



DYNAMAMENT

INFRARED GAS SENSORS
A PST BRAND

PST

PROCESS SENSING
TECHNOLOGIES

AXIOM A2L DETECTOR USER MANUAL



Dynamant Limited

Hermitage Lane Industrial Estate · Kings Mill Way · Mansfield · Nottinghamshire · NG18 5ER · UK.

Tel: 44 (0)1623 663636

email: sales@dynamant.com · www.dynamant.com

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Safety Information – Read First

Read and understand this manual in conjunction with the relevant data sheet before using the Axiom detector. This is not an Intrinsically Safe or Ex Flameproof device.

Axiom A2L Detector

Description

Dynamant infrared detectors operate by using the NDIR (Non-Dispersive Infra Red) principle to monitor the presence of the target gas. The detector contains a long life tungsten filament infrared light source, an optical cavity into which gas diffuses, temperature compensated pyroelectric infrared detectors, an integral semiconductor temperature sensor and electronics to process the signals from the pyroelectric detector .

The detector can be configured to use either digital or analogue outputs.

In analogue mode either 4-20mA or 0-5V output modes may be chosen. An Open Collector output is also available when configured in the either of the analogue modes.

In digital mode, the detector can be configured to communicate over Modbus using either RS232(TTL) or RS485 as the physical protocol. For direct communications with instrument electronics.

The R454B variant of Axiom is certified to UL60335-2-40 4th Edition Annex LL.

Power Supply

The Axiom detector is designed to operate with a supply voltage of between 5V and 24V and draws a maximum of 600mW. Power is applied on the V+ and GND connections of the USB interface.

Detector Mounting

Under normal operation Axiom should be mounted with the gas inlet facing down, as shown below:



Detector warm-up

The detector takes approximately 45 seconds to warm up after power is supplied. The detector is held at -250% of the full-scale output during this time. In 4-20mA mode, the output will be forced to 2.5mA and the Open Collector Output will be active during this time. In 0.2-4.0V mode, the output will be 0V and the Open Collector output will be active during this time.

Serial communications

The detector has a UART interface allowing it to communicate with a range of devices in a serial manner.

The serial interface allows the user to view gas levels, temperature, and other parameters. It also allows the detector to be calibrated.

The communications protocol used is Modbus. A register map can be supplied by Dynamant.

Axiom can be configured to operate at 4 different baud rates – 38400, 19200, 9600 and 4800. 19200 baud is the default setting.

Setting	Value
Baud Rate	38400
Data Bits	8
Stop Bits	1
Parity	None
Flow Control	None

Logic levels

In RS232(TTL) mode, care must be taken to keep signal logic levels under 5V. Any higher voltage will damage the detector microcontroller.

MODBUS Gas Reading Protocol

The sensor can be interrogated (when the output mode is set to RS232 or RS485 serial communications) using the industry standard MODBUS protocol.

The simplest use of this protocol is to read the gas measurement. The message below is a MODBUS data packet that can be used request this information from a sensor. This is based on the sensor having the default MODBUS address of 1. If this is different, then the first byte of the packet would need to have the required address and the CRC at the end of the packet would need to be re-calculated for the changed data.

Byte Position in packet	Value (hexadecimal)	Field Name	Description
0	0x01	MODBUS Address	MODBUS address of sensor (factory default of 1)
1	0x04	Function Code	Function type is "Read Input Register" (Code 0x04)
2	0x75	Register Address MSB	The MODBUS address of the first register holding the gas reading information. The gas reading is held in two registers at address 30,058 (0x756A) and 30,0059 (0x756B)
3	0x6A	Register Address LSB	
4	0x00	Number of registers to read (MSB)	The gas reading is a 32 bit value in IEEE 754 format, which is stored across two 16 bit registers
5	0x02	Number of registers to read (LSB)	
6	0xBC	CRC (LSB)	CRC of frame sent as LSB first unlike the data values within a frame (which are sent MSB first)
7	0xDE	CRC (MSB_)	

The sensor will respond with a packet of data containing the requested gas reading. An example response from the sensor for this packet is depicted below.

Byte Position in packet	Example Value (hexadecimal)	Field Name	Description
0	0x01	MODBUS Address	MODBUS address of sensor responding
1	0x04	Function Code	Response to a read input register request
2	0x04	Number of bytes of data	The total number of data bytes to follow (4)
3	0x40	Gas reading (MSB)	Actual gas reading as a 32 bit value in IEEE 754 floating point number. In this example the number is 0x400B851B which converts to a value of 2.18 %Volume. A value of -250.0 would indicate that the sensor is either still warming up (45 seconds after power on) or has a fault preventing a valid reading from being determined
4	0x0B	Gas reading (Second byte)	
5	0x85	Gas Reading (Third byte)	
6	0x1F	Gas Reading (LSB)	
7	0xBC	CRC (LSB)	CRC of frame sent as LSB first unlike the data values within a frame
8	0xDE	CRC (MSB)	

The gas reading is contained in the 4 bytes is packet positions 3, 4, 5 and 6. They are stored in Most Significant Byte (MSB) order and can be combined to form a 32 bit value, which is the gas reading in standard IEEE 754 format.

If the gas reading has a value of -250, this indicates that the sensor is either still warming up (which it typically does for 45 seconds after power on) or is in a fault condition and cannot provide a valid gas reading.

Analogue output

The analogue output of the detector is proportional to the measured gas level. The analogue output can be configured to be a 4-20mA or a 0.2-4.0V configuration. This configuration is carried out during manufacture and cannot be changed afterwards.

4-20mA Mode

The analogue output range is 4mA to 20mA for zero gas to FSD. Fault modes are indicated by a mA output of 2.5mA.

The table below shows the analogue output for a detector that is configured in 4-20mA mode.

Gas Reading (% of detector range)	Analogue output (mA)
0	4.00
10	5.60
20	7.20
30	8.80
40	10.40
50	12.00
60	13.60
70	15.20
80	16.80
90	18.40
100	20.00
Warmup / Fault	2.50

0.2-4.0V Mode

The analogue output range is 0.2V to 4V for zero gas to FSD.

The table below shows the analogue output for a detector that is configured in 0.2-4.0V mode.

Gas Reading (% of detector range)	Analogue output (V)
0	0.20
10	0.40
20	0.80
30	1.20
40	1.60
50	2.00
60	2.40
70	2.80
80	3.20
90	3.60
100	4.00
Warmup / Fault	0V

Response Times

Axiom conforms to the UL60335-2-4, annex LL specification for response time with a recorded value of <15s

Fault indication

The analogue output is driven to the fault level when an internal fault is detected.

Voltage output

The 0.2-4.0V output will be driven to 0V in the event of a fault.

4-20mA

The 4-20mA output will be driven to 2.5mA in the event of a fault.

Serial Data

The gas readings in the live data are set to -250% of the full-scale during fault conditions. The status flags are set according to the actual fault.

Each of the 4 Status flag registers are 16 bits long and work as bit fields. This means that each of the 16 bits indicates a different fault. Status Flag 4 is inverted because during EEPROM initialisation the memory is set to 0xFFFF which would cause all status flags to raise.

Status Flags 1	Bit Mask	Fault Description
Signal Noise	0000 0000 0000 0100	Checks that the raw count is stable. Signal will be considered noisy if noise appears for more than 5 sec.
Detector 1 Fault	0000 0000 0100 0000	This flag indicated there is a fault with detector1. It gets triggered when a peak cannot be found. This typically happens along with FLAG_SIGNAL_TIMEOUT.
Reference Fault	0000 0000 1000 0000	This flag indicated there is a fault with reference1. It gets triggered when a peak cannot be found. This typically happens along with FLAG_SIGNAL_TIMEOUT.
ADC Overage	0000 0010 0000 0000	This flag is set when the ADC reads a value that is too high; this occurs before it hits the maximum value. This does not just happen because of signal spikes, normally that is filtered out. What typically causes this, is when there is a significant change in the detector environment (for example if you blow on the detector). This increases the dc bias of the signal which pushes the signal to the upper limits of the ADC and clips the signal.

Status Flags 2	Bit Mask	Fault Description
Warm Up	0000 0000 0100 0000	This flag will tell the user that the detector has warmed up. By default, this is set to 45 seconds, except for an extreme environment, the detector should be warm by then.
Max Gas Limit Exceeded	0000 0001 0000 0000	This flag indicates that the gas has exceeded the full scale of the detector. This error can be ignored.

Calibration

Axiom A2L detectors do not require field calibration.

Pressure dependency

NDIR gas detectors exhibit a dependency on the pressure conditions under which they operate. The principle of operation is based upon the absorption of infrared energy by molecules of the target gas within the detector. As the gas pressure is increased, the number of molecules within the detector is increased. This leads to increased absorption, and so the calculated gas reading is increased. The opposite effect is true when the gas pressure is reduced.

Axiom detectors are pre-calibrated at nominal atmospheric pressure, and the accuracy of the reading will be adequate in most instances without the need for pressure compensation.

In cases where the detectors are operated at pressures significantly different from their original calibration pressure, for example high altitudes, the detectors should be recalibrated to restore accuracy. Alternatively, a compensation factor can be applied to the reading based on the pressure within the detector.

For example, when the detector is used at either elevated or reduced pressures, a pressure transducer can be incorporated into the gas flow and its output value can be used to determine the degree compensation to be applied.

Please contact Dynamant for more information.

Maintenance

Dynamant infrared detectors, like any other detectors, require regular maintenance in terms of inspection to prevent a build-up of dust or dirt or any other contamination that might prevent gas from entering the detector.

Maintenance should include cleaning of the housing within which the detector is mounted, a good design will afford some level of protection for the bare detector.

Handling precautions

Axiom incorporates ESD protection circuitry. However, it is recommended that care is taken not to touch the USB-C connector during handling.

Axiom should not be exposed to corrosive gases.

Warranty

Infrared detector warranty and lifetime are given in the detector data sheet, a typical statement is as follows:

All Dynament Axiom detectors carry a **five-year** warranty against defects in materials and workmanship. The warranty is invalidated if the detectors are used under conditions other than those specified in the relevant data sheet.

Particular attention should be paid to the following criteria:

- **Observe the correct supply polarity**
- **Do not exceed the maximum rated supply voltage of 24V**
- **Do not solder directly to the detector connector**
- **Do not expose the detector to corrosive gases**
- **Do not allow condensation to take place within the detector**

Decommissioning

Detectors can be returned to Dynament for safe disposal.

Dynament
Hermitage Lane Industrial Estate,
Kings Mill Way
Mansfield
Nottinghamshire
NG18 5ER
UK.
www.dynament.com

Axiom can be factory configured in 4 different output modes:

OPTION 1

OPTION 2

Analogue

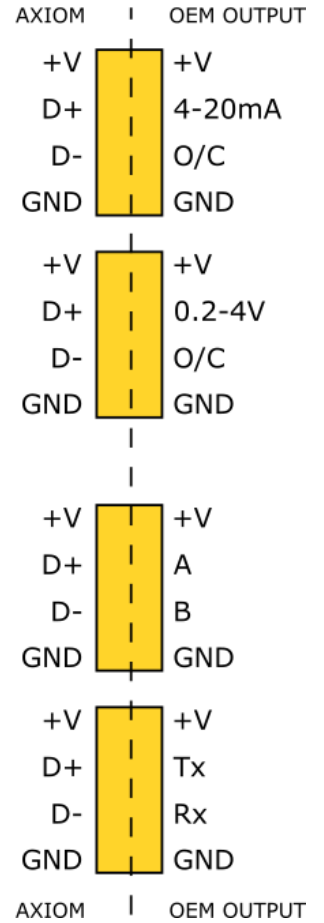
4-20mA

0.2-4V

Digital

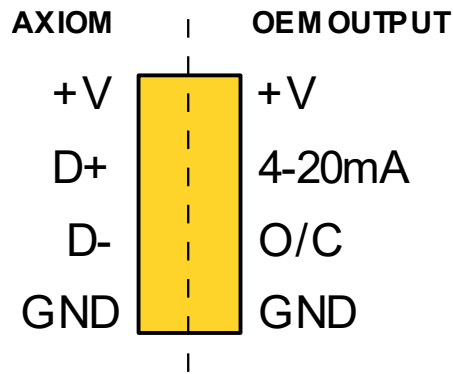
RS485

RS232



When a bare ended USB cable used, the contacts follow the colour code below:

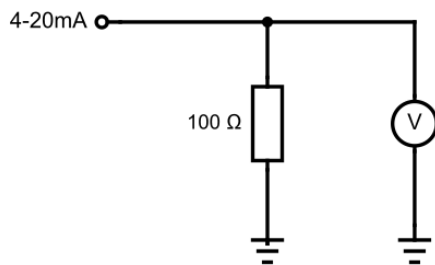
Colour	Axiom Contact
 Red	5-24V DC
 White	D-
 Green	D+
 Black	0V



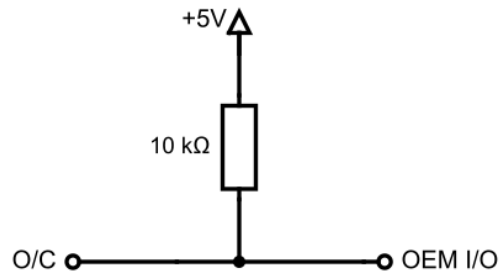
Connection	Function
+V	5.0 – 24V Input
D+	4-20mA Output with fault indication (2.0mA = Fault) 100R Recommended Load Resistor
D-	Open Collector Output Active Low 100mA maximum load 5.5V maximum voltage
GND	System 0V

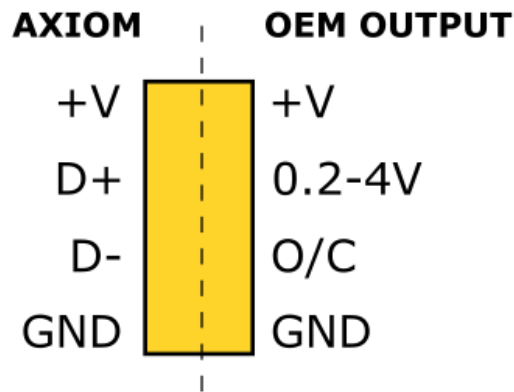
Recommended Output Circuits

4-20mA



Open Collector

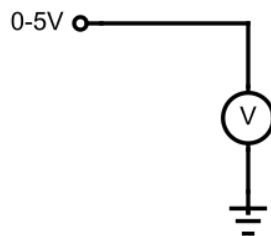




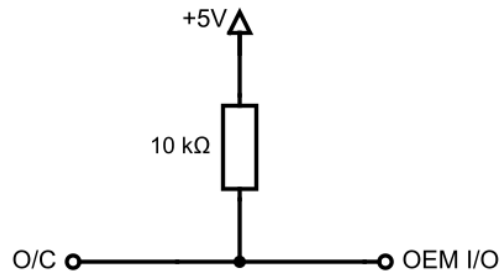
Connection	Function
+V	5.0 – 24V Input
D+	0.2-4.0V Output (0.1V minimum)
D-	Open Collector Output Active Low 100mA maximum load 5.5V maximum voltage
GND	System 0V

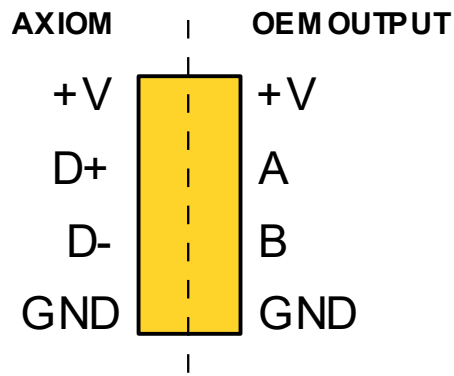
Recommended Output Circuit

0.2-4.0V



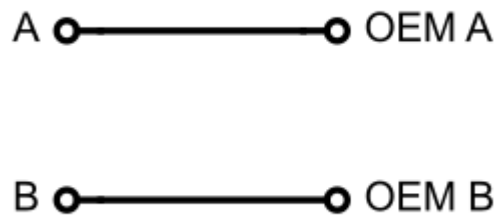
Open Collector

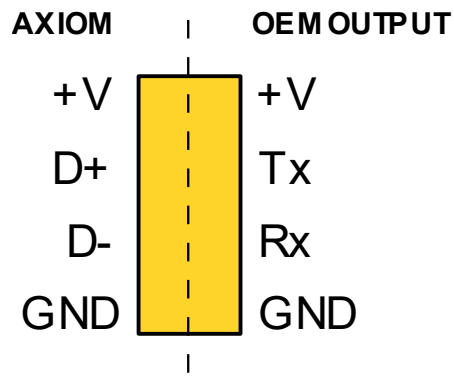




Connection	Function
+V	5.0 – 24V Input
D+	RS485 A
D-	RS485 B
GND	System 0V

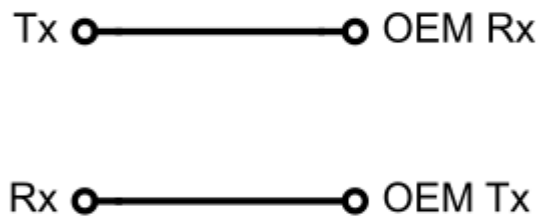
Recommended Output Circuit





Connection	Function
+V	5.0 – 24V Input
D+	RS232 Tx 3.3V TTL
D-	RS232 Rx 3.3V TTL
GND	System 0V

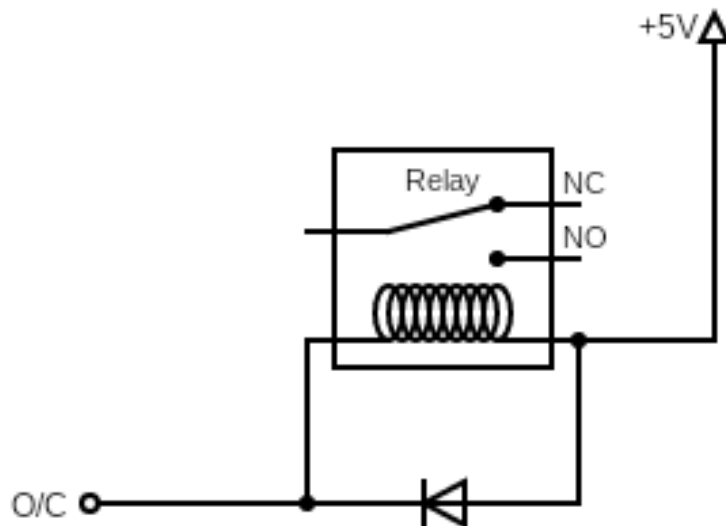
Recommended Output Circuit



Using the Open Collector Output to Drive a Relay

Axiom's Open Collector output can be used to drive a relay when connected as shown below.

To do this, use the connect the relay coil between the Open Collector output (D-) and a 5V supply. On alarm or fault the Open collector output will be driven low, completing the circuit through the coil, and energising the relay.



Please note that the maximum permitted voltage on the Open Collector contact is **5.5V** and the maximum current that can be sunk into the contact is **100mA**.

For applications that require switching of a 24V load or higher currents, Dynamet can provide an Axiom Bridge accessory.

Axiom Bridge

Dynamet offer an optional interface board called Axiom Bridge.

Axiom Bridge features a USB-A connector and screw terminals. is provided with a USB-C to USB-A cable to simplify integration into existing systems.

Furthermore, the board features an Open Collector output capable of switching loads up to 40V and 600mW. Axiom bridge can be provided with an optional on-board 10A relay.

The board also features two LED status indicators for power and fault indication.