Excerpts from the OFS User Guide:

OFS-2000 Specifications

Flow Performance

Technique	Optical scintillation
Range	0.1 to 40 m/s velocity
Accuracy	± 0.1 m/s basic, or <5% of reading, whichever is greater
Resolution	0.1 m/s
Response Time	User selectable 3 sec to 600 sec
Long Term Drift	<1% >6 months
Media Temperature	No limit
Stack/Duct Diameter	1 – 10 m standard, other ranges available
Light Source	670 nm red LED
Beam Divergence	5 degrees
Optics	quartz
Purge	Passive purge. Factory-supplied purged air with 1-2 CFM (optional)

Maintenance

Calibration	Automatic 2- or 3-point calibration once per day or as requested by External Calibration Request
Diagnostics	Continuous monitoring of sensor status including power supply voltage check, performance check, optics contamination, etc
Indicators	TX Optical Unit - LEDs indicating power ON & correct operation RX Optical Unit - LEDs indicating power ON & correct operation Control Box - LEDs indicating correct operation

Operational Environment

Ambient Temperature	-40 to 60 C
Dust Intrusion	IP65
Moisture	0-100% condensing if dry purge air supplied

Data Output

4-20 ma optical isolated output with two relays for fault and calibration indications
RS-232 ASCII, fixed data string - 2 types
Short with only velocity and P/F status
Long with all velocity and status data
- Optional Limited Distance Modem (LDM)
- Optional Fiber Optic Modem (FOM)
User Selectable with Integral Key Pad & Display including …
Sensor ID Baud rate (9600 standard) Averaging Time Units of Measure

Power Requirements Fuse, Surge, & EMI protected

Transmitter Unit	Universal 100-240 VAC, 50/60 Hz, 12 VA
Control Box	Universal 100-240 VAC, 50/60 Hz, 40 VA

Physical Characteristics

Weight	TX & RX Optical Units	5 kg ea
	Control Box	7 kg (nema-4), 6 kg (rack mount)
	Extender	3 kg ea
Dimensions	TX & RX Optical Units	15 x 15 x 14 cm ea
	Control Box	30 x 40 x 25 cm (nema-4), 13x43x51 cm (rack)
	Extender	standard 4-inch pipe flange (9-inch diameter), 6-inch (15 cm) long ea
Materials	TX & RX Optical Units	Aluminum with powder-coat paint
	Control Box	Aluminum with powder-coat paint (nema-4) Steel and Aluminum (rack mount)
	Extender	Aluminum with powder-coat paint

Installation Considerations

The TX and RX Units should be installed in an area of average flow of the stack or duct. Typical installations to a vertical stack and horizontal duct are shown in Figures 7 & 8.

Customer supplied flanges must be installed such that the OFS TX and RX Units mount opposite each other and perpendicular to the movement the media. The flanges may be made from commercially available 4-inch Schedule 40 pipe and flanges as shown in Figure 9.

The TX and RX Units have a 4-inch pipe flange (9-inch diameter) that mounts to an identical flange supplied by the user. A 9-inch diameter Kevlar flange gasket supplied with the OFS must be installed between the two flanges. The units must be installed with the door hinge on the left - this orients the internally optics assemblies mounting correctly.

Air infiltration through improperly sealed flanges or from double walled stacks with dead space between the inner and outer walls may cause incorrect velocity readings. Figure 10 illustrates the incorrect (top) and correct (bottom) methods of installing the OFS. Insure that the mounting flange is well sealed to the stack wall (arrow 1), the OFS flange is well sealed to the stack flange with the supplied gasket (arrow 2), and that any dead space between double walled stacks is penetrated with pipe (arrow 3).

Required by User at Transmitter Location:

1. 4-inch pipe flange (9 inch diameter)
2. Single phase, 100-240 VAC, 50/60 Hz @ 1 A power with appropriately rated and approved power disconnect device adjacent to OFS
3. Clean, dry, oil-free factory air (optional)
4. 1/2-inch conduit from TX housing to AC power junction box

Required by User at Receiver & Control Box Location:

1. 4-inch pipe flange (9 inch diameter)
2. Clean, dry, oil-free factory air (optional)
3. Single phase, 100-240 VAC @ 1 A power with appropriately rated and approved power disconnect device adjacent to OFS
4. Control Box Mounting Hardware
5. 1/2-inch conduit from OFS Control Box to AC power junction box
6. 1/2-inch conduit from OFS RX housing to OFS Control Box
7. 1/2-inch conduit from OFS Control Box to user computer
8. 4-conductor shielded cable for connection of OFS Control Box to user computer or duplex fiber optical cable for FOM option

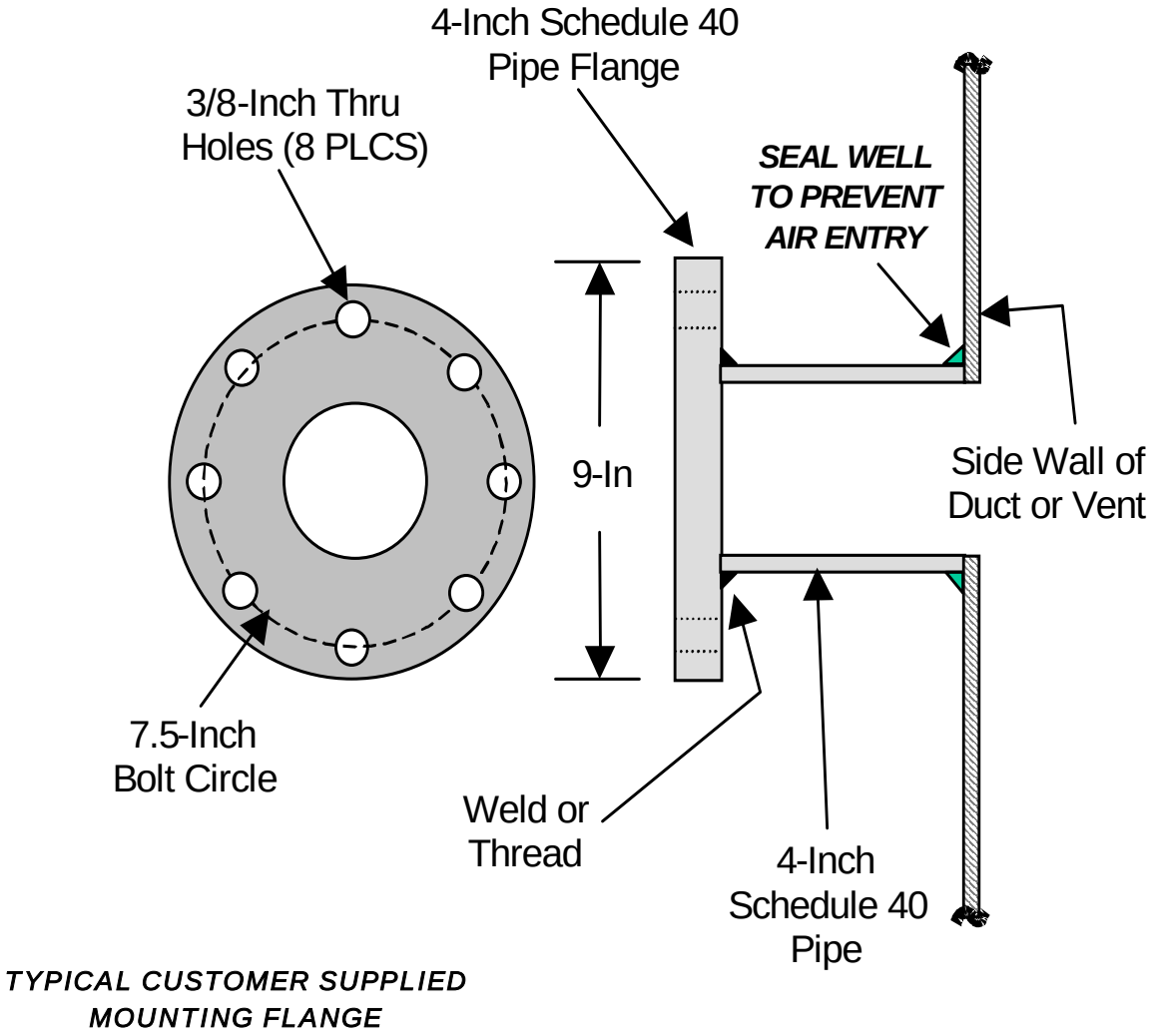

4-Inch Schedule 40
Pipe Flange
3/8-Inch Thru
Holes (8 PLCS)
SEAL WELL
TO PREVENT
AIR ENTRY
9-In
Side Wall of
Duct or Vent
7.5-Inch
Bolt Circle
Weld or
Thread
4-Inch
Schedule 40
Pipe
TYPICAL CUSTOMER SUPPLIED
MOUNTING FLANGE

Figure 9

Mechanical

TX/RX Units

Attach the OFS TX & RX Units to the user-supplied flanges using the hardware as shown in Figure 11a. Match the OFS, extender, and stack flanges at the 12-clock position so that the housing door hinge is vertical before tightening the four bolts. Mounting hardware for installation of the units is included. The top view with dimensions in inches for the TX/RX head with Flange Extender is shown in Figure 11b.

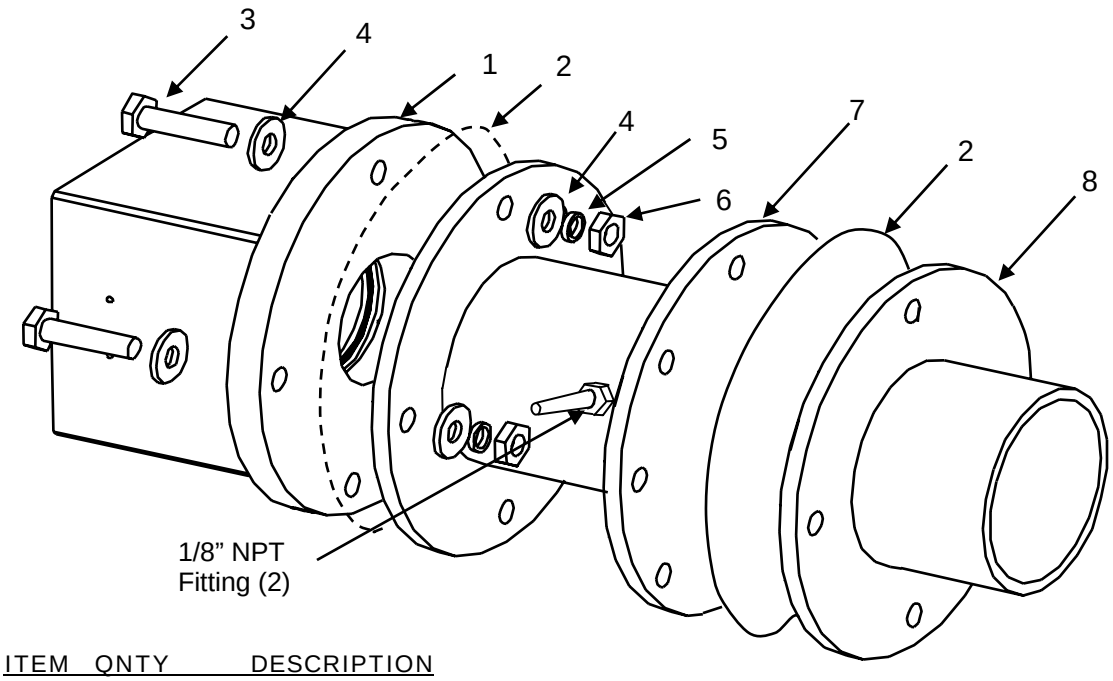
The flange extenders each have two 1/8" NPT purge holes and are supplied with barbed nipples sized for ¼" ID hose. The flanges must be oriented so that a line drawn between the two holes is perpendicular (NOT PARALLEL) to the direction of the flow measurement. The purge holes should be left open to provide passive air purge for negative pressure stacks / ducts. If the stack/duct pressure is positive or the media being measured is excessively dirty, it may be necessary to apply a small amount of compressed instrument-grade air through the NPT fittings. The exact amount of air needed is site dependent, but should not exceed a maximum of 0.5 PSI or 2.0 SCFM. It is recommended that a regulator be installed near the OFS heads to control the airflow. If media pressure is too high, it may be necessary to either plug these purge holes or use a sight glass to seal the test port and isolate the sensor from the media. Contact OSI's customer service for additional assistance if this is your situation.

The description of the flange gasket (item #2 in Figure 11a) is as follows.

OSI Part number:	FS-1456-00
Material:	Premium-grade Kevlar fibers with a Nitrile binder.
Outside Diameter:	9"
Inside Diameter:	4.5"
Thickness:	1/16"
Temperature Range:	-40° to +400° F.
Max. Pressure:	1000 PSI
Resistant to:	Water, oils, gasoline, and hydrocarbons.
Color:	Blue.

As an option for high temperature applications, the OFS can be equipped with a flanged gate valve between the OFS and the customer supplied mating flange. The characteristics of the gate valve are as follows.

OSI Part number:	HZ-1481-00
Body:	Cast iron
O.D.	9"
Pipe Size	4"
Bolt Circle	7-1/2"
No. Bolt Holes:	8
Bolt Size:	5/8"
Valve Blade:	Type 304 stainless steel.
Maximum Pressure:	10 PSI (differential)
Max. Temperature:	-40 to +600 F



ITEM	QNTY	DESCRIPTION
1	1	OFS TX OR RX UNIT
2	2	OFS FLANGE GASKET
3	4	3/8-16X2 INCH SS HEX BOLT
4	8	3/8 INCH SS FLAT WASHER
5	4	3/8 INCH SS LOCK WASHER
6	4	3/8-16 INCH SS HEX NUT
7	1	FLANGE EXTENDER
8	1	CUSTOMER SUPPLIED MATING FLANGE

Figure 11a: OFS TX / RX UNIT MOUNTING INSTALLATION

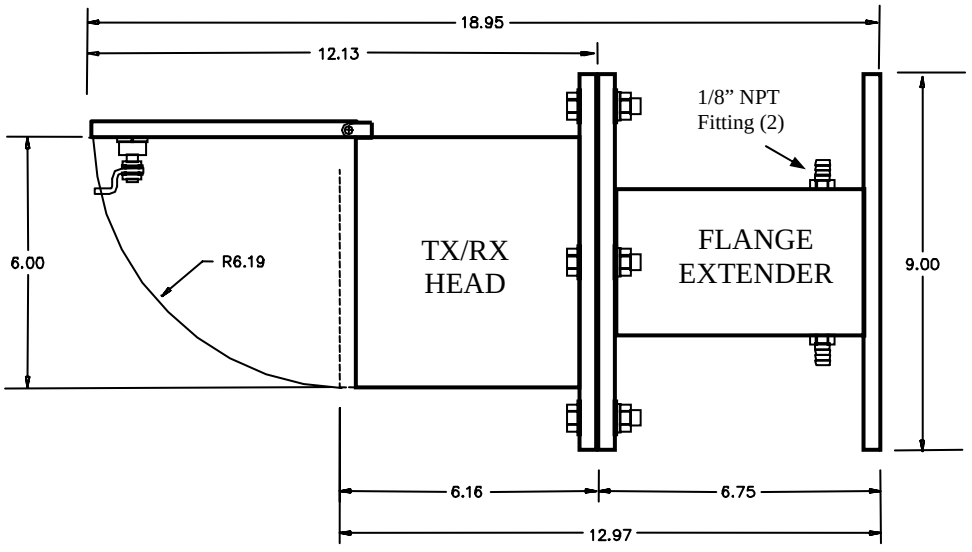


Figure 11b: Top View Dimensions (inches) of OFS TX/RX Head with Extender

Control Box (nema-4)

The Control Box may be mounted to a wall or other surface with user-supplied hardware. It should be located within 15 feet of the RX Unit if the standard P/N 1910-217 cable was ordered. Figure 12a illustrates the Control Box mounting hole pattern.

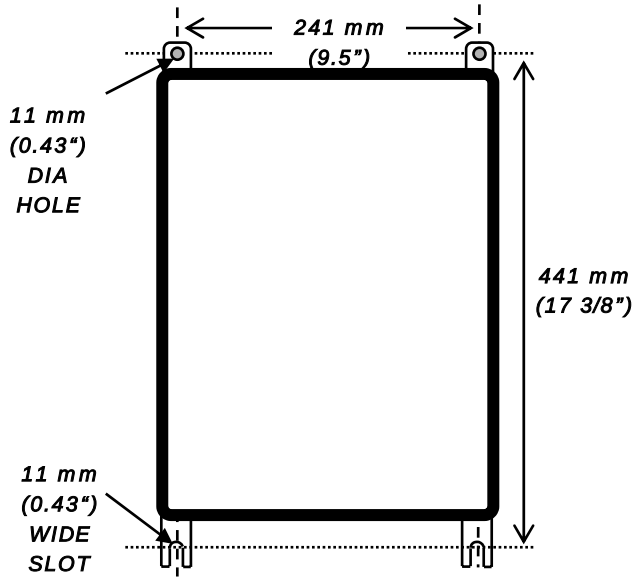


Figure 12a. OFS Control Box Mounting Hole Pattern

Control Box (rack mount)

The Control Box can be mounted to any standard 19-inch rack. It should be located within 15 feet of the RX Unit if the standard P/N 1910-217 cable was ordered. Figure 12b illustrates the Control Box mounting hole pattern.

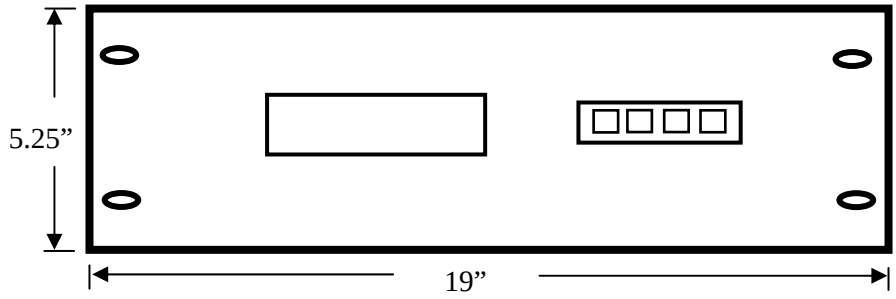


Figure 12b. OFS 19" Rack Mountable Control Box

Electrical

The OFS electrical connections are very simple. It is recommended that the user make the connections in the order shown (sensor interconnections, communications wiring, and AC power connections).

A licensed electrician may be required to make the AC power connections depending on the work and safety rules at your facility. Check with your supervisor before proceeding.

Sensor Interconnections

The OFS Sensor Control Box must be connected to the RX Unit with the P/N 1910-217 shielded cable provided with the system. The standard cable length is 15-feet long but additional cable may be ordered for longer lengths. Shorter cables are preferred to reduce noise pickup. Connect the cable to the terminal board as shown in Figure 13 below. It is recommended that ½-inch flex conduit be used between the RX Unit and Control Box to protect the cable from damage and noise pickup. If desired, the customer may provide the interconnect cable. 10 wire 18-22 AWG, shielded cable is recommended such as Manhattan M2480. The recommended maximum cable length is 90 m (300 feet).

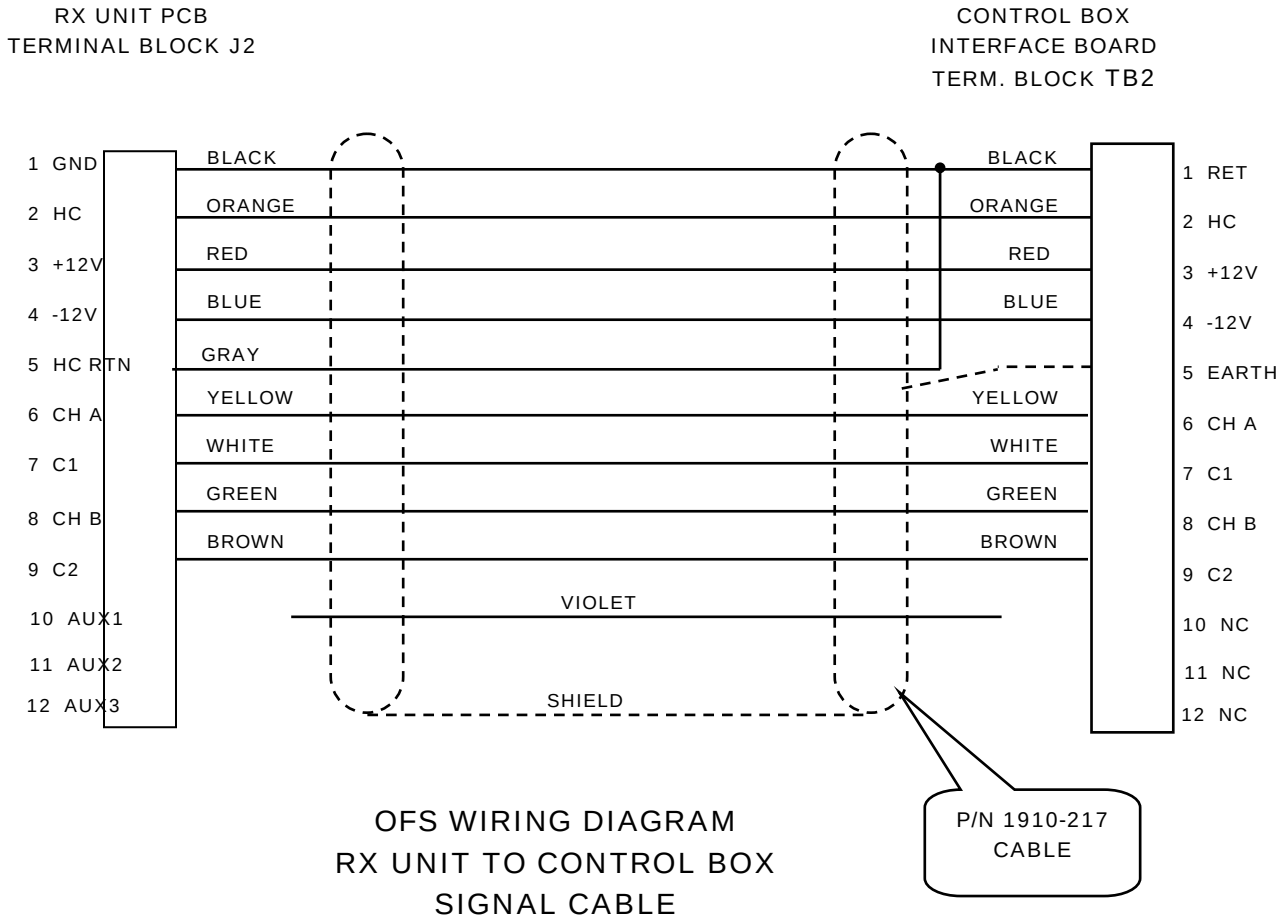
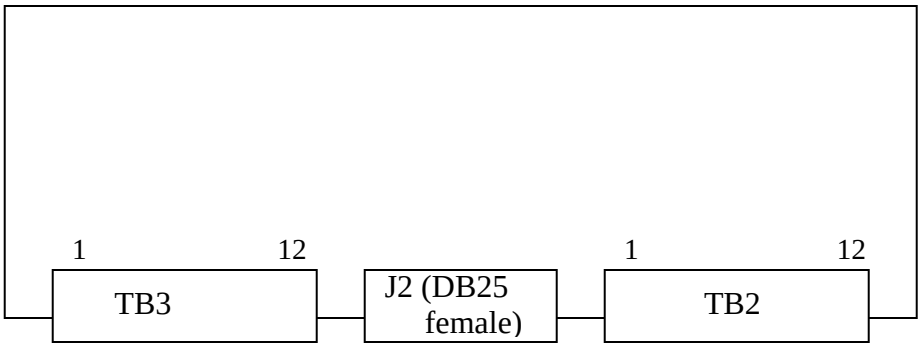


Figure 13

User Interface Connections

The OFS has two communications means on the interface board that are supplied with the standard OFS. The 4-20ma current loop is provided with the terminal block TB3 on pins 1 and 2. The RS-232 link is provided with the DB25 female socket J2 in the middle of the interface board. Others such as Limit Distance Modem (LDM) and Fiber Optic Modem (FOM) can be provided as DS25 socket to the RS-232 connector. Wiring information is shown in figure 14.



4-20ma/RS-232 Interface Board

TB3: 12 pins Terminal Block to customer interface (See Section: 4-20ma & Relay Connections, page 21)

J2: DB-25 female connector for RS-232 interface

TB2: 12 pins Terminal Block connecting to the receiver head.

Figure 14

RS-232 Connections

The OFS Interface Board has an RS-232 socket J2, a female DB25 connector, which is configured as a DCE device and has the following pin designation

Pin 2:	RX
Pin 3:	TX
Pins 1 and 7:	Return

For a typical Personal Computer, the serial port is through a DB-25 male connector that is treated as a DTE device with the following pin designation

Pin 2:	TX
Pin 3:	RX
Pin 7:	Return

A DB-25 male (OFS side) to DB-25 female (PC side) cable should provide adequate communication link because it has pin-to-pin straight connection.

For a typical Laptop computer, the serial port is through a DB-9 male connector that has following configuration

Pin 2:	RX
Pin 3:	TX
Pin 5:	Return

A DB-25 male (OFS side) to DB-9 female (PC side) cable should provide adequate communication link because it has a crossover between Pins 2 and 3, and pin 5 of DB-9 is connected to pin 7 of DB-25.

Limit Distance Modem (LDM) Connections

The LDM option is available for installations where the Control Box must be installed more than 100 feet from the user's computer. The LDM converts the RS-232 levels to current loops for noise free, long distance transmission. Using 24 AWG wire, the LDM will transmit over 3 miles at 9600 baud.

LDMs are used in pairs, one installed in the Control Box and one at the remote computer. The user must supply a 2 twisted pair cable with shield to connect between the LDMs. As shown in Figure 15, the pairs are installed in a crossed pattern with the TX of one LDM connecting to the RX of the other LDM, and vice versa. Since OFS is configured as a DCE device and the user's computer is configured as DTE, the LDM connected to OFS should be set as DTE and the LDM connected to computer should be set as DCE.

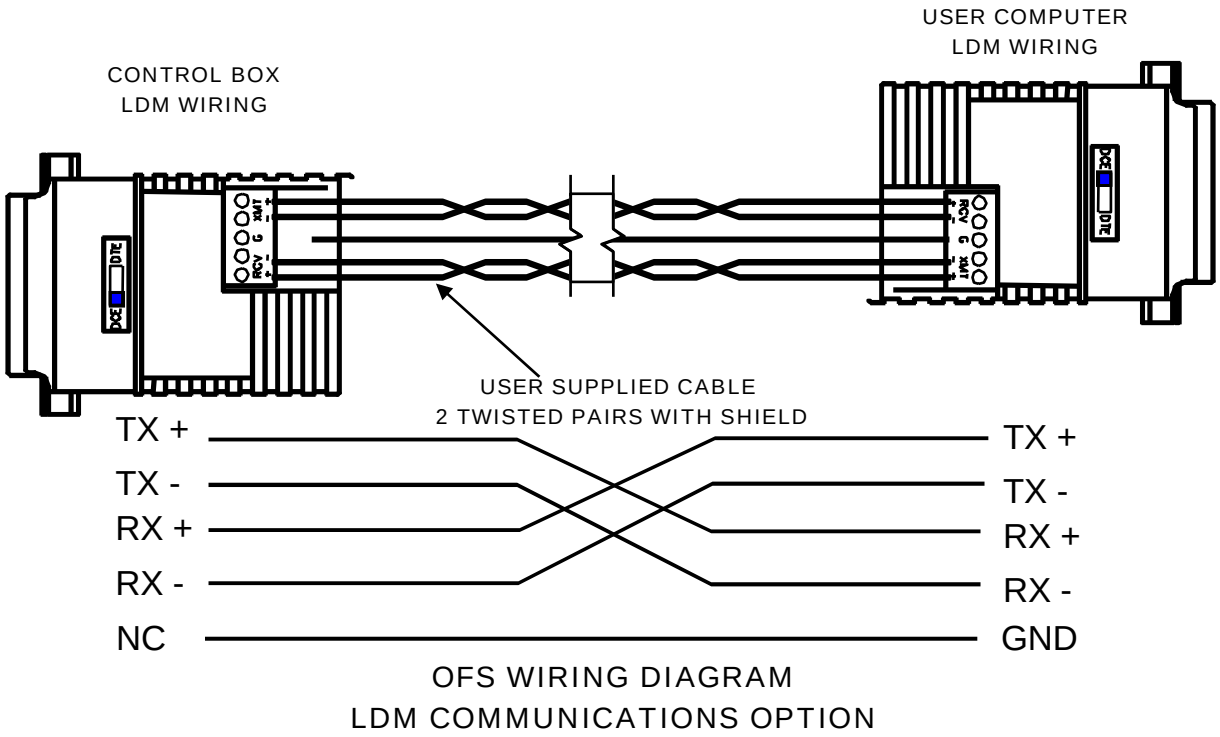


Figure 15

Fiber Optic Modem (FOM) Connections

The FOM option is available for installations where the Control Box must be connected via a fiber to the user's computer. The FOM converts the RS-232 levels to light pulses for noise free, long distance transmission. Using two multi-mode fibers (62.5/125), the FOM will transmit over 1 mile at 28.8 kbps.

FOMs are used in pairs, one DB-25 male connector is plugged in J2 on the Control Box and one at the remote computer. Since OFS is configured as a DCE device and the user's computer is configured as DTE, the FOM at the OFS side should be configured as DTE and the FOM at the user's computer side should be configured as DCE for proper data communication. The user must supply dual multi-mode 62/152 fibers with ST type connectors to connect between the FOMs. As shown in Figure 16, the fibers are installed in a crossed pattern with the TX (Out) of one FOM connecting to the RX (In) of the other FOM, and vice versa.

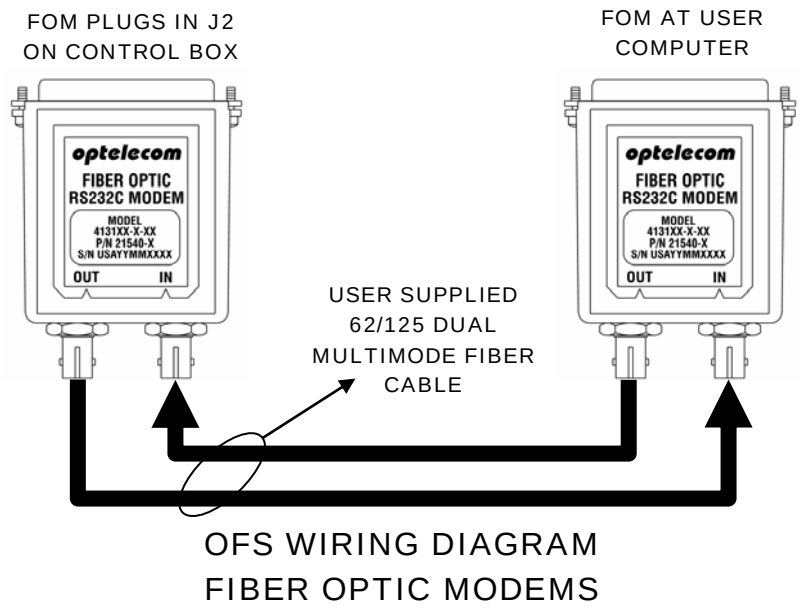


Figure 16

4-20 ma and Relays Connections

The terminal block TB3 of the interface board contains an isolated 4-20 ma circuitry, diagnostic relay, calibration relay and calibration request interface. The pin designation is as follows.

Pin 1: Current Loop –
Pin 2: Current Loop +
Pin 3: No Connection
Pin 4: Fault Relay Common (COM1)
Pin 5: Fault Relay Normal Open (NO1)
Pin 6: Fault Relay Normal Close (NC1)
Pin 7: No Connection
Pin 8: Calibration Relay Common (COM2)
Pin 9: Calibration Relay Normal Open (NO2)
Pin 10: Calibration Relay Normal Close (NC2)
Pin 11: External Calibration Return
Pin 12: External Calibration (ext_cal)

Pins 1 and 2 are for the current loop connection. The maximum loop resistance is ~600 ohms. This includes the cable resistance and the load resistor in the customer data acquisition system. Pins 4 to 6 are connected to the fault relay for diagnostic monitoring. A SPDT normally open/normally closed (NC/NO) relay rated at 30V/5A-250 VAC/8A is used. The relay is activated during normal operation (NO1 shorts to COM1, NC1 open) and deactivated during Ch A/Ch B voltages out of range, power failures, or when the OFS fails a self-test (NC1 shorts to COM1, NO1 open).

Pins 8-10 are connected to the calibration relay for calibration mode indication. A SPDT normally open/normally closed (NC/NO) relay rated at 30V/5A-250 VAC/8A is used. The relay is deactivated during normal operation (NC2 shorts to COM2, NO2 open). The relay is activated (NO2 shorts to COM2, NC2 open) during automatic self-calibration or when there is external calibration request. The external calibration request is activated when pin 12 is shorted to pin 11 for more than 0.1 seconds.

Use the OFS Keypad & Display Set-Up procedure to set the full-scale calibration and other 4-20 ma features.

To convert the current loop readings to velocity, use the following formula:

Velocity (m/s) = (ma – 4) * (F.S./16)

where ma is the measured loop current and F.S. is the full-scale velocity selected

AC Power Connections

TX Unit

AC power connections to the TX Unit are made to TB1 of the TX Electrical Assy located on the left inside of the TX housing. If optional power cords were ordered with the OFS, the power cords and weather-tight cord grips are included with the order. If the user is supplying the power directly from an electrical panel, it is recommended to use ½-inch flex conduit between the TX Unit and electrical panel to protect the cable from damage and noise pickup.

Connect the single phase, 100-240 VAC, 50/60 Hz @ 1 A power from a customer supplied, appropriately rated and approved power, disconnect device adjacent to the OFS Transmitter Unit. The recommended supply wiring size is as follows:

1.0 mm^2 (16 AWG) or 0.75 mm^2 (18 AWG)

Connect the AC power as shown in Figure 17. Note that the green/yellow earth wire from the user supplied AC power cord should be connected to the earth ground stud in the TX Unit. The OFS is supplied with an internal green/yellow ground wire from this stud to the ground terminal on the TX Electrical Assy. Customer supplied protective earth wires must be green/yellow in color and be of the same size (gage) as the incoming mains supply conductors.

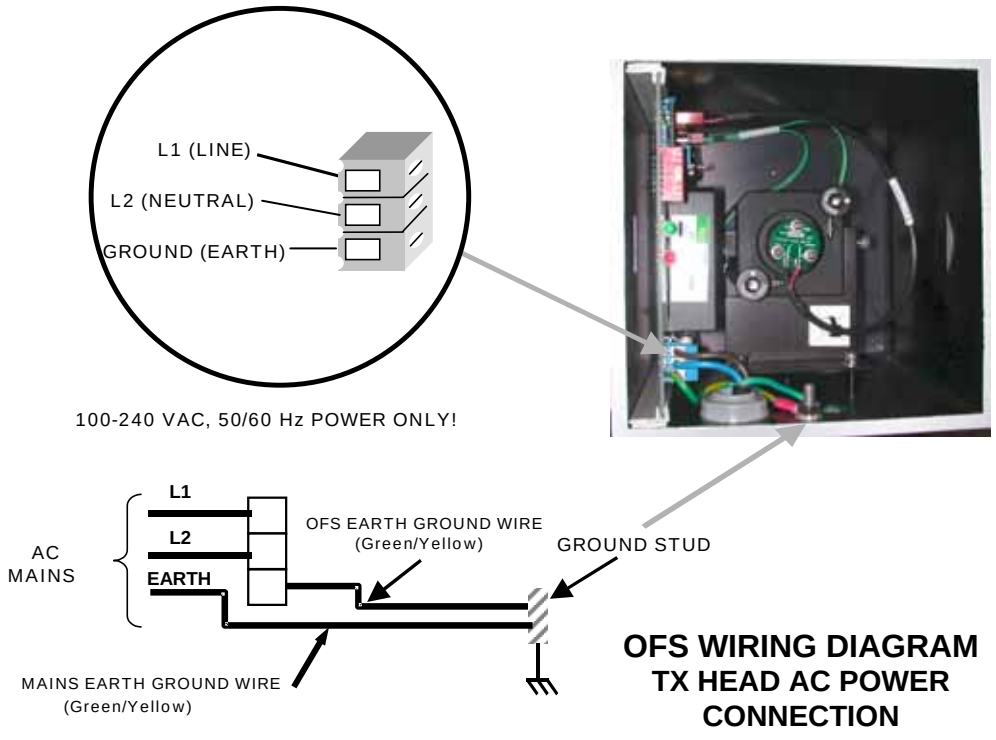


Figure 17

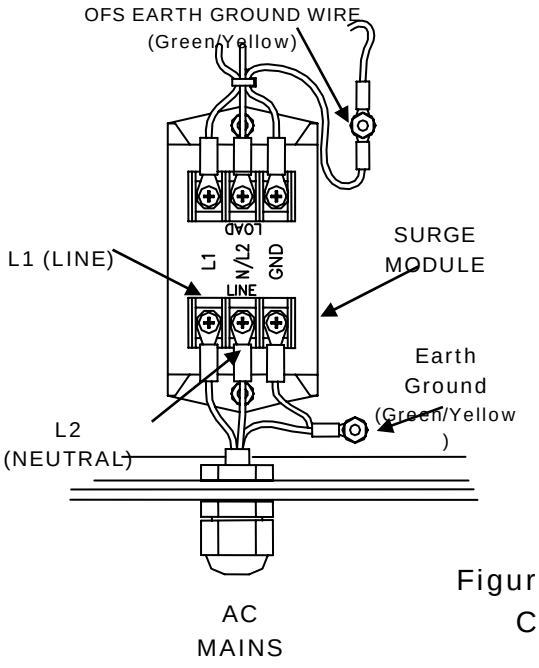
Control Box (nema-4)

AC power connections to the Control Box are made to AC surge protection module located in the lower left of the Control Box housing. If optional power cords were ordered with the OFS, the power cords and weather-tight cord grips are included with the order. If the user is supplying the power directly from an electrical panel, it is recommended to use ½-inch flex conduit between the Control Box and electrical panel to protect the cable from damage and noise pickup.

Connect the single phase, 100-240 VAC, 50/60 Hz @ 1 A power from a customer supplied, appropriately rated and approved power, disconnect device adjacent to the OFS Control Box. The recommended supply wiring size is as follows:

$$1.0\ mm^2\ (16\ AWG)\ or\ 0.75\ mm^2\ (18\ AWG)$$

Connect the AC power as shown in Figure 18. Note that the green/yellow earth wire from the user supplied AC power cord should be connected to the earth ground stud in the Control Box. The OFS is supplied with an internal green/yellow ground wire from this stud to the ground terminal on the Surge Protection Module. Customer supplied protective earth wires must be green/yellow in color and be of the same size (gage) as the incoming mains supply conductors.



100 – 240 VAC, 50/60 Hz POWER ONLY!

Figure 18. OFS WIRING DIAGRAM CONTROL BOX AC POWER CONNECTION

Control Box (rack mount)

The OFS comes with the standard North American AC power socket. Make certain the power switch is off before plugging power cord. Then plug the power cord into your OFS AC socket and the other end to a single phase, 110-120 VAC, 50/60 Hz @ 1 A power from a customer supplied, appropriately rated and approved power.

The fuse box below the power socket has default set to 110-120 VAC operation. For 220-240 VAC operation, use a flat screwdriver and push into the slot to ply open the fuse box. Flip around the fuse box and push the box in so the 220-240 VAC white arrow is aligned with the black arrow on the socket frame. The power supply fuse is rated 3.15 A, 250 VAC, type 5x20mm.

AC power connections to the Control Box are made to AC surge protection module, rated 240 VAC 6 Amp located inside the control box housing.

Connection to Computer

The default OFS interface is set for RS-232 protocol. The user should set up their serial port as follows:

9600 baud, 1 start bit, 8 data bits, 0 parity, and 1 stop bit

The OFS responds to a single character ASCII poll issued by the user computer. The maximum poll rate is 3 seconds but a 60-second poll rate is recommended for most applications. Note that the OFS commands are case sensitive and unless otherwise noted, require the use of capital letters.

The OFS uses comma delimited data frames for ease of analysis with spreadsheet programs such as Excel and Quattro Pro.

"A" Poll - Short Data String

In response to an "A" poll the OFS will respond with the following short 11-byte data frame:

Format:	±	w	w	w	w	,	u	u	u	,	s
	|	|	|	|	|	|	|	|	|	|	|
Byte:	1	2	3	4	5	6	7	8	9	10	11

Description of "A" Poll Response Bytes

Byte	Description	Field Symbol	Description
1	Flow Direction	+	"+" represents flow in direction of arrow in RX Unit.
2-5	Flow Data	wwww	Represents air velocity expressed in units of measure selected by customer
6		,	Comma delimiter
7-9	U/M	uuu	User selected units of measure such as m/s or fps
10		,	Comma delimiter
11	System Status	s	"P" indicates system self-test pass, "F" indicates system failure, “C” indicates ongoing calibration, and “R” indicates system restart

"C" Poll - Long Data String

The OFS responds to “C” poll with the following byte 1 to byte 59 data stream if 2-point calibration is selected, or responds with byte 1 to byte 66 (extra 7 bytes) data stream if 3-point calibration is selected.

Format:	W	,	±	w	w	w	w	,	u	u	u	,	A	,	a	a	a	a	,
Byte:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Format:	B	,	b	b	b	b	,	S	,	s	s	s	s	,	L	,	±	l	.
Byte:	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Format:	l	,	H	,	±	h	.	h	,	R	,	r	r	r	,	U	,	u	u
Byte:	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
Format:	u	u	,	M	,	±	m	.	m										
Byte:	58	59	60	61	62	63	64	65	66										

3-point calibration only for the extra medium calibration point

Description of "C" Poll Response Bytes is as follows.

Byte	Description	Field Symbol	Details
1	Wind Indicator	W	Fixed Field – Velocity
2		,	Comma delimiter
3	Wind Direction	±	"+" represents flow in direction of arrow in RX Unit
4-7	Wind Data	wwww	Represents air velocity expressed in units of measure selected by customer
8		,	Comma delimiter
9-11	Unit of Measure	uuu	User selected units of measure such as m/s or fps
12		,	Comma delimiter
13	Detector “A”	A	Fixed Field – Detector A Signal Strength
14		,	Comma delimiter
15-18	Carrier Level	aaaa	Represents detector “A” carrier strength in volts from 0.10 to 9.99 volts
19		,	Comma delimiter
20	Detector “B”	B	Fixed Field – Detector B Signal Strength
21		,	Comma delimiter
22-25	Carrier Level	bbbb	Represents detector “B” carrier strength in volts from 0.10 to 9.99 volts
26		,	Comma delimiter
27	System Status	S	Fixed Field – Status Codes
28		,	Comma delimiter
29-32	Status Indicator	ssss	OFS status indicators (as described in section below)
33		,	Comma delimiter
34	Low Cal Point	L	Fixed Field – Low Calibration Point
35		,	Comma delimiter
36		+ or -	"+" indicates calibration value is greater than reference, "-" indicates calibration value is less than reference.
37-39	Offset Percentage	l.l	Last calibration value compared to low reference value (~10% span), in %
40		,	Comma delimiter
41	High Cal Point	H	Fixed Field – High Calibration Point
42		,	Comma delimiter
43		+ or -	"+" indicates calibration value is greater than reference, "-" indicates calibration value is less than reference.

44-46	Offset Percentage	h.h	Last calibration value compared to high reference value (~60% span), in %
47		,	Comma delimiter
48	Correlation	R	Fixed Field – A & B Signal Correlation
49		,	Comma delimiter
50-52		rrr	Signal correlation, >30 typical
53		,	Comma delimiter
54	Unprocessed Vel	U	Fixed Field-Unprocessed Velocity
55		,	Comma delimiter
56-59		uuuu	Unprocessed Value
60		,	Comma delimiter
61	Mid Cal Point	M	Fixed Field – Medium Calibration Point
62		,	Comma delimiter
63		+ or -	"+" indicates calibration value is greater than reference, "-" indicates calibration value is less than reference.
64-66	Offset Percentage	m.m	Last calibration value compared to medium reference value (~30% span), in %

Description of Byte 29-32 Status Indicator Codes is as follows.

Byte	Unit of Measure	Description
29	0	m/s
	1	kph
	2	mph
	3	fps
	4	fpm

Byte	Averaging Time	Description (sec)
30	0	10
	1	30
	2	60
	3	120
	4	300
	5	600
	6	3

Byte	Operation Mode	Description
31	0	Normal Operation
	1	N/A
	2	Velocity out of the range defined by Byte 32
	3	N/A
	4	Calibration Mode
	5, 6, 7	N/A
	8	OFS reset

Byte	Full Scale Range	Description
32	0	0-40 m/s
	1	0-20 m/s
	2	0-10 m/s
	3	0-5 m/s