OUR KNOWLEDGE
IS YOUR SUCCESS

Communication connection GA EMS – measuring computer

Document version: V2.6
Initial date 14-12-2009
Date 19-11-2016

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

OUR KNOWLEDGE
IS YOUR SUCCESS

Introduction

The Postharvest Gas Analyser for ethene measurements of EMS is a system that is a full featured measurement system with integrated control mechanism for a reliable communication between a measurement computer and the ethene gas analyser. The communication is relative simple and done by some potential free in- and outputs that has to be controlled and readout with the measurement computer. There is also an advanced method where the 4-20 mA output signals act as a status control line so that the ethene analyser sends information in the analog output region of 0-4 mA. The ethene gas analyser provides the measurement system with information of alarms, status and error information. In this way works the ethene gas analyser as a slave to the measurement computer with this advantage that control around the ethene measurement itself is fully controlled and maintained by the ethene gas analyser.

This document describes how interfacing is done with the measurement computer. First a description is given for ethene gas measurement systems in the measurement range of 0-500 ppm. After that section a description is given with a measurement range of 0-5000 ppb with the exceptions. The measurement range of 0-5000 ppb ethene gas concentration needs another procedure while accuracy on the latest ppb could be important.

If hereafter is mentioned that that parameters can be software configured, this means that parameters can be controlled by either:

- Display and keypad: User menu, service menu or EMS menu
- RS232 communication
- RS485 communication
- EMS MACView Portal by internet communication

For information how to adjust the software configurable parameters in the menu we refer to the manual of the ethene gas analyser.

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

OUR KNOWLEDGE
IS YOUR SUCCESS

Minimum required and also advised setup (READ THIS FIRST !)

Please read this first:

To make a reliable setup between an ethene gas analyser and a measurement system it is important to consider and to follow the next advice. This advice is a minimum requirement. Following this minimum requirement will give the maximum of guarantee that the information from the ethene gas analyser is interpreted in the right way. Especially when internal errors occurred and must be send to the user or when information around status signals is necessary to control the process, this document is important.

Measuring

- From a central measurement system the measuring computer controls all the storage rooms. The ethene gas analyser (GA) has to know when a storage room is switched for measurement of a new storage room. When changing from one storage room to another storage room the measuring computer sends on a digital output a pulse to (for example) the digital input 2 of the ethene gas analyser. This pulse must have a duration of (advice) 2 seconds. So the GA knows that a new storage room is addressed. Pulse width must in between a time duration of 0 and 5 seconds. All pulses outside this time frame are not recorded as storage room switch pulse, but as an verification / zero pulse. (See later more).
- This function is therefore twofold shared with the verification pulse or zero pulse.
- The pulse that the measurement systems sends is derived from a potential-free output contact (output) and is connected to ethene gas analyser to a potential free input contact (input).
- After getting the pulse, the ethene gas analyser starts then a measurement cycle in time ranging between 450 seconds (default) up to 600 seconds for a measurement of one of the storage rooms.
- In a menu of the ethene gas analyser, the duration of the measurement-time is adjustable. The user / technician can adjust this measurement time during installation.
- The minimum measurement time per storage room must be considered in the following situations. Also the time that is needed for getting the right airflow through the external hoses and external valves in the ethene measurement systems is an important time to consider.

Measurement range	Nominal advised measurement time	Minimum necessary measurement time	Maximum possible measurement time
0 – 500 ppm	450 seconds	300 seconds*	7200 seconds
0 – 5000 ppb (measurements between 100-5000 ppb)	450 seconds	450 seconds*	7200 seconds
0 – 5000 ppb (measurements between 0-100 ppb)	450 seconds	450 seconds**	7200 seconds

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

* In this case the seconds are the standard measurement time. With this time it is guaranteed that a optimum of accuracy is reached. Bringing down the measurement time, it is in some situations possible that the accuracy will drop. In most applications this is no issue, but in certain situations it is important to consider this.

** In this case mostly soft fruit will be measured. In this case the ethene gas analyser will from the factory settings default configured on this measurement range and measurement time if this is given up at the order. It must be sure then that the measurement range in normal condition is in the lower range of 0-100 ppb

- We always advice to use the slower sample speeds in the range of 450 seconds up to 600 seconds. This will always guarantee the best accuracy.
- If faster measurement time is needed then the standard 450 seconds (for example 300 seconds), please contact us before about the situation and circumstances and the need for such a sample speed. We then can give you the best advice.
- If the measurement cycle is at the end of its measurement cycle, the analog output will keep its value during 10 seconds. The verification mode is then already started. In other words: In the first 10 seconds of the verification mode, the analog output will keep its measured value. So the measurement computer can the determine and read the measured value.

Verification / zero measurement

- With the same digital input configured to choose the room (setting 3) on the ethene gas analyser also a verification measurement or zero measurement can be performed. The measurement system must perform this zero measurement periodically so that the ethene gas analyser can periodically perform a zero measurement.
- When the measurement systems sends on digital input a pulse longer then 5 seconds de ethene gas analyser will start with the zero mode. The minimum time for this mode is software configurable. An indication is the longer this time last, the better the accuracy is. Take care! All pulses on digital input 2 that are shorter then 5 seconds are interpreted as storage room switch pulses!
- During this verification mode the system will send out 3.5 mA on the analog output.
- This function is therefore twofold shared with the storage room switch pulse.
- The pulse that the measurement systems sends is derived from a potential-free output contact (output) and is connected to ethene gas analyser to a potential free input contact (input).

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

The following verification intervals are advised to perform periodically necessary zero interval:

Measurement range	Nominal advised zero / verification interval	Minimum necessary zero / verification interval	Maximum possible zero / verification interval
0 – 500 ppm	4x per day	1x per day	1x per 1 measurement cycle
0 – 5000 ppb (measurements between 200-5000 ppb)	8x per day	24x per day	1x per 1 measurement cycle
0 – 5000 ppb (measurements between 0-100 ppb)	1x per 1 measurement cycle	1x per 1 measurement cycle	1x per 1 measurement cycle

Zero intervals can only be performed by the measurement computer. The ethene analyser acts in this case as a slave. If no zero measurement has been done for the minimum required time that is given in the above table, then the zeroing will be performed automatically by the ethene gas analyser. The analog output will tell the connected measurement system that it is in verification or zero mode measurement for several minutes.

In case of very low ppb range ethene concentrations (Measurement of kiwi's or soft fruit) it is necessary to do after every measurement cycle a zero measurement. This is necessary because the accuracy of the last ppb is important. Only in the case of 0-100 ppb measurement range, in the way the accuracy can be guaranteed.

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

Input – output structure

Connections

On the backside of the ethene gas analyser several electrical connections are mounted. This is an overview of the connections:

- 3 x digital potential free input contacts
- 3 x digital potential free output contacts (relays)
- 2 x analog outputs
- 1 x RS232 format string (Will not discussed in this document.)
- 1 x RS485 format string (Will not discussed in this document.)

Digital inputs

All 3 digital inputs are potential free inputs in the range of 5 – 24 Volts AC /DC. That means there in no potential and if you want to switch a voltage, you have to add a voltage in the circuit. All inputs are dedicated used and configurable for a specific function. This means that every input can be configured for a specific task. An overview of the tasks are (Numbers are in order of the settings which can be set):

<u>Digital Input 1, digital input 2 and digital input 3 (digital input x):</u>

0. Digital input x is software configurable only used for backflush mode
1. Digital input x is software configurable used for backflush mode or standby mode only or combined together in one function.
2. Digital input x is software configurable to start a measurement in special modes. For example to synchronize with special equipment.
3. Digital input x used for zero-mode and room-switch indicator. With this function a measurement on a room can be performed as well a zero-measurement of the analyser can be performed.

   The setting 3 of digital input x has a double function which can be software configured as on / off:

   Function 1: Digital input x is software configurable to get an indication from the central measurement system that a measurement of a storage room is switched. This is necessary for the ethene gas analyser to synchronize and control measurements on its reliability. (Storage room switch input function).

   Function 2: Digital input x is software configurable to get an indication from the central measurement system that a zero measurement may be performed. Zero measurements are periodically necessary to keep the system working reliable. (Verification or zero mode switch input function).

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

Summary: The setting 3 of the digital input x is software configurable:
Digital input x is software configurable:

a) To get an indication from the central measurement system that a measurement of a storage room is switched.
b) To get an indication from the central measurement system that a verification mode or zero mode must be performed.

4. Digital input x used for starting the calibration.
5. Digital input x used as dosing feedback (Valve open-closed)
6. The function of digital input x is put off.

Digital input 1

As a rule most of the users does not use digital input 1. The digital input 1 is an advanced function that mostly is not used for standard users. Digital input 1 is by factory default configured for both backflush mode or standby mode together in one function.
- Backflush can be disabled by software when RF = 1 is choosen.
- Standby can also be disabled by software when DI = 3 is choosen and then back to DI = 1.If you like to use digital input 1.

Before use please first contact EMS to discuss the use and right usage of this advanced function.

Digital input 2

Digital input 2 is by factory default configured as setting number 3 which controls the room selection for measurement and the verification mode.

Digital input 2 used for zero-mode and cel-switch indicator:
<= 5 seconds electronic pulse = cel switch
> 5 sec seconds electronic pulse = switch to zero-mode

Digital input 3

Digital input 3 is an advanced mode for dosing ethylene. It gives feedback of a dosing valve, if it is open or closed.

Before use please first contact EMS to discuss the use and right usage of this advanced function.

Digital outputs

Because all outputs are based on relays (potential free contacts), during installation a supply must be used in the circuit of the potential free contact to provide this circuit from power. (This potential can be used from a supply on the back side of the ethene gas analyser.) All outputs are software selectable. This means that all available output functions can be assigned to all available digital output relays. An overview of the functions and the digital outputs are (Numbers are in order of the settings which can be set):

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

Digital output 1, output 2 and output 3

0. A digital output (or relay) can be used as error signal. If any error occurred in the ethene gas analyser, the relay will be switched on. (default assigned to relay 2.)
1. A digital output (or relay) can be used as concentration alarm high or concentration low alarm with adjustable hysteresis (default assigned to relay1.)
2. A digital output (or relay) can be used as Cooltrap (This is a special mode to insert an extra condensation trap with a valve to allow to remove the condensation water to flow of automatically.)
3. A digital output (or relay) can be used as status output for ready-indication to start measurement after standby.
4. A digital output (or relay) can be used as backflush output-alarm. (This function is only interesting when working with flush options.)
5. A digital output (or relay) can be used as baseline trigger output This option is only usefull when combining with other measurement devices. (default assigned to relay 3.)
6. A digital output is used as signal to indicate that the system is in the following modes: 1, 2, 3, 4, 5, 6, 7, 8, 10 (Relay off in measurement and standby mode (0 & 9).
7. A digital output is used as Mode trigger at mode 0, mode 1 and mode 3 (Used during calibration in calibration setup.)
8. A digital output is used as dosing relay for ethene C2H4.
9. A digital output function is switched off.

For controlling and alarming, you can connect the relay in two different ways: as “normally closed” (break connection) or as “normally open” (make connection). When using the relay as a “normally closed” (NC) relay, the circuit with the relay is normally closed. It will be interrupted when an alarm situation occurs. When the relay is switched as “normally open” (NO), the circuit will be interrupted as long as there is no alarm situation, it will be closed when an alarm situation occurs. For a detailed description of the wiring of these configurations, please consult the manual.

In case the relay is used to signal internal gas analyser errors, an alarm will occur when a warning is active and when the system enters critical error mode. This way an error in the system can be detected.

This function of reporting errors through the relay, is the standard assignment to relay 2 and is important to be able to detect any errors that may be in the system. Not using the relay, or changing the function of the relay into a different function, is at your own risk!

The relay can switch a maximum of 250 VAC at 1A. When switching heavier loads a heavier relay capable of switching the load needs to be used in conjunction with the system relay.

If heavier loads are switched without the use of a second relay capable of switching this load, life threatening situations may arise and the product can become broken!

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

OUR KNOWLEDGE
IS YOUR SUCCESS

Analog output

The analog output of the system can be used based on the measured ethene concentration, to control an external system. You can think of a measurement computer, climate computer, control computer, an adjustable air valve, a frequency controller, or an external readout unit. The coupling of the system to (for example) a measurement computer can have multiple aims. For one it is possible to link back the measured ethylene concentrations back to the ventilation or circulation of the air. Another purpose is that with a measurement computer all parameters including the ethene concentrations can be measured, displayed and if desired be alarmed.

The output range of concentration of the analog outputs corresponds standard with the measurement range of the ethene gas analyser measurement range. It is possible to adjust this, but it is not recommended if this is not strictly used.

The analog outputs are factory default configured as mentioned below:

Fixed Postharvest Gas Analyser	Analog output 1 -> Ethene concentration (backside) Analog output 2 -> Oxygen concentration (backside) Analog output 3 -> Carbon dioxide concentration (backside) *
Portable Postharvest Gas Analyser	Analog output 1 -> Ethene concentration (backside) Analog output 2 -> Oxygen concentration (inside) Analog output 3 -> Carbon dioxide concentration (inside) *

* note: The analog output 3 is an option which is configured at the factory. The output is normally not available, but if this output is cofigured, then it is available on the “Power output” section on the backside of the analyser.

The analog output is software configurable:

- 0-10 Volt
- 0-20 mA
- 4-20 mA
- 4-20 mA & status
- EMS Specific

Below is a description of every configuration.

Mode 0-10V
In this configuration the terminals of the analog output will drive a voltage varying from 0 to 10 Volt, by which 0 Volt corresponds with 0 % and 10 Volt with 100 % drive.

The voltage on the terminals is given by the following formula:

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

V_{out} = 10 Volt * (measured concentration / setpoint concentration)

The maximum load resistance in this configuration is 600 Ohm.

> **Warning! This mode cannot signal warnings or critical errors on the analog output! In case of a critical error, the output will fall back to 0 Volt.**

Mode 0-20mA
In this configuration the analog output drives a current on the terminals, ranging from 0 up to 20 milliamps, by which 0 mA corresponds with 0 % and 20 mA with 100 % drive.

The current on the terminals is given by the following formula:

I_{out} = 20 mA * (measured concentration / setpoint concentration)

The maximum load resistance in this configuration is 450 Ohm.

The advantage of this method of current driving compared to voltage driving, is that the cable lengths practically do not matter. The cable can have a virtually unlimited length as long as the resistance of the cable an application together do not exceed 450 Ohm. Cables can be seen as series resistance.

> **Warning! This mode cannot signal warnings or critical errors on the analog output! In case of a critical error, the output will fall back to 0 mA.**

Mode 4-20mA
In this configuration the analog output drives a current on the terminals, ranging from 4 to 20 milliamps, by which 4 mA corresponds **with 0 % and 20 mA with 100 % drive.**

The current on the terminals is given by the following formula:

I_{out} = 4 mA + 16 mA * (measured concentration / setpoint concentration)

The maximum load resistance in this configuration is 450 Ohm.

The advantage of this method compared to the 0-20 mA driving is:

- Errors like a broken cable, hardware failure or critical error mode can be automatically detected and will, accordingly, not be interpreted incorrectly as a concentration of 0 ppb ethylene.
- Zero point errors in the signal can be calibrated away.

> **Warning! This mode cannot signal warnings on the analog output!**

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

Mode 4-20mA with status information

This configuration is equal in functionality to the 4-20 mA driving above, with an addition. This addition means that special status signals can be sent over the analog output. These status signals show which mode the measurement system currently is in. These status signals are in the range between 0 and 4 mA. The following overview shows the amperage and meaning of each of the signals.

Signal	Status	Explanation
0 mA	Off	The system is shut down or broken, or malfunction of signal cable.
0,5 mA	Calibration alarm / calibration in progress	The system will send this signal when the system is busy with calibration or when there is an alarm caused by a long period of non calibration. If the system gives this warning it is urgently advised to have your system calibrated.
1 mA	Critical error	The system has an error that needs attention of the supplier. Look at the display for a possible message.
1,5 mA	Standby	The system is in standby mode.
2 mA	Warning	The system has an error that has to be reset manually. The system could be working ok in this condition, but certain parts are however in an error state. It could be that the system tries to cancel out the errors. However if the error appears again the supplier should be notified. This signal can be sent during verification mode.
2,5 mA	Startup	The system is currently in warm-up or start-up mode.
3 mA	Backflush	The system is currently in backflush mode.
3,5 mA	Verification	The system is currently in verification mode.
4-20 mA	Measurement	The system is currently in measurement mode and returns the measured concentration with the 4-20mA signal.

EMS specific mode

In this configuration an EMS specific signal is driven on the terminals of the analog output. This signal form can be used in combination with other EMS products and/or modules, like the MACView® IPR card, by which the analyser can be read out through the intranet or internet. Please consult your supplier for these options.

Warning! This mode cannot signal warnings or critical errors on the analog output! In case of a critical error, the output will fall back to concentration value of 0 ppb.

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

OUR KNOWLEDGE
IS YOUR SUCCESS

Periodic calibration

With (for example) digital input 3 the ethene gas analyser can be triggered to start a calibration from a measurement computer. This calibration will be performed when the input is longer then 5 seconds.

- With (in this example) digital input 3 the ethene gas analyser can be triggered to start a calibration from a measurement computer. This calibration will be performed when the input is longer then 5 seconds is active.
- In this mode the analog output signal goes to 0.5 mA output state. (calibration runs or calibration alarm)
- After calibration (that takes 10 – 15 minutes) the ethene gas analyser goes to standard mode. The output on the analog output of 0.5 mA will then also be stopped. The analog output can then go to every other output value.
- The ethene gas analyser will control the number, interval and necessity of calibration runs. If it is not necessary to calibrate, the ethene gas analyser will pass over the calibration command received on the digital input 3.
- For the calibration mixture it is advised to use always a little amount of O2 in the bottle of around 1% or more.

Physical IO connections minimum necessary

To get a most reliable connection between a ethene gas analyser and a measurement system there are 4 connections advised:

- Analog output of 4-20 mA with status information from the ethene gas analyser to the measurement system. Special attention is to implement the 0-4 mA statuses in software so that the measurement system can recognize the different statuses in which the ethene analyser runs. Also warning and critical error modes are recognised.

  Implement the warning mode as a pre alarm but not as a final alarm. This is a warning when for example sudden temperature changes occur or when a sudden flow drop is detected in the flow line. The ethene gas analyser will always try to solve a warning mode and clear the alarm in short time. This warning level needs not to be forwarded to a user. In this state the system works reliable, but the user has to take attention if the error not becomes critical.

  If a warning mode can not be solved by the system or the external situation asks direct response from people or a technician, then the critical error mode is activated. This mode must be forwarded to the user as a real alarm and in most cases a technician or an expert is needed to solve the internal problem in the ethene gas analyser or solve an external problem outside the analyser. A critical warning also indicates that reliable working is impossible. The system will not function anymore if this state occurs and need to be reset.

- Digital input (in this example) on digital input 2 for periodic zero measurement and for storage room

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

triggering.

- Digital input (in this example) on digital input 3 for periodic calibration.

- Digital output 2 for (default on output 2) signalling critical alarms. This digital output alarms signals the critical alarm state and helps the system to become more reliable. This connection is not necessary when the analog output with status information is used. If you use the 4-20 mA without status information, then it is necessary to use this digital output error alarm on relay 2.

Tube connections

- The measurement line (IN1 or IN2) will be connected as a shunt line. The ethene gas analyser get gas from an outlet at which air flows free with any speed bigger then 150 ml/min. The ethene gas analyser get its own necessary flow. The rest amount will be past by a T-piece. Take care that not a to big pressure is put on the inlets.
- The calibration line can be connected in parallel with the input line.
- To the backside of the ethene gas analyser connections for hoses can be connected as well as connections for Swagelok tubing. G1/8” female connections are standard, and every ferule that is used with this standard can be easily connected. The connection is female (inner thread) in which a male (outside thread) connection can be placed. (Take care to use a little Teflon tape to prevent possible leakages. In no way use any glue to tight holes or leakages because glue contains solvent chemicals that can negative influence the senor element.)

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl

OUR KNOWLEDGE
IS YOUR SUCCESS

Practical things to consider before starting

- Think before about the dimensions of the system..
- Think how many storage rooms or measurement points must be measured. What is the measurement time when all storage rooms in a certain time must be measured.
- Think how about how you want to calibrate the system.
- Think about the measurement range you want to use. 3 ranges are standard.
- Check your analog impedance of the analog 4-20 mA input with the impedance of the analog output of the ethene gas analyser.
- Product numbers for orders are:
  - 102231 Postharvest ethene gas analyser measurement range of 0-500 ppm
  - 102241 Postharvest ethene gas analyser measurement range of 0-5000 ppb
- Check and test that all strange situations in the gas analyser will be detected and send to the measurement computer or measurement system so that in no way errors are not recorded and send to the user!

Raiffeisenstraat 24
4697 CG Sint-Annaland

t +31 (0) 166 65 72 00
f +31 (0) 166 65 72 10

e info@macview.nl
I www.macview.nl