Version 004.01

OPERA Inc.

6000 Series

Digital Gas Dector/Controller

OPERATION MANUAL

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1.0 General Description

The Opera series 6000 gas detectors offer commercial building owner's the precision to assure the health and safety to occupants with the tightest possible controls on energy consumption. It is a versatile, self-contained dual gas sensor that is network ready for either peer-to-peer (master slave) operation or central control for a smooth integration into new or existing energy management systems.

1.1 Applications:

- Vehicle Emissions
- Combustible Gases
- Refrigerant Gas Leak Detection
- Industrial Health and Safety

1.2 Features:

- Stand-alone operation with 1 or 2 adjustable alarm relays, indicators and strobe
- BTL listed Smart Sensor
- BACnet MS/TP RS485 interface
- CAN network interface for master-slave operation or central control
- Pre-calibrated plug-and-play sensor modules
- Impact resistant, water resistant enclosure.

1.3 Specifications:

- Supply; 24 vac 50/60 hz (17-28 vac) 0.21 amps, 5 va
- Operating temperature; -20 ºC to 50 ºC (-4 ºF to 122 ºF)
- Operating humidity; 15-95% Relative humidity, non condensing
- Accuracy - + 3% reading
- For indoor use
- Flame resistant Polycarbonate ABS enclosure rated UL94 V0, 5VB, and 5VA

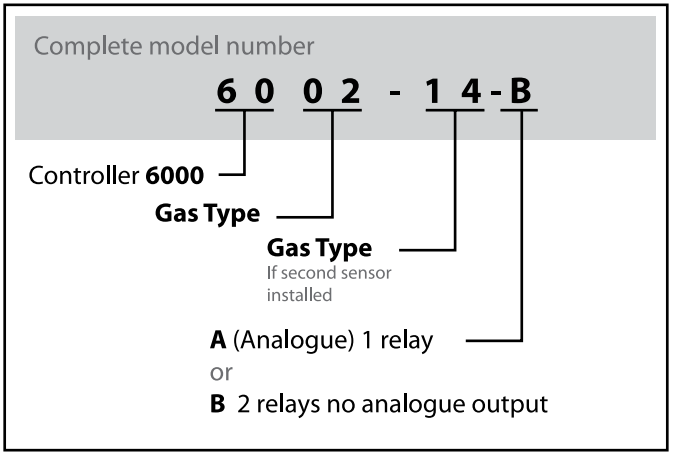
- Relays; (1 or 2) SPDT, 5 amp @ 125 vac, non-inductive
  On delay; 0-999 seconds (16 minutes)
  Off delay; 0-999 seconds (16 minutes)
- Standards; Conforms to UL61010-1, CSA C22.2 61010-1-12, ANSI/ISA 61010-1, CSA C22.2 no. 205-12
- Analogue outputs; 4-20 ma or 2-10v (model 6000-A)
- Knock-out entries 1/2" pipe; 2 top, 2, bottom, one in rear
- Response time; 60 seconds to 95% reading
- BACnet MS/TP Smart Sensor, up to 76,800 bps

1.4 User Interface:

- Back lit LCD display shows gas concentration, user settings, calibration controls
- Red LED alarm indicators, level 1 and 2
- High intensity white LED strobe on level 3
- Audible alarm, 85 db at 1 meter
- 4 pushbutton user keypad
- Password control for settings

2.0 Model Selection Guide

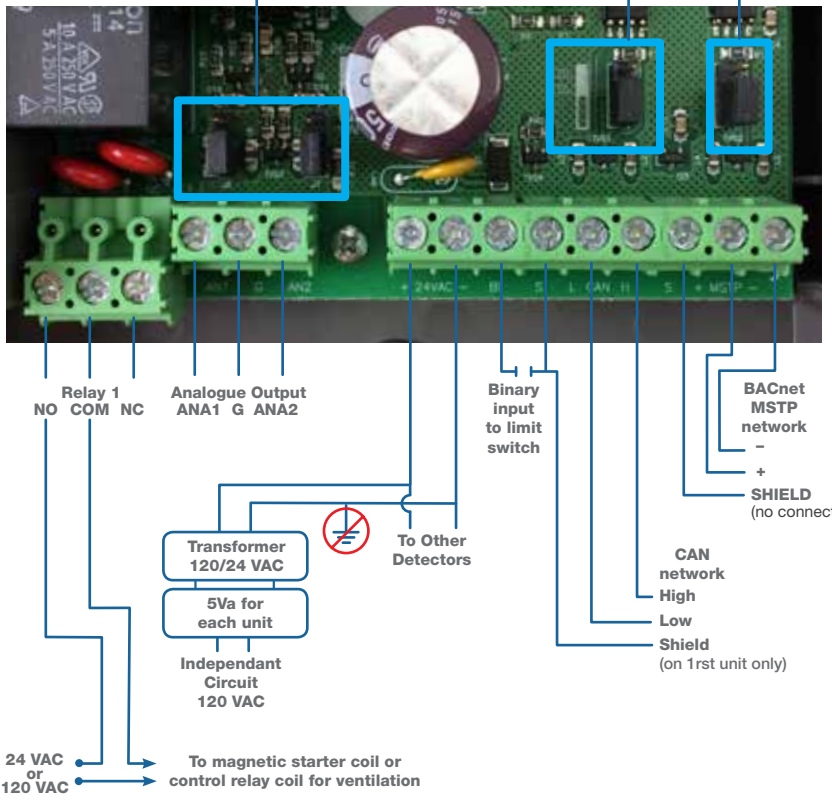
Exemple:



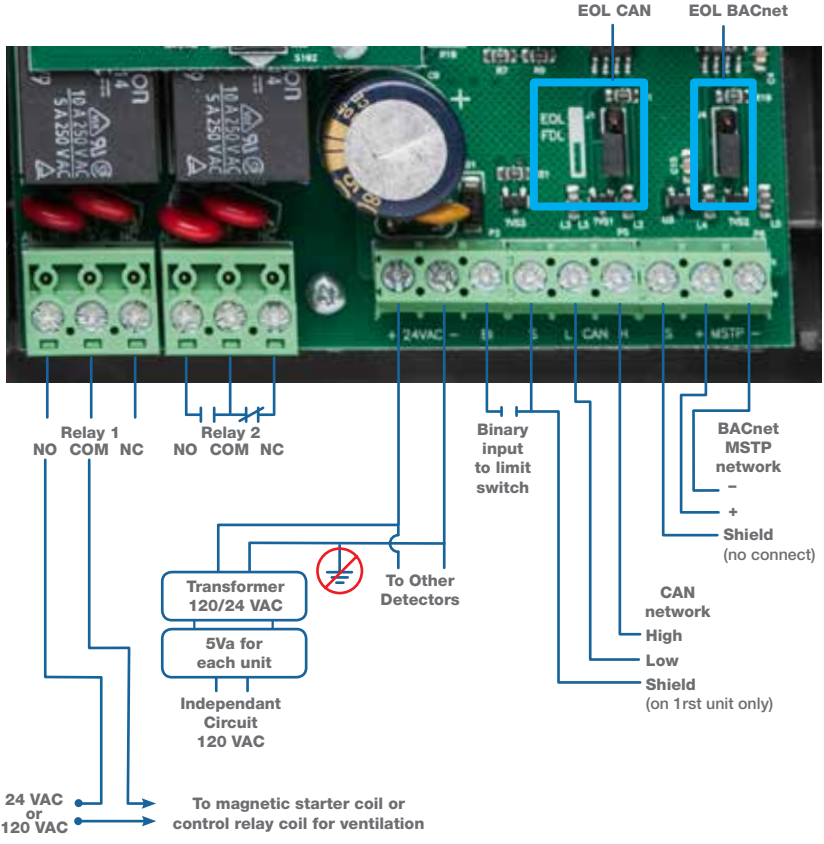
		Gas Type	Range
NH_3	Ammonia	04	0-250 ppm
Ar	Argon (O_2 depletion)	23	0-50% O_2
C_4H_{10}	Butane	05	0-50% LEL
CO_2	Carbon dioxide	15-2000	0-2000 ppm
CO_2	Carbon dioxide	15-5000	0-5000 ppm
CO	Carbon Monoxide	02	0-100 ppm
CO	Carbon Monoxide	02-250	0-250 ppm
CO H_2nil	Carbon Monoxide	02H2nil	0-100 ppm
CL_2	Chlorine	17	0-10 ppm
$C_2H_4(OH)_2$	Ethylene glycol	01	0-1000 ppm
C_2H_5OH	Ethanol	01	0-1000 ppm
	HCFCs	13	
	HFCs	20	
He	Helium (O_2 depletion)	23	0-25% O_2
H_2O in air	Humidity (relative)	25	0-100% RH
H_2	Hydrogen	08	0-50% LEL
H_2S	Hydrogen sulfide	16	0-50 ppm
C_4H_{10}	Iso-butane	05	0-50% LEL
C_3H_7OH	Iso-propyl Alcohol	01	0-1000 ppm
CH_4	Methane	05	0-50% LEL
CH_3OH	Methanol	01	0-1000 ppm
N_2	Nitrogen (oxygen depletion)	23	0-50% O_2
NO_2	Nitrogen dioxide	14	0-10 ppm
VOCs	Organic Vapors	01	0-1000 ppm
O_2	Oxygen	22	0-50% O_2
C_3H_8	Propane	06	0-50 % LEL

3.0 Installation

3.1.1 Wiring Model 6000-A



3.1.2 Wiring Model 6000-B



3.2 Installation Guidelines

Important. All wiring must conform to local building codes, regulations and laws. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

1. Use ½ in EMT conduit for all wiring.
2. A switch or circuit breaker must be included in the installation. It must be suitably located and easily reached in a secure location and identified as the disconnect for the “Gas Detection System”.
3. Install enclosed 120/24 vac transformer, 5 va per sensor or controller, using 18 to 20 AWG two conductor wire. Do not tie the secondary to ground. Connect multiple sensors. Ensure that the polarity of the connections is the same at each sensor or controller.
4. Connect relay contacts (usually relay 1) to ventilation system. Use a magnetic starter so that the sensor contacts energize the starter coil and not the fan motor directly.
5. For multiple sensors interconnect using the CAN network. Chain a shielded twisted pair cable 22 to 24 AWG from screw 11 and 12 on one sensor, to the next and continue chain to the last sensor. Maintain the same polarity on each unit. Do not use star configuration. T connections should be less than 3 meters (10 feet) from the chain. Best to make all chain connections at the sensors to avoid T connections.
6. Move the end-of-line jumper (the one above terminal 11, 12) to the on position (UP) on the first sensor, or controller, on the chain and the last sensor/controller on the chain. A controller can be located anywhere on the chain. Ensure its EOL jumper is off if it is in the middle. Any sensor/controller address can be in any location on the chain.

7. Power on the units. They will display the gas type and reading. To verify if sensors are communicating correctly, change setting on one unit. Press → to, option 56. Press ↑ from 0 to 1 to turn on the network display. Press ↑ and ← simultaneously to save, then press and hold ← for a few seconds to return home. The unit will display each sensor connected. If the unit does not display the other sensors scrolling by, check the following;
    - each unit must have a unique address, setting 39, with no duplicates
    - end-of-line jumpers are set on units at ends of cable only
    - polarity of the communication cable and the 24 vac is the same on all units
    - verify wire connections for shorts, and loose wires, etc.
8. To further test communication, press and hold the up button on a sensor for 5 seconds to start manual mode (5 minutes). This will close the relay 1 on that unit and all of the other units on the network. See section 5 to set up a configuration for multiple zones.

For technical assistance contact;

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Phone 514 556 3013

3.3 Sensor Placement

Coverage

Guidelines for sensor placement of diffusion type sensors are based on the reasonable delay for gas to get from the source to the sensor. All sensors are created equal in this regard.

- **For air quality control** of exhaust emissions and accumulations of toxic gases the generally acceptable maximum radius of coverage is 50 feet (15 meters). Approximately 7500 square feet (700 square meters).
- **For leak detection** of combustible gases, ammonia, refrigeration gases the maximum radius is 30 feet (10 meters) since they can escape more quickly and the risk is greater.

The radius of coverage of any sensor does not extend beyond any obstruction that impedes natural circulation of air. This includes walls, stairs, elevators, shelving with solid fill, tool chests, etc. The sensor must "see" the area of coverage; if not, another sensor(s) is required.

Mounding Heights

Mounting heights for gas sensors are based on their density, relative to air. There are three groups;

1. **Lighter than air** and will be more concentrated near the ceiling; hydrogen, methane (natural gas), ammonia, helium. Install at 1 to 3 feet from ceiling.
2. **Similar density to air** and will be diluted in air equally at all levels; - carbon monoxide, nitrogen dioxide, hydrogen sulfide, oxygen, carbon dioxide. For vehicle emissions; carbon monoxide detectors or carbon monoxide detectors combined with nitrogen dioxide detectors are installed at 3 to 5 feet (1 to 2 meters) from the floor where the ceiling is 7 to 10 feet high. If the ceiling height is higher than 10 feet, example; for heavy equipment, the carbon monoxide detectors are installed at 3 to 5 feet (1 to 1.5 meters) from the

floor as per the requirements of the building code regulations and the nitrogen dioxide detectors should be installed at 50% of the ceiling height and above the vehicle height to be in the open circulation of the air. If the exhaust pipes of diesel vehicles are below the vehicles, then the nitrogen dioxide detectors should be installed at 3 to 5 feet (1 to 1.5 meters) from the floor. Other gases in this group are typically installed at 3 to 5 feet (1 to 1.5 meters) from floor but can be installed up to 50% of the ceiling height. In all cases the detectors must be installed above obstructions blocking circulation of air in front of the detectors, for example; maintenance areas in automobile dealerships where tool chests, work tables and storage racks typically line all walls require the installation of sensors at 6 to 10 feet (2 to 6 meters) off floor to be in the free flow air circulation.

3. **Heavier than air** and will concentrate near the floor; - HFCs, HCFCs, propane, chlorine, most organic vapors (consult Opera), butane. Install sensors at 1-3 feet from floor.

For all types of sensors avoid drafts, obstacles, aerosols, silicones. Place sensors in the center of its coverage area as much as possible.

4.0 OPERATION

4.1 Screen Display

The LCD shows the type of gas and the current gas concentration, depending on the model of sensor module plugged in. If two sensor modules are installed, the display will alternate between them.

The bottom left corner will also display the alarm status;

1 indicates alarm 1 on, according to the settings 0, 1, 2 or activated by another sensor on the CAN network via setting 36. This is usually the low gas level alarm.

2 indicates alarm 2 on. Per settings 3, 4, 5 or if activated by another sensor on CAN network per setting 37.

3 indicates alarm 3 on. Per settings 6, 7, 8 or if activated by another sensor on CAN network per setting 38.

M indicates manual override mode active. Useful to start ventilation system without the risk of leaving it on (and freezing the space in winter). Press and hold ↑ for 5 seconds to start manual mode. Then click again to increase time from 5 to 60

minutes. This activates alarm 1, 2, or 3 (per setting 69) and sends alarm transmit messages in settings 9-17 to other sensors on the CAN network. The unit will return to automatic operation after the time runs down. To cancel manual mode press ↓ several times to reduce time left to run. It will take a few seconds to stop.

T indicates alarm 1 on due to high ambient temperature, setting 51. Useful for summer ventilation.

4.2 Default Settings

User settings are factory pre-loaded with default values to facilitate set up and can be changed at any time. Upgrading firmware will not affect user settings.

Alarm thresholds should be set to suit local regulations. Default values for these are general guidelines only.

4.3 Changing Settings

Press → and ← to move through the settings. If the keypad lock is on then enter the password first. The screen will display the setting number 0, 1, 2, etc. plus the short description (e.g.; AL1) and the current setting value.

Press the ↑ or ↓ buttons to increase or decrease the setting. To save, press ↑ and ← buttons at the same time. The word “OK” will appear. If you do not see “OK” and the new value it is because the buttons were not pressed simultaneously. Try again.

4.4 List of Settings Sensor A (upper socket) settings

No.	Name	Description	Range	Default
0	AL1	Alarm 1 threshold, activates relay 1	by sensor	
1	A1Del	Alarm 1 Delay on (seconds)	0-999	30
2	A1Off	Alarm 1 Delay off (seconds)	0-999	20
3	AL2	Alarm 2 threshold, activates relay 2	by sensor	
4	AL2Del	Alarm 2 Delay on (seconds)	0-999	30
5	AL2Off	Alarm 2 Delay off (seconds)	0-999	20
6	AL3	Alarm 3 threshold, sounder	by sensor	
7	A3Del	Alarm 3 Delay on (seconds)	0-999	180
8	A3Off	Alarm 3 Delay off (seconds)	0-999	20
9	A1Tx	Alarm 1 transmit message, CAN network	0-255	1
10	A1Tx	Alarm 1 transmit message, CAN network	0-255	
11	A1Tx	Alarm 1 transmit message, CAN network	0-255	
12	A2Tx	Alarm 2 transmit message, CAN network	0-255	2
13	A2Tx	Alarm 2 transmit message, CAN network	0-25	
14	A2Tx	Alarm 2 transmit message, CAN network	0-255	
15	A3Tx	Alarm 3 transmit message, CAN network	0-255	3
16	A3Tx	Alarm 3 transmit message, CAN network	0-255	
17	A3Tx	Alarm 3 transmit message, CAN network	0-255	

4.4 List of Settings Sensor B (lower socket) settings

No.	Name	Description	Range	Default
18	AL1-B	Alarm 1 threshold, activates relay 1	by senor	
19	A1Del	Alarm 1 Delay on (seconds)	0-999	30
20	A1Off	Alarm 1 Delay off (seconds)	0-999	20
21	AL2-B	Alarm 2 threshold, activates relay 2	by sensor	
22	A2Del	Alarm 2 Delay on (seconds)	0-999	30
23	A2Off	Alarm 2 Delay off (seconds)	0-999	20
24	AL3-B	Alarm 3 threshold, sounder and strobe	by sensor	
25	A3Del	Alarm 3 Delay on (seconds)	0-999	180
26	A3Off	Alarm 3 Delay off (seconds)	0-999	20
27	A1x A1Tx	Alarm 1 transmit message, CAN network	0-25	1
28	A1Tx	Alarm 1 transmit message, CAN network	0-255	
29	A1Tx	Alarm 1 transmit message, CAN network	0-255	
30	A2Tx	Alarm 2 transmit message, CAN network	0-255	2
31	A2Tx	Alarm 2 transmit message, CAN network	0-25	
32	A2Tx	Alarm 2 transmit message, CAN network	0-255	
33	A3Tx	Alarm 3 transmit message, CAN networ	0-255	3
34	A3Tx	Alarm 3 transmit message, CAN network	0-255	
35	BITx	Binary input transmit message for limit switch, CAN network	0-255	0

4.4 List of Settings Continued
General settings

No.	Name	Description	Range	Default
36	R1Rx	Receive message to activate relay 1, CAN network	0-255	1
37	R2Rx	Receive message to activate relay 2, CAN network	0-255	2
38	R3Rx	Receive message to activate sounder and strobe CAN network	0-255	3
39	Adr	Sensor identification address, CAN network	0-32	0
40	AnZA	Adjustment for analogue zero output (4ma or 2V) senor A to tweak output for controller input errors. Accessing this option forces output low for testing.		
41	AnSA	Adjustment for analogue span output (20ma or 10V) senor A to tweak output for controller input errors. Accessing this option forces output high for testing.		
42	AnZB	Adjustment for analogue zero output (4ma or 2V) senor B to tweak output for controller input errors. Accessing this option forces output low for testing.		
43	AnSb	Adjustment for analogue span output (20ma or 10V) senor B to tweak output for controller input errors. Accessing this option forces output high for testing.		
44	Temp	Temperature display enable off/on	0/1	0
45	Aud	Local audio alarm enable on alarm 3	0/1	1
46	BAC	BACnet MSTP mode select 0 = BACnet communication disabled 1 = BACnet communication enabled 2 = BACnet communication enabled and display all sensors on CAN network	0/1/2	0
47	BMA	BACnet MAC address	127	0

No.	Name	Description	Range	Default
48	BBR	BACnet baud rate 0 = 9600 1 = 19200 2 = 38400 3 = 76800	0/1/2/3	3
49	KLB	Keyboard lock	0/1	0
50	TMod	Temperature modify/calibrate	-9/+9 °C	0
51	ATHi	High temperature alarm limit used for summer ventilation. Alarm 1 is activated when temperature exceeds option. Deg C	0-99 °C	60
52	W/U	Warm up delay disables alarms till sensors stabilize (mins)	0-99	60
53	BMM	BACnet maximum MAC address when polling for master	0-127	127
54	BDiag	BACnet diagnostic display while accessing this option. In format XXXYYZZ. Where YY is MAC address (in hex) of the sensor that just passed the token to the current one. ZZ is the sensor to which the token was passed to. Example 0305 would display on sensor with MAC address 4		
55	ATLo	Low temperature alarm limit (alarm 3) Deg C. 0=off	0-99	0
56	Net	Enable local display of all sensors on home screen CAN network	0/1	0
57	Ref-A	To select refrigerant scale and type of gas for sensor A. **For model 5520:** R507, R23, R134a, R152a, R492a, R404a, R407a, R408a, R410a, R500, R502, R507 **For model 5513:** R22, R21, R141b, R142b, R401a, R402a, R408a, R409a, R502a	select from list	R507 R22
58	Ref-B	As setting no. 57 but for sensor B (bottom socket)		

4.4 List of Settings Continued
General settings

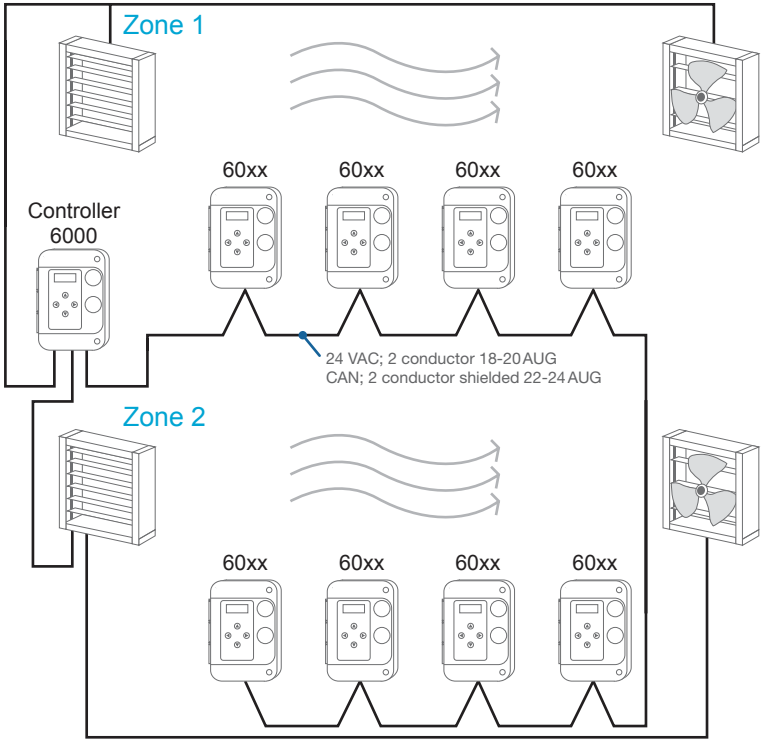
No.	Name	Description	Range	Default
59	FltTx	Fault alarm transit message, CAN network	0-255	0
60	ADTxA	Analogue drive transmit message, sensor A (top) CAN network	0-255	0
61	AMinA	Analogue drive. Minimum percent of scale for zero output. Sensor A	0-100	0
62	AMAxA	Analogue drive. Maximum percent of scale for full scale output. Sensor A	0-100	100
63	ADRxA	Receive message code to control local analogue output	0-255	0
64	ADTxB	Analogue drive transmit message, sensor B (bottom) CAN network	0-255	0
65	AMinB	Analogue drive. Minimum percent of scale for zero output. Sensor B	0-255	0
66	AMaxB	Analogue drive. Maximum percent of scale for full scale output. Sensor B	0-100	100
67	ADRxB	Receive message code to control local Analogue output B	0-255	0
68	Baud	Baud rate for CAN network Maximum network wire length is 1500 feet at rate 0 and 3000 feet at rate 1	0-1	0
69	Man	Manual mode activates alarms 1, 1+2 or 1+2+3. See screen display section.	1-3	1
70	BDI	BACnet device instance replace default 5,000 + BMA setting	0-4,194, 304	50000

5.0 Network Configuration

5.1 Using CAN Network with a Central Controller

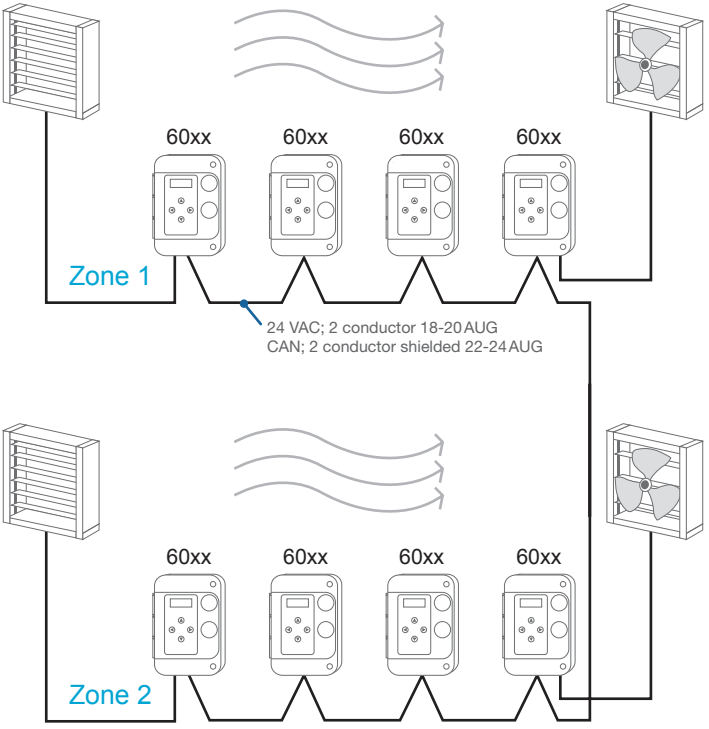
A model 6000 controller serves as the central connection point for the ventilation system. Model 60XX gas sensors transmit alarm messages to the central controller.

A controller will display up to 32 sensors on the network (64 for dual units). It also displays their address, gas types, gas concentration, and alarm status for each. The two relays on board can be configured for different levels of gas or to operate different ventilation systems, zones or groups.



5.2 Using CAN Network with No central controller (master/ slave operation)

One of the 60XX series gas sensors can perform the same function as the controller. It can activate the ventilation for all the sensors, or a group. The use of a dedicated controller is optional, - to add a display in some specific location, such as before entering a mechanical room or to interface with several fan starters located in one place. The low cost of a basic controller makes it easy to reduce costly field wiring. Starters and air dampers are connected to the sensor closes to in in each zone.



5.3 Default Configuration

Sensors are shipped pre-loaded with default settings which can be changed in the field to suit the desired sequence with simple keypad input. Using the default settings, when a sensor goes into alarm level 1, 2 or 3 it activates its relays and transmits a message to all other sensors to activate their relays also. The ventilation system can be connected to any of the relays (usually level 1). This is essentially a one zone configuration.

5.4 Addresses

Set each sensor and controller to a different address (setting 39). 1, 2, 3, 4 etc. It is important to have no duplicates on the same network cable.

5.5 Creating Zones or groups

To control multiple zones, set the transmit message on sensors to different messages for different zones. The default transmit messages are 1, 2, 3 for alarm levels 1, 2, 3 for zone 1.

Set zone 2 sensors to transmit messages to 4, 5, 6
Set zone 3 sensors to transmit 7, 8, 9 and so on.

5.6 Output Relays

Relay number 1 and 2 will activate if the gas on that sensor goes into alarm level 1, or 2. It will also activate when it sees it's receive code (setting 36, 37) go by on the network, sent by other sensors.

A 6000 basic controller has no sensors on board so the relays will only activate if it sees it's receive codes on the network. The 6000 controller could control two zones via its two relays. When no controller is used, the master needs to be a member of the group it is controlling.

6.0 Maintenance Guide

All sensors are shipped from the factory pre-calibrated. To maintain accuracy and conformity with standards it is essential that they be calibrated by a qualified technician at least once per year using certified bottled gas mixtures.

6.1 Quick Test Caution

Opera does not approve the use of the so called “bump test”. This where a gas of a higher concentration than the alarm level is simply injected into the sensor to cause the alarm to trigger. The gas in these bottles is a higher concentration than what is used for proper calibration. This only test the operation of the alarm with no regard for the intended alarm settings, similar to simply pressing a test button.

Use certified precision mixtures to adjust the sensitivity of the sensor due to normal wear and aging and guarantee that the designed alarm set points are respected. It will also indicate the general condition of a sensor that is due for replacement. So called “automatic calibration” or “self-test” will not provide this level of security.

6.2 Calibration Procedure

1. Use certified bottled calibration gas mixtures only. Ensure that sensors are powered on for a minimum of the break-in period for the sensor. For electro-chemical sensors this is only a few minutes.
2. Press the right arrow to enter settings
3. Press the ↑ and → at the same time to enter calibration mode. SAZ (sensor A zero) will display and the current gas reading on the top line

4. Inject bottled zero gas into first sensor. Use a flow rate of 0.1 LPM to 2 LPM. The gas fitting to sensor should not be sealed tight. If it is the pressure will increase and distort the reading (high).
5. Adjust gas reading to zero with the ↑ and ↓ buttons
6. Press ↑ and ← at the same time to save
7. Press → The display will show SAS (sensor A span) and the current gas reading
8. Inject bottled span gas into first sensor and wait until the gas reading stops going up. The span gas should must be within the range of sensor's scale.
9. Adjust the reading to match the concentration in the bottle
10. Press ↑ and ← at the same time to save
11. If second sensor installed press → and repeat steps 3 to 10 for sensor B
12. Press left arrow several times to return to settings.

7.0 BACnet Network Configuration

Check settings on sensors or controllers connected directly to the MSTP network. See section 4 of Model 6000 Operation Manual for instructions on changing settings. Use option 54 as a diagnostic tool to verify MSTP token passing.

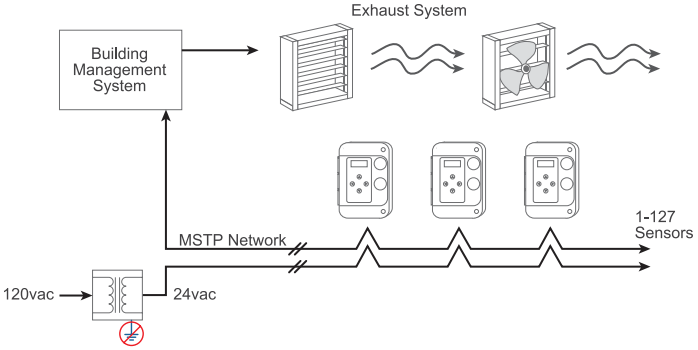
Setting 46	Bacnet Mode select 0 = communication disabled 1 = communication enabled 2 = communication enabled and display all sensors on CAN network	0, 1, 2	Default 0
Setting 47	BMA MAC address	0-127	0
Setting 48	Baud rate	0 = 9600 1 = 19200 2 = 38400 3 = 76800	3
Setting 53	Max Master	0-127	127
Setting 70	Device ID	4,194,304	50,000+BMA

Object Table

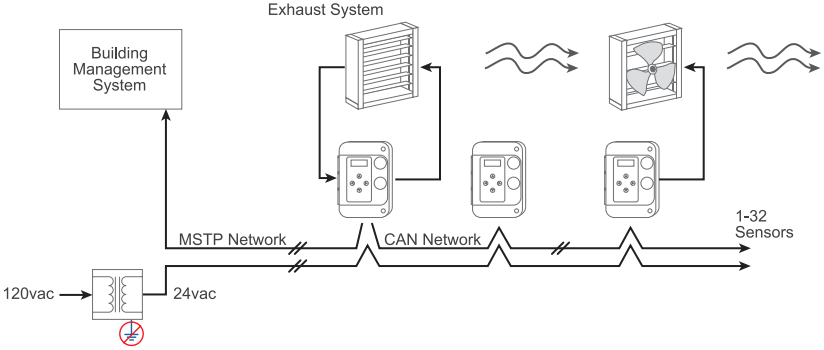
Type and Instance	Object Name	Object Property	Parameter
AV0	gas reading 1	Present value (R)	Gas reading local sensor A
AV1	gas reading 2	Present value (R)	Gas reading local sensor B
AV2	Ambient temperature	Present value (R)	Temperature in celsius
BI 0	Input 1	Present value (R)	Auxiliary input state 0/1
BO 0	Relay 1	Present value (R/W)	Relay 1 status on 0/1
BO 1	Relay 2 0r alarm 2	Present value (R/W)	Relay 2 or alarm 2 status 0/1
BO 2	Alarm 3	Present value (R/W)	Alarm 3 Indicator status 0/1
AV XYY	Gas reading XYY	Present value (R)	Gas reading remote sensors

X = sensor 1 (top) 2(bottom), YY = CAN Address
Analogue value for each gas reading will display description of gas type and scale

7.1 Ventilation Controlled by BACnet Building Automation



7.2 Ventilation Controlled directly by Gas Sensors



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