ID Settings

0RQWRURQWKHWRUHTXHKUHQWM,RWKFDHGLWLOQXGRWK56RWRUN7K
IDFWRUGHIDDW,RIWKHWLY\KUHIRUHWKZLOORHGWREHFEOHGWREWM,WHWK
&RLJMDWLRQ&RIDUHWRFEOHWK,V

4. S930 Specifications

Power (user supplied)	9&PPDOH 9&
Analogue output	PRSWR LRODWHG 9
External signal type	7UDDWRURWSWPPD[
External signals (4)	/RODUPLJDUP&RWUROLDRWLFV
LED Display	2SWLRQO
Inputs	6WDQEWRJJOH
Communication	56 URRDOSURSULHWDUSURWRFRO
Jumpers	---WHUPLQWLRQHLWRUV
Connectors	6FUHZ
ID	HIDDWXUFRQLJMDEOHIURPWR
Alarm set points (2)	XUFRQLJMDEOH
Control set point	XUFRQLJMDEOH
Removable/replaceable sensor head	HV
Sampling method	FWLYHDPSOLQYLDLWHUQOHRUDQ
Temperature & humidity sensor (Optional)	5DOH &WR&)WR)5DOHWR5+
Configuration software	3&&RQLJMDWLRQRIWDUH
Data logging & networking software	3&DWD/RJJLQ1HWRUNLQ 6RIWDUH
Enclosure casing	)LEUHUHLRUFHGSROFDUERQWH1MWKYDOHV
Enclosure size	PPP5Q
Weight	JR]
Approvals	3DUWRI&&5R+HV (1

5. Gas Measurement Guidelines

7K6KDGEHLWDOOHGDWDORFDWLRQWVWLUHHIURPFRWDPLQWVWPLJWDIIHFWWK
SUIRUPDHRIWKHMURKDG3OHDMFRWDFWWHFFDOHURDORFPIRUWLWDEHZWKHFLILF
FKPLFDOWWRHOLHYHPDDGYHUODIIHFWWKSSOLHGMRU,OHRDUODWK6KKDG
neverEHHSRMGWR

6WHDPLRHWHURUFKPLFDOSDU\

$JUHLYHROYHWV

LJKRQHORLGLW\

&RRNLQYDSRMURPDV

3DLWLRHV

LJKOHYHORLGW

(RHWWWKFRWUROOHUSURWHFWHGIURPFHLYHDWHUSODKDQGWYLEUDWLRQFHLVHKDW
RUFRODHFHLVHZLVOGLWDQJDFRHOWUDWLRQWLGHWKUDHRIWKSHFLILFRU
KDG

6. Troubleshooting

Fault Description	Possible Cause	Remedy
No Power	Power connection broken	Reconnect power cable
	Power supply failure	Replace 24V power supply
	S930 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
	Sensor head not fitted correctly	Insert head correctly
4-20mA output failure	30V input exceeded	Replace S930
Network unstable	ID conflict	Modify IDs so that no S930 units share the same ID
	Noise on cable	Use shielded twisted pair cable
	Jumpers set incorrectly	Set jumpers correctly
	930 units too close together	The cables between the S930 units should be a minimum of 30 cm in length
If connected to a display: Display shows -1	Over-range (>20mA) reverse loop current	Loop polarity is incorrect. Reverse the polarity. Incorrect loop polarity can cause irreversible damage to the 930 unit
Display shows 1	Over-range loop current (>20 mA)	Reduce loop current
Display shows -.125	4-20mA loop not powered	Power loop. The display requires the loop to be powered to read correctly
Display oscillated between min and max	Sensor head not fitted correctly	Insert sensor correctly
Sensor failure when new sensor connected	Insufficient warm-up	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 environment and recheck baseline
	Interference gas present	Move sensor to clean environment and recheck baseline
	Sensor zero drift	Rezero sensor in a clean, stable environment
	Sensor damaged	Replace sensor
Sensor showing higher than expected reading in the presence of sensor gas	Zero calibration incorrect	Zero calibrate sensor
	Span calibration incorrect	Span calibrate sensor
	Interference gas present	Move sensor to clean environment and check reading upon exposure to know concentration of gas
	Sensor calibration lost	Replace sensor

	Zero calibration incorrect	Zero calibrate sensor
Sensor showing lower than expected reading in the presence of sensor gas	Span calibration incorrect	Span calibrate sensor
	Sensor inlet contaminated	Clean sensor inlet filter and mesh
	Interference gas present	Move sensor to clean environment and check reading upon exposure to know concentration of gas
	Gas reactive and decomposing before detection	Move the monitor closer to the source of the gas
	Sensor calibration lost	Replace sensor
Sensor output noisy	S930 power supply unregulated	Install regulated power supply
	Local air flow too high	Reduce air flow
	Environmental conditions fluctuating	Reduce fluctuations

7. Diagnostics

The S930 has inbuilt diagnostics to detect sensor faults. If the sensor fails it can be easily replaced by removing and installing a new sensor head. The failed sensor can be sent back to Aeroqual for replacement or disposal.

The fault conditions are explained in the below table:

Fault Description	DIAG output	4-20mA output	RS485 output
No fault	Floating	Valid gas reading	Valid gas reading Status 1 = 0x00
Sensor failure	GND	20mA	Last valid gas reading Status 1 = 0x01
Sensor aging	GND	20mA	Last valid gas reading Status 1 = 0x02
Sensor not fitted correctly	GND	Oscillated between 4 and 20mA	No reply

8. RS485 Protocol

The S930 network system is based on industrial protocol RS485. This command protocol is specified by Aeroqual Limited. Copyright reserved 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 S930 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 S930. 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 930 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. 930 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), RESERVED, STATUS1, STATUS2, CHECKSUM

Section 2

S930 Network ID specified commands. These commands generate a response by a specified S930 unit.

Every command needs a corresponding reply.

01. Gas Data request command. The command asks for the gas data that a specific S930 unit currently holds.

The S930 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, 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 measured value, otherwise it's new measured value.

* TEMP - 2 bytes unsigned int value, its actual value equals the int value divided by 10 (TEMP/10) for its real temperature value of S930 unit

* RH - 2 bytes unsigned int value, its actual value equals the int value divided by 10 (RH/10) for its real relative humidity value of 930 unit

* For 930 the field TEMP and RH will be always zero for Version 1.5 and later.

* However, for S930 version 1.4 and earlier can't use this command to request temperature and humidity.

02. Standby command. The S930 unit will set its sensor head to standby state.

The 930 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 930 reset command. The command will reset the 930 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 930 unit connected sensor head version number request command and reply. PC or other devices can request sensor head version information through 930 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 930 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 NAME_LENGTH value, the sensor head name ASCII code that connected to 930 unit,

05. Modify 930 unit network ID command that can change current 930 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 3 for details.

* OLD_ID - the 930 unit old network ID.

* NEW_ID - the 930 unit new network ID

06. Specific 930 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, RESERVED, STATUS1, STATUS2, CHECKSUM

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

* DATA2 - 4 bytes, default 930 current output max scale factor floating point value

07. 930 unit configuration settings upload command, which sets the 930 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 3 for details.

* Reply just used for confirm uploading successfully, DATA1 and DATA2 no real meanings.

08. 930 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 930 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 930 unit

   * SENSOR_COUNT - 1 byte, actually used to specify its 930

   > if it's 0x01, that is 930 no temperature and humidity sensor connected,

   > if it's 0x03, that is 930 there is a temperature and humidity sensor connected.

10. Temperature and relative humidity data request command. The command asks for the temperature and humidity data that a specific 930 unit currently holds. The 930 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 930 unit,

   * RH   - 4 bytes IEEE754 floating point data, measured relative humidity value of 930 unit

   * For 930 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 930 ID that is zero *

01. Broadcast 930 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 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 930 reset command; it will reset whole network sensor heads that connected to.

The command generates no reply. To check whether a 900 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 930

SENSOR = 0xAA reply header used for 930 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 930 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 930 ID reserved for information broadcast

PARAMETERS_UPLOAD   = 0x19 command to upload configure settings to 930

PARAMETERS_DOWNLOAD = 0x18 command to download configure settings from 930

EMPTY = 0x00 no meanings at all, reserved space

RESERVED can be any value, not any 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 sum to zero.

NETWORK_ID range: 0x00 -- 0xFF, 0x00 is reserved for broadcast command. 0x01 will be the default ID when 930 has 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
RESERVED	b4	reserved
RESERVED	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, 930 alarm enabled, b0 = 1, 930 alarm disabled
	Alarm2_Triger b1 = 0, 930 alarm 2 triggered when reading exceed alarm 2
	b1 = 1, 930 alarm 2 rigged when reading below alarm 2
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.

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

9. Care and Maintenance

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

- 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 may damage sensitive electronics and the Li battery.
- Do not use or store in dusty, dirty areas.
- Do not store the monitor in temperatures below 10°C or above 35°C.
- This unit is designed for use at temperatures between -5°C and +45°C however please consult recommended operating temperature for the sensor head which may be different. Avoid sudden changes in temperature which may cause condensation that can damage the electronics.
- Do not attempt to open. 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

9.1. 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 Polycarbonate / ABS blended material (PC + ABS) and is marked accordingly.

10. Appendix

10.1. Copyright

10.2. Software License

10.3. Terms and Conditions

This product is warranted according to Aeroqual Ltd.'s Terms of Trade. For further warranty information, please refer to the standard Product Warranty Policy as published on the Aeroqual website at www.aeroqual.com.

10.4. Statements of Compliance

1. The Aeroqual Series 930 Fixed Monitor complies with EN 50082-1: 1997
2. The Aeroqual Series 900 Fixed Monitor complies with EN 50081-1: 1992
3. The Aeroqual Series 900 Fixed Monitor complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
   - These devices may not cause harmful interference, and
   - 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.