

OPM4001 Opacity/Dust Density Monitor Installation and Operation Manual

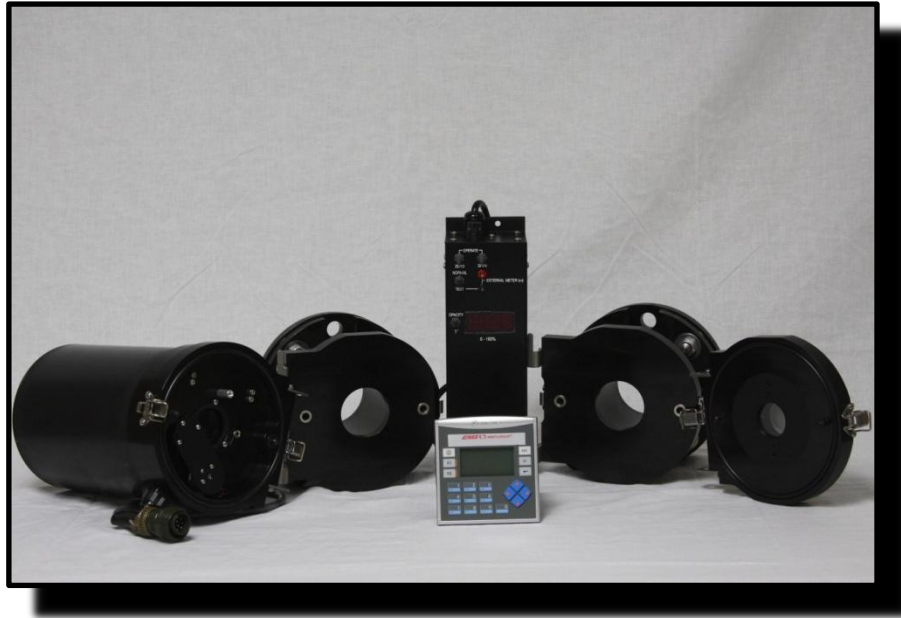


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Technical Support Hotline

For assistance with problems, please call the Customer Support Center (CSC).

Phone: 1-800-433-6076 1-440-914-1261

In addition to CSC, you may also contact Field Watch. Field Watch coordinates Emerson Process Management's field service throughout the U.S. and abroad.

Phone: 1-800-654-RMST (1-800-654-7768)

Emerson Process Management may also be reached via the Internet through e-mail and World Wide e-mail: GAS.CSC@emerson.com

World Wide Web: www.raihome.com

World Wide Web: www.raihome.com

Warnings and Safety Guidelines for user safety and equipment protection

This manual is intended to aid trained and competent personnel in the installation of this equipment. Only a technician or engineer trained in the local and national electrical standards should perform tasks associated with the electrical wiring of this device.

Warnings

- Under no circumstances will Emerson Process Management be liable or responsible for any consequential damage that may arise as a result of installation or use of this equipment.
- All examples and diagrams shown in the manual are intended to aid understanding. They do not guarantee operation.
- Emerson Process Management accepts no responsibility for actual use of this product based on these examples.
- Due to the great variety of possible applications for this equipment, the user must assess the suitability of this product for specific applications.
- Make sure to have safety procedures in place to stop any connect3ed equipment in a safe manner if the controller should malfunction or become damaged for any reason.
- Do not replace electrical parts or try to repair this product in any way.
- Only qualified factory trained service personnel trained in its operation should open the device's housing or carry out repairs.
- The manufacturer is not responsible for problems resulting from improper or irresponsible use of this device.

Instruction Manual 2.1

- You may cause an electric shock, fire or damage the equipment if you ignore any of these safety precautions.

Manual Prepared by James F. Cagnetta

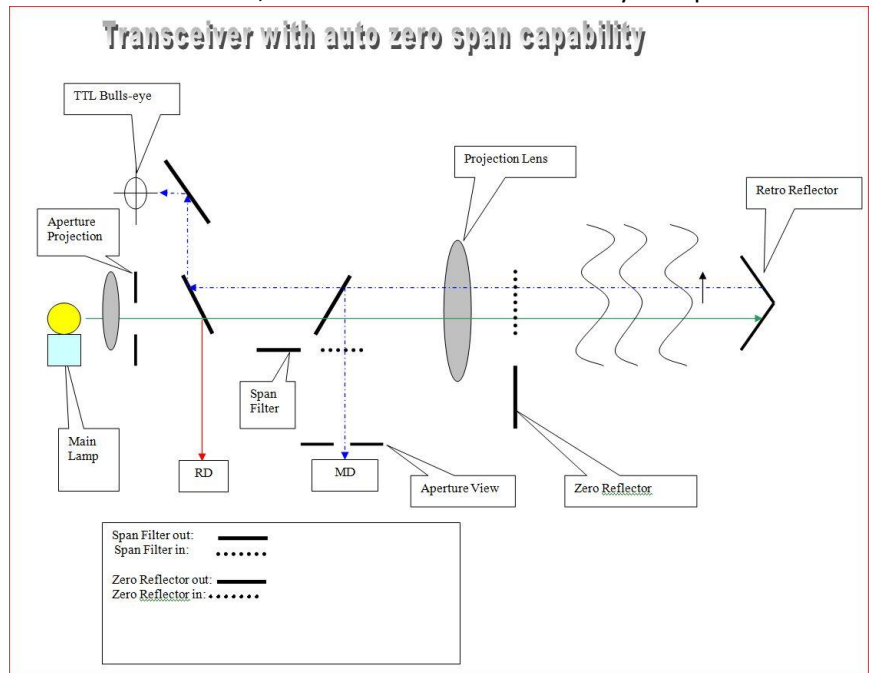
Section 1 System description

Transmissometer /retro reflector

The OPM4001 is a precision, double-pass, dual beam Transmissometer that consists of a transceiver (transmitter/receiver) mounted on one side of a stack or duct and a passive reflector mounted on the opposite side. The light source, photo detectors, and all measurement/reference optics used in opacity measurement are housed in the transceiver.

Normal mode of operation

The Dual beam measurement system has a stack mounted Transmissometer sensor system consists of an optical transceiver mounted on one side of the stack and a retro reflector mounted on the other. To avoid errors due to ambient light, the **lamp** (See Drawing) is electronically modulated and projects a collimated beam of light, which is split into a reference beam, and a measurement beam by an optical **Beam splitter**. The reference beam is directed to the reference detector, **RD**. The measurement beam is projected across the stack to a **Retro reflector** that returns the beam back across the stack to a beam splitter and directs the measurement beam to the measurement detector, **MD**. A portion of the returning light is also sent to the TTL (Thru the Lens) bulls-eye target viewed through a window provided at the rear of the Transmissometer. The bulls-eye is used to correct changes in alignment and is unique in that no moving parts are used!



The ratio of the measurement and reference detectors is used to provide Transmittance T^2 (T^2) signal. Because the same light source is used for both detectors, and a Measurement / Reference ratio is used throughout for the calculations, the monitor is insensitive to variations in light intensity. Since all measurements are made on a ratio basis, all resulting computations are independent of the absolute intensity of the light source or contamination of the optics associated with the collection and focusing of the energy from the lamp. The (T^2) signal is converted to a current format and sent to the control unit for processing. At the control unit the signal is processed to read 0-100% Opacity, provide alarms and outputs.

Internal calibration system, zero mode

Zero and span calibration checks can be initiated manually, automatically or by a PLC or computer. During the zero calibration mode a calibrated **zero reflector** is placed in front of the transceiver optical package testing all optical surfaces and electronic components to assure zero point has not changed.

Internal calibration system, Span mode

In the span mode a **Span filter** of known Neutral Density is placed in the measurement path and produces a specific upscale reading in accordance with the latest E.P.A. requirements. The zero and span cycle provides a continuous check of all the optical components and surfaces, the main lamp, the detector, interconnecting wiring, control unit and computation analysis.

Remote Control Unit (RCU)

The RCU provides instrument control functions, opacity readings, alarms, analog outputs, communications, system information and more. The RCU can be DIN rail mounted or panel mounted (3.7x3.7" – 93x93mm) in a control room environment and is rated NEMA 4X/IP65 when panel mounted. Battery backup for all memory is typically 7 years.

The control unit should be mounted in a control room environment i.e., clean, temperature with max/min of +0° to +50° C (+32° to +122° F). The control unit provides instrument control functions, opacity readings, alarm and fault indicators, analog outputs, and diagnostics with contact closures.



Optional Air Purge Weather Cover System

The transceiver and reflector may be mounted in weather covers. The weather covers are fairly compact to allow movement around them even on a three-foot walkway or platform. They protect the stack-mounted components from dirt, moisture; stack temperatures within the specified ambient temperatures limits, and errant air currents around the stack.

The air purge system constantly circulates air past the optical window. The air flow is directed through the hose to an air plenum on the stack side of the optical window. The air flow in the air plenum area results in reduced pressure and increased velocity. This venturi effect tends to continually draw the air around the optical window into the purge air stream, thereby keeping the lens clean for long periods.



Alignment system

The OPM4001 includes a built-in through-the-lens alignment system. The alignment target can be viewed through a window on the transceiver. Adjustments to changes in alignment are provided by a 3-point alignment system, which is integral to the air plenum.

Cabling

The standard cabling used between the stack-mounted units and the control unit is at a minimum 6-pair, #20 AWG, twisted, shielded cable separation distance approximately 1000FT. More pairs or larger than 20 AWG is acceptable.

OPM4001 Specifications:

| | |
|------------------------------|---|
| <i>Remote Control unit:</i> | |
| Enclosure | Panel mounted IP65/NEMA4X Dimensions 96x96x64 mm (3.8"x3.8"x2.5"). |
| Approvals | CE and UL Listed |
| Digital Display | LED backlight, Instant and Average Opacity -5 to 99% Opacity |
| Ambient Temperature Range | 0 to +50° C (+32 to + 122° F) |
| Power Requirements | Power 20.4 to 28.8VDC < 10% ripple, 20va |
| Alarm Time Delay & set point | Field programmable. |
| Alarm Reset | Manual or Automatic |
| Analog Outputs | Two 12-bit Analog outputs 4-20mA, Field selectable range - 5.0 to 100%. |
| Exit Correlation (Lx / Lt) | 0.3~1.0 OPLR |
| Calibration check options | Selectable internal timed or computer initiates or push button on demand. |
| Communication | Remote access, RS485 MODBUS networking. |
| Battery Backup | 7 years typical |

| | |
|---------------------------------|--|
| <i>Transceiver/ Reflector:</i> | |
| Enclosure/Power Requirements | NEMA 4X watertight enclosure. Power 120 or 240VAC +/- 10%, 50/60Hz. 65va for transceiver, 65va for Service module. |
| Path Length | 2 to 50 feet (0.6 to 4.6 15.2 meters) |
| Optical System | Double Pass with LSEM (Light Source Electronic Modulation). |
| Ambient Light Immunity | Solid state LSEM (Light Source Electronic Modulation) |
| Reflector | Type 1 (plastic) reflector assembly |
| Alignment Verification | Built-in through-the-lens system standard |
| LSEM Aging Compensation | Automatic |
| LSEM Expected Life | 70,000 hours (Field proven for > 8 years) |
| Ambient Temperature Limits | -40 to +130° F (-40 to +54° C) |
| Process Gas | Up to 750° F (400° C) higher available contact the factory. |
| Mounting Flanges | 3 inch IPS, 150# flange (other sizes available) |
| <i>Design and performance:</i> | |
| Peak and Mean Spectral Response | Photopic; 515 to 585 nm, less than 10% of peak response outside the desired 400 to 700 nm region. USDEP 40 CFR 60 appendix B PS-1 and ASTM D 6216 specifications |
| Angle of View | < 4.0° from optical axis |
| Angle of Projection | < 4.0° from optical axis |
| Calibration Error | < ±2% of full scale |
| Response time | < 10 second |
| Zero Drift | < 1% (24 hours) |
| Calibration Drift | < 1% (24 hours) |
| Operational Period | 6 Months |

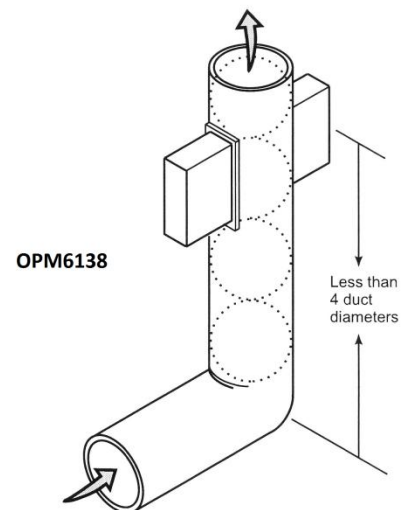
Section 2 Installation Considerations

Regulatory/Process Considerations

The EPA has established the following guidelines for choosing an opacity/dust density monitor installation site:

- 1) Locate the transmitter across a section of a duct or stack that will provide a particulate matter flow through the path of the transmitter beam representative of the duct or stack flow.
- 2) Ensure the transmitter location is down-stream from all particulate control equipment.
- 3) Locate the transmitter as far from bends and obstructions as practical.
- 4) If a transmitter is to be located less than 4 duct diameters downstream from a bend, install the transmitter in the plane defined by the bend, as shown in the figure below.
- 5) Ideally, locate the transmitter eight to ten stack diameters upstream from the stack exit and three to five diameters downstream from any bends, junctions, or other constrictions in the stack or duct.

For best results, mount the transceiver and retro reflector modules so the light beam is exactly perpendicular to the stack or duct and the beam goes through the center. Do not install the transmitter downstream of a wet scrubber. The water droplets introduced to the gas stream by such equipment will interfere with the opacity readings. For an accurate measurement under these conditions, choose a location upstream from a wet scrubber or a location downstream from the scrubber where the water droplets are vaporized by the reheating of the gas. The stack exit correlation is especially important to verify. If possible all dimensions should be verified by actual measurements. Measure and record inside stack dimensions at the measuring point and at the stack exit, and compute the Optical Path Length Ratio (O.P.L.R.). Check that the calculated and the O.P.L.R. found in the Factory OPLR Check step found further in this section are within +/- 2%.



Note: The transceiver and retro reflector are shown with the optional weather covers installed.

Stack Exit Correlation Computations

NOTE: The stack exit correlation is especially important to verify. If possible, all dimensions should be verified by actual measurements. Using the instructions below verify that the values are correct as displayed in the About page.

Lx/Lt is the ratio of the inside diameter at the top of the stack to the inside diameter of the stack where the instrument is located. If the ratio is greater than 1.0, the exit opacity will be greater than the opacity at the instrument location. The OPM4001 uses this correction factor to calculate the stack exit opacity. It is not practical to have an Lx/Lt factor much greater than 2.0 because the error of the instrument increases as Lx/Lt becomes greater.

Lx = inside stack diameter at stack exit.

Lt = inside stack diameter at the transmitter location.

Lf = flange to flange distance between the transceiver and retro reflector unit.

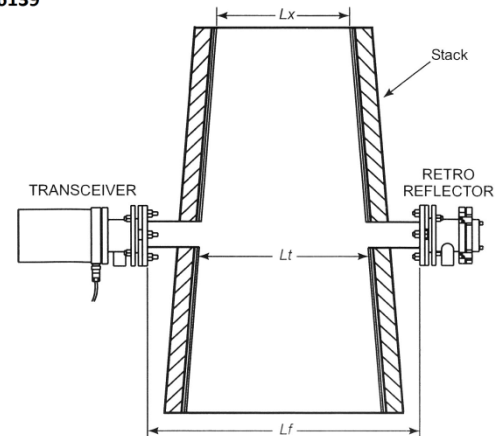
- 1) Measure and record Lx and Lt and compute the Optical Path Length Ratio (OPLR).
- 2) Check that the calculated value and the OPLR found in the 2nd About page are within ±2%.
- 3) Example: A stack with a 120 in. (3048 mm) stack exit ID and a 120 in. (3048 m) path length.

- 4) Enter the exit diameter (Lx) and measured diameter (Lt) in the control unit. Refer to Section 4: Operation, for info on using the control unit.

$$OPLR = \frac{Lx}{2 * Lt}$$

$$OPLR = \frac{120}{2 * 120} = 0.50$$

OPM6139



Note: Transceiver and retro reflector are shown without the optional weather covers.

Choose an installation site; the primary considerations for choosing a site for the OPM4001 are accessibility, ambient environmental conditions, and locating the unit to obtain a representative sample of the process. Review the excerpt from the *Federal Register* in appendix for suggestions before selecting an installation site. The following general guidelines should also be considered.

Sensors height from Platforms, walk way/ decks, etc, A platform or walkway must be available for access to the weather covers. The optimum condition would have the mounting flanges and weather covers approximately 5 feet up from the floor. Railings and other obstructions should allow the weather cover to swing clear as shown in the installation drawings.

Locate the stack-mounted units in an area with ambient temperatures between -4° to $+130^{\circ}$ F. (Consult the factory for other temperature ranges.) Areas that are clean and dry are desirable. Avoid areas with condensation.

Maintenance intervals are directly related to the installation environment. Intervals can vary from 2 to 3 months in fairly clean environments, to twice a month in dirty environments. Lens cleaning is a function of the ambient conditions and cleanliness of the purge air.

Locate the instrument to avoid excessive vibration or shock.

Locate the control unit in an easily accessible area with temperatures between $+32^{\circ}$ to 122° F. To permit the operator to read and/or change controls, the unit should not be mounted higher than five feet from floor level.



Stack exit, Locate the transceiver more than two stack diameters down from the stack exit is recommended.

Installation – Mechanical

A review of the drawings and procedures provided will help to produce an error free installation. However, there are important additional points that must be observed. The beam of the instrument must be kept in the horizontal plane; the transceiver cannot be rotated more than $\pm 10^\circ$ from vertical. The weather covers must be installed vertically plumb.

Installation and wiring diagrams are found at the end of this manual. Please review all drawings prior to starting installation or wiring. If you have any questions please contact our Customer Support Center (CSC) Phone: 1-800-433-6076 or 1-440-914-1261

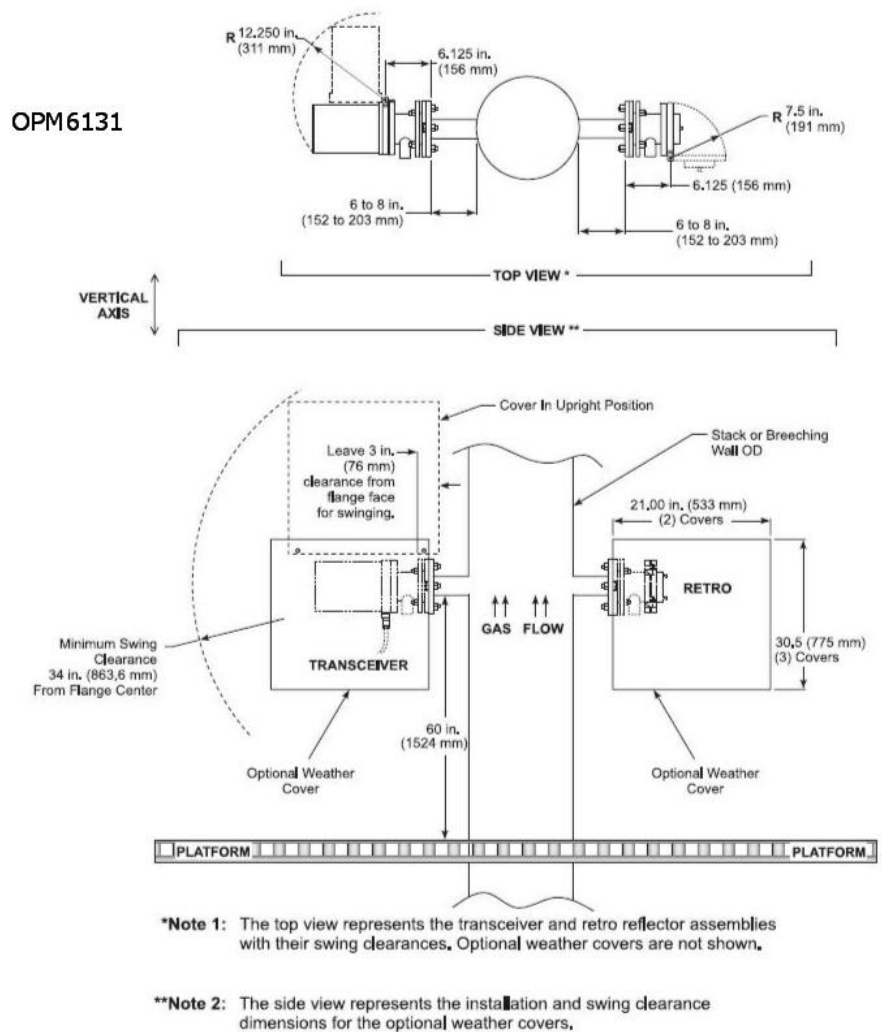
E-mail: GAS.CSC@emerson.com

Installation procedure - stack flanges

For an opacity monitor, the customer is required to supply and install two 3" I.P.S. flanges at eye level directly across from each other. The flange faces, mounted on pipe stubs, should be approximately 6" to 8" from the stack or insulation. On completion of the installation, the flanges must be aligned so that the total deviation of the light source flange relative to a common centerline, does not exceed $\pm 1^\circ$ and the retro reflector flange does not exceed $\pm 3^\circ$.

Flanges should be mounted approximately 5 feet up from the deck of platforms, roof or walk way.

At installations where conditions permit, this may be accomplished by using a piece of 2 1/2" pipe suspended across the stack protruding far enough to allow slipping the 3" flange pipe assemblies over each end and welding in place as shown on the following page.



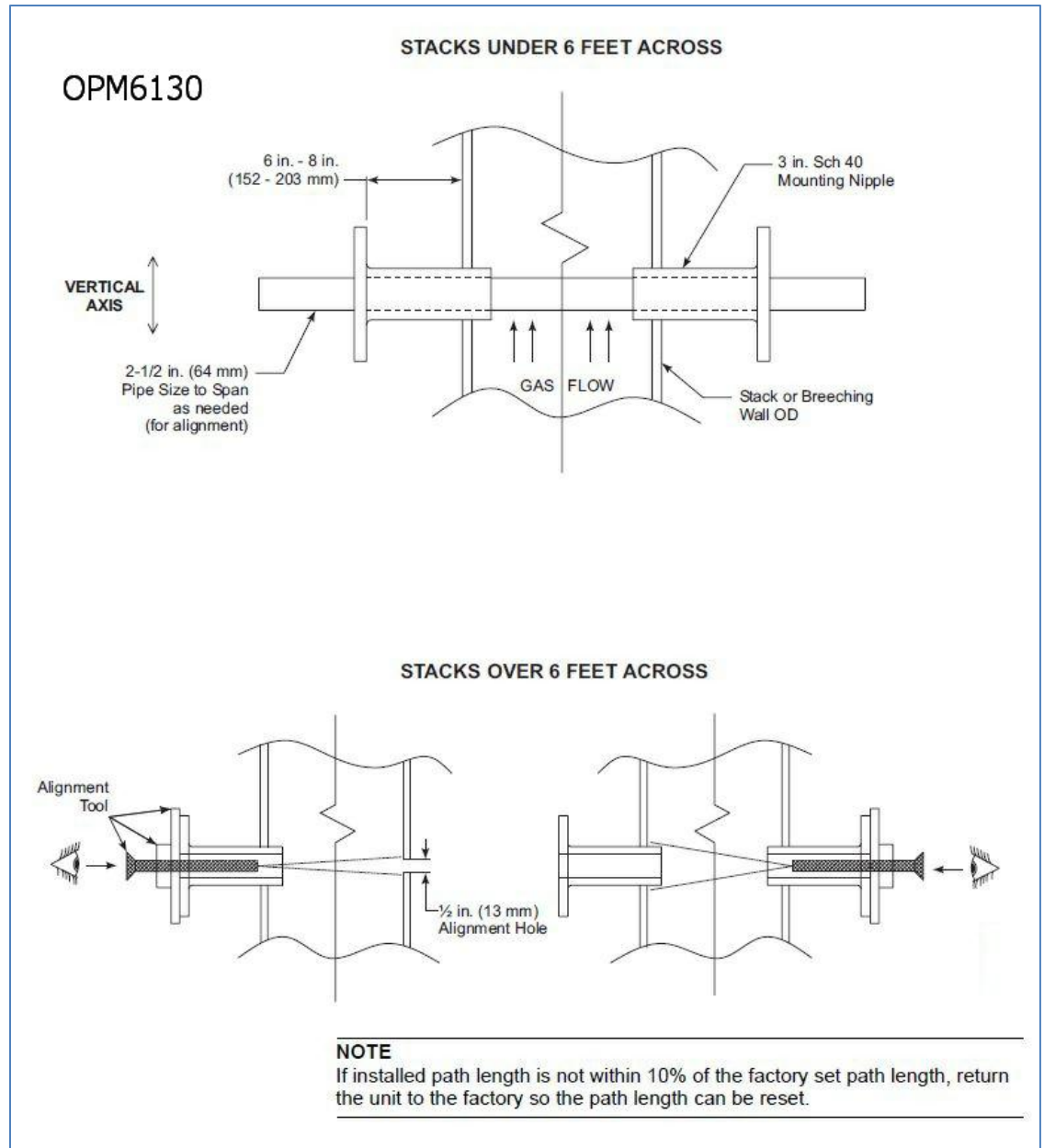
Any deviation up to the previously specified limits can be adjusted out during the installation and alignment of the light source and retro reflector with the system's alignment adjustments.

Where installations do not permit the use of the aforementioned method, the following procedure will accomplish the same results. (See drawing EMS1002. An alignment tool can be purchased from the factory to insure accurate alignment.

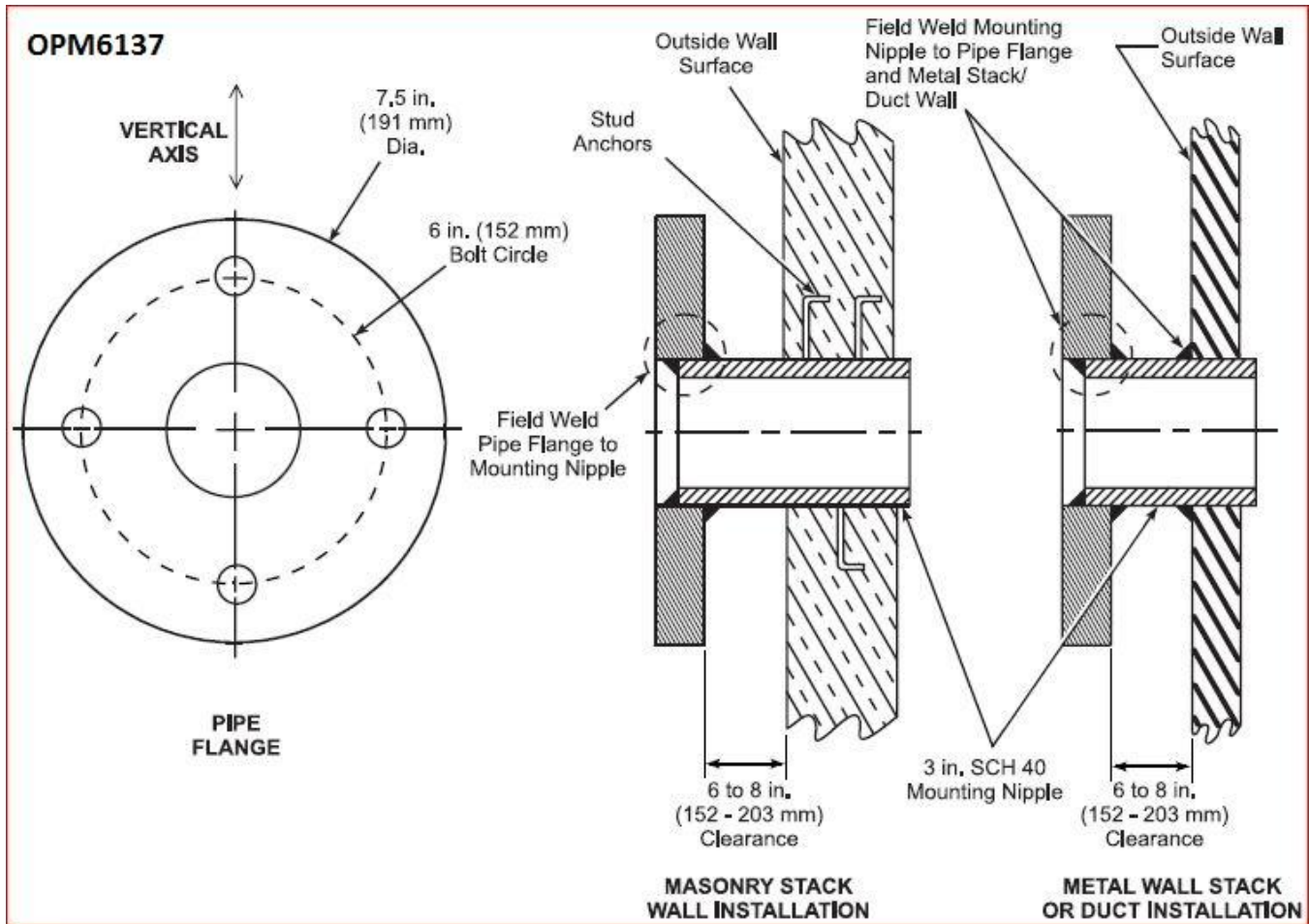
Accurately locate one 3 1/2" diameter hole (large enough to accept the 3" pipe) and the other hole approximately 1/2" diameter, directly across from each other. Attach the alignment tool to the flange/pipe assembly and insert the pipe into the 3 1/2" hole in the stack wall. Align the assembly with the 1/2" diameter hole on the opposite side by viewing through the alignment tool and weld the pipe in place. Care must be exercised when welding to maintain alignment.

The 1/2" diameter hole should now be enlarged

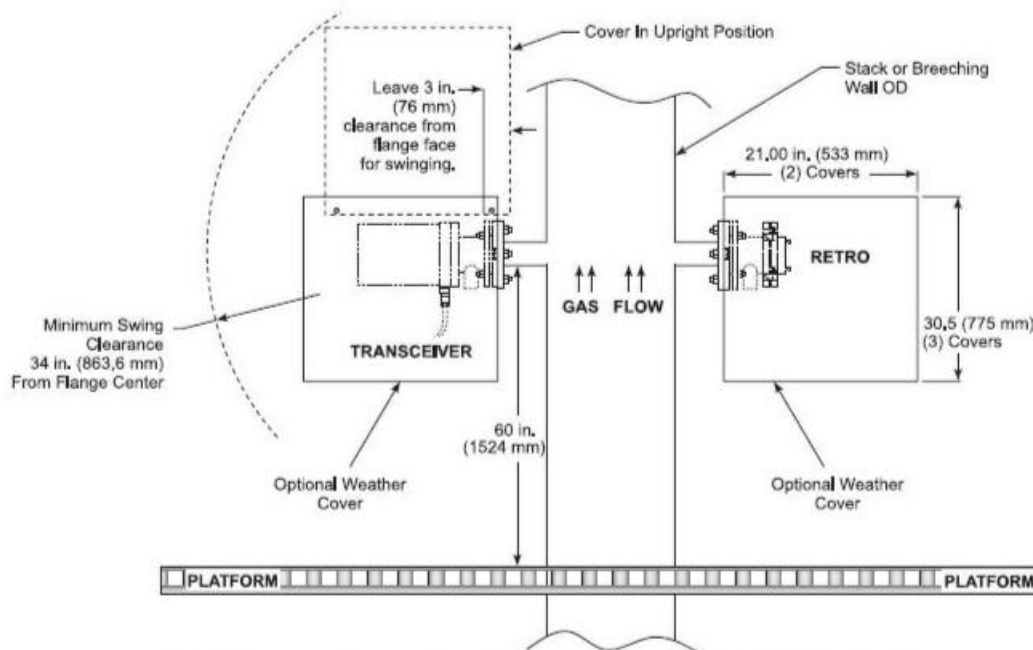
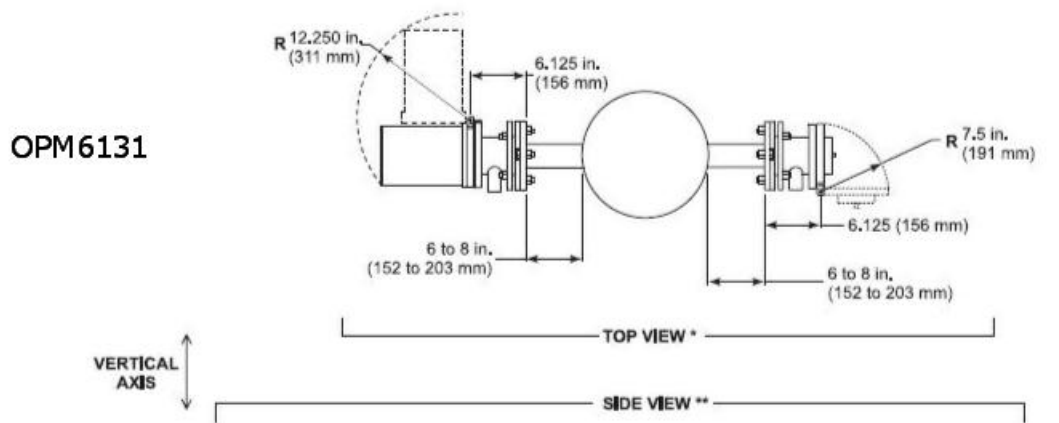
approximately 3 1/2" to accept the other flange/pipe assembly. Proceed in the same manner, installing the assembly with the alignment tool attached, and weld in place maintaining concentric alignment with the 3" pipe previously installed on the opposite wall.



Flange to stack installation



Air purge/Weather cover mechanical Installation



***Note 1:** The top view represents the transceiver and retro reflector assemblies with their swing clearances. Optional weather covers are not shown.

****Note 2:** The side view represents the installation and swing clearance dimensions for the optional weather covers.

NOTE

If installed path length is not within 10% of the factory set path length, return the unit to the factory so the path length can be reset.

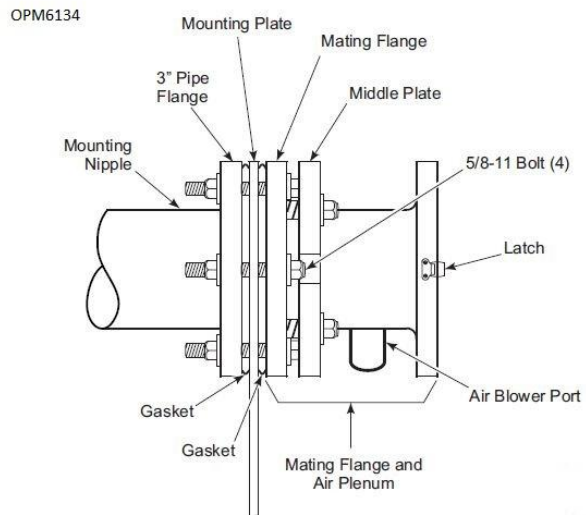
Mounting the air plenum and weather covers

WARNING! Control unit, Transceiver & Retro serial numbers must match.

After the installation site has been selected and the platform requirements have been met, the mounting flanges should be installed and aligned as described on Drawings EMS - 1001 and EMS - 1002. Flanges should be installed with the mounting faces on the vertical plane.

- 1) Before installing the Transceiver, Retro reflector or any type of weather cover remove the air plenum from both the Transceiver and retro reflector. Removal will make the installation easier and less chance of damage while mechanical attachment of the air plenums and optional weather covers when provided.

- 2) If the transceiver and retro reflector have been shipped from the factory with the air plenum attached, unclip both hold down latches, swing open and lift up & off the hinge pins. Place the Transceiver and retro in a safe place.



- 3) The air plenum is attached to the customer supplied 3" pipe flange by four 2 1/2" long 5/8-11 bolts. Working from the 3" flange the correct assembly is; gasket then air plenum.
- 4) If you have weather covers remove the two (2)-weather cover hood hinge pins located on the upper right and left hand corner of the hood. The air plenum and weather cover are attached to the 3" pipe flange by four (4) 2 1/2" long 5/8-11 bolts. Working from the 3" flange the correct assembly is; gasket, weather cover mounting plate, gasket, mating flange & air plenum. Place the 5/8-11 bolt through the top hole of the middle plate. Place a flat washer between the middle plate and mating flange and pass the bolt through. Slip a split lock washer over the bolt and secure with a nut. Repeat for the remaining three mounting bolts.
- 5) Any wiring or air hoses can be connected now.

Transceiver and retro reflector assembly

- 6) Attach the Transceiver and Retro reflector to the air plenum assembly by placing them on the hinge pins.
- 7) Close transceiver & retro and secure in place with the two hold down latches.
- 8) The air-purge blowers should be powered up at this time to prevent stack particulate from accumulating in the nipple and air-purge housing.



Caution: If installed location has a positive pressure the air-purge system must be used continuously during installation to prevent process gases from contaminating optical surfaces or over heating instrument electronics. If the system is shut off for more than momentary interruptions, the instrument may be damaged. Failure to provide continuous air-purge may void the warranty.

All wiring from the control unit to the transceiver should be completed at this time.

NOTE: THE AIR PLENUM ASSEMBLY FOR BOTH TRANSCEIVER AND RETRO MUST BE INSTALLED AS BELOW, I.E. THE PINS ON THE LEFT SIDE POINTING UP!

Section 3 Remote Control Unit (RCU) operation Page Description

RCU buttons

About page

When power is first applied press ESC to display the Main page.

The left, right, up, down arrows are used to move display arrows or move to other pages.



The ESC button is used to move back from the page you are on to the previous page.



The enter or return button is used when entering variable. Press it and the variable will change from steady to blinking, enter the new value and follow screen tip at the bottom to complete the operation.



The info button is used for setting the PLC functions. This is not used during normal operation. When required the use of the functions will be explained in this manual.



The key pad is used to enter values.




The +/- is used when (-) sign for values are required.





These buttons are not used on this model.



When power is first applied press ESC to display the screen for the operator to select the function of interest by pushing the Up or the Down Arrow to select the function desired, press the return/enter button .



By pushing UP or the DOWN arrow  you can select the OPM4001 Display, Setup or About pages. Use the return/enter button  to enter the page (screen) you desire.



To get to the About page scroll down to About and press the right arrow button to enter the 1st page of the about page. This will display the Model & s/n, Date of manufacture and Flange to Flange.



About page 2 displays Modbus network, Stack exit I.D., Path length I.D. and OPLR (Optical Path Length Ratio).



Start up Verifying instrument operation and configuration

Zero/Span Check

For assistance with problems, please call the Customer Support Center (CSC).

Phone: 1-800-433-6076 1-440-914-1261

In addition to CSC, you may also contact Field Watch. Field Watch coordinates Emerson Process Management's field service throughout the U.S. and abroad.

Phone: 1-800-654-RMST (1-800-654-7768)

Worcester Polytechnic Institute may also be reached via the Internet through e-mail and World Wide Web:

e-mail: GAS.CSC@emerson.com

World Wide Web: www.raihome.com

World Wide Web: www.raihome.com

Alignment procedure must be completed as outlined in Section 2.


Power applied to both the control unit and the sensors for a minimum of 30 Minutes before any adjustments are attempted.

The zero calibration has been set at the factory by placing the instrument on an optical bench using the flange-to-flange dimensions specified by the customer and recorded in the customers final test report. This zero value is critical as it can offset smoke measurement plus or minus if not correctly set. The measurement reflector contains an aperture that is chosen during the factory calibration and is fixed. The Transceiver is aligned with the beam centered on the retro reflector and the electronics is adjusted to produce a zero opacity value.


The calibration zero reflector is adjusted to provide a low value typically 1-2% and the span filter upscale value is recorded and entered in the set up page under "Fault setup" When the system enters a manual or auto cal check cycle the current zero and span values are checked against the stored values. If either the zero or span current value exceeds the stored value by +/- 2% opacity the fault system will energize.

Initiate a Z/S check by pressing the F1 button. The next screen will ask you for a selection; press Enter to choose "Yes". The screen will return to the Display and the Right column will show In Cal icon. When the zero check "Instant value" stabilizes (@15 seconds) record the zero value. The Zero check will remain for 3 minutes, next will be Span and will last for another 3 minutes. When Span is stabilized record the span upscale value. The system will automatically return to monitoring the process at the 6 minute point from cal start. You will know this because the In Cal icon will turn off.





Check to see if the controller has the same values by pressing ESC and scroll down to the Setup and press return/enter button  you will be at the password page. Enter 1234 from key pad and press the return/enter button.



Scroll to *Cal Z/S Value setup* and press the return/enter button . The true span check will be blinking. If zero and span values are the same as you recorded +/- 0.5% opacity do nothing just press the ESC button. Should the displayed values be greater than +/- 1.0% but less than 3% from your recorded values enter the recorded values. Press



 the right arrow  to highlight the value to change. Press the return/enter button and use the key pad to enter your value. Press the +/- dot button above the return/enter button for decimal point. When correction is made press the return/enter button to save (it will stop blinking and move to the next value).

The Fault squelch timer should be left at 1 Min.


The fault timer is that time from fault detection to initiation of the fault alarm and should be not less than 10 seconds.

The (-ve) negative opacity fault YES= on, NO= Off.

When you are finished press the ESC to exit.

| | |
|---|--|
| <p>NOTE: If the Zero or Span <u>value stored</u> is +/- 3% Opacity from <u>your recorded value</u> contact our service department because it may indicate other adjustments are required.</p> | |
|---|--|

Scrolling multiple main display pages

Pressing ESC will get you back to the selection page, scroll to OPM4001 Display and press return/enter button  the process opacity display page will be displayed:

Upper line; Next cal in HH:MM:SS

Middle line; Instant opacity %

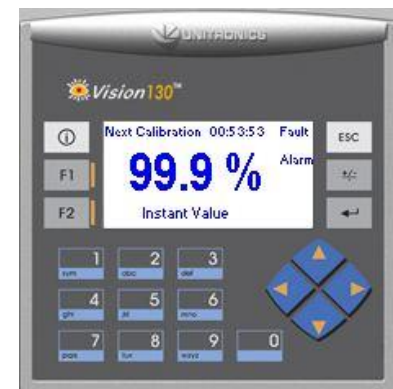
Bottom line; 6 Minute average opacity %

Pressing the up or down arrow you can scroll to the 3 display pages that is best for your application.

Page 1 is a split screen with instant and average opacity. *NOTE: If input goes negative a 4th screen will appear, when signal goes positive it will return to page 1 the default page.*

Page 2 is average opacity only.

Page 3 is Instant opacity only.



Password protected parameters

Password 1234 - From any screen press ESC until the Main, setup and about screen is visible. Scroll to Setup and press the return/enter button. The password is 1234.



Alarm set point - return/enter button and set the alarm set point from 0-99% and the alarm delay – In seconds. Press enter to set, ESC to exit.



Calibration Cycle setup – Press return/enter button and set the frequency you want the cal cycle to initiate. EPA regulations call for 24hr. The OPM4001 will initiate the cal cycle if Cal trigger is “Internal”. To use an external command scroll down to cal trigger and choose external by pressing key pad #2 then press return/enter button to set. Input momentary ground to I3.



Note: No input to I3 and External selected the system will not go into cal cycle, however you can still use the F1 button to force an manual cal cycle.

Alarm Auto/Manual setup – Press return/enter button to enter. Choose between 1-auto or 2-manual.

Auto means when the high opacity alarm has been activated and when the level of smoke drops below the alarm point the alarm contacts O2 & O4 and icon will reset automatically.

Manual reset means when the high opacity alarm has been activated, pushing the return/enter button O4 contact will de-energize but O2 will remain energized. When the level of smoke drops below the alarm point the return/enter button is pushed and both O2 & O4 will be de-energised.



Output type setup – Press return/enter button to enter. “Output type” refers to the 4-20mA outputs.

Ins – instant opacity, z/s outputted during cal cycle.

Avg – 6 minute opacity average z/s outputted during cal cycle.

Last - instant opacity, last value is held during cal cycle.

Note: Last should be used if you are using the output for process control signal.



Output scaling setup – Press return/enter button to enter. Set Ch 1 or 2 to desired opacity range i.e, for 4ma to represent minimum opacity and 20mA to represent maximum opacity. The 20mA value of 99.9 is used to represent 100%.

Note; For CFR 40, PS-1 the set 4mA to -5% To get negative values press +/- once for negative then button 5 then +/- again for the decimal placement. i.e, Ch.1 4 mA: -5.0 % 20mA: 99.9 %



Section 4 Modbus

Modbus Setup

MODBUS I.D. – Press return/enter button to enter and input the node number (1 to 32) desired press Press return/enter button to to set then ESC to exit.



Modbus Write

| <i>Write:</i> | | |
|----------------------|-------|---|
| Remote Cal. Initiate | MB 51 | Initiate cal =1 |
| In maintenance | MB 49 | In Maint. =0, Not In Maint. =1 |
| Power status | MB 50 | Lost power to SM (service module) =0, Power OK =1 |
| T2 Signal | MB 34 | Signal OK =0, Lost signal =1 |
| -ve opacity | MB 37 | Positive opacity =0, Negative Opacity =1 |
| Zero Cal Fail | MB 38 | Fail =1, Not fail =0 |
| Span Cal Fail | MB 39 | Fail =1, Not fail =0 |

Modbus Read

| | | |
|---|-------|------------------------------|
| MB = Modbus Poll Read Discrete inputs (100001....20000) | | |
| MI = Modbus Poll Read Holding (40000...50000) | | |
| Read: | | |
| 0% to 100% (x.x) instantaneous opacity | MI 35 | Read |
| 0% to 100% (x.x) average opacity | MI 98 | Read |
| Relay 05 (Zero DAS) | MB 43 | Zero, not cal = 0, in cal =1 |
| Relay 06 (Span DAS) | MB 44 | Span, not cal = 0, in cal =1 |
| Relay 07 (No Air flow) | MB 45 | OK =0, Not OK =1 |
| Relay 03 (High alarm Audible) | MB 46 | No alarm =0. Alarm =1 |
| Relay 04 (Fault) | MB 47 | No fault =0. Fault =1 |
| Relay 02 (High alarm) | MB 48 | No alarm =0. Alarm =1 |
| Alarm Set point | MI 22 | Read |
| Alarm delay | MI 24 | Read |
| Common fault individual blocks: | | |

RS/485 Communications and connection

Port 2, 6-pin R J25 connector Pin 1 (+), Pin 6 (-). RS-485 cabling may be up to 2000 feet in length. Belden P/N 3106A cable is recommended.

If not specified in the original order default is as follows. NOTE: The following communication perimeters cannot be changed in the field the controller must be returned to the factory.

Baud Rate 9600

Data Bits 8

Parity None

Flow Ctrl None

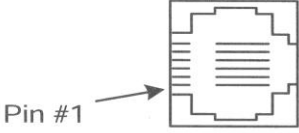
Timeout 0.2 seconds.

RS485: Pin out

Use RS485 to create a multi-drop network containing up to 32 devices.

Note: port #1 is set to RS485

- Note that the ports are not isolated. If controller is used with a non-isolated external device, avoid potential voltage that exceeds +/- 10V. To avoid damaging the system, all non-isolating device ports should relate to the same ground signal.

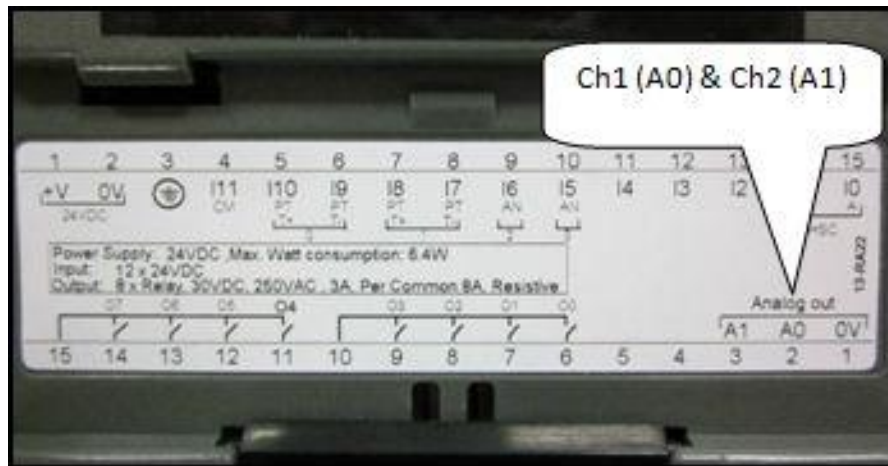
| Diagram | Pin Number | Function |
|--|------------|----------------|
|  | 1 | A signal (+) |
| | 2 | (RS232 signal) |
| | 3 | (RS232 signal) |
| | 4 | (RS232 signal) |
| | 5 | (RS232 signal) |
| | 6 | B signal (-) |

- Use shielded, twisted pair cables.
- Minimize the stub (drop) length leading from each device to the bus.
- Ideally, the main cable should be run in and out of the network device.
- Do not cross positive (A) and negative (B) signals. Positive terminals must be wired to positive and negative terminals to negative.

Section 5 Output Connections

Channel #1 and 2, 0-100% Opacity 4-20mA outputs to recording devices

(Maximum 500 ohm device load) Connect the (-) minus wire from your device to the bottom connector terminal 0V and the (+) plus wire from your device to the terminal AO for channel 1 and AI for channel 2.



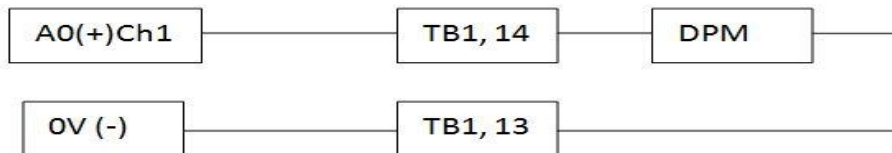
Analog outputs 4-20ma

The OPM4001 comes with two 4-20mA output channels. The ranges are set during final test to the information supplied by the customers. Field changes can be made in the set up page. Maximum output Loop compliance is 500 Ohms.

| OPM4001 Analog output wiring list wiring list | |
|---|--|
| | |
| Bottom Connector | |
| Common for mA outputs - 0V | |
| Positive 4-20mA output CH1 - A0 | |
| Positive 4-20mA output CH2 - A1 | |
| | |

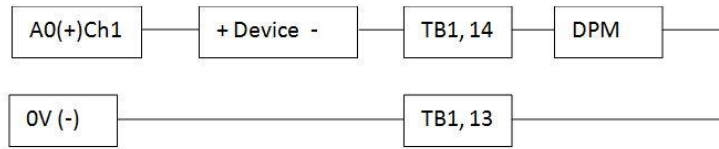
Channel 1: 0V & A0 supplies the opacity signal to the service module 14 & 13 (on TB1, OPM6142) for display at the service module.

Channel 2: 0V & A1 can be used for DAS, recorder etc.

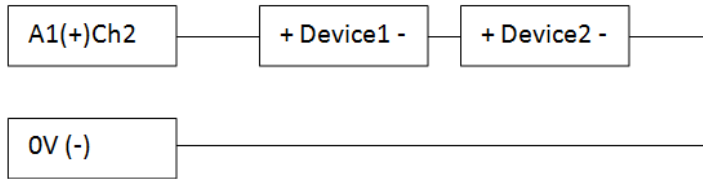


Other output connections possible

To utilize an external device (max 250 ohm) in Ch1 current loop:



To utilize an external device in Ch2 current loop (max 500 ohms total):



To check devices such as recorders or DAS are responding correctly use the following procedure; On the control unit front panel press the F1 Push button to put the system in a maintenance zero and span cycle. Both outputs will correspond to the opacity display value.

Section 6 Clear Path Adjustments

Service module

| | | |
|---------------------|--|--|
| <p>OPERATE/ZERO</p> | <p>This switch controls the zero mirror solenoid. In the operate position the mirror is not in the measuring path and is considered normal operation. When the mirror solenoid is energized, the mirror is placed in the measurement path and is considered a maintenance condition, i.e. signal is not representative of the stack smoke. The control unit will indicate a fault.</p> <ul style="list-style-type: none"> • Energize and observe the digital meter to test the systems response to zero % opacity. • Energize in conjunction with the span filter to observe the upscale span % opacity calibration point. | |
| <p>OPERATE/SPAN</p> | <p>This switch controls the span filter solenoid. In the operate position the span filter is not in the measuring path and is considered normal position. When the span filter solenoid is energized, the span filter is placed in the measurement path and is considered a maintenance condition, i.e., signal is not representative of the stack smoke. The control unit will indicate a fault.</p> <ul style="list-style-type: none"> • Energize in conjunction with the zero mirror to observe the upscale span calibration point. | |
| <p>NORMAL/TEST</p> | <p>This switch controls the External mA Meter connections. In the normal mode the terminals are shorted. In the test mode the terminals are open and the current loop from the transceiver is interrupted allowing the use of an external current meter to be placed in series with the transceiver current output. When this is in the test mode position it is considered a maintenance and fault condition. If no current meter is in the test jacks, the loop current in the control unit will indicate full scale and the control unit will indicate a fault.</p> | |
| <p>OPACITY/T2</p> | <p>This switch selects the display of the stack digital meter. In the Opacity mode, the digital displays % Opacity from the control unit. In T2 mode, it is the signal out of the transceiver in % Transmittance squared.</p> | |

Clear on stack zero and span calibration

The instrument has been calibrated at the factory to specifications received with the order and if the actual dimensions of the flange to flange are exactly as received the calibration adjustments required will be minimal or none at all. The following adjustments are for the first time the instrument is installed. To calibrate or adjust the OPM4001 use the following steps.

NOTE: Calibration must be performed with the process shut down to produce a clear stack condition. If a clear conditions is not possible go to “Off stack zero calibration” procedure later in this manual.

Before proceeding clean both transceiver and retro reflector lens.

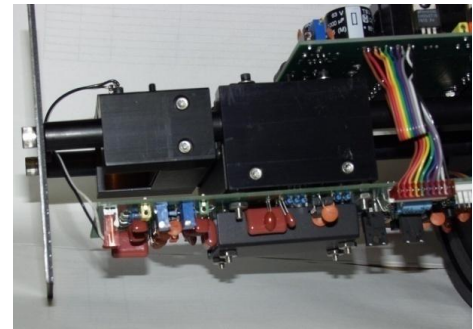
Remove the transceiver cover (Always disconnect power when removing or replacing the transceiver cover) by removing the screw below the target viewing window and pulling the cover straight back until it clears the Optical plate.

To complete this procedure the following items are required: Micro-turn 200 on-line test kit (p/n 6A00188G07) a manual for the audit device is included with the device.

1. Swing both the retro and transceiver open and clean the protective windows. Return both to the closed position.
2. Verify alignment, returning beam is centered on the TTL target.
3. On the transceiver remove the screw below the target viewing window and pulling the housing straight back until it clears the optical plate.
4. On the Service Module (Figure 2) the normal/test switch must be in the “Normal” position and the Opacity/ T² is in “Opacity” position. NOTE: All adjustments are on the PCB 222-1667 (p/n 1A99993H03 for replacement).

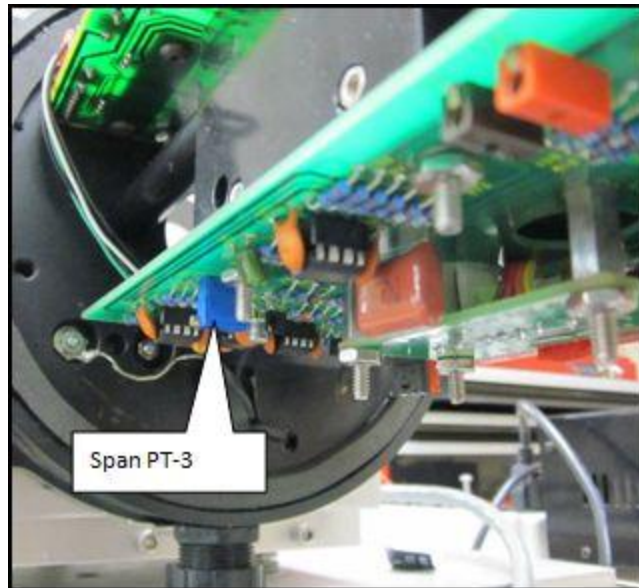


5. Adjust the 20 turn Zero potentiometer on board 222-1667 marked "PT -1", CW until you increase to about 20% opacity, then slowly turn the PT-1 CCW until you have Zero % opacity, 0-1% opacity.
6. Install the Micro-turn 200 on-line test reflector on the transceiver and screw the device to the transceiver with the mounting screw. With the thumbwheel adjust the on-line reflector for the same opacity as in previous step and lock it in place.



7. Place the highest value filter (for best results at least a 0.8 O.D.) in the slot provided. Adjust the Span potentiometer on board 222-1667 marked "PT -3" for the filters correlated value on the service module opacity display equals to the correlated value. See section six (6) for filter correlation formulas.
8. Remove the filter and adjust the Zero potentiometer PT-1 for 0-1%.

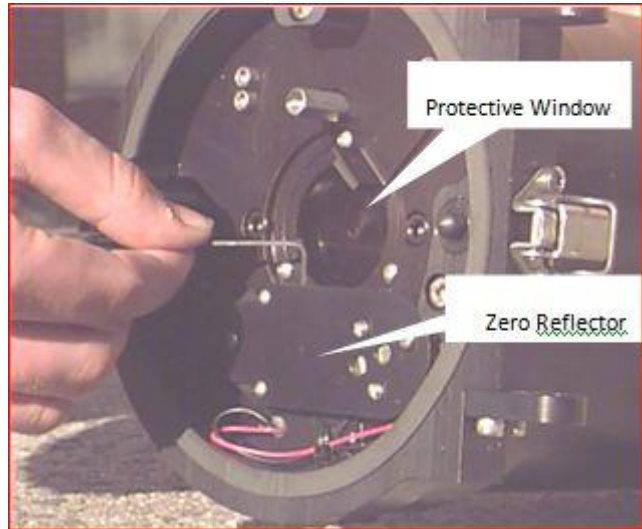
9. Insert the High filter again adjust PT-3 for its value, repeat steps until the values come within 0.5 % Opacity.
10. Remove the on-line test reflector and replace the transceiver cover and secure the transceiver in place. You must complete "Zero Reflector Adjustment" procedure next.



Zero reflector adjustment

After a clear or off stack zero has been performed the zero reflector needs to be adjusted.

1. Find and record the zero offset value found in the set up page under "Zero Cal Value".
2. On the service Module place the Opacity/ T2 switch in the Opacity position to observe the correlated opacity on the digital display.
3. Swing open the transceiver and initiate a zero with the zero switch on the service module to raise the zero reflector into place. Observe and record the zero value after 30 seconds. Return the mirror to normal resting position by returning the zero switch to operate position.
4. If required, insert a 1/16" Alan wrench into the adjustment set screw located on the top of the zero reflector. Turn the set screw clock-wise 1/8 turn.
5. Remove the Alan wrench and initiate a zero utilizing the zero switch on the service module and after 15 seconds observe the reading is moving toward the desired value. (if value is away from desired repeat step 4 turn set screw C.C.W.)
6. Repeat steps 4 & 5 each time making small 1/8-turn increments until the desired value is reached. Cycle 2-3 times more waiting 15 to 20 seconds between cycles to assure unit repeats desired value +/- 0.5% Opacity. Swing transceiver into operate position and secure in place. Record the zero final value.



Span filter value

1. With the zero switch in zero, place the span switch in span. Span is not adjustable, final value is a function of filter value, transceiver calibration and OPLR. Record the final value.
2. Return both zero and span switches to operate, normal/test to normal, T2/Opacity to Opacity.

Record the zero/span values

1. To record the final values you will need to enter the zero and span into the set up page under "Cal Z/S Value setup ". This completes the calibration.

Off stack zero calibration

This procedure may be used if: A clear stack condition is not possible and the zero appears to be incorrect or if the flange to flange distance on site are different than the original factory set up.

This procedure may be used if: A clear stack condition is not possible and the zero appears to be incorrect or if the flange to flange distance on site are different than the original factory set up.

Remove the transceiver and retro reflector from the hinge pins, remove the service module and install the system on portable off stack test stands (p/n 1A99993H37) and at the correct flange to flange distance plus 11 inches. The additional 11 inches compensates for air plenum spacing, as the air plenums are not used for the off stack zero calibration.

1. Clean transceiver and retro windows.
2. Connect the control unit with the cables that came with the Off Stack kit and apply power to the system.
3. The retro reflector must be level.
4. Follow instruction for "Clear on stack zero and span calibration".



Section 7 Filter correction formula

If you have an OPLR (correlation factor) other than 0.5 your slides will read differently. To calculate what the slide will read with another OPLR use the formula:

$$\left(1 - \left(\left(1 - \frac{Op1}{100} \right)^{\frac{M2}{0.5}} \right) \right) * 100 = OP2$$

Where:

OP1 = Standard filter Value in %

M2 = OPLR for your instrument

OP2 = Standard Filter value at your OPLR in %

Example:

Standard filter value is 23.1% what will it read at OPLR of 1.5?

$$\left(1 - \left(\left(1 - \frac{23.1}{100} \right)^{\frac{1.5}{0.5}} \right) \right) * 100 = 54.5\%$$

Filter re-calibration is available from EMS and if not regulated by EPA regulations in your State to a more frequent schedule we suggest you re-calibrate at the minimum of once a year. If you have filters from other manufacturers we can also calibrate them as well (call for pricing). Filters are tested per USA Code of Federal Regulations 40CFR60 Appx. B, Performance Specification 1, Section 7.1.3 Attenuation Calibration.

Filter certification

QA/QC testing of the filters at an interval of not more than 6 months is recommended. Filter certification, replacement or additional Neutral Density .

Neutral Density Filters for Micro-turn 200 are calibrated on a Perkin-Elmer Lambda Series 6 / PECSS Spectrophotometer per Federal Environmental Protection Agency specifications. These specifications are contained in the Code of Federal Regulations 40 CFR 60, Appendix B, Performance Specification 1, Attenuator Calibration. The filters are scanned over the visible region from 380 to 780 nanometers in one nanometer steps and the resulting transmittances of the filter are weighted to the Source C Human Eye Response by multiplying each value by its associated response factor. The corrected values of transmittance are converted to % Opacity and the value is recorded on the filter and associated chart.

| Density (O.D.) | Nominal % Opacity |
|-------------------|---|
| 0.02 | Special contact the factory for details, 3-6% |
| 0.04 | 9% |
| 0.1 | 20% |
| 0.2 | 36% |
| 0.3 | 50% |
| 0.4 | 60% |
| 0.5 | 70% |
| 0.6 | 75% |
| 0.7 | 80% |
| 0.8 | 85% |
| 0.9 | 88% |

Section 8 Preventive/Corrective Maintenance

Preventive/corrective maintenance schedule

Daily:

Check Zero/Span marks are within specification (+/- 2%)

Check for fault conditions

Monthly or as required:

Clean transceiver and retro windows

Check alignment, correct if necessary

Check air filters replace if necessary

Quarterly:

All daily and monthly checks

Perform COM Audit per EPA regulation 40 CFR, 60 App. B, PS-1.

Replace air filters

Check all air hoses and clamps for tightness and wear, correct as necessary

Check weather cover gaskets for leakage

Check all bolts for tightness

Check all electrical connections are secure

Check air blower for excessive noise

Assure that airflow switch is operating properly

Yearly:

Clear stack or off stack zero

All quarterly checks

Remove transceiver and retro, clean air plenum

Replace any worn hoses and gaskets

Clean inner optics if necessary

Check all system operations

General

Corrective and preventive maintenance schedules should be adjusted according to site specific conditions to ensure the maximum availability of accurate measurement data. Routine checks should be implemented to:

Observe and correct the operation of the air-purge system giving particular attention to keeping the optical path within the mounting flanges clear of dirt build-up.

Observe and correct the operation of peripheral accessory equipment such as recorders, computers, etc.

Observe and correct the stack zero measurement whenever a clear stack condition exists. Care should be exercised to ensure that both transmittance and opacity measurements are at their prescribed values.

Verify that instrument operating manuals are available and that maintenance logs are properly maintained and reviewed.

Every 3-5 Years:

EMS recommends periodical, depending on the severity of the sensor locations 3-5 years between overhaul of our opacity system to keep them working at their optimal level. Overhauls become necessary do to the fact that over time dust, out gassing of electronic parts, removing protective covers, etc., manifest itself as overall optics degradation causing more frequent adjustments and poor performance of the opacity monitor.

For assistance with problems, please call the Customer Support Center (CSC).

Phone: 1-800-433-6076 1-440-914-1261

In addition to CSC, you may also contact Field Watch. Field Watch coordinates Emerson Process Management's field service throughout the U.S. and abroad.

Phone: 1-800-654-RMST (1-800-654-7768)

Worcester Polytechnic Institute may also be reached via the Internet through e-mail and World Wide Web:

e-mail: GAS.CSC@emerson.com

World Wide Web: www.raihome.com

World Wide Web: www.raihome.com

Warnings and Safety Guidelines for user safety and equipment protection

Trouble Shooting

| Problem | Possible Cause | Remedy |
|--|---|--|
| Control unit reads 99%, Alarm icon is on, Fault message T2 4-20mA FAULT, service module meter in T2 reads -20 or higher. | Transceiver current loop to the control unit is open | Operate/test switch must be in Operate. Check wiring for open from control unit I6 & 0V to terminal 17 & 16 at service module location. |
| Alignment is good but control unit reads high opacity or erratic in normal, zero & span mode, service module meter in opacity reads high or erratic. | 1- Reference voltage TP-2 on signal processor 1667 is lower than 9.3V 2- Main lamp out | 1- Adjust lamp drive PT-2 on the power modulator 1668 until Reference voltage TP-2 on signal processor 1667 is 10.0 +/- 0.2Volts. 2- Replace main lamp assembly |
| Control unit reads High, zero/span values are OK | 1- Smoke 2- Alignment is out | 1- Correct process 2- Adjust alignment until centered on target. |
| High dust alarm and /or cal fail cal message | Transceiver window and/or zero mirror is dirty | Clean window and or zero mirror |
| Control unit reads High, zero/span values are OK, alignment is good | Dirt built up in flanges | Swing open transceiver & Retro. Clean flanges with push rod. |
| Air purge icon on in the lower right corner of the Main Display | No air flow | Replace air blowers as necessary Replace air filters as necessary Tighten hose clamps as necessary |
| No stack power fault message | Service module lost power or failed | Check power, check SM fuse. Replace as needed |

Trouble shooting -continued

| Problem | Possible Cause | Remedy |
|--------------------------|---|--|
| Maintenance Mode message | Maintenance switch or maintenance function is on 1- Control unit zero/span key was pressed. 2- Service module zero/operate switch in zero, span/operate switch in span 3- Service module test/operate switch in test | Return all to operate positions. |
| Control unit blank | Control unit fuse open | Replace and check for shorts in the power supply or individual boards. |

Section 9 Spare parts

| | | | |
|------------|--|---|--------------------------------|
| 1A99993H03 | OPM T Signal processor with detector board assembly installed. | X | Transceiver |
| 1A99993H04 | Power Supply/Modulator Board-PCB | X | Transceiver |
| 1A99993H06 | Zero reflector iris assembly with rotary solenoid, reflector tape and zero arm for Opacity Transceiver . | X | Transceiver |
| 1A99993H08 | Replacement Air flow switch for air purge blower. | X | Transceiver Retro reflector |
| 1A99993H09 | 8 Pack Air filter replacement element (ID 1.5 OD 4.5 HT 5.875 Black) | X | Transceiver Retro reflector |
| 1A99993H11 | P1 - Service Module output cable assembly | X | Control Unit Service Module |
| 1A99993H12 | P2 - Transceiver output cable assembly | X | Transceiver Service Module |
| 1A99993H13 | Service Module Assembly with Digital display, local zero/span and test jacks. | X | Service Module |
| 1A99993H30 | OPM4000 series control unit to service module 10' test cable. | X | Control Unit Service Module |
| 1A99993H35 | OPM3000/4000 Series Opacity Detector Board-PCB | X | Transceiver |

| | | | |
|------------|--|---|--------------------------------|
| 1A99993H36 | Retro Assembly Drop on pin type 3-15Ft. | X | Retro reflector |
| 1A99993H37 | Off the Stack Opacity Test Stand for OPM3000/4000 series. | X | Transceiver Retro reflector |
| 1A99993H39 | Pair of Opacity Air plenum Plant Air Adaptors, accepts 1/4" or 1/2" NPT | X | Transceiver Retro reflector |
| 1A99993H40 | OPM3000/4000 Series Air Plenum Assembly (with lift-off hinge), opacity fits either Transceiver or Retro. | X | Transceiver Retro reflector |
| 1A99993H41 | OPM3000/4000 Series Opacity Transceiver protective window kit, 3-screws, 1-150x50mm lens, 1-O-ring, 1-lens retaining ring. | X | Transceiver |
| 1A99993H43 | OPM4001 Base Control Unit Spare/Replacement | X | Control Unit |
| 1A99993H45 | OPM SD Standard Backup Card (2GB) | X | Control Unit |
| | OPM4000 Series Service Module Zero-Span controller main PC board. | X | Control Unit |

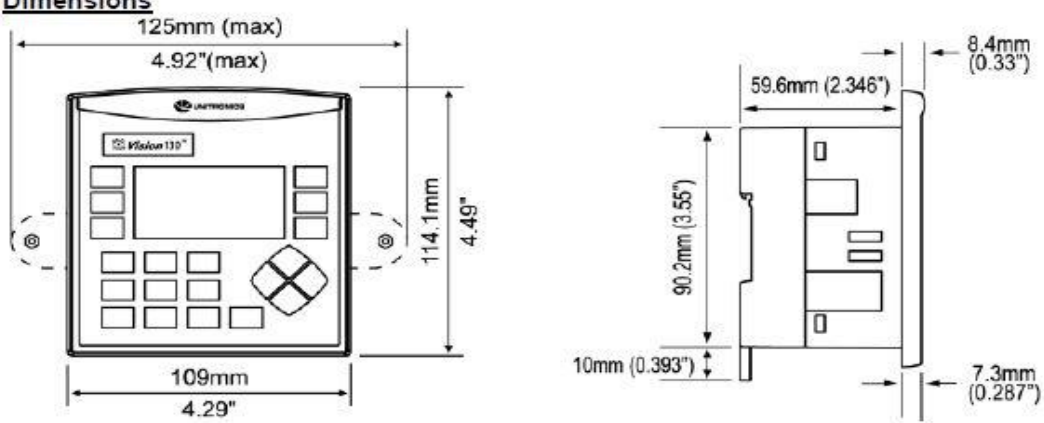
Section 10 Drawings

It is recommended to print drawings with the highest print quality.

OPM4001 control unit dimensions

Mounting

Dimensions

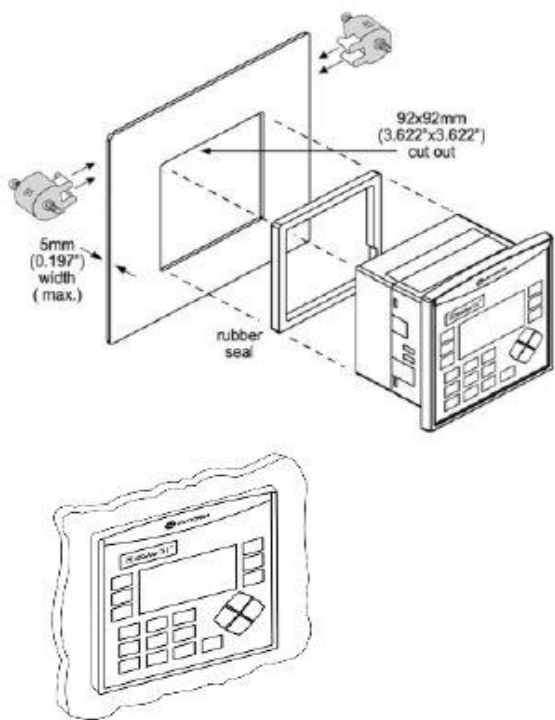


The front view shows a square control unit with a screen and keypad. Dimensions are: total width 125mm (max) / 4.92" (max), total height 114.1mm / 4.49", and a central width of 109mm / 4.29". The side view shows a depth of 59.6mm (2.346"), a mounting flange height of 90.2mm (3.55"), a bottom lip height of 10mm (0.393"), and a top lip height of 8.4mm (0.33").

Panel Mounting

Before you begin, note that the mounting panel cannot be more than 5 mm thick.

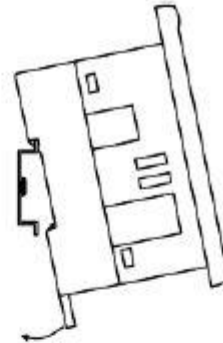
1. Make a panel cut-out measuring 92x92 mm (3.622"x3.622").
2. Slide the controller into the cut-out, ensuring that the rubber seal is in place.
3. Push the 2 mounting brackets into their slots on the sides of the controller as shown in the figure to the right.
4. Tighten the bracket screws against the panel. Hold the bracket securely against the unit while tightening the screw.
5. When properly mounted, the controller is squarely situated in the panel cut-out as shown in the figure to the right.



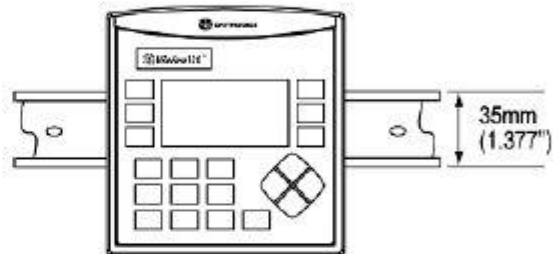
The diagram illustrates the panel mounting process. It shows a 5mm (0.197") wide panel with a 92x92mm (3.622"x3.622") cut-out. The OPM4001 unit is inserted into the cut-out, with a rubber seal between the unit and the panel. Two mounting brackets are shown being pushed into the side slots of the unit. The final result shows the unit mounted flush with the panel.

DIN-rail Mounting

1. Snap the controller onto the DIN rail as shown in the figure to the right.



2. When properly mounted, the controller is squarely situated on the DIN-rail as shown in the figure to the right.



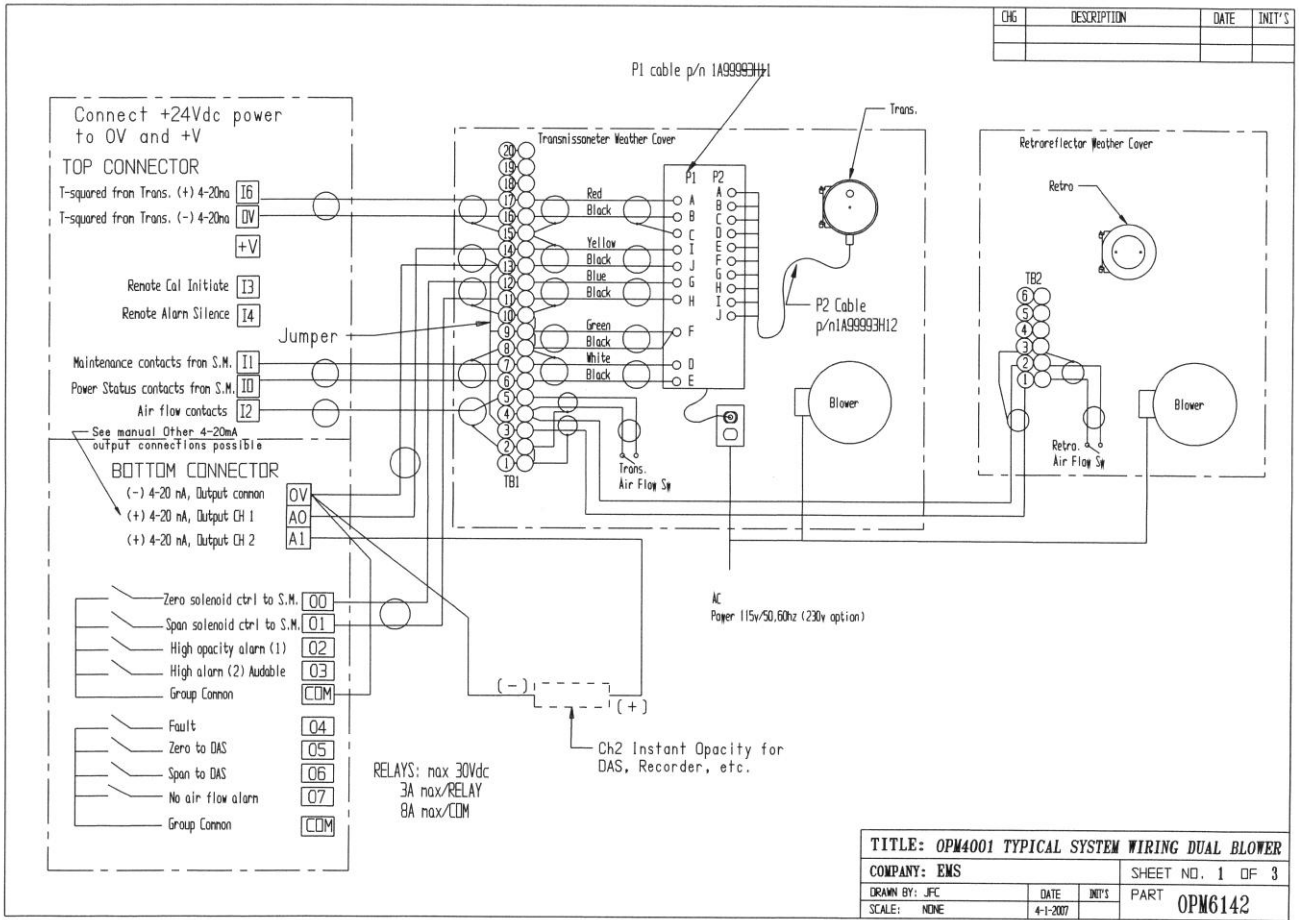
Wiring

- | | |
|----------------|--|
| | <ul style="list-style-type: none"> Do not touch live wires. |
| | <ul style="list-style-type: none"> Install an external circuit breaker. Guard against short-circuiting in external wiring. Use appropriate circuit protection devices. Unused pins should not be connected. Ignoring this directive may damage the device. Double-check all wiring before turning on the power supply. |
| <i>Caution</i> | <ul style="list-style-type: none"> To avoid damaging the wire, do not exceed a maximum torque of 0.5 N·m (5 kgf·cm). Do not use tin, solder, or any substance on stripped wire that might cause the wire strand to break. Install at maximum distance from high-voltage cables and power equipment. |

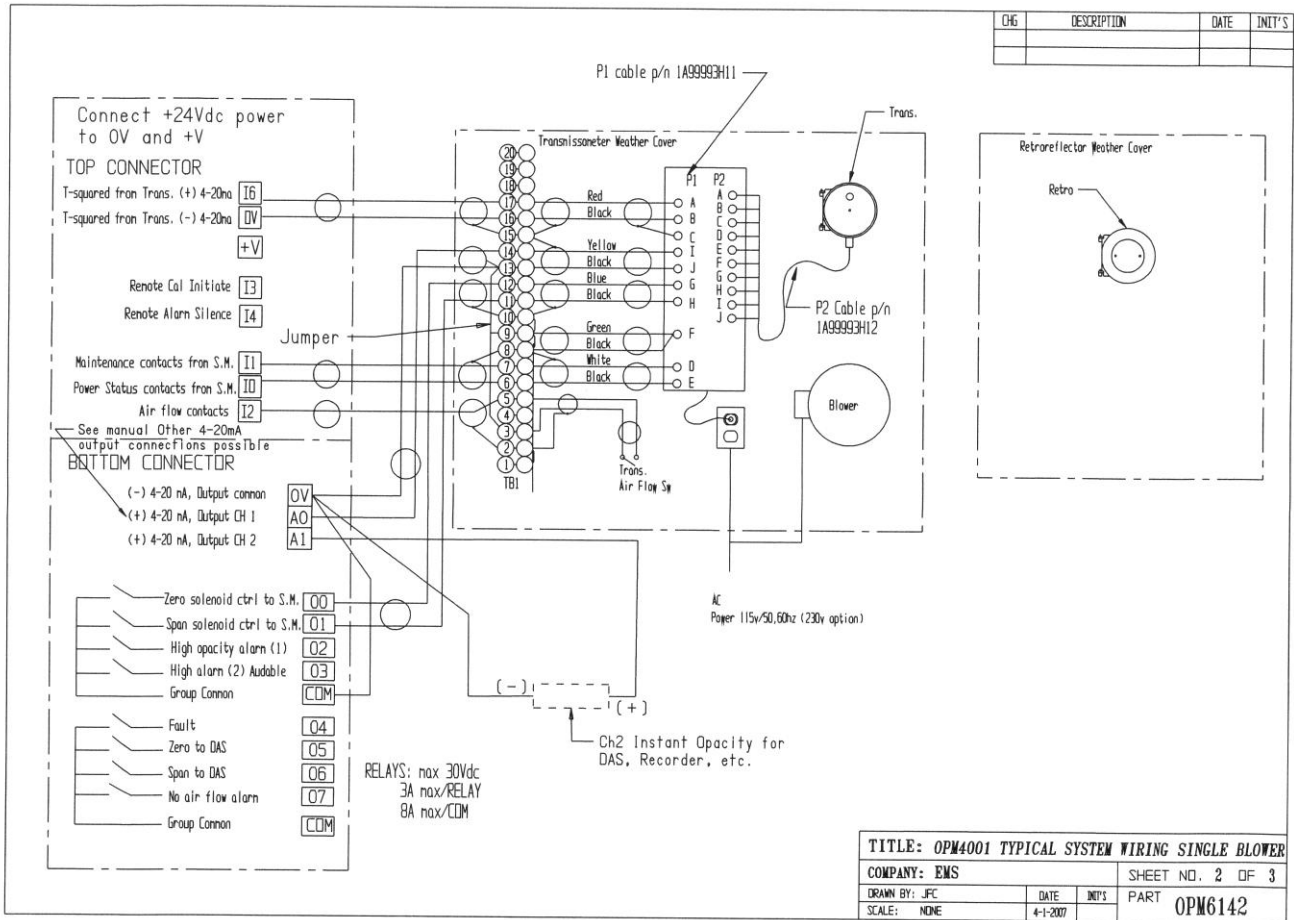
Wiring Procedure

- Use crimp terminals for wiring; use 26-12 AWG wire (0.13 mm²–3.31 mm²).
1. Strip the wire to a length of 7±0.5mm (0.250–0.300 inches).
 2. Unscrew the terminal to its widest position before inserting a wire.
 3. Insert the wire completely into the terminal to ensure a proper connection.
 4. Tighten enough to keep the wire from pulling free.
 - Input or output cables should not be run through the same multi-core cable or share the same wire.
 - Allow for voltage drop and noise interference with input lines used over an extended distance. Use wire that is properly sized for the load.
 - The controller and I/O signals must be connected to the same 0V signal.

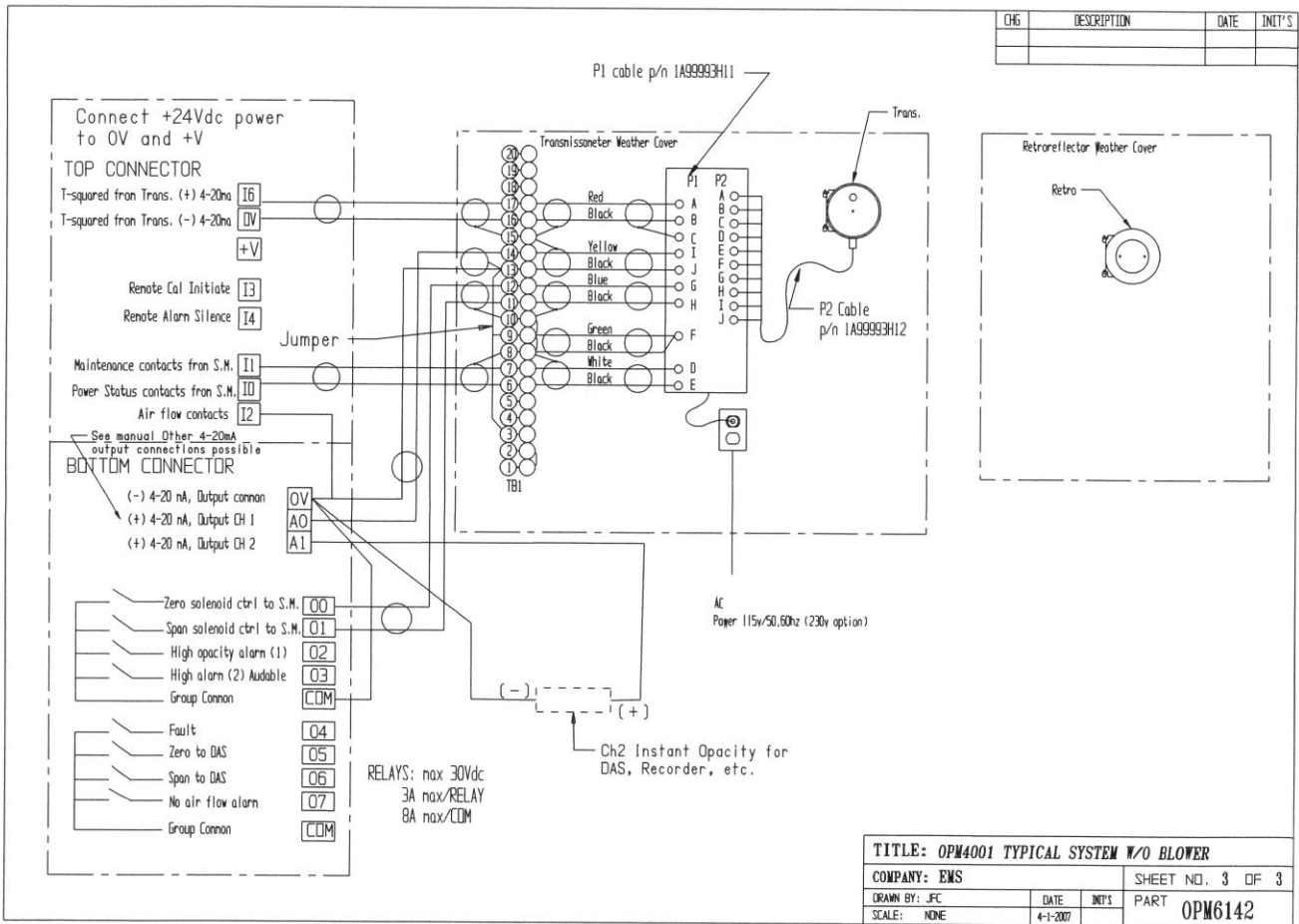
OPM6142 1of3 - wiring



Instruction Manual 2.1
OPM6142 2of3 - wiring



Instruction Manual 2.1
OPM6142 3of3 - wiring

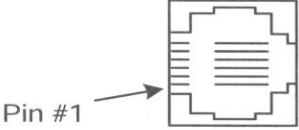


RS485: Pin out

Use RS485 to create a multi-drop network containing up to 32 devices.

Note: port #1 is set to RS485

- Note that the ports are not isolated. If controller is used with a non-isolated external device, avoid potential voltage that exceeds +/- 10V. To avoid damaging the system, all non-isolating device ports should relate to the same ground signal.
- Use shielded, twisted pair cables.
- Minimize the stub (drop) length leading from each device to the bus.
- Ideally, the main cable should be run in and out of the network device.
- Do not cross positive (A) and negative (B) signals. Positive terminals must be wired to positive and negative terminals to negative.

| Diagram | Pin Number | Function |
|--|------------|----------------|
|  | 1 | A signal (+) |
| | 2 | (RS232 signal) |
| | 3 | (RS232 signal) |
| | 4 | (RS232 signal) |
| | 5 | (RS232 signal) |
| | 6 | B signal (-) |