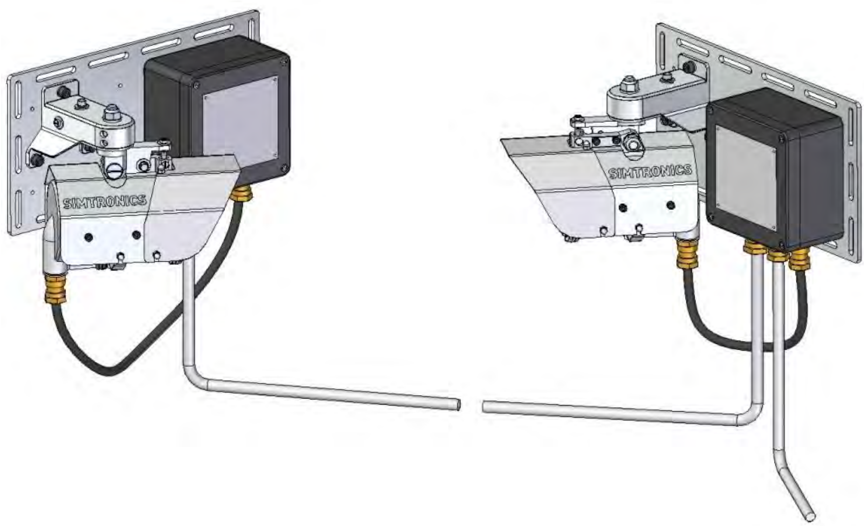
Operating Manual



Simtronics GD1 MK2
Toxic Open Path Gas Detector

SIMTRONICS
Fire & Gas

Doc: 850-816926 R04

Note

This manual must be carefully read by those who have or will have the responsibility for the operation or maintenance of this product. The product may not perform as designed if it is not used and maintained in accordance with the manufacturer's instructions.

The warranties made by Simtronics with respect to the product are voided if the product is not used and maintained as described in this manual.
Please read the general warnings in chapter 2.

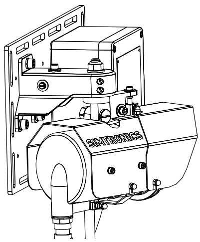
TABLE OF CONTENTS

1. INTRODUCTION

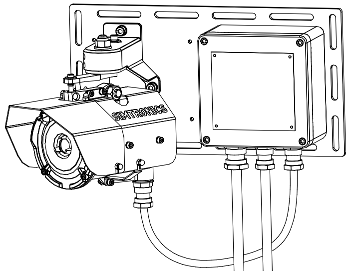
1.1. The system

The GD1 is a laser-based open path Gas Detector with a separate transmitter (RX) and receiver (RX). The transmitter emits infrared laser light which is detected by the receiver. The detection principle is based on measuring the absorption of light by the gas molecules along the optical line-of-sight.

RECEIVER



TRANSMITTER



1.2. Definitions

TX	Transmitter
RX	Receiver
Absolute transmission	Strength of the optical signal.
Relative transmission	Strength of the optical signal relative to the signal stored when finishing alignment. During commissioning the GD1 is set up with optimum alignment and signal strength. The relative transmission is used to keep track on how dirty or out of alignment the system has become after the GD1 was commissioned.

2. WARNINGS

This document is not contractual. The specifications may be modified without notice to improve the product, or to meet applicable standards.

2.1. Safety

The Simtronics GD1 gas detector is certified for and intended for use in potentially hazardous areas. Install and use the Simtronics GD1 gas detector in accordance with the appropriate local or national regulations.
The GD1 system must be properly earthed to protect against electrical shock and minimize electrical interference.
Test gases may be toxic and/or combustible. Refer to Material Safety Sheets for appropriate warnings.
Operators must be fully aware of the actions to be taken if the gas concentration exceeds safe level.
The detector should be installed and operated by trained and qualified personnel only.
Do not open the detector. All warranties void if opened. There are no user serviceable parts or settings inside, and calibration is factory set. Return to factory for service or repair.

2.2. Ownership and confidentiality

The information, design data, drawings and diagrams contained in this document remain the property of SIMTRONICS and are confidential.
The information contained in this document cannot be used, either partially or wholly, nor divulged or reproduced without the prior agreement of SIMTRONICS.

2.1. Liability

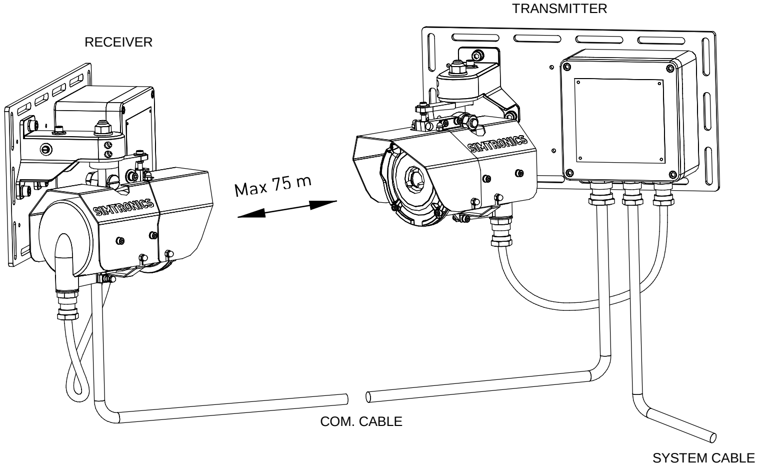
The liability of SIMTRONICS shall be limited to any direct prejudice resulting from failure on SIMTRONICS part to fulfil the contract. SIMTRONICS shall decline all liability for any indirect prejudice caused.
By explicit agreement between the parties, the term "indirect prejudice" shall refer in particular to any financial loss, moral damage, loss of profit, earnings, clients or order, or any action taken against the client by a third party.
Moreover, any damages due from SIMTRONICS for any reason whatsoever shall not exceed the tax-exclusive value of the contract, except in the event of an intentional or fraudulent offence on the part of SIMTRONICS.
Application of the equipment warranty is subject to compliance with the state of the art and the operating instructions contained in this manual.
The SIMTRONICS warranty shall not apply; furthermore SIMTRONICS declines all liability, for damage to equipment or harmful accidents caused by negligence,

failure to supervise the equipment or failure to use the equipment in compliance with the applicable recommendations, standards and regulations stipulated in the present manual.
The SIMTRONICS warranty shall not apply to faults resulting either, from materials supplied by the Purchaser, from design imposed by the Purchaser, from servicing or maintenance carried out on SIMTRONICS equipment by a third party not explicitly authorized, or from the use of unsuitable storage conditions.
In order to guarantee correct operation of the system, any addition of equipment to the system or any modification of the installation must be validated by SIMTRONICS.

3. INSTALLATION

! **The area in which the detector may be installed must be in accordance with the certification of the detector and in accordance with the standards of the appropriate authority in the country concerned.**

3.1. System parts



The complete GD1 system consists of a TX sending a laser beam to the RX. Communication to control room and power to the GD1 is connected to the TX. Between the TX and RX there is a cable with communication and power.
The TX where the laser is located sends a diffused light beam (invisible) to the receiver. The beam is shaped as a cone, not a focused laser beam as you might expect from a laser pointer. The TX comes complete with the TX and junction box mounted on a backing plate.
The RX has a larger optical aperture to collect the transmitted light and add margin to path alignment. The TX and RX communicate on a data link (cable). The RX comes complete with the RX and junction box mounted on a backing plate.

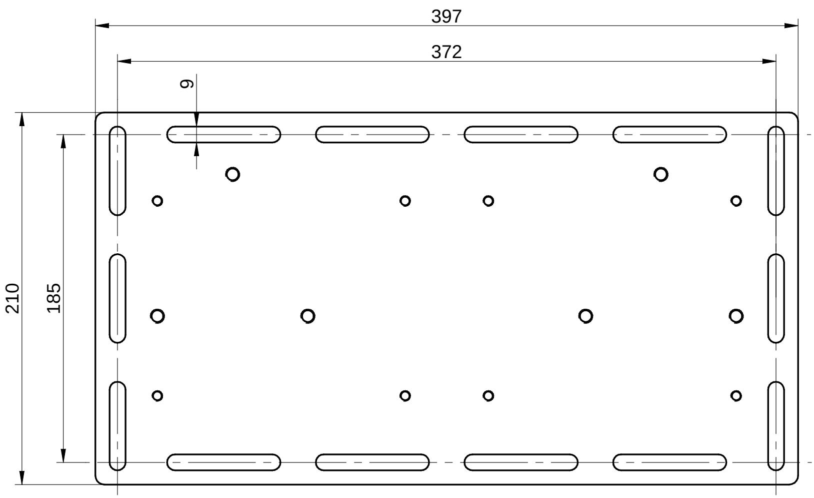
3.2. Positioning

Deciding on how the GD1 detectors should be placed at the site is discussed in section 0. During installation the detector should be positioned according to the following points:

- Check that there is a free line of sight between the TX and RX.
- The measuring path should be horizontal.
- Avoid that the measuring path is blocked by temporary scaffolding, parked cars, high traffic and moving structures.
- The detector should be attached to a mechanically rigid structure.
- The GD1 should be positioned as to avoid more than one TX transmitting into a RX. Failing to do this can lead to interference between the detectors and false alarms.
- The transmitter and receiver units are to be fitted perpendicular to the measuring path, within ± 20 degrees.

3.3. Mounting

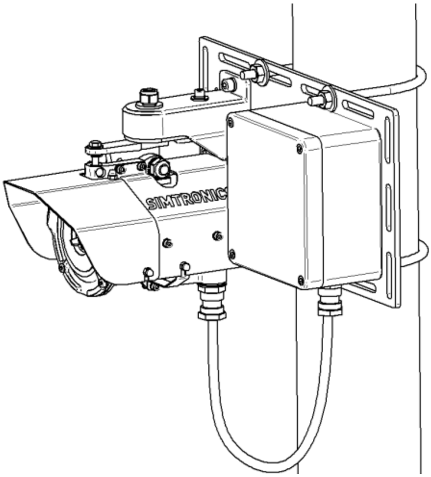
The GD1 Transmitter and Receiver system assemblies are delivered on a 6mm (1/4") universal mounting plate suitable for most mounting situations. See figure below for general dimensions (mm).



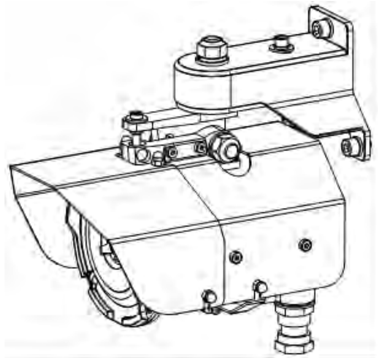
The transmitter and receiver units are to be mounted perpendicular to the measuring path, within ± 20 degrees.

3.3.1. Mounting on pole

If the detector is mounted on a pole/pipe, it is important that the pole/pipe is structurally rigid enough that the detector will not move out of its alignment tolerances. The diameter of the pole/pipe diameter needs to account for the mounting height. Simtronics recommends that for a mounting height of 2m, minimum Ø 3" (75 mm) pole is used for sufficient rigidity. If mounting height is increased, pole/pipe diameter should increase accordingly.



3.4. Sun shielding

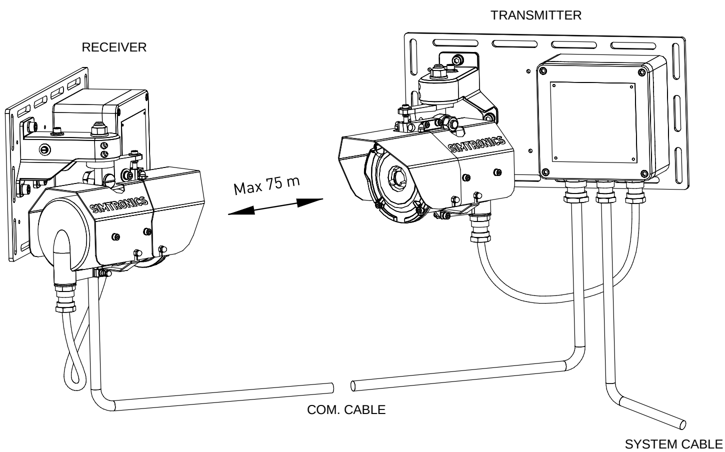


The transmitter and receiver are fitted with a sun shield as standard. The visor part of this is removed during alignment. This is easily removed by loosening the 4 nuts on the stud bolts. Make sure the visor is refitted when alignment is finished.

In locations where there is a risk that the temperatures can exceed the certified limits for the ambient temperature, it is suggested to mount a small canopy above the detector for additional sun shielding.

It is not recommended to store a GD1 for a long time un-powered outside in a hot environment. If the detector is stored unpowered in high temperatures for several months, it might lead to settings needing adjustment.

3.5. Electrical connection and wiring

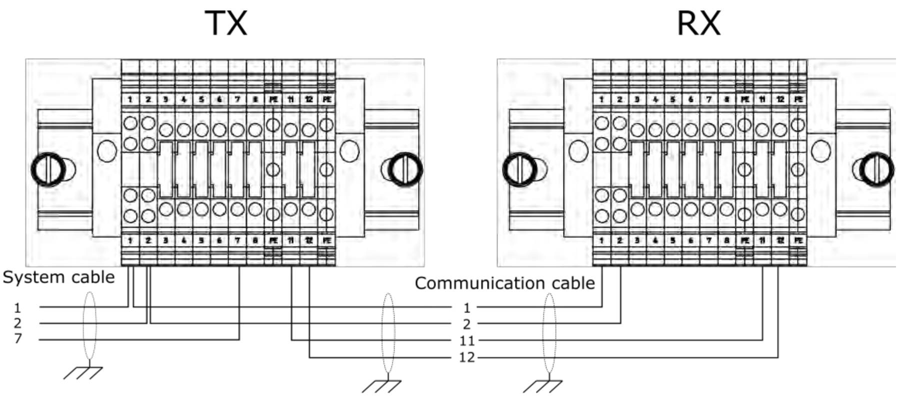


Make sure that power is disconnected or switched off before connecting any cable.

The system supplying power to the GD1 shall have a fuse allowing maximum 1 A of current to enter the GD1.

The detector must be earthed for electrical safety and to limit the effects of radio frequency interference. Earth connection points are provided on the underside of the GD1 housing and inside the Junction Box.

The connection terminals are accessed by removing the covers of the junction boxes. Wiring diagrams are shown below. The system cable only goes to the transmitter unit. The cable between the junction boxes carries the power to the receiver and the communication signals. Unless otherwise instructed, please observe that the system power and analogue output cable is terminated on the transmitter side of the GD1 system.



Wiring overview Transmitter Junction Box:

System cable	Terminal	Cable from GD1 instrument Wire color	Transmitter Junction Box	Com. cable
+24 VDC	1	White	+24 VDC	+24 VDC
0 V Return (GND)	2	Brown	0 V Return	0 V Return (GND)
	3	Green	Ethernet®	
	4	Yellow	Ethernet®	
	5	Black	Ethernet®	
	6	Violet	Ethernet®	
Signal to control room	7	Blue	4-20 mA primary gas value and **HART®**. Default is source configuration with 4-20 mA measured between terminals 7 and 2 (0V). For sink configuration 4-20 mA is measured between terminals 7 and 1 (24 V).	
	8	Red	Secondary current loop: Relative transmission (configurable).	
	PE	-	Earth	
	11*	Gray	TxRx Com 1 from Rx	TxRx Com 1
	12*	Pink	TxRx Com 2 from Rx	TxRx Com 2
	PE	-	Earth	
Note! Instrument damage can occur if incorrectly connected.				

* Wires to terminal 11 and 12 shall be twisted.

Wiring overview Receiver Junction box:

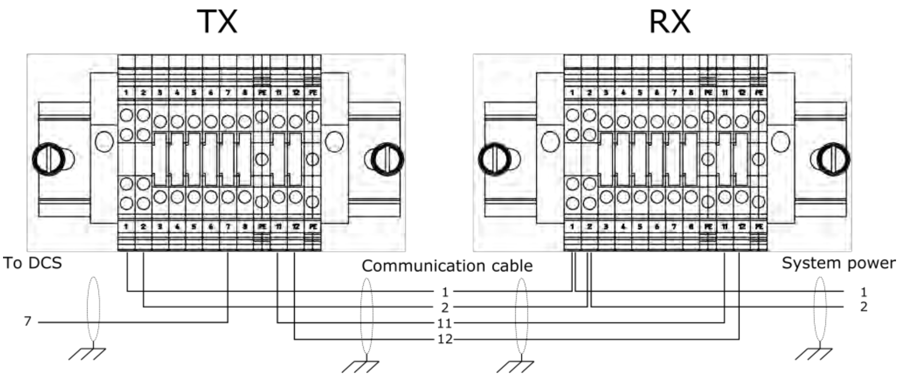
System cable	Terminal	Cable from GD1 instrument Wire color	Receiver Junction Box	Com. cable
	1	White	+24 VDC from Tx	+24 VDC
	2	Brown	0 V Return from Tx	0 V Return (GND)
	3	Green	Do not connect.	
	4	Yellow	Do not connect.	
	5	Black	Do not connect.	
	6	Violet	Do not connect.	
	7	Blue	Tertiary current loop: Relative transmission (configurable).	
	8	Red	Do not connect.	
	PE	-	Earth	
	11*	Gray	TxRx Com 1 from Tx	TxRx Com 1
	12*	Pink	TxRx Com 2 from Tx	TxRx Com 2
	PE	-	Earth	
Note! Instrument damage can occur if incorrectly connected.				

* Wires to terminal 11 and 12 shall be twisted.

3.5.1. Alternative wiring configurations

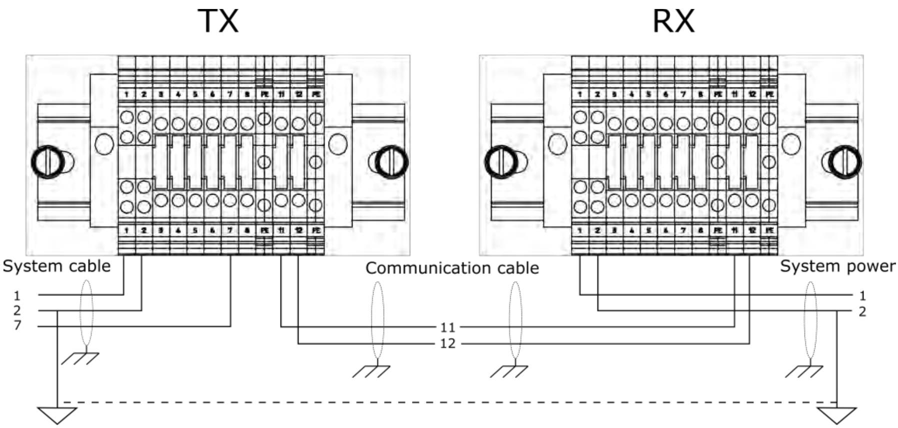
The default wiring configuration for the GD1 is with power and 4-20 mA connected to the TX side, and with power supplied to the RX via the TX junction box.

Wiring alternative 1: System power connected on the receiver side



Wiring alternative 2: Power on both receiver and transmitter side

The instrument 0 V shall be the same for both RX and TX.



3.5.2. Cable types and specification

Cables must be chosen in accordance with applicable regulations.

<u>System cable:</u>
Cable from the GD1 system to control system. The table below indicates maximum cable lengths (2-wire) restrictions due to voltage drop over the power supply cable.

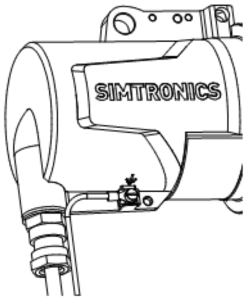
<table>
<tr><th>Min. single wire cross area</th><th>0.75 mm^2</th><th>1.25mm^2</th><th>2.5 mm^2</th><th>4.0 mm^2*</th></tr>
<tr><td>Supply voltage 24 VDC, terminal 1. Max length.</td><td rowspan="2">125 m</td><td rowspan="2">250 m</td><td rowspan="2">400 m</td><td rowspan="2">800 m*</td></tr>
<tr><td>Supply voltage 0 V Return on terminal 2.
Max length.</td></tr>
<tr><td>Primary Loop, terminal 7.</td><td colspan="4">The wiring should be such that the total impedance of the current loop, including cabling, connections and input on control system should be maximum 500 Ω.</td></tr>
</table>

*The GD1 is by default delivered with terminal blocks for wires up to 2.5 mm^2.

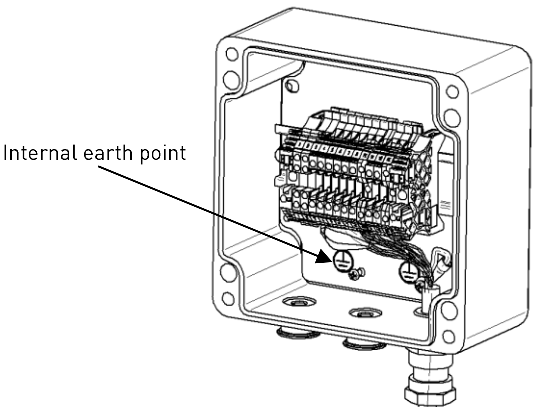
TX / RX communication cable:
Cable between the GD1 Transmitter and Receiver, containing data and power supply. The cable shall be an instrument type with 2 twisted, individually shielded pairs and with an overall shield. Wiring up to 200 meters shall have a minimum cross section of 0.75 mm^2. For longer distances the maximum impedance of 70 Ω must be considered.

3.5.3. Earth connection

The detector housing must be connected to local earth via the external earth point. The wire should be minimum 4 mm^2 (8 AWG) and as short as possible.



The shield of the system cable should be connected to instrument earth in the central control module, and is normally not terminated at the detector. Exception: If extra RFI protection is required, and the installations grounding principles/regulations allows it, the shield is terminated to local ground via the internal earth point at the detector instead.



4. COMMISSIONING

The commissioning of the GD1 consists of four steps:

- Section 4.1 Preparation.
- Section 4.2 Coarse alignment with laser pointer.
- Section 4.3 Fine tuning
- Section 4.4 Function test

4.1. Preparation

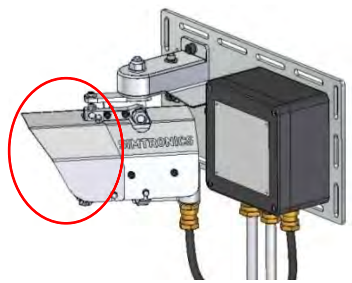
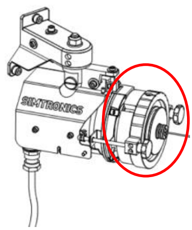
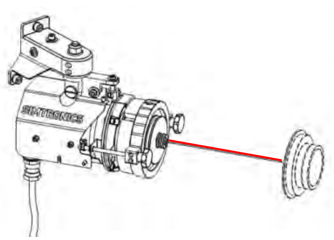
Before starting the commissioning check that the following points are fulfilled:

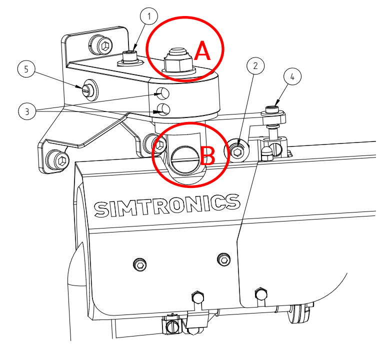
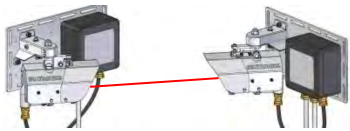
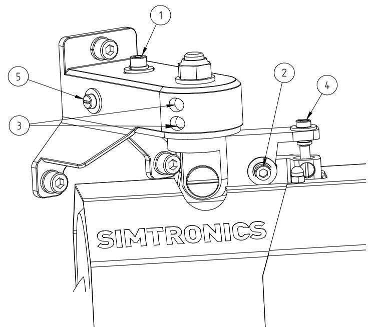
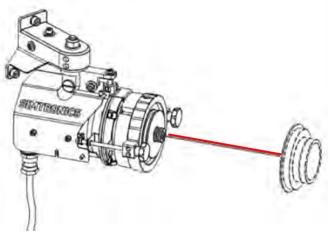
- Commissioning should be carried out in clear weather in order to allow for correct transmission settings.
- There is a free line of sight between the transmitter (TX) and receiver (RX).
- Check that optical surfaces on the detector and reflector are clean and dry.
- There should be no H_2S gas present during commissioning.

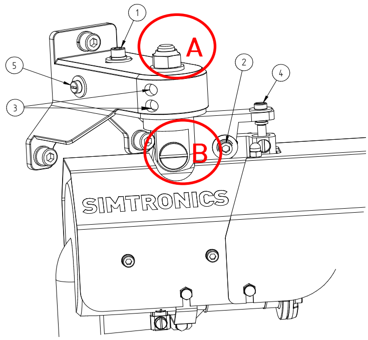
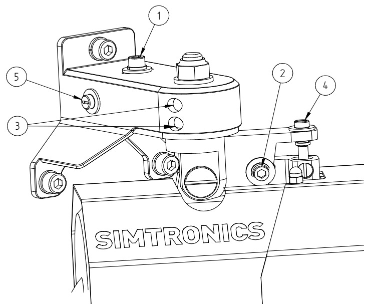
Power up the GD1 system and let it warm up for 30 minutes before doing the final alignment in section 4.3.

4.2. Coarse alignment with laser pointer

The object for the coarse alignment is to set an initial transmission level. This signal level is then used as a reference for further tuning, and a minimum signal level must be present before fine alignment can be performed.
It is recommended that a GD1 Alignment Kit is used. The Alignment Kit contains, among other things, a laser pointer, Alignment Interface Unit (AIU) and special safety glasses for eye protection and better viewing of the laser spot. Although it is possible to perform a coarse alignment without the aid of tools, it is more time consuming. The following procedure assumes the use of a GD1 Alignment Kit.

#	Description	Illustration
1	Remove sunshade	
2	Attach one Alignment Interface Unit (AIU) on the TX and one on the RX.	
	Do not stare directly into the Alignment Laser when it is operating. It is recommended that laser safety glasses are used. In sharp sunlight, the glasses will also make it easier to see the laser pointer.	
3	Insert the Alignment Laser into the AIU on the TX, and the Laser Target Plate on the RX side.	

4	Loosen screws 1, 2 and 3 of the TX. Check that the fine adjustment screw 5 is set approximately to middle position (indicated by the screw 1 being in the middle of the slot). **Important:** Nut **A** and nut on bolt **B** are tightened correctly in the factory and should not be touched. If tightened too much, they may jeopardize the correct operation of adjustment screws 2 and 5.	
5	Rotate horizontally by hand the TX towards the RX. Tighten screws 3 fully.	
6	**Note!** Make sure screws 1 and 2 have been loosened before adjusting alignment. If screws 1 and 2 are fixed during the next steps, damage can occur to the alignment mechanism. Adjust the TX with screws 4 (vertical direction) and 5 (horizontal direction) until the laser spot hits the target plate on the RX. Tighten screws 1 and 2 on the TX.	
7	Insert the Alignment Laser into the AIU on the RX, and the Laser Target Plate on the TX side.	

8	Loosen screws 1, 2 and 3 on the RX. Check that the fine adjustment screw 5 is set approximately to middle position (indicated by the screw 1 being in the middle of the slot). **Important:** Nut **A** and nut on bolt **B** are tightened correctly in the factory and should not be touched. If tightened too much, they may jeopardize the correct operation of adjustment screws 2 and 5.	
9	Rotate horizontally by hand the RX towards the TX. Tighten fully screws 3.	
10	Adjust the RX with screws 4 and 5 until the laser spot hits the target plate on the TX. Tighten screws 1 and 2 on the TX.	
11	Carefully detach the Alignment Interface Units and proceed to fine tuning.	
Coarse alignment finished!		

4.3. Fine tuning

⚠ Please be aware that the GD1 4 – 20 mA output going to control system is set to 2 mA during alignment, 1 mA during Init (reboot).

Note! Poor alignment will reduce system performance. Use care to ensure good alignment. Be aware that the nature of the GD1 system's laser beam implies a smaller target area than with traditional open path systems, and higher alignment accuracy is needed to achieve sufficient optical transmission levels.

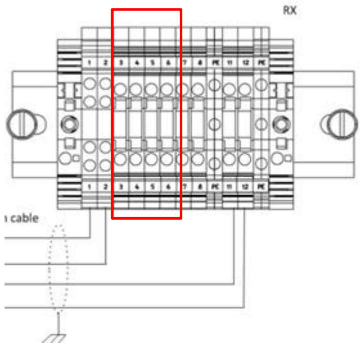
Tuning of signal strength (transmission tuning) can be performed with two different methods:

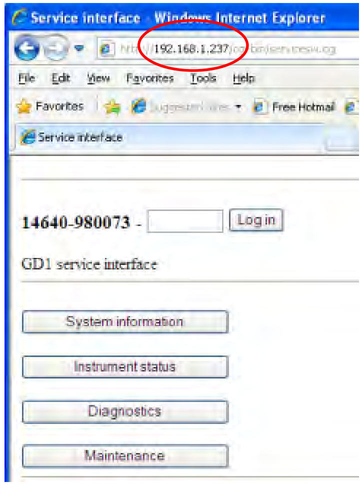
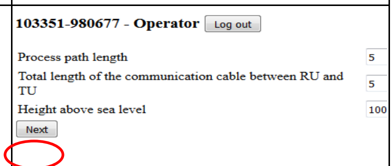
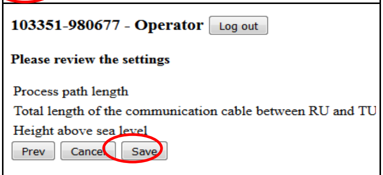
- Using a Web browser through an Ethernet connection. This is the preferred method.
- Using a HART® terminal connecting through the 4-20 mA current loop (Primary current loop) and a multimeter.

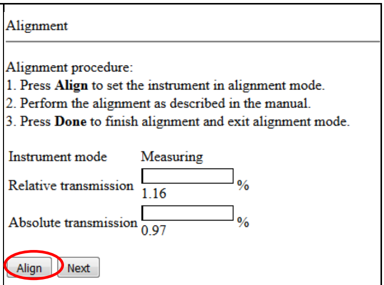
Both methods are explained in the two sections below.

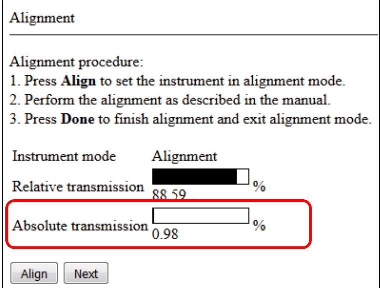
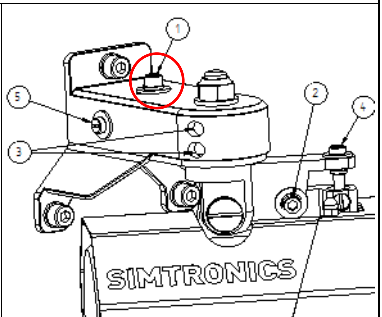
4.3.1. Using a Web browser for tuning of signal strength

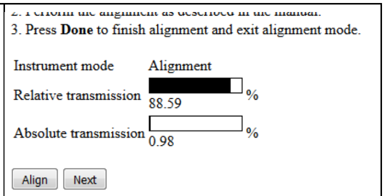
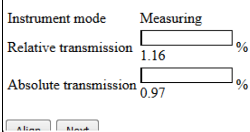
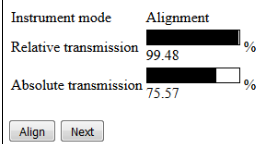
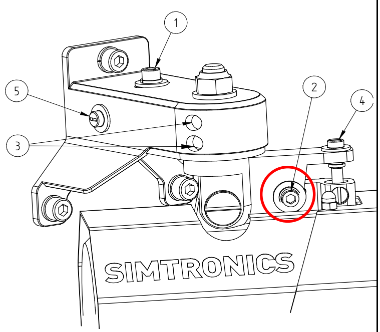
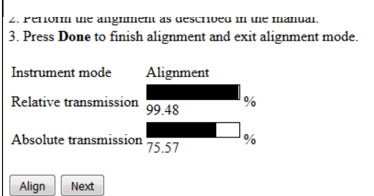
All functions for the GD1 Service Interface are described in section 12.5. The procedure for fine alignment and transmission tuning is as follows:

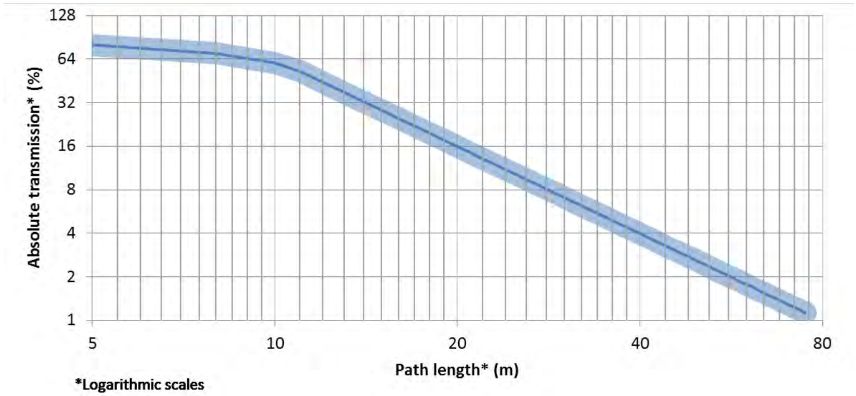
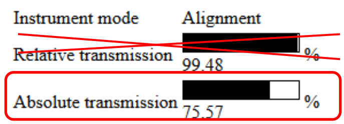
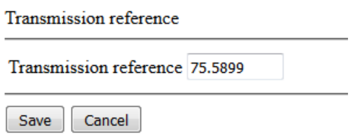
#	Step description	Illustration
1	Clean the lenses of both transmitter (TX) and receiver (RX) for any dirt before proceeding. The optical path should be clear at the time of aligning (avoid fog, mist, steam, rain, snow, etc.).	
2	On the transmitter, connect the Ethernet adapter to the Junction Box terminals 3 - 6.	

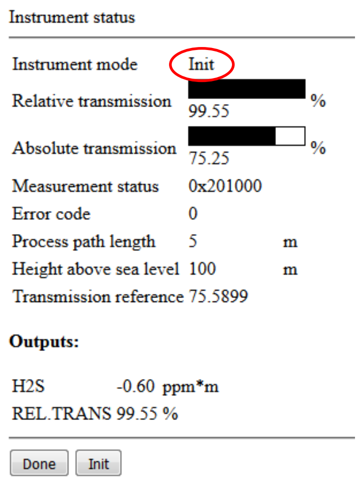
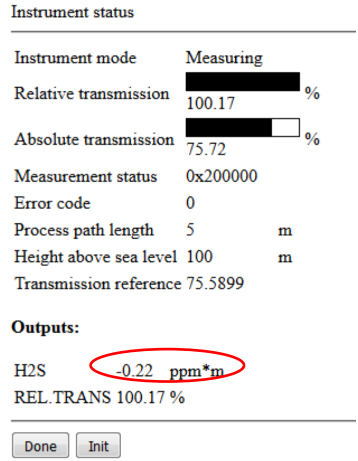
3	Use a device having Web browsing capabilities, for example laptop, to connect with the wireless router or Ethernet cable. In the web browser of your device, enter the GD1 Service Interface on the address http://192.168.1.237	
4	Log into the Service Interface with the Operator password: "**gd1tlc**" After logging in as Operator more functions are accessible as illustrated in the right image.	
5	Click COMMISSIONING followed by ALIGNMENT to get into the alignment page. Enter the parameters for *path* length, cable length and altitude. Path length does not affect the H2S measurement and is only used for troubleshooting. Cable length and height above sea shall have a precision of better than ±300 meters. Click "Next" followed by "Save".	

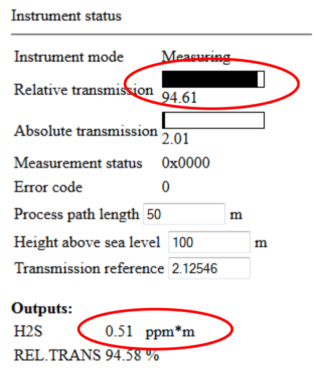
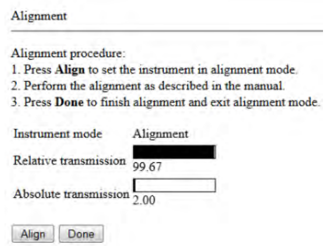
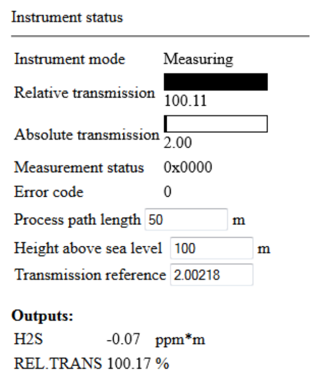
<table>
<tr>
<td>6</td>
<td>Clicking the “Align” button sets the system in Alignment Mode. If sufficient laser light is collected by the RX, the signal strength will be shown in the <u>Absolute transmission</u> field.</td>
<td>
</td>
</tr>
<tr>
<td>7</td>
<td>The relative transmission is automatically set to 100% when entering alignment mode.

Notice that it is the <u>Absolute transmission</u> that shall be optimized. The Relative transmission is only used to assist in the alignment process since it will “remember the highest <u>absolute transmission</u> seen since going into align mode.</td>
<td>
</td>
</tr>
<tr>
<td colspan="3">A new reference can be set at any time by pressing “Align” again. This reference is than used as 100% relative transmission until alignment is improved and is used as reference.</td>
</tr>
<tr>
<td>8</td>
<td>Slightly loosen only <u>screw 1</u> just enough for the alignment mechanism to be able to move in the horizontal direction.</td>
<td>
</td>
</tr>
<tr>
<td colspan="3">Note! If at some stage during the fine alignment process, the beam is adjusted totally out of position and signal is “lost”, it is a good idea to clip the Alignment Interface Unit back on and use the Alignment Laser as an aid to get back to an adjustable position.</td>
</tr>
</table>

9	Align in horizontal direction by turning screw 5. Turn very slowly in the direction whereby the absolute transmission increases. The relative transmission will stay close to 100% as long as the absolute transmission is increasing.		
10	When continuing to turn the screw after the maximum signal strength is reached, the absolute and relative transmission will start to drop.		
11	Turn screw 5 back the other direction until the relative transmission is better than 95%. This should be close to the optimum position in the horizontal direction.		
12	Tighten screw 1.		
13	Slightly loosen **only** screw 2 just enough for the alignment mechanism to be able to move in the vertical direction. Note that the absolute and relative transmission will typically drop slightly when screw 2 is loosened. If the values drop significantly, it can be helpful to reset the relative transmission to 100% again by clicking the "Align" button.		
14	Align in vertical direction by turning screw 4. As for the horizontal alignment, turn very slowly in the direction whereby the absolute transmission increases. After reaching the maximum and the signal starts to drop, turn back until the relative transmission is better than 95%.		
15	Tighten screw 2.		

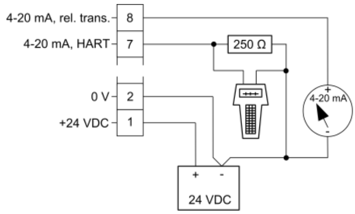
16	Check that the absolute transmission is as expected (indicated in the graph below). The obtained absolute transmission can vary somewhat from detector to detector. If the signal is significantly lower than the suggested values, this is an indication that the fine alignment needs to be improved, the RX is poorly aligned or the lenses are dirty. The RX is usually well enough aligned during the Coarse alignment, but this can also be a reason for too low signal. 	
17	If the absolute transmission is acceptable click DONE. If the absolute transmission is significantly lower than expected then also perform fine tuning for RX in addition to the TX.	
18	Click “Save”.	

19	Enter the screen "Instrument status" and wait for the GD1 to reboot and finish the Init procedure. In some cases, it can take several minutes for "Init" to finish.	
20	When the GD1 is in Measuring mode check that the noise level is OK by checking how the H2S output is fluctuating. The H2S level can fluctuate up to <u>± 8 ppm*m</u> in normal conditions. If the noise is at an acceptable level, step 21 to 23 can be omitted.	

<table>
<tr>
<td>21</td>
<td>If the signal in step 20 was too noisy (outside ± 8 ppm*m), adjust slightly vertical or horizontal alignment until the noise is reduced to an acceptable level. Avoid reducing the signal strength too much; a drop of 5 % in relative transmission is fine.</td>
<td>
</td>
</tr>
<tr>
<td>22</td>
<td>When finished minimizing the noise, enter Alignment mode, click "Done" and "Save" on the following screen.</td>
<td>
</td>
</tr>
<tr>
<td>23</td>
<td>Verify that the GD1 enters Measuring mode.</td>
<td>
</td>
</tr>
<tr>
<td colspan="3">Note! As a default the zero filter is activated, filtering any noise/measurement and outputting 4 mA on the analogue output as long as the measurement is below 7% FS.</td>
</tr>
<tr>
<td colspan="3">Fine tuning finished!</td>
</tr>
</table>

4.3.2. Using a HART® for tuning of signal strength

For tuning of signal strength and setting of transmission reference level, use the Alignment Interface Unit and a HART® terminal.

#	Step description	Illustration / response
1	Clean the lenses of both transmitter (TX) and receiver (RX) for any dirt before proceeding. The optical path should be clear at the time of aligning (avoid fog, mist, steam, rain, snow, etc.).	
2	Connect the HART® terminal between terminal 7 and 2, in parallel with a resistor as shown in the figure to the right. See section 12.6 for a more detailed description on HART®.	 HART® terminal connection for source variant
3	On the HART® terminal start the "Alignment procedure". This can be found in the following path: Configuration→Setup→Alignment	
4	On the HART® terminal enter the command: #SM	Terminal response: SM Analogue loop 1 (terminal 7) and loop 2 (terminal 8) will output 2 mA.

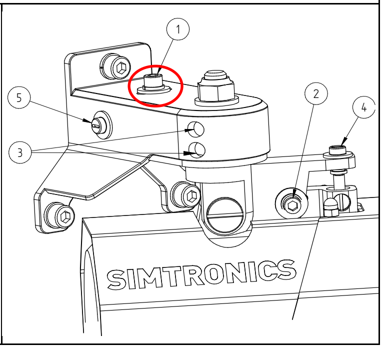
The system is now entering Service Mode. Using HART, it is necessary to go through Service Mode to enter or exit Alignment Mode.

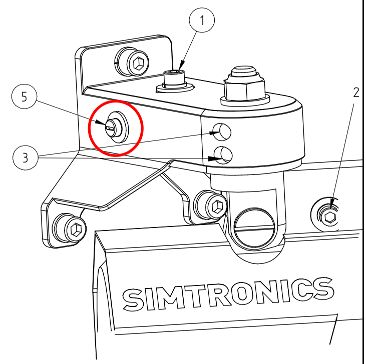
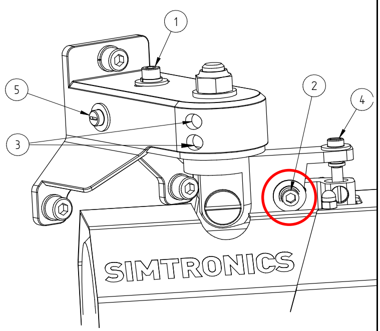
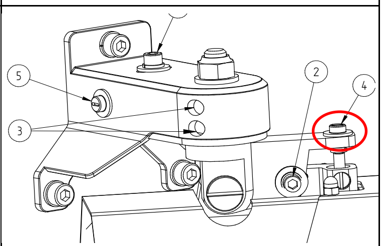
5	On the HART® terminal enter the command: **#AM**	Terminal response: **AM** Response on secondary loop (terminal 8) is set to between 3 and 14 mA depending on the strength of the optical signal received on the RX.

The system is now entering Alignment Mode (AM). If sufficient initial IR laser light is collected by the receiver, the mA meter will show a value near 14 mA. If too little laser light is received at the RX, the meter will show 3 mA. If this is the case, repeat coarse alignment until the mA meter shows a higher value.

By factory setting, 14mA represent the strongest optical signal received after entering AM. Any value lower than 14 mA means that the alignment between TX and RX is less optimized than the best position seen during AM. If the alignment is improved the signal strength is increasing and the value on the mA-meter will increase. If the signal strength is increased to above 14 mA, the scale will automatically be increased so the new best position again is 14 mA. By outputting this information it allows for a user to gradually narrow down to an optimal alignment position by manually sweeping the beam spot back and forth in each direction.

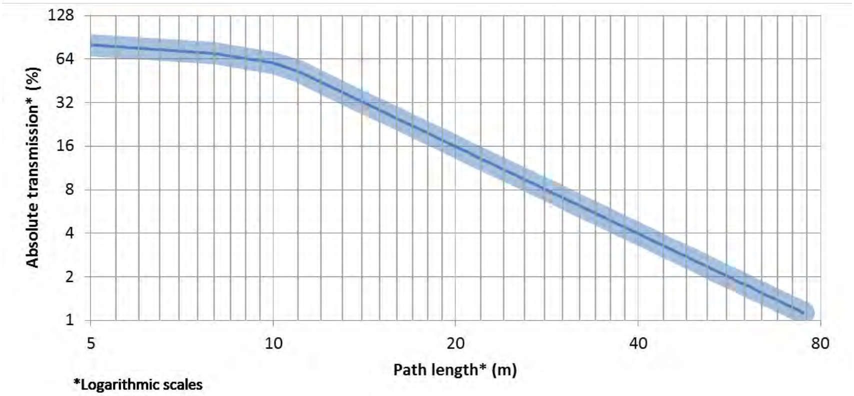
Note! If at some stage during the fine alignment process, the beam spot is adjusted totally out of position and is "lost", it is a good idea to clip the Alignment Interface Unit back on and use the Alignment Laser as an aid to get back to an adjustable position.

6	Slightly loosen <u>screw 1</u> just enough for the alignment mechanism to be able to move in the horizontal direction.	

7	Align in horizontal direction by turning <u>screw 5</u>. Turn very slowly in the direction whereby the signal strength increases. The signal reading will stay close to 14 mA as long as the signal strength is increasing.	
8	When the maximum signal strength is reached and the mA reading will start to drop.	
9	Turn <u>screw 5</u> back the other direction until the signal strength is back at maximum. The typical signal strength after a successful fine alignment should preferably be above 13.9 mA. Do not expect to see exactly 14 mA.	
10	Tighten <u>screw 1</u>.	
11	Slightly loosen <u>screw 2</u> just enough for the alignment mechanism to be able to move in the vertical direction. Note that the signal strength will typically drop slightly when <u>screw 2</u> is loosened. If the value drops significantly, it can be helpful to reset the maximum recorded signal strength by entering #AM on the HART terminal.	
12	Align in vertical direction by turning <u>screw 4</u>. As for the horizontal alignment, turn very slowly in the direction whereby the signal increases. After reaching the maximum and the signal starts to drop turn back until the signal is back close to the maximum.	
13	Tighten <u>screw 2</u>.	

14	Store the current signal strength (absolute transmission) and exit Alignment mode by entering the following command in the HART terminal: **#SAV**	Terminal response: SM:OK Saves the current settings, exits Alignment Mode and enters Service mode.
15	Set the elevation above sea level by entering: **#MW 0 <altitude in meters>** For example, for a setting of 100 meters above sea level, the syntax is: #MW 0 100 **Note!** The height should be in whole meters.	Terminal response for the left example: REGISTER 0(ALTITUDE)=100 The accuracy of the height should be better than ±350 meters.
16	Set the distance between the TX and RX by entering the following command: **#MW 1** <path length> For example, for a 15 meter path, the syntax is: #MW 1 15 **Note!** The length should be in whole meters.	Terminal response: REGISTER 1(PATH_LENGTH)=1 15
17	Check the current stored signal strength (absolute transmission) by entering the command: **#MR 5**	Terminal response: REGISTER 5(ABS_TRANS)=[absolute transmission]
18	Store the current signal strength (optimum alignment) to the transmission reference by entering the following command: **#MW 2** <absolute transmission> Use the <absolute transmission> value received in the step above.	Terminal response: REGISTER 2(TRANS_REF)=[transmission reference]

Check that the absolute transmission is as expected (indicated in the graph below). The obtained absolute transmission can vary somewhat from detector to detector. If the signal is significantly lower than the suggested values, this is an indication that the fine alignment needs to be improved, the RX is poorly aligned or the lenses are dirty. The RX is usually well enough aligned during the Coarse alignment, but this can also be a reason for too low signal.



19	Save the alignment settings to the system by entering the following command **#SAV**	Terminal response: **IM:OK** This saves the current settings, exits Service Mode and initialize (reboots) the system.

Note! After initializing has completed the GD1 will enter Measuring Mode (normal operational mode). The initialization can take up to 5 minutes.

Note! The H_2S measurement can now be read between terminal 7 and 2. It is normal that the H_2S value is fluctuating with up to ± 0.6 mA (± 8 ppm*m). Noise can be reduced by adjusting the alignment as described in section 7.2.

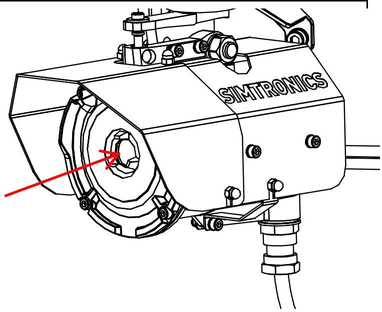
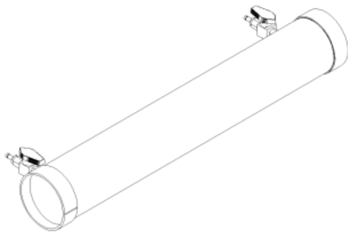
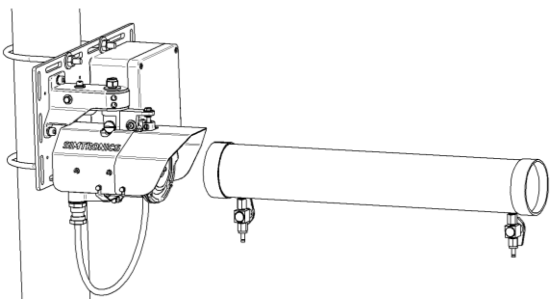
Note! As a default the zero filter is activated, filtering any noise/measurement and outputting 4 mA on the analogue output as long as the measurement is below 7% FS.

Fine tuning finished!

4.4. Function test

Warning! During the test, the GD1 4 – 20 mA output going to control system will be indicating gas when performing the procedure below.

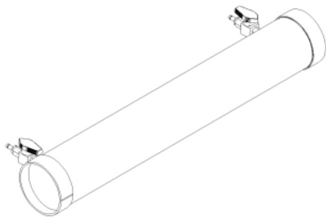
Note! The Safety Integrity Level (SIL) of 2 is based on a function check once per year.

#	Step description	Illustration / response
1	Clean the lenses on the TX and RX as described in section 6.2.	
2	Fill the Test Cell as described in the section 5.2.	
3	Position the Test Cell in front of the receiver (RX) as indicated in the figure below. 	

4	Verify the 4 – 20 mA output. The output should change according to the length of the Test Cell **multiplied** with the gas concentration. The table below contain some typical values	Expected output value (ppm*m): **<length> * <concentration>**

Note! Depending on the precision of the gas mix inside the Test Cell, do not expect to see an exact 1:1 response compared to the test gas concentration.

Functional test finished!

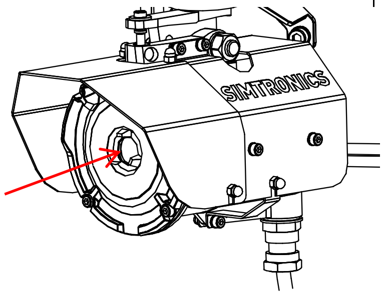
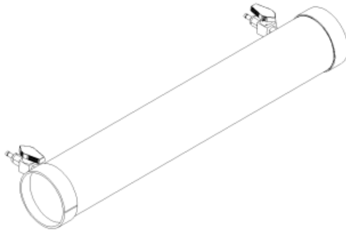
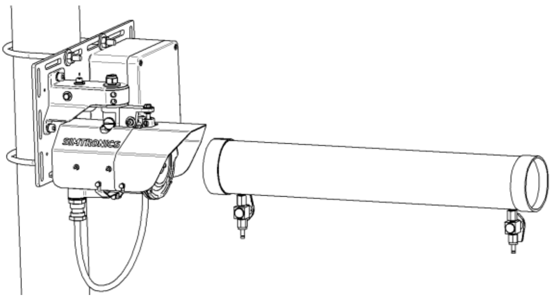
Gas concentration (ppm)	Expected response Test Cell (length 0.54 m) (ppm*m)* 
50	27
100	54
185	**100** (50% full scale)**
300	162
690	373 (out of default range)

* The expected response on the GD1 can be calculated from the following formula:
Response_GD1 = length_test_cell (meters) * gas_concentration (ppm) + noise
where the noise normally vary at less than ± 8 ppm*m.

** A test gas with approximate 50% full scale response is good practice.

4.4.1. Performing function test with CO_2 as a non-toxic alternative

As a non-toxic alternative to using H_2S for the functional test, the GD1 is also set up to look for a peak in the CO_2 wavelength. This response however, is only available using a Web terminal through the service interface. The CO2 measurement is not available on the 4-20 mA analogue output.

#	Step description	Illustration / response
1	Clean the lenses on the TX and RX as described in section 6.2.	
2	Fill the Test Cell with CO_2 as described in the section 5.2, but with CO_2 instead of H_2S. Recommended CO_2 test gas concentration is 10 000 – 100 000 ppm.	
3	Position the Test Cell in front of the <u>receiver</u> (RX) as indicated in the figure below. 	

4

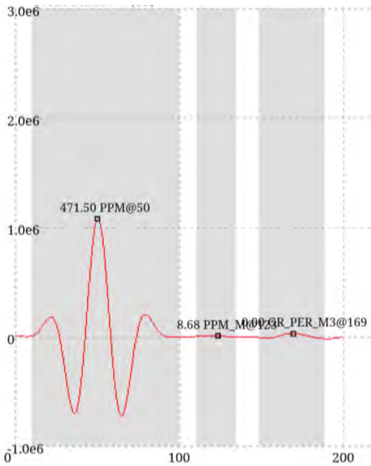
Verify the response in the GD1 spectrum.

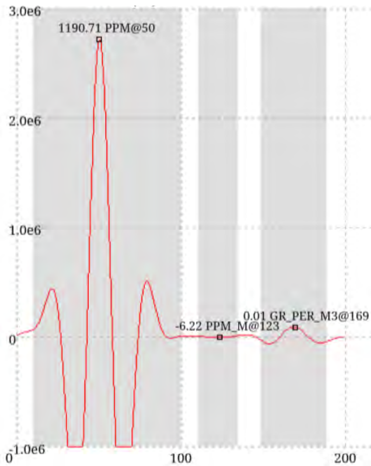
The output should change according to the length of the Test Cell **multiplied** with the gas concentration. Below is an example with 40000 ppm CO_2 filled into the Test Cell by breath.

Expected output value (ppm CO_2):

$$\frac{C_{cell} * 0.54 + C_{air} * Path\_length}{Path\_length}$$

Where C_{cell} and C_{air} is the CO_2 concentration in respectively the Test Cell and air.





The above spectrum is found in GD1 Web interface. Spectrum to the left showing 472 ppm of CO_2 in the air. To the right a spectrum showing 1 191 ppm as a result of introducing the Test Cell filled with 40 000 ppm CO_2.The value can be verified by using the formula in step 4.

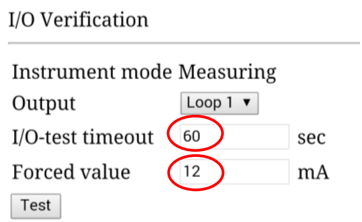
Note! Depending on the precision of the gas mix inside the Test Cell, do not expect to see an exact 1:1 response compared to the test gas concentration.

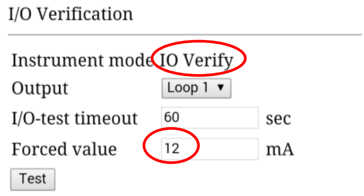
5

Run loop testing in the Web interface "I/O verification" screen.

Recommend to use 60 sec test time.

Enter test value. For example 12 mA is 50% of full scale.



6	After the GD1 reboots and goes into "IO Verify" mode, verify that the analogue output matches the test value.	
Functional test with CO_2 finished!		

5. OPERATION

! **The GD1 has no user adjustable parts inside. Do not open the GD1 housing, as this will change the internal atmosphere, and the initial calibration could be affected. Opening the GD1 also voids all warranty offered at the time of sale**

The GD1 has no user controls or adjustments (except for the specified HART settings). Gas reading and fault signaling is given through the 4-20 mA current loop interface.

5.1. Analogue Output Protocol

Condition	Analogue output 1	Analogue output 2**	Comment
Normal gas reading	4 - 20 mA	10 - 100 %	4 mA = 0% full scale 20 mA = 100% full scale and higher
Early Dirty Optics Warning (90% signal reduction)	3 mA	2 - 10 %	Detector will still output gas concentration if reading is > 7 % full scale.
Beam block, Alignment mode or Service mode	2 mA	0 - 2 %	Default 60 sec delay before entering beam block. No gas detection.
Fault or Init mode (booting up)	1 mA	Err	No gas detection.
No power	< 0.5 mA	Err	No gas detection.

* The gas reading is clipped at 3.75 mA and 20 mA and will not go outside this range as long as the GD1 is in Measurement mode.

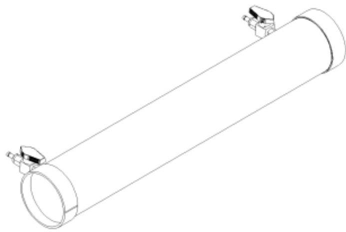
** Relative transmission.

5.2. Test Cell filling and emptying instructions

When working with Hydrogen Sulphide (H_2S) gas, observe the following:

- **H_2S is very toxic by inhalation**
- **Handle and use only in a well-ventilated space**
- **In case of accident or if you feel unwell, seek medical advice immediately.**

! **Read and understand the filling and discharging instructions before using the Test Cell**

#	Step description	Illustration / response
	Note! When filled with H_2S, the Test Cell should be kept in a well-ventilated area only. Discharge the cell to a safe area or suitable ventilator system after use.	
	Note! Maximum allowed overpressure is 100 mbar.	
1	Fit a filler hose from the H_2S gas cylinder to one of the valves on the Test Cell. Gas from gas cylinder must be run through an mbar pressure regulator regulating the pressure down to less than 1 barg. Fit an exhaust hose to the other valve. Exhaust must be released to a safe area or into a suitable ventilator system. Dimension of the valve nozzles are 6.4 mm (1/4") OD.	
2	Open both valves on the Test Cell.	
3	Start the filling of H_2S from the gas bottle to the Test Cell. With a gas flow of 3 liter/minute, wait for approximate 2 minutes. For a lower gas flow filling time has to be increased accordingly. For example for a flow of 1 liter/minute a filling time of 6 minutes is required. Too short filling time will result in the gas reading being lower when performing Function test.	
4	Close the gas bottle.	
5	When the gas stops flowing, quickly close both valves on the Test Cell.	
6	Disconnect the Test Cell from the hoses.	

Note! After filling, the Test Cell will only be able to hold the gas at a reliable concentration for a limited amount of time (few days). Replenish or refill the cell if the concentration is suspected to have dropped.
Filling of Test Cell finished!

6. MAINTENANCE

6.1. Regular maintenance

The detector does not have any internal functions that require regular monitoring or maintenance. Regular maintenance consists only of cleaning the optics.
The GD1 has no user adjustable parts. Do not open the GD1. Opening the GD1 could result in changes in the internal atmosphere, calibration and Ex safe properties of the detector. Opening the GD1 also voids all warranty offered at the time of sale. All repairs must be done by the manufacturer. Please refer to the general warnings in chapter 7.

6.2. Cleaning of optical surfaces

Take care not to scratch the lenses and optical coating while cleaning.

1) First remove dust, sand, or other hard minerals using a soft brush or cloth, bulb blower or dry and clean compressed gas or air. If using a compressed air gun or a cloth, use it very lightly.
2) Spray the lens with a dilute solution of mild (dishwasher) detergent and water. It is a good idea to first spray richly and let the cleaner dissolve some dirt and let it drip off naturally. Repeat if necessary. If the dirt is still sticking a stronger solvent might be required, a 1:1 mix of isopropyl alcohol and water can be used.
3) Wipe the lens lightly and carefully with a clean microfiber cloth or a lens cloth, repeating step 2) and 3) until the surface is clean. Cotton swabs / Q-tips can be used as an alternative.
4) Rinse with water and wipe dry.
5) Do not touch the lenses with your fingers.

7. TROUBLESHOOTING

Service and repairs shall be done by Simtronics. Troubleshooting as specified can be performed by the user.

The detector can also give fault messages if the mounting brackets are not sufficiently stable over time or in the event of mechanical changes which may, for example, be caused by temperature changes or movement in the mounting structure. The above-mentioned conditions should be checked before troubleshooting is commenced.

The most typical issues are the following:

- Misinterpretation of ppm*m as ppm. Described in section 12.4.
- Poor alignment. Please be aware that it is the absolute transmission that should be optimized, not the relative transmission (section 4.3).
- Interference from a second transmitter as described in section 0.

Troubleshooting should always start by inspecting the detector's lenses for contamination and/or defects. The following list may be helpful:

Issue	Possible source of problem	Suggested correction
Clean optics warning (3 mA)	Dirt on lens.	Clean optics (see section 6.2).
	Detector out of alignment.	Realign detector (see chapter 4).
Beam block (2 mA)	Dirt on lens.	Clean optics (see section 6.2).
	Detector out of alignment.	Realign detector (see chapter 4).
	Objects that block the measuring path.	Remove objects that block.
	Detector in alignment or service mode	Reboot detector by Service Interface (Ethernet), HART, or by cutting/reconnecting power.
Fault (1 mA)	Check error code in the Service interface Status screen.	See section 7.1 for a description and suggestion on how to solve the issue.
No Power (0 mA)	No power to the detector.	Verify with multi meter in the Junction box that detector has power.
		Check both detector and system cable wires on terminal 1 and 2 in the junction box.

No wireless or cable Ethernet connection	Not connected to network	Make sure your browser is connected to the GD1 wireless network.
	Loose connector	Check that the terminal adapter is securely connected to terminals 3 – 6
	Loose wire in Junction Box	Check terminals 3 – 6. Unscrew each wire, both internal and external wiring to the terminals, and ensure wires are properly connected to the terminals.
No Ethernet cable connection	Fault on cable	Check cable.
	Laptop not set up to connect to fixed IP address	Configure laptop network settings to connect to static IP.
	Fault in detector	Contact Simtronics.
Fluctuating H2S level	Noisy signal	Tune alignment as described in section 7.2.
	Interfering detector	See section 0.
Other error	Check error code in the Web Service or by HART.	See section 7.1 for a description and suggestion on how to solve the issue.
		Note! After solving an issue the Error code might still be displayed for some time.
Absolute transmission not as high as expected during alignment	Dirty optics	Clean optics
	Alignment of TX not optimum	Perform tuning of TX as described in section 4.3.
	Alignment of RX not optimum	Perform tuning of RX with the same method as for TX described in section 4.3.
	Laser beam obstructed by an object	Move the obstructing object or the GD1.

7.1. Error codes

Error codes are obtained by entering the Status screen through the Service Interface. After an error has been corrected, it can still be displayed in the Status screen in the Service interface.

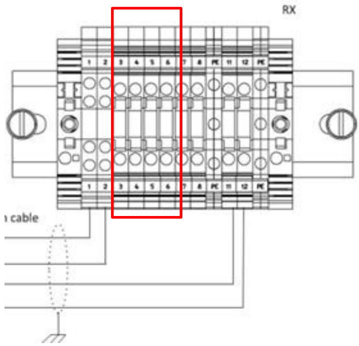
Error #	Description	Action
1-4	Only relevant for vendor.	Contact Simtronics.
5	Issue with communication between	Check wiring. See actions on

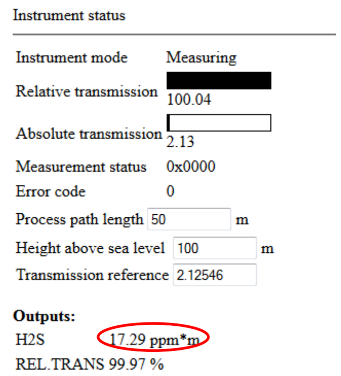
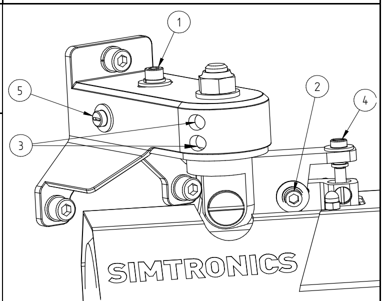
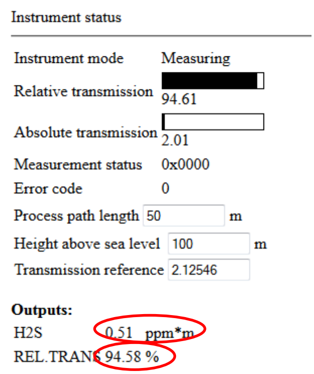
	TX and RX.	error 22.
6-7	Only relevant for vendor.	Contact Simtronics.
8	Issue booting up the receiver.	Check wiring. See actions on error 22.
9-13	Only relevant for vendor.	Contact Simtronics.
14	Beam block. Possibly laser from TX is obstructed by an object or alignment need to be improved.	Remove blocking object or improve alignment.
15	High transmission. Relative transmission >125%.	Redo alignment. Make sure lenses are clean before aligning
16	Timeout. Initialization took too long time for some reason.	Reboot the detector. Contact Simtronics if Error persists.
17	Unable to track the CO_2 line	Too short path length. Distance between TX and RX shall be 5 meters or more.
	Not able to find the CO line during CO verification.	Contact Simtronics.
18-21	Hardware error.	Contact Simtronics.
22	No contact with RX. Possible poor electrical connection in the Junction Box or no power at RX.	Check power on RX. Check wiring on terminals 1, 2, 11, 12 in both TX an RX Junction Box.
23-31	Hardware error.	Contact Simtronics.
32	Laser temperature too high. The detector might be too hot for the laser to start up.	Disconnect power, cool down the detector and reboot.
33-40	Software error.	Restart the detector by turning power off and on again. If problem persists please contact Simtronics.

7.2. Tuning detector for less noise

It is normal to see fluctuations of the H_2S signal below ± 8 ppm*m. This is due to noise in the measurement. Several effects can influence the noise in the H2S measurement such as: Alignment between RX and TX, dirt on lenses, rain, sandstorm, snow, reflections and interference from other detectors. The interference from another detector, is observed as sudden high values of H_2S, and is described in section 0.

To tune for less noise on the GD1 we will adjust the alignment slightly to as described in the procedure below:

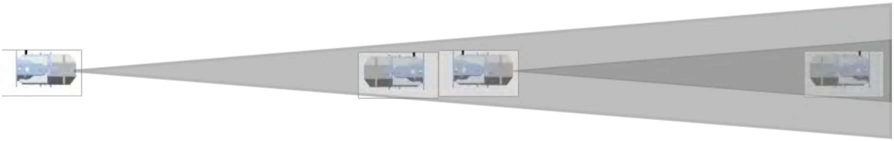
#	Step description	Illustration
1	Clean the lenses of both transmitter (TX) and receiver (RX) for any dirt before proceeding. The optical path should be clear at the time of aligning (avoid fog, mist, steam, rain, snow, etc.).	
2	Log into the service interface with Ethernet connection or HART®.	
3	Check that the detector has been aligned to the center position before tuning for less noise. See section 4.3 for details on how to tune the alignment for optimum position.	

<table>
<tr>
<td>4</td>
<td>Observe H_2S level and signal strength on the Web Interface Status screen, or with a mA-meter on terminal 7 (H_2S signal) and 8 (signal strength). It is normal for the H_2S signal to fluctuate up to ± 8 ppm*m.</td>
<td>
</td>
</tr>
<tr>
<td>5</td>
<td>Loosen only <u>screw 1 or 2</u> for adjustment in respectively the horizontal (screw 5) or vertical (screw 4) direction.</td>
<td rowspan="2">
</td>
</tr>
<tr>
<td>6</td>
<td>Adjust detector slightly with <u>screw 5 or 4</u> for respectively horizontal or vertical direction.</td>
</tr>
<tr>
<td>7</td>
<td>Observe that H_2S fluctuations stay within ± 8 ppm*m. It can take up to a minute for the noise signal to stabilize. Preferably the relative transmission should not drop below 90% during this tuning. If the signal is OK and relative transmission did not drop too much, continue to the step 9.</td>
<td>
</td>
</tr>
</table>

8	If the signal still needs tuning go back to step 6. If it is not possible to get low fluctuations by tuning in the current direction without going below 90% relative transmission, go back to step 5 and start adjusting in another direction.	
9	Make sure screw 1 and 2 are tightened.	
10	Go into the COMMISSIONING → ALIGNMENT screen and set the detector in "Alignment mode". Then store the new relative transmission by clicking DONE and SAVE.	
11	Go to the Status screen to verify the detector is in Measurement mode and noise level is OK.	
Tuning noise finished!		

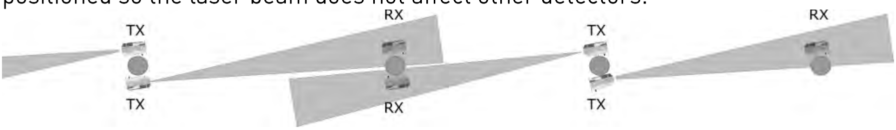
7.3. Interference from another GD1

Interference from other detectors is observed as sudden very high values of H_2S. This can occur if the laser from more than one transmitter is picked up by the same receiver. In the image below this effect is illustrated where two transmitters are emitting into one receiver.

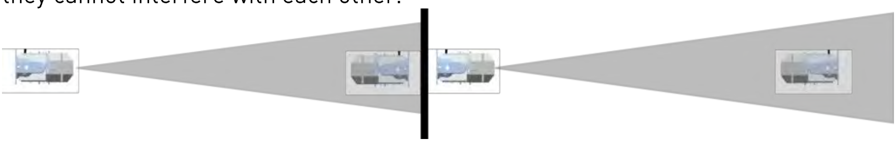


Below is a simple solution to prevent interference from another transmitter. The position of transmitter and receiver is swapped so the laser beams are going in opposite directions. This solution will not work if there are many GD1's positioned in a line.

Below a second possible solution is illustrated. In this example several GD1's are positioned so the laser beam does not affect other detectors.



If it is not possible or too late in the project to organize the detectors so they will not interfere, there is a simple third solution illustrated below. This solution is simply to place a physical barrier, here in form of a small plate, between the GD1's so that they cannot interfere with each other.



NOTE: In some cases the interfering transmitter can actually be mounted behind the receiver, but the laser can be reflected back from a unfortunately mounted reflective surface (e.g. sign, structural plate metal).

7.4. Download the Diagnostics file

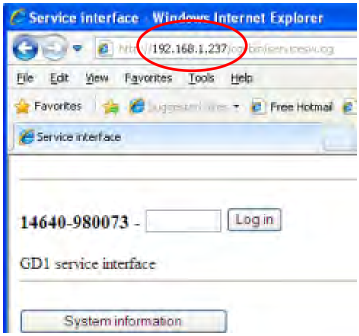
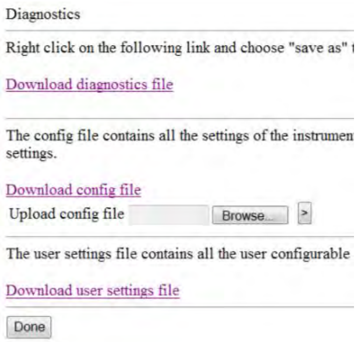
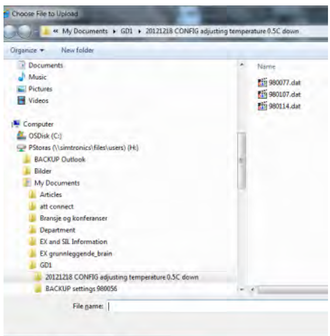
A diagnostics file is required when contacting Simtronics or its authorized distributors for support. The diagnostics file contains information concerning serial number, the present settings and errors in the instrument. Follow the instructions to download a diagnostics file:

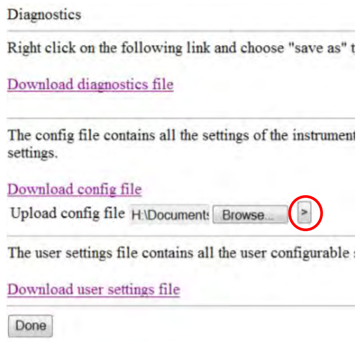
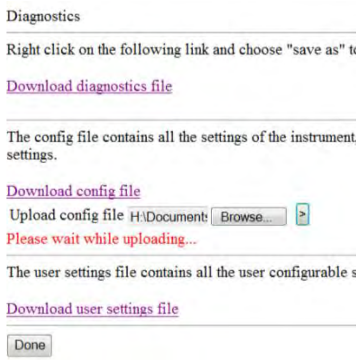
1. Connect to the GD1 with the Ethernet connection and use a Web browser to log into the GD1 Service Interface on http://192.168.1.237 .
2. Enter the Diagnostics page.
3. Right Click "Download diagnostics file" and select "Save Target As..." or "Save Link As", depending on what type of browser being used.
4. Store the file to a disc. In the file name please use the site detector ID tag number.
5. Click Done to return to main menu
6. Send the diagnostics file to SIMTRONICS support.

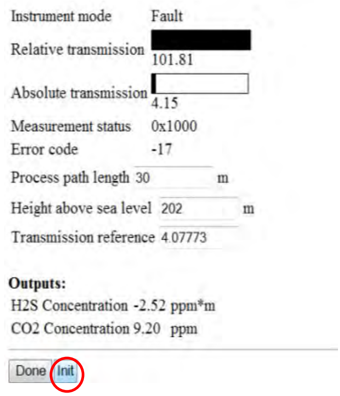
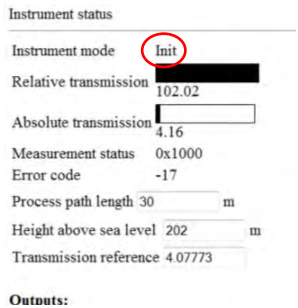
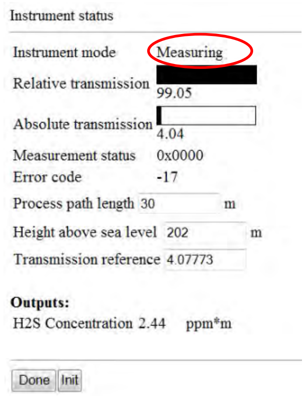
7.5. Uploading a Configuration file

Simtronics can create an encrypted settings file for upload to the GD1. This enables Simtronics to change the settings on the GD1. This can be used in situations where the customer requests a settings change, for example changing the span of the detector. The file is encrypted to avoid non authorized persons changing critical settings. It is important to ensure that the Configuration file belongs to the actual instrument at hand. Follow the procedure below to upload a settings file:

Note! It is recommended to back up the initial Configuration file, by downloading it from the instrument. If needed, this file can later be used to reset the GD1 back to the original state. The Configuration file is downloaded on the Diagnostics page in the Service interface.

#	Step description	Illustration
1	Connect to the GD1 Service Interface as described in section 12.5. IP address: http://192.168.1.237	
2	Enter the Diagnostics page. Click "Download config file" and store this in a safe place. This file can be used later to go back to the original settings if necessary.	
3	Click "Browse" to find the new settings file.	

4	Click the arrow to start uploading the file to the GD1.	
5	The new settings are being uploaded.	
6	When the uploading is finished, click "Go" to return to the Diagnostics page. Click "Done" on the Diagnostics page.	

7	Click "Init" to restart the GD1 and initiate the new settings.	 
8	After some time the GD1 should enter Measuring mode.	

Configuration upload finished!

8. WARRANTY

The GD1 comes with a 5 year limited warranty on the product. The warranty covers correct function inside specified tolerances. Warranty is void if the detector has been installed or operated in conflict with specifications and procedures given in this operating manual.

9. CERTIFICATIONS AND STANDARDS

9.1. Certification

The GD1 has been certified according to ATEX Directive 94/9/EC, EMC Directive 89/336/EEC Article 4:

Description	Simtronics reference
DNV 08 ATEX 18877X	806-816763
IECEx DNV 10.0002X	806-816770

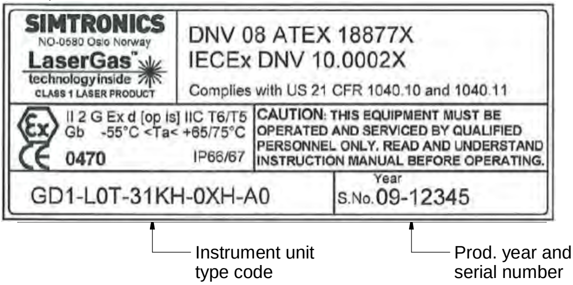
9.2. Standards

The following standards are applicable:

IEC 61508 part 1 to 7	Functional safety of electrical/electronic/ programmable electronic safety (SIL 2)
EN 60079-0/IEC 60079-0	Electrical apparatus for potentially explosive atmospheres. General requirements
EN 60079-1/IEC 60079-1	Electrical apparatus for potentially explosive atmospheres. Flameproof enclosure "d"
EN 60079-28/IEC 60079-28	Protection of equipment and transmission systems using optical radiation
EN 50270:2006	EMC for Electrical apparatus for detection and measurement of combustible gases, toxic gases or oxygen.
EN 60529	Ingress protection level (IP 67)
NEK EN 60079-29-4:2009	Gas detectors - Performance requirements of open path detectors for flammable gases
IEC 60079-29-1 Ed. 1.0	Gas detectors - Performance requirements of detectors for flammable gases
IEC 60825-1; 2001-08	Safety of laser products (Class 1)

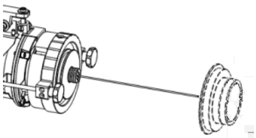
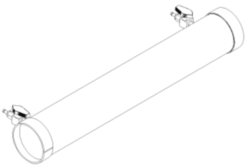
9.3. Marking

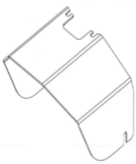
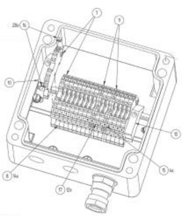
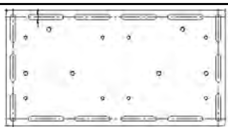
The GD1 product identification labels are shown in the figure below. The composition of the labels is in accordance with ATEX Directive 94/9/EC.

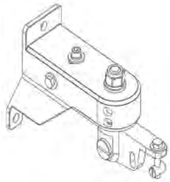
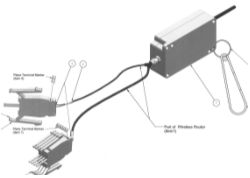


NB! Please refer to full serial number (2+4 digits) for factory enquiries, service or support.

10. ACCESSORIES AND SPARE PARTS

Accessory	Part Number	Description
	GD1-X00-TT01	Alignment Kit Laser alignment tools, Alignment Interface Unit and carry case.
	GD1-X00-TT05	Gas Test Cell Kit – long version Airtight chamber for function and calibration tests. The chamber has a length of 54 cm.

Spare part	Part Number	Description
	599-816662	Sunshade front
	499-816526	Junction box (temperature range -40 to +65°C
	GD1-X00-TB01	Mounting plate

	499-816755	Adjustment bracket
	499-816649	Alignment laser unit
	499-816845	Wireless router
	419-906123	Laser glasses
	814-816855	Spare screws and nuts for the GD1.
	700-816859	All typical tools needed for alignment and service of the GD1.

10.1. Ordering information for the GD1

Mode l	Description							
GD1	-L0*	-**	**	-0*	*	-**		
	T	Transmitter						
	R	Receiver						
		31	H2S					
		nn	Other gases in the future					
			KH	0 – 200 ppm*m scale				
			KJ	0 – 500 ppm*m scale				
			KK	0 – 1 000 ppm*m scale				
			KL	0 – 2 000 ppm*m scale				
			KM	0 – 5 000 ppm*m scale				
			KN	0 – 10 000 ppm*m scale				
				X	SS316 / ATEX			
					H	4-20 mA source interface + HART		
					J	4-20 mA sink interface + HART		
						A0	Mark I	
						A1	Mark II	
						XX	Other factory variants	
↓	↓	↓	↓	↓	↓	↓		
GD1	-L0T	-31	KH	-0X	H	-A1	← Typical ordering number	

11. TECHNICAL SPECIFICATIONS

GENERAL

Detection method	Near IR laser scanning
IR-Source	Tunable laser diode Laser Class 1, eye safe
Detected gas	H_2S
Range	0 - 200 ppm*m (default)
Path length	5 - 75 m
Self-test	Continuous
Calibration	Factory set, no field recalibration
Safety Integrity Level	2 (Functional test interval of once per year)

PERFORMANCE

Accuracy	<±4% of full range
Repeatability	<±4% of full range
Response time	5 sec.

OPTICS

Alignment	±0.3°
Optics Heated (Transmitter and Receiver)	
Obscuration	>98% to signal Beam block (2 mA)
Optional:	Warning (3 mA) >90% to signal "Early clean optics"

OUTPUT SIGNAL

Standard	4-20 mA sink or source (factory set), max. load impedance 500 Ω, HART®
Fault signals	Fault 1 mA Beam block 2 mA Option: Warning 3 mA
Zero filter	The “Zero filter” is by default set to filter any noise/measurement below 7 % Full Scale.

ELECTRICAL

Power supply	24 V DC nominal, range 18-32 V DC
Power consumption	< 15 W (RX: <5W + TX: <10W)
Cable entry	M25
System fuse	Power to the GD1 shall be protected by 1A fuse

TEMPERATURE RANGE

Operating	-55°C to + 65°C (-67°F to +149°F)
ATEX Flameproof	-55°C to + 75°C (-67°F to +167°F)
IECEx Flameproof	-55°C to + 75°C (-67°F to +167°F)

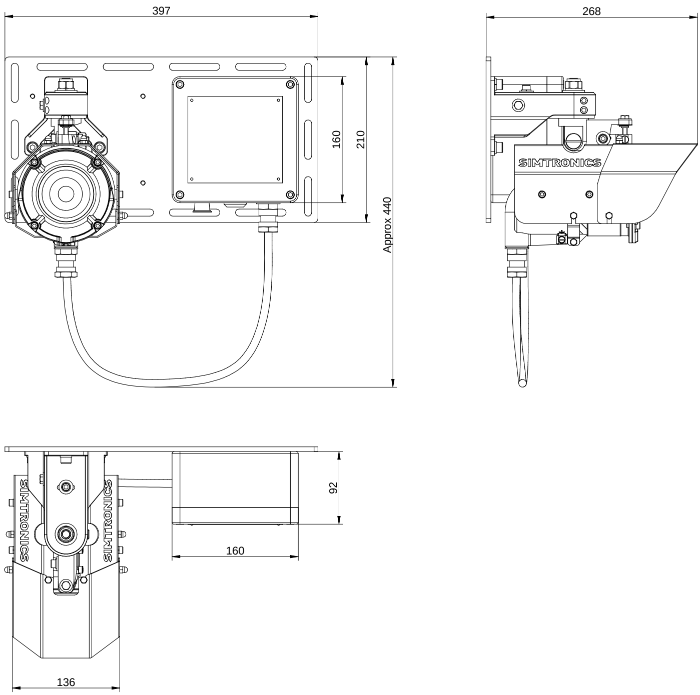
ENVIRONMENTAL

Ingress protection	IP66 / IP67 IEC 60529
Humidity (operation)	0 – 100% RH
Humidity (storage)	0 – 95% RH

MECHANICAL

TX and RX Housing:	
- Material	Stainless steel (ASTM 316)
- Weight	5.5 Kg (12 lbs) (each)
- Dimensions	Ref outline drawing
Junction Box:	
- Material	GRP
- Weight	2.0 Kg (4.4 lbs) (each)
- Dimensions	Ref outline drawing
Total assembly weight	12 kg (26 lbs) (Tx or Rx + JB + bracket + plate)

OUTLINE DIMENSIONS



12. SYSTEM DESCRIPTION

The Simtronics GD1 sets a new standard for toxic gas detection. Using a tunable laser diode, the GD1 delivers enhanced coverage and fail safe detection. The performance improvement marks a major step for safety systems and life cycle cost savings.

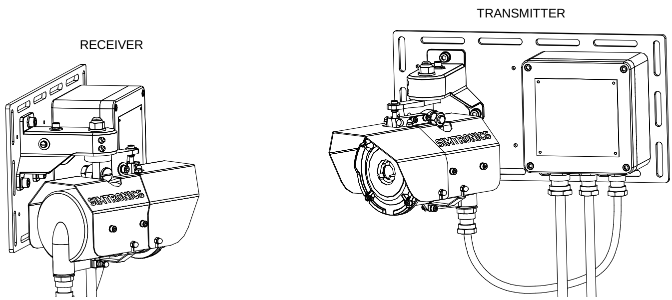
The GD1 has been designed with features that provide an effective response to the detection of gas hazards in a wide range of industrial environments from offshore production facilities to wastewater treatment plants.

At the heart of the detector is a tunable laser diode that eliminates environmental effects from sun, rain and fog. The laser scans single absorption lines where there is no interference from other gases. The laser operates in the near infrared wavelength region, and is invisible to the naked eye. The GD1 laser is eye safe, and does not present any danger even if looked straight into.

Unlike traditional methods for detecting H_2S, MOS or EC cell, the GD1 needs no recalibration and can replace multiple standard detectors to cover the same risk. The measurement technique used in the GD1 is intrinsically a baseline-free technique. Therefore, a calibration of the zero level is never done. The complete optomechanical design and construction is so stable that an ultra-fast speed of response can be achieved whilst providing unparalleled service life and detector stability, thus saving on maintenance and service costs.

12.1. System

The GD1 is an optical open path Gas Detector with a separate transmitter (TX) and receiver (RX). The transmitter emits infrared laser light which is detected by the receiver. The detection principle is based on measuring the absorption of light by the free gas molecules present in the measuring path.



In contrast to traditional hydrocarbon open path detectors which emit broad-banded light, the GD1 uses a tunable diode laser (TDL) as its light source and emits light at a very narrow bandwidth. This technology enables high-resolution spectroscopy and the ability to measure absorption from single absorption lines, eliminating direct interference from other gases and subsequent false gas alarms.

The laser diode has a very long service life and requires no recalibration or replacement.

The GD1 technology enables ultra-fast detection to single gas species at low concentrations. The laser diode is tuned in wavelength and temperature to match the absorption line to be measured. The laser is then scanned across the absorption line. The line itself is carefully selected to ensure there is no interfering absorption in the scan area.

The GD1 continuously monitors the measuring path and the optical and electronic functions. The detector will always show correct gas concentration as long as there are no error messages.

The transmitter and receiver optics are heated to keep the optical surfaces free from dew, snow and ice.

Maintenance will normally only consist of cleaning the optics. The detector gives an error message if cleaning is required.

The GD1 offers digital communication capabilities along with standard 4-20 mA analogue current loops, to aid installation, setup, configuration and servicing.

12.2. Application areas

Area monitoring of:

- Oil and gas installations onshore and offshore
- Petrochemical plants
- Chemical plants
- Refineries
- Pipelines
- Marine
- Waste disposal plants
- Process water facilities
- General industry

12.3. Positioning considerations

Open path detectors are more susceptible to external interference compared to point detectors. To avoid performance reduction and downtime, the following should be taken into consideration when choosing mounting location.

The detector should be attached to a mechanically rigid structure to help keep the unit in alignment due to influences such as:

- Thermal movement due to the effects of the sun and temperature changes
- The effects of strong wind, vibration from equipment such as pumps, turbines and cranes, high-pressure flushing of the detector etc.
- Other mechanical effects, particularly in high-traffic areas.

The measuring path should be horizontal to minimize environmental effects such as rain and snow. Other factors to be taken into account could be temporary scaffolding, large vehicles etc.

12.3.1. General positioning considerations regarding a gas cloud

The gas concentration of a gas cloud rapidly reduces as the distance from the leak source increases. The detector should therefore be placed as close as possible to potential leakage sources. Normally prevailing wind directions must be taken into account when positioning the detector.

Positioning height of the detector should also be taken into consideration. H_2S is heavier than air and has a tendency to accumulate in low areas. Due to the H_2S being heavier than air the detector should normally be positioned in a low position.

In places where there can be thick fog or heavy snowdrifts it is recommended to keep the measuring path as short as possible.

Even if GD1 is practically solar blind, positioning the measuring path in a North – South direction is preferable to avoid direct sunlight.

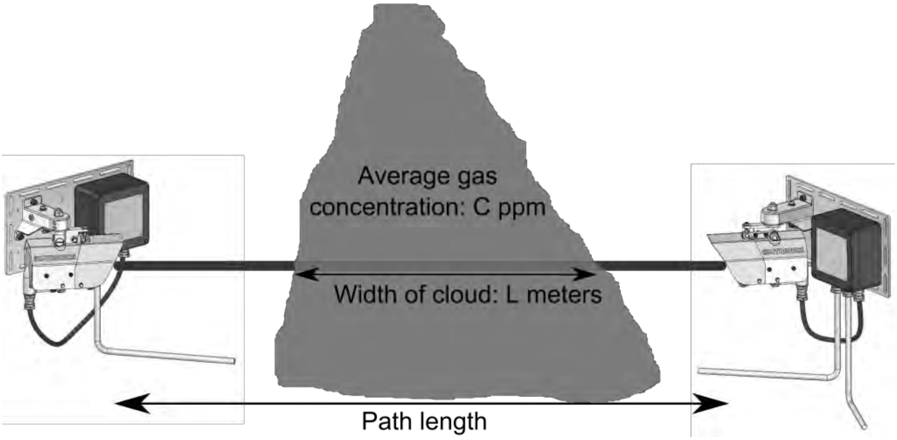
The performance of an Open Path gas detector is influenced by:

- Distance from leak source
- Weather and environmental conditions
- Temporary or permanent path obstruction
- Leakage characteristic (pressure, size, fluid, temperature)
- Gas density (heavier or lighter than air)
- Vibration and stability of mounting structure
- Exhaust or steam discharges hitting the optics.

The detector should be placed according to a gas dispersion analysis taking into account all the factors above.

12.4. Detection principles

Unlike a point detector, the GD1 Open Path Detector will not measure the concentration of the gas in the path between transmitter and receiver. The GD1 measures the total amount of H_2S in the path and the value returned by the GD1 is in ppm*m. Below are three examples with calculations on what value is expected on the GD1 for different gas clouds.



The drawing above illustrates a GD1 positioned with a gas cloud from a H_2S drifting into the laser beam of the GD1. The average concentration of the gas cloud is C ppm H_2S. The width of the gas cloud is L meters where the beam is crossing. If the path length is smaller than the gas cloud, the distance L will be equal to the path length. For the gas cloud in this example, we would expect the following signals from the GD1:

Example 1 - gas cloud characteristics: C = **5 ppm; L = 15 meters**
Expected measurement of the GD1 = C * L = 5 ppm * 15 m = 75 ppm*m

Example 2 - gas cloud characteristics: C = **10 ppm; L = 15 meters**
Expected measurement of the GD1 = C * L = 10 ppm * 15 m = 150 ppm*m

Example 3 - gas cloud characteristics: C = **150 ppm; L = 1 meters**
Expected measurement of the GD1 = C * L = 10 ppm * 15 m = 150 ppm*m

Observation 1! Same cloud size will give same measurement irrespective of path length (this provided that the gas cloud is smaller than the path length).

Observation 2! If cloud size is known, the average cloud concentration can be calculated by dividing the ppm*m measurement with path length. This can typically be done only if a spreading analysis shows that the cloud always will cover the whole path length between the TX and RX, for example if the GD1 is placed sufficiently far from the leak point.

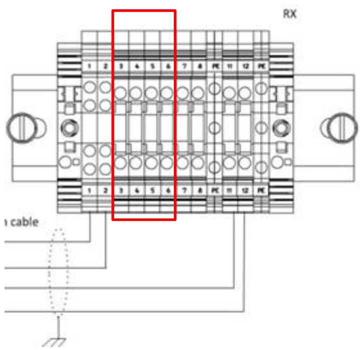
Observation 3! Example 3 shows that different cloud can give same measured value. Therefore the GD1 is typically more used as a "safe fence" around an installation to signal if there is an abnormal and potentially unsafe situation, and not to measure the actual concentration of the gas.

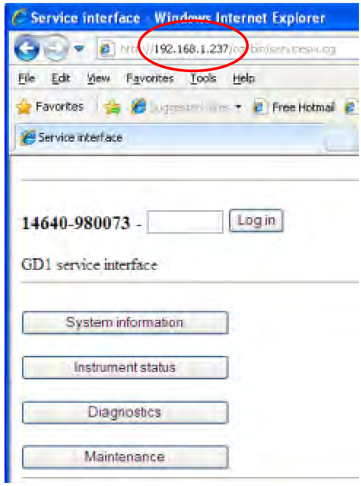
12.5. How to connect to the web interface with the Ethernet cable

In some circumstances it might be requested by the user to be able to connect with cable and not the Wireless router. Below is a description on how to connect to the GD1 Service Interface with a web browser:

Note! When connecting with the Ethernet cable, it is necessary to configure the network interface card to static IP and the following settings:

IP address 192.168.1.236
Subnet mask 255.255.255.0
Default gateway 192.168.1.253

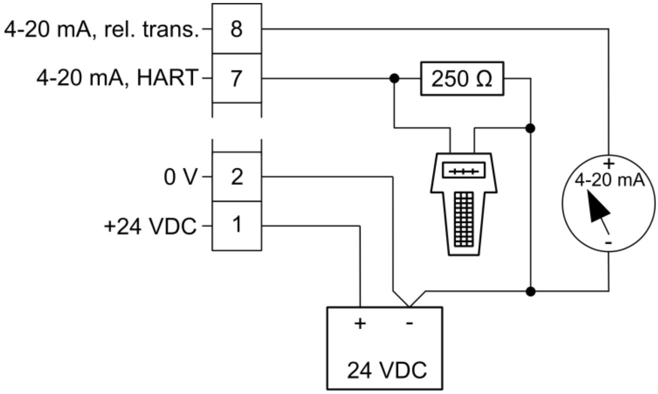
#	Step description	Illustration
1	On the transmitter, connect the Ethernet adapter to the Junction Box terminals 3-6.	

<table>
<tr><td colspan="2">A image of the Ethernet adapter is displayed to the right.</td><td></td></tr>
<tr><td>2</td><td>Select a device having Web browsing capabilities with the wireless router or Ethernet cable. In the web browser of the device, enter the GD1 Service Interface on the address http://192.168.1.237</td><td>
</td></tr>
<tr><td>3</td><td>Log into the Service Interface with the Operator password: "gd1tlc"

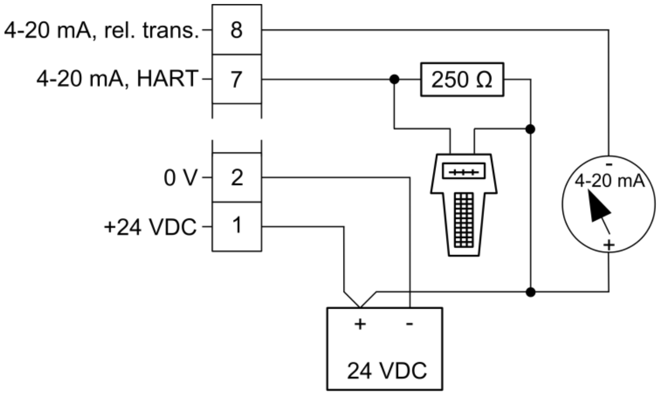
After logging in as Operator more functions are accessible as illustrated in the image to the right.</td><td>
</td></tr>
<tr><td colspan="3">Procedure finished!</td></tr>
</table>

12.6. HART® Interface

Simtronics GD1 detector supports generic HART®. For access to the detectors HART® features, connect an industry standard HART® communicator as shown in the following figures depending on the type of analogue interface (source or sink).



HART® terminal connection for source variant



HART® terminal connection for sink variant

HART® commands for alignment and commissioning are described in section 4.3.2. The following sections describe some of the HART® commands/functions supported by the GD1:

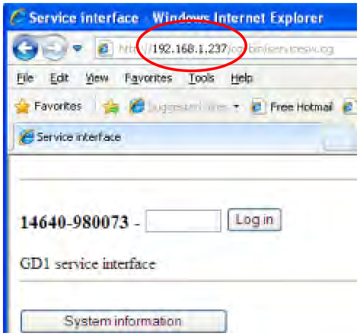
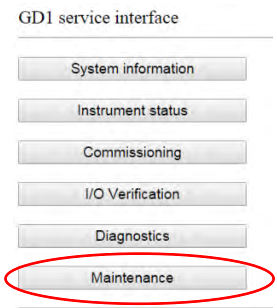
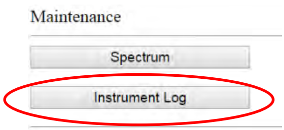
12.6.1. Overview HART™ menu

Item	Description
PV	Primary Value. H2S reading in ppm*m.
PV URV	PV Upper Range Value
PV LRV	PV Lower Range Value (always zero)
PV loop current	Primary Value. H2S reading in mA (4 mA zero gas reading and 20 mA for PV URV gas reading).
Configuration→	
Configuration→Setup→	
Altitude	Installation altitude. This shall have an accuracy better than ± 350 meters
Path length	Distance between transmitter and receiver. This value does not impact on the PV readings.
Transmission reference	Transmission reference
Commit GD1 settings	Stores the altitude, path length and Trans.ref.
Configuration→Device→	
Mode	What mode the detector is in.
RX serial number	Receiver manufacturing number.
TX serial number	Transmitter manufacturing number.
Software version	Software version.
Configuration→Device→HART→	
Configuration→Device→HART→HART output	
PV URV	Primary value upper range.
PV LRV	Primary value lower range.
Loop current mode	

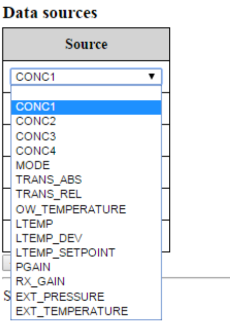
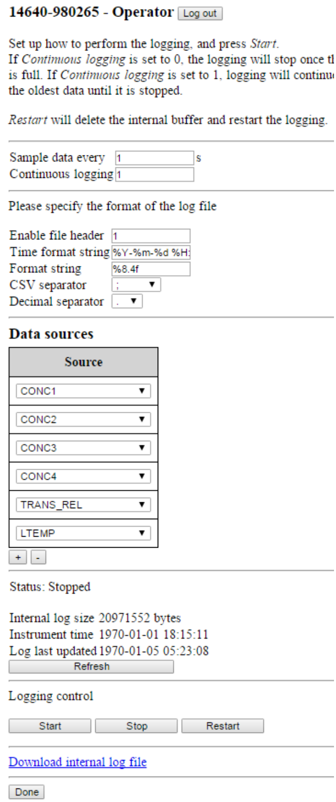
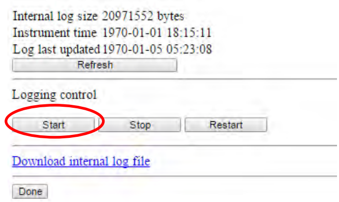
Num resp preams	
Configuration→Device→HART→Installation data	
Long Tag	Open for editing by user.
Tag	Open for editing by user.
Descriptor	Open for editing by user.
Date	Open for editing by user.
Configuration→Device→HART→ Revision #'s	
Final assembly num	
PV Snsr s/n	
Fld dev rev	
Software rev	
Hardware rev	
Measurements→	
Mode	Detector mode (FAULT, MEASUREMENT, ...)
H2S reading	H2S gas reading in ppm*m.
Relative transmission	Relative transmission.
CO2 reading	CO2 gas reading in ppm.
Measurements→ Device status	
Status	
Failure flags Meas	
Failure flags Fault	
Ext dev status	
Instrument error codes	Error code. See section 7.1 for details.

12.7. Data logging functionality

The GD1 has 24 MB of space reserved for storage of data chosen by the user. The user can specify at what interval the data shall be recorded and stored. The data log can be downloaded for review of for example gas releases recorded during the latest months. The GD1 can typically store several years of data logging before it is starting to overwrite the oldest data entries.

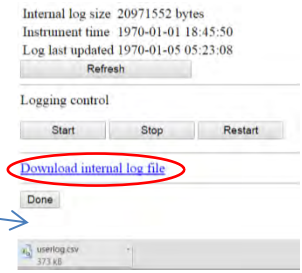
#	Step description data logging	Illustration
1	Connect to the GD1 Service Interface as described in section 12.5. IP address: http://192.168.1.237	
2	Enter the “Maintenance” page.	
3	Enter the “Instrument Log” page.	

<table>
<tr>
<td>4</td>
<td>In the “Instrument Log” page the operator set up what data should be logged and at what interval. Up to six data variables can be logged and is chosen from a drop-down menu as shown below.


</td>
<td>
</td>
</tr>
<tr>
<td>5</td>
<td>Click “Start” to start logging the selected variables in the previous step.</td>
<td>
</td>
</tr>
</table>

6 The data log can be downloaded by clicking the "Download the internal log file".

Data being downloaded.



7 Data log can then be imported and viewed in a suitable program as shown below.

	A	B	C	D	E	F	G	H
1	#FILE	CONC1	CONC2	CONC3	CONC4	TRANS_REL	LTEMP	
2	08.07.2015 16:57	7.768	68.8692	0.0831	5.0198	68.8692	31.2091	
3	08.07.2015 16:57	7.768	68.8692	0.0831	5.0198	68.8692	31.2091	
4	08.07.2015 16:57	6.9521	68.4236	0.1178	5.0253	68.4236	31.2089	
5	08.07.2015 16:57	7.768	67.9025	0.1276	5.0206	67.9025	31.2089	
6	08.07.2015 16:57	7.8616	67.3983	0.1696	5.0216	67.3983	31.2088	
7	08.07.2015 16:57	5.1733	67.001	0.1553	5.0302	67.001	31.2088	
8	08.07.2015 16:57	4.3574	66.5638	0.172	5.0432	66.5638	31.2087	
9	08.07.2015 16:57	7.6743	66.091	0.2263	5.0381	66.091	31.209	
10	08.07.2015 16:57	6.9735	65.5552	0.1821	5.0372	65.5552	31.209	
11	08.07.2015 16:57	6.9735	65.5552	0.1821	5.0372	65.5552	31.209	
12	08.07.2015 16:57	0.8586	64.9389	0.1343	5.0417	64.9389	31.2088	
13	08.07.2015 16:57	0.8052	64.4546	0.1376	5.0549	64.4546	31.2088	

Data logging completed.

13. SUPPORT AND CONTACT DETAILS

You will find an updated list of distributors on our web pages:

www.simtronics.eu

Email address for general enquiries: mail@simtronics.no

Post address:

Simtronics AS
P.O.Box 314, Økern
N-0511 Oslo, Norway

Tel: +47 2264 5055

Shipping and visiting address:

Simtronics AS
Kabelgaten 8, Økern Nord
0580 Oslo
NORWAY

13.1. Shipping instruction sending units to support

In case of shipping a GD1 to support please follow the procedure below:

1. Download and save the Diagnostics file as described in section 7.4.
2. Prepare an e-mail with additional important information collected during the troubleshooting and the following information:
    - Unit serial number
    - If available, support reference number
    - Short description of the error or problem
    - A list of all items to be packed in the box
    - Contact information with telephone number and e-mail address
3. Attach the Diagnostics file to the e-mail.
4. Send the e-mail to support.
5. Print the e-mail.
6. Turn off the power of the instrument.
7. Dismount the instrument. Do NOT remove the optical housing or the junction box from the mounting plate.
8. Put the complete GD1 with mounting plate in a protected packing box.
9. Put the printed e-mail in the packing box.
10. Mark the packing box with the following information:
    - Unit serial number
    - Sender
11. Ship the transmitter unit package to support.

EU DECLARATION OF CONFORMITY

SIMTRONICS Fire & Gas

EU Declaration of Conformity (807-816807)

We, Simtronics AS, as manufacturer, declare under our sole responsibility that the product

Toxic Open Path Gas Detector GD1

to which this declaration relates, and which is covered by the following certificate:

DNV 08 ATEX18877X
Issued by notified body
#0575 DNV

is in conformity with the following standards or other normative document(s) provided that it is installed, maintained and used in the application for which it is made, with respect of the "professional practices", relevant installation standards and manufacturer's instructions:

EN60079-0: 2012 / IEC60079-0: 2011
EN60079-1:2007 / IEC60079-1: 2007
EN60079-28:2007 / IEC60079-28: 2006
EN50270:2006
EN60945: 2002 (EMC Emission only)

following the provisions of:

Directive 2014/34/EU (ATEX)
Directive 2014/30/EU (EMC)

Place and date:

Oslo, 2016.04.20

Signature:

Even Rognlien
Quality/EH&S Manager

Simtronics AS
P.O. Box 314, Økern
N-0511 Oslo, Norway

DOC. REV	DATE	CHANGE NOTE		
1	2016.04.20	-		

EU Declaration of Conformity	807-816807	1/1

SIMTRONICS
Fire & Gas