealer or contact Aeroqual at **technical@aeroqual.com** about your application if you are in doubt.

Installation, Wiring and Operation.

Installation Guide

To install the S940:
- Screw-fix to the desired surface.

Wiring Guide

The connector pin designations are shown in the diagram below.
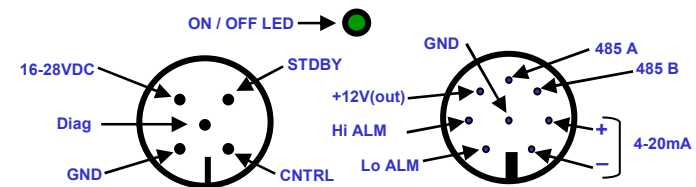
Connection Description

Power: 16-28VDC / GND. Connect 24V power and ground wire to these.

STBY*: Hardware toggle switch. If set to GND it puts the sensor head into Standby mode and the S940 into Sleep mode.
If set to GND again it will return to normal operation.

DIAG*: This is set to GND when sensor fails, else floating.

LoALM*: This is set to GND when low alarm point is reached, else floating. Use the Configuration Program to setup.

HiALM*: This is set to GND when high alarm point is reached, else floating. Use the Configuration Program to setup.

CNTRL*: See details of the control outputs on the following page.

GND Ground pins.

RS485: RS485A/B communication lines. These need to be wired up in order to configure the S940.

**4-20mA:** The output is linearly proportional to concentration. The default concentration scale is dependent on the concentration range of the sensor head type. The concentration scale can be defined by the user using the Configuration Program (on page 11). If the sensor fails the output will be 20 mA. **The output is opto-isolated and designed to be externally powered with a voltage range of 12-24v.**
(**NOTE:** The LED display models are designed to operate in conjunction with the 4-20mA circuit. If the 4-20mA output in not being used the display can still be enabled by connecting the positive 4-20mA terminal to the +12v terminal and also connecting the negative 4-20mA terminal to GND (ground). If the 4-20mA output is used, then the above two jump wires are not required.)
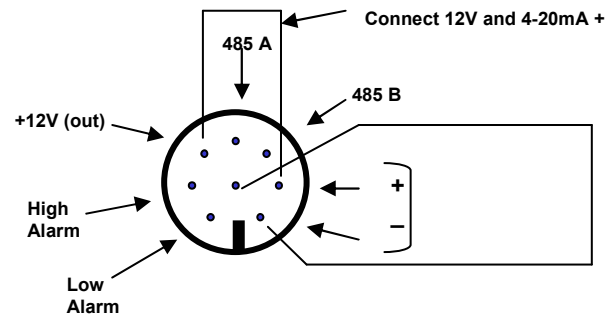
Internal powered loop circuit diagram

NOTE:
- All of the transistor outputs (those shown asterisked above *) are open collector current sink. The maximum rating of these transistor outputs is 24VDC at 150mA
- Should you connect a relay or any other inductive load to the transistor outputs, a back EMF suppression diode must be fitted across the load.
- Aeroqual accepts no responsibility for damage to this product or any other issues arising from the non-compliance with the above directives. Failure to implement these directives will invalidate the warranty on this product.

RS485 Communication Settings

The Series 940 unit is factory set to communicate directly (as a single unit) using the RS485 communication protocol .ie. without modification of termination resistors.

Network Use Only: If the unit is to be used as part of a "daisy chained" RS485 network, 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 S940 units in a chain except the last powered S940 unit in the network chain. If there is only one unit then set the jumpers in place. Please contact technical@aeroqual.com for assistance in this regard.

Using the alarm, control and diagnostic 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.

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.

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 setpoint. The output can be used to drive an alarm relay or similar.

CNTRL
This is set to GND when the gas concentration is rising in the range from below Control low setpoint to the Control high setpoint at which stage, it is set to floating. It remains floating until the concentration falls below the Control low setpoint at which point, it is reset to ground. Use the Configuration Program to set the Control setpoints. This output can be used to control, for example, a gas generator or vent in a process operation.
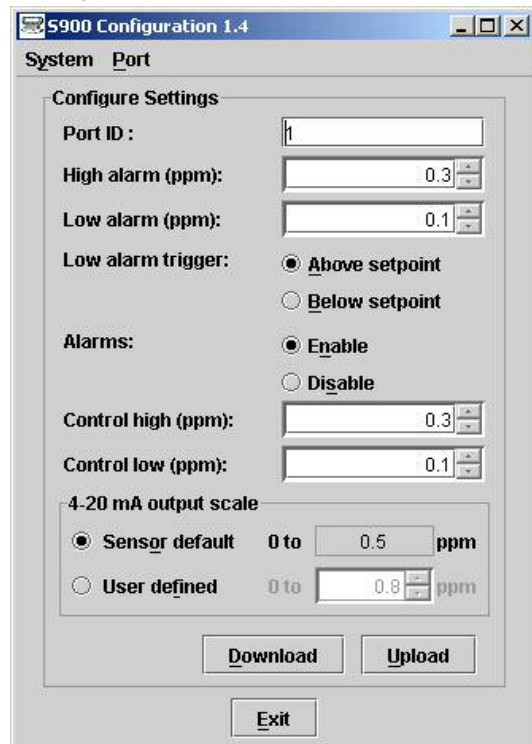
Using the Stand-by input

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 S940 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.

User Modified Settings
(Series 940 Configuration Program)

The Series 940 settings can be modified using the supplied Configuration Program shown below.

```
S900 Configuration 1.4                    _ □ X
System  Port
┌─ Configure Settings ──────────────────────┐
│  Port ID :             [1            ]      │
│                                             │
│  High alarm (ppm):     [        0.3 ]▲▼     │
│                                             │
│  Low alarm (ppm):      [        0.1 ]▲▼     │
│                                             │
│  Low alarm trigger:    ● Above setpoint     │
│                        ○ Below setpoint     │
│                                             │
│  Alarms:               ● Enable             │
│                        ○ Disable            │
│                                             │
│  Control high (ppm):   [        0.3 ]▲▼     │
│                                             │
│  Control low (ppm):    [        0.1 ]▲▼     │
│  ┌─ 4-20 mA output scale ─────────────────┐ │
│  │ ● Sensor default  0 to [  0.5 ] ppm    │ │
│  │ ○ User defined    0 to [  0.8 ]▲▼ ppm  │ │
│  └────────────────────────────────────────┘ │
│                                             │
│       [ Download ]      [ Upload ]          │
│                                             │
│              [ Exit ]                       │
└─────────────────────────────────────────────┘
```

Computer requirements
- CD-ROM Drive
- RS232 port
- Windows OS version 95 or later.
- 45 Mb of spare hard drive space

Additional components required:
- 24V power supply
- RS485/RS232 converter
- RS485 wired S940

Procedure
1. Connect the Series 940 RS485 port leads to the computer (this will typically require a RS485/RS232 adaptor).
2. Install the Aeroqual Series 940 Configuration Program on the computer if not already installed.
3. Power up the Series 940 unit.
4. Run the Aeroqual Series 940 Configuration Program.
5. Select Unit by entering the ID of the S940 you wish to modify (and click on "Download" to download the units current values).
6. Modify settings
7. Click Upload to upload the settings to the S940
8. Click Exit
9. Power down the S940 and install.

Parameter Descriptions

Change 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. 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 reaches 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 S940.

Download

Clicking this button downloads the settings from the S940 or S945. Use this function to check the settings are correct.

Network Systems

4-20 mA Systems

The Series 940 can be connected to a PLC via the 4-20 mA output to provide only concentration information. The 4-20 mA output is opto-isolated from the Series 940 unit. A voltage in the range 12-24 V needs to be applied with the correct polarity as labeled. The current output is proportional to concentration with the scale set by the user during the configuration procedure. If the sensor fails the output will be 20 mA. The DIAG (diagnostic) output can be used to monitor for fault conditions.

Procedure

1. Connect the 4-20 mA output leads to the 4-20 mA input channel of the PLC ensuring the polarity is correct.
2. Power on the S940 and PLC
3. Check the PLC to ensure data is present.

Digital Systems

Connecting to a Computer

Computer requirements
*   CD-ROM Drive
*   RS232 port
*   Windows OS version 95 or later.
*   45 Mb of spare hard-drive space

Additional components
*   24V 1A power supply
*   RS485/RS232 converter
*   Cabling

Procedure

1. Connect the RS485 leads of the S940 to the RS485 inputs of the converter
2. Connect the RS232 output of the converter to the RS232 port of the PC.
3. Power on the S940 and PC

4. Run the Aeroqual S940 PC Comms Software. Should you require any assistance contact your local dealer or email technical@aeroqual.com.

Connecting to a Digital PLC

The Series 940 can be connected to a PLC using RS485 communication systems which allow for full functionality and control of the unit.

RS485 communication

Each installation will require its own PLC communication program to be developed, based on the Series 940 RS485 Protocol (see RS485 Protocol section below).

Procedure

1. Connect the RS485 leads of the S940 to the RS485 inputs of the PLC
2. Power on the S940 and PLC
3. Run the PLC communication program based on Aeroqual's RS485 Protocol (see RS485 Protocol section).

Series 940 RS485 Protocol

The RS485 Protocol described below is provided to enable users to write their own communication software for a PLC or similar.

The S940 network system is based on industrial protocol RS485. This command protocol is specified by Aeroqual Limited. Copyright reserved 2004.

Version 1.2
Date: 8-04-2004

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 S940 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 S940. 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 S940 network ID.
* OTHERS - may used to extend functions later, it can be left as empty for now
* CHECKSUM - makes the data stream total sum byte value to zero. That's tow's complement of the total sum of the data stream, except CHECKSUM byte.

02. S940 unit basic reply command format will be a 15 bytes stream (see section 2 for details):

index 0   1   2   3 - 6   7 – 10   11   12   13   14
SENSOR, COMMAND, NETWORK_ID, DATA1(4 bytes), DATA2 (4 bytes), NOT_USED, STATUS1, STATUS2, CHECKSUM

Section 2. S940 Network ID specified commands. These commands generate a response by a specified S940 unit. Every command needs a corresponding reply.

01. Gas Data request command. The command asks for the gas data that a specific S940 unit currently holds.
The S940 unit responds with an gas value. The gas data validity depends on the DATA_UNVALID bit of STATUS1 flag (please see Section 4 for details).

Command: BASE, DATA_REPORT, NETWORK_ID, EMPTY, CHECKSUM
Reply: SENSOR, DATA_REPORT, NETWORK_ID, DATA1, DATA2, NOT_USED, 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 measured value,, otherwise it's new measured value.
* DATA2 - No meanings

02. Standby command. The S940 unit will set its sensor head to standby state.
The S940 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, NOT_USED, STATUS1, STATUS2, CHECKSUM

* DATA1 and DATA2 - no meanings.
* The reply just confirms that it performed action, to find it check status bit.

03.   Specific S940 reset command. The command will reset the S940 at any time.

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

* DATA1 and DATA2 - no meanings.
* RESET - 1 byte reset command, see section 4 for details.

04.   Specific S940 unit connected sensor head version number request command and reply. PC or other devices can request sensor head version information through S940 unit.

Command: BASE, VERSION, NETWORK_ID, EMPTY, CHECKSUM
Reply: SENSOR,   VERSION,   NETWORK_ID,   VERSION_NUM, DISPLAY_TYPE,   NAME_LENGTH,   SENSOR_NAME,   NOT_USED, CHECKSUM

* VERSION_NUM - 1 byte, the version number of sensor head plugged in the S940 unit
* DISPLAY_TYPE - 1 byte, the decimal value display type, different gas sensor head are different, see section 3 for details
* NAME_LENGTH - 1 byte, the sensor head name length.
* SENSOR_NAME - 7 bytes max, valid length depends on AME_LENGTH value, the sensor head name ASCII code that connected to S940 unit,

05.   Modify S940 unit network ID command, that can change current S940 unit network ID.

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

* CHANGE_NETWORK_ID - 1 byte command, see section 3 for .
* OLD_ID - the S940 unit old network ID.
* NEW_ID - the S940 unit new network ID

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

Command: BASE,   FACTOR_REQUEST,   NETWORK_ID,   EMPTY, CHECKSUM
Reply: SENSOR, FACTOR_REQUEST, NETWORK_ID, DATA1, DATA2, NOT_USED, STATUS1, STATUS2, CHECKSUM

* DATA1 - 4 bytes, gas unit ppm to mg/m3 convert factor floating point value
* DATA2 - 4 bytes, default S940 current output max scale factor floating point value

07.   Specified S940 unit configure settings upload command, which set the S940 unit "Low Alarm", "High Alarm", defined output scale and alarm enable settings. Total 17 bytes data stream.

Command: BASE, PARAMETERS_UPLOAD, NETWORK_ID, EMPTY, CHECKSUM

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

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

* ALARM1 - 4 bytes alarm level 1 set point value, see section 3 for its data representation
* ALARM2 - 4 bytes alarm level 2 set point value, see section 3 for its data representation
* DEFINED_SCALE - 4 bytes user defined max output scale value.
* ALARM_STATUS - 1 byte alarm state settings, see section 3 for details
* Reply just used for confirm uploading successfully

08.   Specific S940 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 "Low Alarm" set point value, see section 4 for its data representation
* ALARM2 - 4 bytes "High Alarm" 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

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 S940 ID that is zero *

01.   Broadcast S940 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 940 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 3 for its value

02.   Broadcast S940 reset command, it will reset whole network sensor heads that connected to.
The command generates no reply. To check whether a 940 unit has performed the command, the network master should check   STATUS2's STAND_BY bit.

BASE, RESET, BROADCAST, EMPTY, CHECKSUM

* BROADCAST - 1 byte broad cast indicator, see section 3 for its value

Section 4. Protocol commands value and descriptions:

BASE = 0x55   command header used for network master to S940

SENSOR = 0xAA   reply header used for S940 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

DATA_REPORT = 0x10   command to request/report measured gas concentration value

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 S940 ID reserved for information broadcast

PARAMETERS_UPLOAD = 0x19 command to upload configure settings to S940

PARAMETERS_DOWNLOAD = 0x18   command to download configure settings from S940

EMPTY = 0x00   no meanings at all, reserved space

NOT_USED can be any value, not any meanings at all

CHECKSUMdata stream check sum used to verify the command data stream information lost or noise. It makes the data stream total sum to zero.

NETWORK_ID range: 0x00 -- 0xFF, 0x00 is reserved for broadcast command.
0x01 will be the default ID when S940 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,
FAN_STATUS	b2	reserved
UNIT_UNSTABLE_FLAG	b3	sensor head is at setting up stage not stable yet
NOT_USED	b4	reserved
NOT_USED	b5	reserved

SensorResetFlag
b6   sensor head is doing reset DATA_UNVALID
b7   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
                       b4 = 0, sensor head in normal working mode
RESERVED   b5   reserved
RESERVED   b6   reserved
RESERVED   b7   reserved

ALARM_STATUS (1 byte)   used for alarm status setting

Alarm_Enable   b0 = 0, S940 alarm enabled, b0 = 1, S940 alarm disabled
Alarm2_Triger   b1 = 0, S940 "High Alarm" triggered when reading exceed "High Alarm"
                       b1 = 1, S940 "High Alarm" rigged when reading below "High Alarm"
Define_Ouput_Scale b2 = 0, use sensor head default current output 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.

Section 5. Data transfer mechanism

1. 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 broadcast 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.

Section 6. RS485 communication port settings:
Baud rate: 4800
Data bits: 8
Stop bits: 1
Parity: none
Flow control: none

Removing and Replacing the Sensor Head
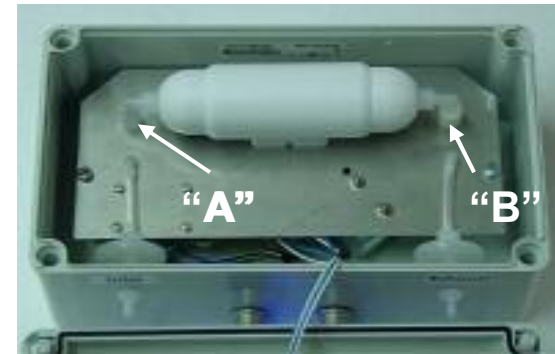
- Undo the four lid screws, remove lid and view the interior of the enclosure as shown above.
- Unscrew the inlet & outlet nozzles "A" & "B" (Note: Turn the plastic nut clockwise). Remember the small elbows form part of the sensor head.
- Now replace the sensor head (keyed to fit one way only) tighten the inlet and outlet nozzles "A" and "B" (Note: Turn the plastic nut anti-clockwise) .
- Replace the lid and tighten the four lid screws.

Care and Maintenance

Your Aeroqual S940 is a product of superior design and quality and should be treated with care. When using your S940:

- Keep it and all its parts and accessories out of the reach of small children.
- Keep it dry. Avoid water and/or condensation as humidity and liquids containing minerals may corrode electronic circuits.
- Do not use or store in dusty, dirty areas.
- Do not expose sensor heads to high levels of ozone.
- Do not store the controller in temperatures below 10°C.
- This unit is designed for use at temperatures between -5°C and +50°C (23°F and 120°F). Sudden changes in temperature will cause condensation that may damage the electronic componentry.
- Non-expert handling of the device may cause damage.
- Do not drop, knock or shake as this could lead to internal damage.
- Do not use harsh chemicals, cleaning solvents or strong detergents for cleaning. Wipe with a soft cloth slightly dampened with a mild soap-and-water solution.

Disposal / Recycling

Please note that this is an electronic product and disposal should be in line with your local or country legislation. The plastic casing of the product is made from a PC, ABS,PS blend.

Troubleshooting
Series 940 Transmitter /Controller

Fault Description	Possible cause	Remedy
No power	Lead connection broken	Reconnect power lead
	Power supply failure	Replace 24V power supply
	S940 damaged	Replace unit
RS485 communications unstable	RS485/RS232 adaptor faulty	Reconfigure/replace adaptor
	Connections broken	Reconnect leads
	ID incorrect	Check ID
	Noise on cable	use shielded twisted pair cable
4-20 mA output failure	30V input exceeded	Replace S940
Network unstable	ID conflict	Modify IDs so that no S940 units share the same ID
	Noise on leads	use shielded twisted pair cable
	Jumpers set incorrectly	Set jumpers correctly
	S940 units too close together	The leads between S940 units should be a minimum of 30 cm in length.

Sensor
Sensor Failure
The S940 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 Faults

Fault Description	Possible cause	Remedy
Sensor failure when new sensor	Insufficient warmup	Run the sensor for 24-48 hours
	Air contaminated	Move the sensor to cleaner environment and check reading
	Sensor damaged	Replace sensor
Sensor showing high baseline reading under zero gas conditions	Background gas level higher than normal	Move sensor to clean air and recheck baseline
	Interferent gas present	Move sensor to clean air and recheck baseline
	Sensor zero drift	Re zero sensor in a clean, stable background
	Sensor damaged	Replace sensor
Sensor showing lower than expected reading in the presence of sensor gas	Sensor correct	Check calibration of gas generator.
	Sensor inlet contaminated	Clean sensor inlet filter and mesh
	Sensor fan failed	Replace sensor
	Interferent gas present	Move sensor to clean air and check reading upon exposure to known gas concentration
	Gas reactive and decomposing before detection	Move the monitor closer to the source of the gas
	Local air flow too high	Reduce the airflow into and around sensor head.
	Sensor calibration lost	Replace /refurbish sensor

Fault Description	Possible cause	Remedy
Sensor showing higher than expected reading in the presence of sensor gas	Sensor correct	Check calibration of gas generator.
	Interferent gas present	Move sensor to clean air and check reading upon exposure to known gas concentration
	Sensor calibration lost	Replace /refurbish sensor
Sensor output noisy	S940 power supply unregulated	Install regulated power supply
	Local air flow too high	Reduce air flow
	Environmental conditions fluctuating	Reduce fluctuations

Statements of Compliance

1. The Aeroqual Series 940 Ozone Controller comply with EN 50082-1: 1997

2. The Aeroqual Series 940 Ozone Controller comply with EN 50081-1: 1992

3. The Aeroqual Series 940 Ozone 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. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
   - Reorient or relocate the receiving antenna.
   - Increase the separation between the equipment and receiver.
   - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
   - Consult the dealer or an experienced radio/TV technician for help.

Warranty

Thank you for purchasing this Aeroqual product. To get maximum use of the features of your new product we recommend that you follow a few simple steps:
- Read the guidelines for safe and efficient use.
- Read all the terms and conditions of your Aeroqual Warranty.
- Save your original receipt. You will need it for warranty repair claims. Should your Aeroqual product need warranty service, you should return it to the dealer from whom it was purchased or contact Aeroqual.

Our 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 940 Base Unit	One year from the date of purchase
High Ozone Concentration Head	Six months from the date of purchase
Low Ozone Concentration Head	Six months from the date of purchase

All accessories for the product are covered by a warranty for a period as follows:

Accessories	Warranty Period
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.

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Conditions

1. 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.

2. 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.

3. 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.

4. 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.

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

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

7. 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 levels of ozone 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.

8. 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.

9. 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.

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S940 Specification

Ozone Measurement Range

Low Concentration Ozone Head	0.000 to 0.500 ppm
High Concentration Ozone Head	0.00 to 20.00 ppm

Ozone Sensor Head Accuracy

Low Concentration Ozone Head	±0.008 ppm (0 to 0.100ppm) ±10% ppm (0.100 to 0.500ppm)
High Concentration Ozone Head	±10% ppm (0.20 to 2.00ppm) ±15% ppm (2.00 to 20.00ppm)

T90 response rate (standard)

Low Concentration Ozone Head	55 seconds
High Concentration Ozone Head	40 seconds
Power	24VDC
Outputs	4-20 mA (opto-isolated), 10-24 V Hi alarm Low alarm Control Diagnostics
Inputs	Standby toggle
Communication	RS485
Jumpers	J1, J2, J3 termination resistors
Sampling Pump	12VDC, long life, brushless, Rotary pump
Ingress Protection	IP40 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
Enclosure	Polycarbonate
Mounting	Screw fix
Operating temperature	-5 ^{o}C to 50 ^{o}C
Operating relative humidity	0 to 95% non-condensating
Enclosure size	See page 32

940 Factory Default settings

Low Ozone Head

ID	1
High Alarm	0.300ppm
Low Alarm	0.100ppm
Low Alarm Trigger	Above Setpoint
Alarms	Enabled
Control High	0.300ppm
Control Low	0.100ppm
4- 20mA Output Scale	0 to 0.5ppm
Jumpers	Fitted

High Ozone Head

ID	1
High Alarm	1.0 ppm
Low Alarm	0.5 ppm
Low Alarm Trigger	Above Setpoint
Alarms	Disabled
Control High	0.8 ppm
Control Low	0.5 ppm
4- 20mA Output Scale	0 to 20.0 ppm
Jumpers	Fitted

Dimensions