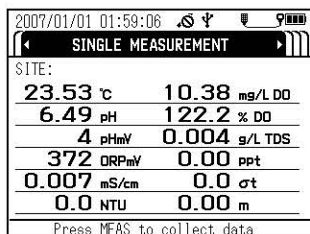


3.5.2 Deleting data

Follow the steps below to delete all the data stored in memory.

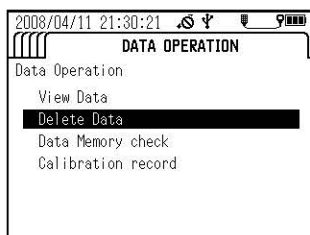
1. Press the control unit's **POWER** key for about 1 second to turn the power ON.
The "MEASUREMENT" screen appears after about 10 seconds.



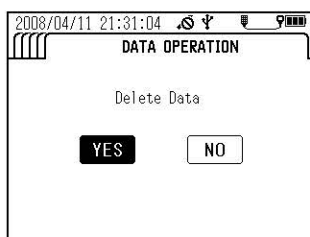
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. Press the right (▶) key 3 times to display the "DATA OPERATION" screen.
3. Press the down (▽) key to move the cursor to "Delete Data", then press the ENTER key.



4. Press the left (◀) key to move the cursor to YES, then press the ENTER key.
All the data has been deleted when the indicator appears along with the message "No data exists".



3.5.3 Checking the data memory

You can check the used data capacity and the remaining data capacity.

1. Press the control unit's **POWER** key for about 1 second to turn the power ON.
The "MEASUREMENT" screen appears after about 10 seconds.

2007/01/01 01:59:06	
← SINGLE MEASUREMENT →	
SITE:	
23.53 °C	10.38 mg/L DO
6.49 pH	122.2 % DO
4 pHmV	0.004 g/L TDS
372 ORPmV	0.00 ppt
0.007 mS/cm	0.0 σt
0.0 NTU	0.00 m
Press MEAS to collect data.	

Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. Press the right (▷) key 3 times to display the "DATA OPERATION" screen.
3. Press the down (▽) key to move the cursor to "Data Memory Check", then press the ENTER key.

2008/04/11 21:32:30	
DATA OPERATION	
Data Operation	
View Data	
Delete Data	
Data Memory check	
Calibration record	

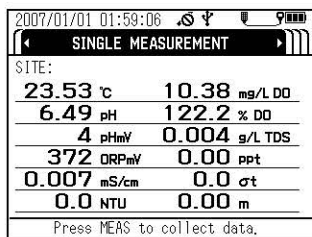
The amount of memory in use and amount of available memory are displayed.

2008/04/11 21:34:21	
DATA OPERATION	
Data Memory check	
Used memory	
0 Data	
Available memory	
10000 Data	

3.5.4 Checking the calibration record

Follow the steps below to check the latest calibration history.

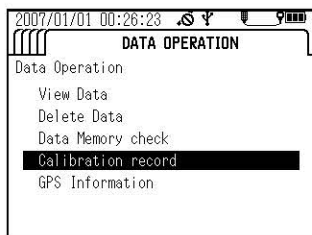
1. Press the control unit's **POWER** key for about 1 second to turn the power ON. The "MEASUREMENT" screen appears after about 10 seconds.



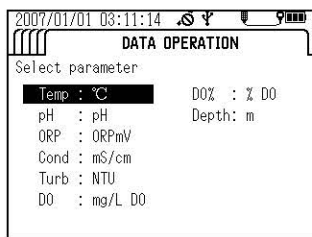
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

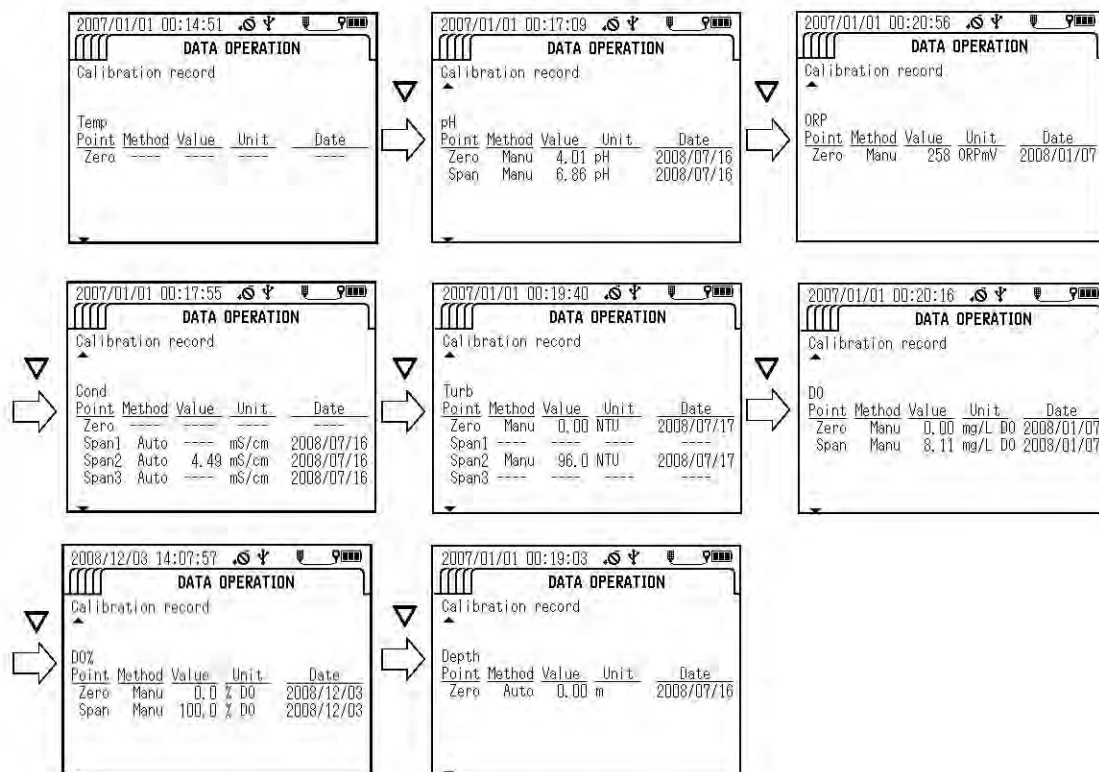
2. Press the right (▷) key 3 times to display the "DATA OPERATION" screen.
3. Press the down (▽) key to move the cursor to "Calibration record", then press the ENTER key.



4. Move the cursor to the display items on the parameter selection screen and press the ENTER key.



5. The latest calibration record is displayed.

6. You can use the $\Delta \nabla$ key to check up to 10 items of past data.

3.5.5 GPS data operations

The menu for GPS data operations appears on the display to which the GPS unit is mounted.

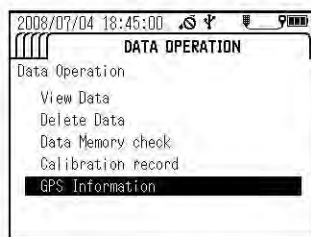
- **GPS information**

Follow the steps below to display acquired GPS information.

Note

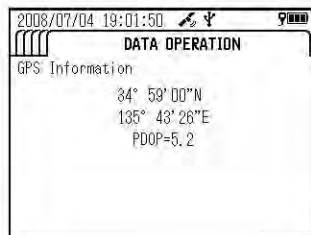
Turning the power OFF erases the GPS information.

1. Press the right (▷) key to switch the display to the "DATA OPERATION" screen.
2. Press the down (▽) key to move the cursor to "GPS Information", then press the ENTER key.

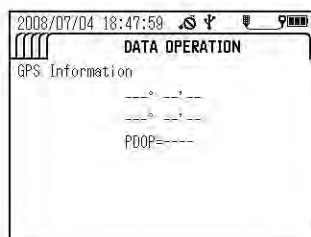


The last GPS information acquired is displayed.

- When received data exists



- When no received data exists



3.6 Sensor information

You can check the state of the sensor probe.

1. Press the control unit's **POWER** key for about 1 second to turn the power **ON**.
The "MEASUREMENT" screen appears after about 10 seconds.

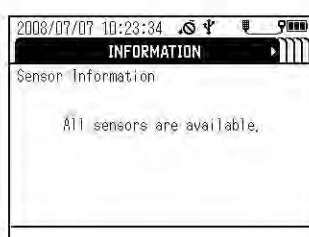
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

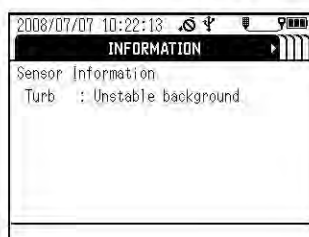
2. Press the left (<) key once to display the "INFORMATION" screen.

The "Sensor Information" screen displays the sensor probe's status.

- When the sensor probe is normal, the display below appears.



- When there is a sensor probe problem, individual measurement parameters generate messages such as the one shown below. Follow the troubleshooting information to remove the problem before continuing to operate the system.

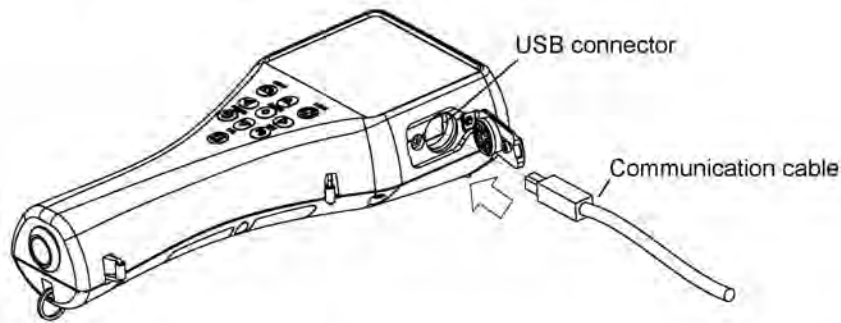


3.7 USB communication

The separately-sold, dedicated PC connection cable comes with data collection software. This software allows data to be downloaded from the control unit in CSV format.

This section contains instructions for communication commands used for USB communication.

● Connecting the cable



Dedicated cable

Part name: Communication cable (with data collection software)

Part no.: 3200174823

● Cautions when using USB communication

Take care to observe the following when using USB communication.

- Use the dedicated cable (with data collection software) or a commercially-available USB cable (A-B type) to connect to a PC.
- Be sure to match the transmission format on the control unit and the computer.
The control unit uses the following transmission format:

Baud rate:	19200 bps
Number of stop bits:	1 bit
Data bit length:	8 bits
Parity:	None
Flow control:	None

Tip

If the transmission formats do not match, a communication error occurs and USB communication will not function normally. After changing the transmission format, restart the control unit and the computer.

- If received data is not sent back or an error occurs after a data request has been sent, adjust the program configuration so that it allows a little waiting time before a data request is sent again. This will enable more stable communication.
- The unit does not use DCD, CTS, or DSR signals. Take care of this when creating programs.

3.7.1 Communication settings

Baud rate:	19200 bps
Number of stop bits:	1 bit
Data bit length:	8 bits
Parity:	None
Flow control:	None

3.7.2 Commands

Tip

Contact your nearest sales outlet for the details about communication commands.

Instant data requests

Request command format

```
#   RD  @   XX  [CR] [LF]
1   2   3   4
```

1	Header	1 character
2	Command	2 characters
3	Delimiter character	1 character
4	Frame check sequence (FCS)	2 characters

The two ASCII-code characters created by converting the 8 bits of data created by successively combining the value of each character from # through @ in an exclusive OR (XOR) operation with the value of the next character.

Example: #RD@

(1)	0	XOR	35	(ASCII code of # symbol)	⇒	35
(2)	35	XOR	82	(ASCII code of R)	⇒	113
(3)	113	XOR	68	(ASCII code of D)	⇒	53
(4)	53	XOR	64	(ASCII code of @ symbol)	⇒	117 (decimal)
						↓
						75 (hex)
						↓
						Sets "75".

Example: 35 XOR 82 operation

35 in binary	⇒	0	0	1	0	0	0	1	1	
82 in binary	⇒	0	1	0	1	0	0	1	0	
XOR result		0	1	1	1	0	0	0	1	⇒ 113 (decimal)

Note: Set "XX" if you do not want to test for communication frame errors with FCS.

Response format

```
# RD  AAAAAAAAAAAAAAAAAAAAAA  X X  XXXX  XX  X X  XXXXX X
1 2 3                               4 5 6      7 8 9 10 11
```

```
XX X X  XXXXX X  XX X X  XXXXX X XX X X  XXXXX X
12 13 14 15      16 17 18 19 20      21 22 23 24 25 26
XX X X  XXXXX X  XX X X  XXXXX X  XX X X  XXXXX X
27 28 29 30      31 32 33 34 35      36 37 38 39 40 41
```

```
XX X X  XXXXX X XX X X  XXXXX X XX X X  XXXXX X
42 43 44 45      46 47 48 49 50      51 52 53 54 55 56
```

```

XX  X  X  XXXXX X  XX  X  X  XXXXX X  XX  X  X  XXXXX X
57  58 59 60      61 62  63 64  65      66 67  68 69 70      71

```

```

XX XX XX XX XX XX XX XX XX X  X  XXX XX XX X  X  @  XX [CR] [LF]
72 73 74 75 76 77 78 79 80 81 82 83  84 85 86 87 88 89

```

1	Header		1 character
2	Command		2 characters
3	Site name	Upper- and lowercase letters, numbers, periods (.) hyphens (-) and spaces ()	20 characters
4	Probe status	(3) Status code	1 character
5	Probe error	(4) Status error code	1 character
6	Unused		4 characters
7	Parameter 1 code	(1) Parameter code	2 characters
8	Parameter 1 status	(5) Parameter status code	1 character
9	Parameter 1 error	(6) Parameter error code	1 character
10	Parameter 1 data	5 characters including decimal point, right-justified with blanks filled	5 characters
11	Parameter 1 unit	(2) Unit code	1 character
12	Parameter 2 code	(1) Parameter code	2 characters
13	Parameter 2 status	(5) Parameter status code	1 character
14	Parameter 2 error	(6) Parameter error code	1 character
15	Parameter 2 data	5 characters including decimal point, right-justified with blanks filled	5 characters
16	Parameter 2 unit	(2) Unit code	1 character
17	Parameter 3 code	(1) Parameter code	2 characters
18	Parameter 3 status	(5) Parameter status code	1 character
19	Parameter 3 error	(6) Parameter error code	1 character
20	Parameter 3 data	5 characters including decimal point, right-justified with blanks filled	5 characters
21	Parameter 3 unit	(2) Unit code	1 character
22	Parameter 4 code	(1) Parameter code	2 characters
23	Parameter 4 status	(5) Parameter status code	1 character
24	Parameter 4 error	(6) Parameter error code	1 character
25	Parameter 4 data	5 characters including decimal point, right-justified with blanks filled	5 characters
26	Parameter 4 unit	(2) Unit code	1 character
27	Parameter 5 code	(1) Parameter code	2 characters
28	Parameter 5 status	(5) Parameter status code	1 character
29	Parameter 5 error	(6) Parameter error code	1 character
30	Parameter 5 data	5 characters including decimal point, right-justified with blanks filled	5 characters
31	Parameter 5 unit	(2) Unit code	1 character
32	Parameter 6 code	(1) Parameter code	2 characters
33	Parameter 6 status	(5) Parameter status code	1 character
34	Parameter 6 error	(6) Parameter error code	1 character

35	Parameter 6 data	5 characters including decimal point, right-justified with blanks filled	5 characters
36	Parameter 6 unit	(2) Unit code	1 character
37	Parameter 7 code	(1) Parameter code	2 characters
38	Parameter 7 status	(5) Parameter status code	1 character
39	Parameter 7 error	(6) Parameter error code	1 character
40	Parameter 7 data	5 characters including decimal point, right-justified with blanks filled	5 characters
41	Parameter 7 unit	(2) Unit code	1 character
42	Parameter 8 code	(1) Parameter code	2 characters
43	Parameter 8 status	(5) Parameter status code	1 character
44	Parameter 8 error	(6) Parameter error code	1 character
45	Parameter 8 data	5 characters including decimal point, right-justified with blanks filled	5 characters
46	Parameter 8 unit	(2) Unit code	1 character
47	Parameter 9 code	(1) Parameter code	2 characters
48	Parameter 9 status	(5) Parameter status code	1 character
49	Parameter 9 error	(6) Parameter error code	1 character
50	Parameter 9 data	5 characters including decimal point, right-justified with blanks filled	5 characters
51	Parameter 9 unit	(2) Unit code	1 character
52	Parameter 10 code	(1) Parameter code	2 characters
53	Parameter 10 status	(5) Parameter status code	1 character
54	Parameter 10 error	(6) Parameter error code	1 character
55	Parameter 10 data	5 characters including decimal point, right-justified with blanks filled	5 characters
56	Parameter 10 unit	(2) Unit code	1 character
57	Parameter 11 code	(1) Parameter code	2 characters
58	Parameter 11 status	(5) Parameter status code	1 character
59	Parameter 11 error	(6) Parameter error code	1 character
60	Parameter 11 data	5 characters including decimal point, right-justified with blanks filled	5 characters
61	Parameter 11 unit	(2) Unit code	1 character
62	Parameter 12 code	(1) Parameter code	2 characters
63	Parameter 12 status	(5) Parameter status code	1 character
64	Parameter 12 error	(6) Parameter error code	1 character
65	Parameter 12 data	5 characters including decimal point, right-justified with blanks filled	5 characters
66	Parameter 12 unit	(2) Unit code (6) Parameter error code	1 character
67	Parameter 13 code	(1) Parameter code	2 characters
68	Parameter 13 status	(5) Parameter status code	1 character
69	Parameter 13 error	(6) Parameter error code	1 character
70	Parameter 13 data	5 characters including decimal point, right-justified with blanks filled	5 characters
71	Parameter 13 unit	(2) Unit code	1 character
72	Year	00 to 99	2 characters

73	Month	01 to 12	2 characters
74	Day	01 to 31	2 characters
75	Hour	00 to 23	2 characters
76	Minute	00 to 59	2 characters
77	Second	00 to 59	2 characters
78	Longitude (degrees)	00 to 90 or "--" (no GPS data)	2 characters
79	Longitude (minutes)	00 to 59 or "--" (no GPS data)	2 characters
80	Longitude (seconds)	00 to 59 or "--" (no GPS data)	2 characters
81	Unused	1 character	1 character
82	North latitude/South latitude	N: North; S: South	1 character
83	Latitude (degrees)	000 to 180 or "---" (no GPS data)	3 characters
84	Latitude (minutes)	00 to 59 or "--" (no GPS data)	2 characters
85	Latitude (seconds)	00 to 59 or "--" (no GPS data)	2 characters
86	Unused		1 character
87	East longitude/West longitude	E: East; W: West	1 character
88	Delimiter character		1 character
89	Frame check sequence (FCS)		2 characters

● Memory data requests

● Request command format

```
#  RM X  X  AAAAAAAAAAAAAAAAAAAAAA  XX  XX  XX  @  XX  [CR]  [LF]
1  2  3  4  5                               6  7  8  9  10
```

1	Header		1 character
2	Command		2 characters
3	Data specification ^{*1}	0: Start search; 1: Next data item; 2: Previous data item; 3: Request same data again	1 character
4	Search method specification	0: All data; 1: Site search; 2: Date search	1 character
5	Search site ^{*2}	Upper- and lowercase letters, numbers, periods (.) hyphens (-) and spaces ()	20 characters
6	Search year ^{*3}	00 to 99	2 characters
7	Search month ^{*3}	01 to 12	2 characters
8	Search day ^{*3}	01 to 31	2 characters
9	Delimiter character		1 character
10	Frame check sequence (FCS)		2 characters

*1: When sending the RM command, first send 0 [Start search], then 1 [Next data item], 2 [Previous data item] or 3 [Request same data again].

*2: [Search site] is only needed when [Site search] is specified as the search method. If another search method is specified, fill this field with spaces.

*3: [Search year], [Search month] and [Search day] are only needed when [Date search] is specified as the search method. If another search method is specified, fill this field with spaces.

● Response format

(when data exists)

```

#  RM  AAAAAAAAAAAAAAAAAAAAAA  XX X  X  XXXXX  X
1  2  3                               4  5  6  7      8

XX X  X  XXXXX  X  XX X  X  XXXXX  X  XX X  X  XXXXX  X
9  10 11 12      13 14 15 16 17      18 19 20 21 22 23

XX X  X  XXXXX  X  XX X  X  XXXXX  X  XX X  X  XXXXX  X
24 25 26 27      28 29 30 31 32      33 34 35 36 37 38

XX X  X  XXXXX  X  XX X  X  XXXXX  X  XX X  X  XXXXX  X
39 40 41 42      43 44 45 46 47      48 49 50 51 52 53

XX X  X  XXXXX  X  XX X  X  XXXXX  X  XX X  X  XXXXX  X
54 55 56 57      58 59 60 61 62      63 64 65 66 67 68

XX XX XX XX XX XX XX XX X  X  XXX XX XX X  X  @  XX [CR] [LF]
69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86

```

1	Header		1 character
2	Command		2 characters
3	Site name	Upper- and lowercase letters, numbers, periods (.) hyphens (-) and spaces ()	20 characters
4	Parameter 1 code	(1) Parameter code	2 characters
5	Parameter 1 selection	0: No selection; 1: Selection made	1 character
6	Parameter 1 error	(6) Parameter error code	1 character
7	Parameter 1 data	5 characters including decimal point, right-justified with blanks filled	5 characters
8	Parameter 1 unit	(2) Unit code	1 character
9	Parameter 2 code	(1) Parameter code	2 characters
10	Parameter 2 selection	0: No selection; 1: Selection made	1 character
11	Parameter 2 error	(6) Parameter error code	1 character
12	Parameter 2 data	5 characters including decimal point, right-justified with blanks filled	5 characters
13	Parameter 2 unit	(2) Unit code	1 character
14	Parameter 3 code	(1) Parameter code	2 characters
15	Parameter 3 selection	0: No selection; 1: Selection made	1 character
16	Parameter 3 error	(6) Parameter error code	1 character
17	Parameter 3 data	5 characters including decimal point, right-justified with blanks filled	5 characters
18	Parameter 3 unit	(2) Unit code	1 character
19	Parameter 4 code	(1) Parameter code	2 characters
20	Parameter 4 selection	0: No selection; 1: Selection made	1 character

21	Parameter 4 error	(6) Parameter error code	1 character
22	Parameter 4 data	5 characters including decimal point, right-justified with blanks filled	5 characters
23	Parameter 4 unit	(2) Unit code	1 character
24	Parameter 5 code	(1) Parameter code	2 characters
25	Parameter 5 selection	0: No selection; 1: Selection made	1 character
26	Parameter 5 error	(6) Parameter error code	1 character
27	Parameter 5 data	5 characters including decimal point, right-justified with blanks filled	5 characters
28	Parameter 5 unit	(2) Unit code	1 character
29	Parameter 6 code	(1) Parameter code	2 characters
30	Parameter 6 selection	0: No selection; 1: Selection made	1 character
31	Parameter 6 error	(6) Parameter error code	1 character
32	Parameter 6 data	5 characters including decimal point, right-justified with blanks filled	5 characters
33	Parameter 6 unit	(2) Unit code	1 character
34	Parameter 7 code	(1) Parameter code	2 characters
35	Parameter 7 selection	0: No selection; 1: Selection made	1 character
36	Parameter 7 error	(6) Parameter error code	1 character
37	Parameter 7 data	5 characters including decimal point, right-justified with blanks filled	5 characters
38	Parameter 7 unit	(2) Unit code	1 character
39	Parameter 8 code	(1) Parameter code	2 characters
40	Parameter 8 selection	0: No selection; 1: Selection made	1 character
41	Parameter 8 error	(6) Parameter error code	1 character
42	Parameter 8 data	5 characters including decimal point, right-justified with blanks filled	5 characters
43	Parameter 8 unit	(2) Unit code	1 character
44	Parameter 9 code	(1) Parameter code	2 characters
45	Parameter 9 selection	0: No selection; 1: Selection made	1 character
46	Parameter 9 error	(6) Parameter error code	1 character
47	Parameter 9 data	5 characters including decimal point, right-justified with blanks filled	5 characters
48	Parameter 9 unit	(2) Unit code	1 character
49	Parameter 10 code	(1) Parameter code	2 characters
50	Parameter 10 selection	0: No selection; 1: Selection made	1 character
51	Parameter 10 error	(6) Parameter error code	1 character
52	Parameter 10 data	5 characters including decimal point, right-justified with blanks filled	5 characters
53	Parameter 10 unit	(2) Unit code	1 character
54	Parameter 11 code	(1) Parameter code	2 characters
55	Parameter 11 selection	0: No selection; 1: Selection made	1 character
56	Parameter 11 error	(6) Parameter error code	1 character
57	Parameter 11 data	5 characters including decimal point, right-justified with blanks filled	5 characters
58	Parameter 11 unit	(2) Unit code	1 character
59	Parameter 12 code	(1) Parameter code	2 characters

60	Parameter 12 selection	0: No selection; 1: Selection made	1 character
61	Parameter 12 error	(6) Parameter error code	1 character
62	Parameter 12 data	5 characters including decimal point, right-justified with blanks filled	5 characters
63	Parameter 12 unit	(2) Unit code	1 character
64	Parameter 13 code	(1) Parameter code	2 characters
65	Parameter 13 selection	0: No selection; 1: Selection made	1 character
66	Parameter 13 error	(6) Parameter error code	1 character
67	Parameter 13 data	5 characters including decimal point, right-justified with blanks filled	5 characters
68	Parameter 13 unit	(2) Unit code	1 character
69	Year	00 to 99	2 characters
70	Month	01 to 12	2 characters
71	Day	01 to 31	2 characters
72	Hour	00 to 23	2 characters
73	Minute	00 to 59	2 characters
74	Second	00 to 59	2 characters
75	Longitude (degrees)	00 to 90 or "--" (no GPS data)	2 characters
76	Longitude (minutes)	00 to 59 or "--" (no GPS data)	2 characters
77	Longitude (seconds)	00 to 59 or "--" (no GPS data)	2 characters
78	Unused		1 character
79	North latitude/South latitude	N: North; S: South	1 character
80	Latitude (degrees)	000 to 180 or "---" (no GPS data)	3 characters
81	Latitude (minutes)	00 to 59 or "--" (no GPS data)	2 characters
82	Latitude (seconds)	00 to 59 or "--" (no GPS data)	2 characters
83	Unused		1 character
84	East longitude/West longitude	E: East; W: West	1 character
85	Delimiter character		1 character
86	Frame check sequence (FCS)		2 characters

When no data exists, or memory is at capacity)

#	RM	@	XX	[CR]	[LF]
1	2	3	4		

1	Header	1 character
2	Command	2 characters
3	Delimiter character\	1 character
4	Frame check sequence (FCS)	2 characters

● Memory data count request

● Request command format

#	RN	@	XX	[CR]	[LF]
1	2	3	4		

1	Header	1 character
2	Command	2 characters
3	Delimiter character\	1 character
4	Frame check sequence (FCS)	2 characters

● Response format

#	RN	XXXXX	@	XX	[CR]	[LF]
1	2	3	4	5		

1	Header	1 character	
2	Command	2 characters	
3	Total data count	0 to 10000	5 characters
4	Delimiter character\	1 character	
5	Frame check sequence (FCS)	2 characters	

● Command parse failure response

#	??	X	XX	X	@	XX	[CR]	[LF]
1	2	3	4	5	6	7		

1	Header	1 character
2	Command	2 characters
3	Command parse failure reason ^{*4}	1 character
4	Received command ^{*5}	2 characters
5	(3) Status code for probe status ^{*5}	1 character
6	Delimiter character	1 character
7	Frame check sequence (FCS)	2 characters

*4: List of command parse failure reasons

- 1: Frame length error
- 2: FCS mismatch
- 3: Undefined command
- 4: Data error
- 5: Data out of range
- 6: No "@" delimiter character
- 7: No "#" header character
- 8: No [Carriage return] + [Line feed] footer
- 9: Cannot accept command in this timing.

*5: Only set for command parse failure reason 9, [Cannot accept command in this timing]. Otherwise this field is filled with spaces.

4 Maintenance

Tip

HORIBA Advanced Techno recommends regular manufacturer maintenance checks in order to ensure a long product life.

4.1 Contact for maintenance

Manufacturer: HORIBA Advanced Techno Co., Ltd.
31, Miyanonishi-cho, Kisshoin Minami-ku, Kyoto 601-8308, Japan

4.2 Routine care

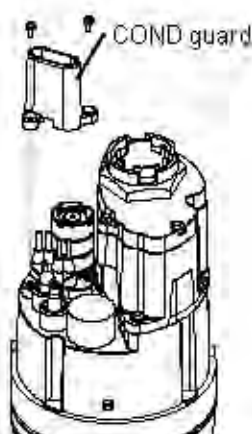
● After measurement

1. Press the control unit's POWER key for about 1 second to turn the power OFF.

Note

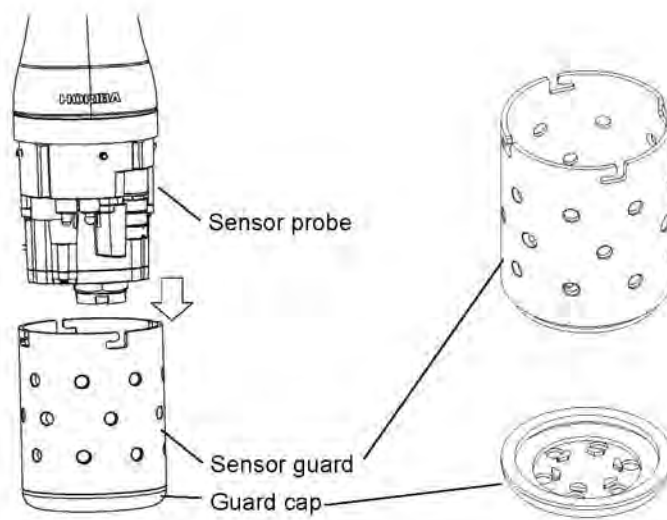
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. Remove the sensor guard, and clean the sensor with tap water.
3. Clean the turbidity sensor with the cleaning brush provided.
4. Remove the two screws securing the COND guard, and the COND guard itself, and use a test tube brush to gently remove any dirt from the electrical conductivity electrode.



5. Wipe off any dirt with a soft cloth. If parts are very dirty, clean them with neutral detergent, then rinse them. If parts are contaminated by oil, wipe it off with a soft cloth soaked in alcohol.
6. Put the COND guard back in place.

-
7. Remove the sensor guard's guard cap, wash off any dirt with tap water, then put the guard cap back in place.



4.3 Every 2 months maintenance

● Dissolved oxygen (DO) sensor

Note

- The DO sensor's internal solution is potassium chloride (KCl). Although KCl is harmless, protective equipment such as gloves and goggles should be worn when working with it.
- Internal solution can be disposed of down a sink.
- Use #306 as the internal solution.

- Replace the membrane cap.
- Polish the gold and silver electrodes when replacing the membrane cap.
The gold electrode does not need to be polished if it is not dirty.

● Silver electrode

Polish a silver electrode part with sandpaper (#600) and then wash metal electrode parts with water.



● Gold electrode

Polish a gold electrode part with green polishing sheet (#8000) by the lusterless side. Add water on the green polishing sheet before polishing. And then wash metal electrode parts with water. Do not use sandpaper on the gold electrode.



Replace a membrane cap after clean metal electrodes parts.
Refer to "4.6 Replacing the membrane cap" (page 92).

● Reference electrode

Note

- The pH reference internal solution is potassium chloride (KCl). Although KCl is harmless, protective equipment such as gloves and goggles should be worn when working with it.
- Internal solution can be disposed of down a sink.
- Use #330 as the internal solution.

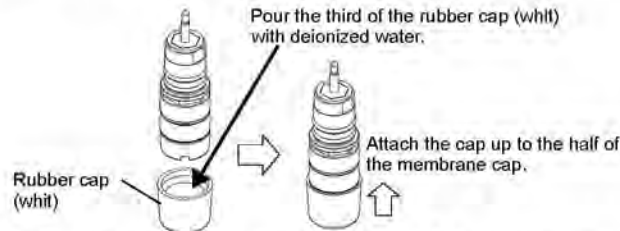
1. Remove the rubber liquid junction plug from the reference electrode and dispose of the internal solution.
2. To prevent air entering, fill the reference electrode to the brim with its internal solution (#330).
3. Put the rubber liquid junction plug back in place.

If the rubber liquid junction plug is dirty, replace the liquid junctions (set of two; No. 3200043587). The reference electrode's internal solution will spill when replacing the liquid junctions. Rinse parts with tap water and dry them with a soft cloth.

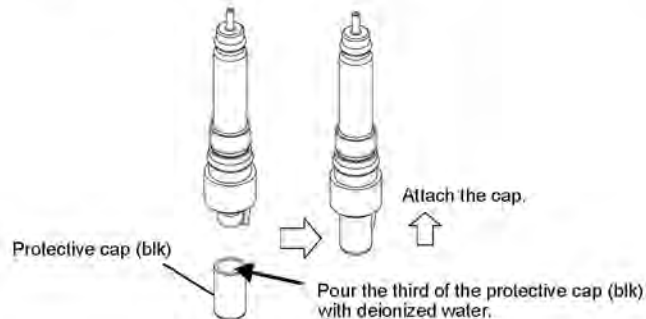
4.4 Storage

● Short-term (under 2 months) storage

- Before storing the DO sensor, pour the third of the rubber cap (whit) provided with deionized water and cover the DO sensor with them.



- Before storing the pH sensor, pour the third of the protective cap (blk) provided with deionized water and cover the pH sensor with them.



Note

Before measurement, remove the rubber cap (whit) and the protective cap (blk).

● Long-term (2 months or more) storage

- Remove a membrane cap from DO sensor, and wash the gold electrode and silver electrode parts with water. Wipe off the moisture before storing DO sensor in the pack.
- Prevent internal solution seeping out of the reference chip by taping over the point of seepage with electrical tape.
- Before storing the system, remove the control unit's batteries to prevent battery leakage.

4.5 Replacing the turbidity sensor

1. Press the control unit's POWER key for about 1 second to turn the power OFF.

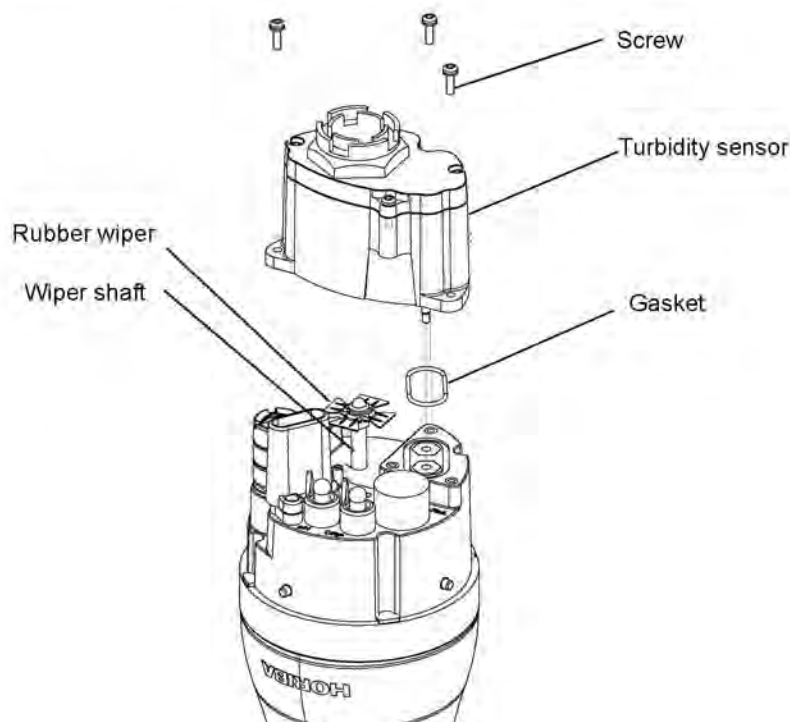
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. Remove the sensor guard, and clean the sensor probe with tap water.
3. Use dry air to blow away and dry off any moisture.
4. Remove the three screws holding the turbidity sensor by using No. 2 Phillips head screwdriver.
5. Pull out the turbidity sensor horizontally.
6. Remove the rubber wiper and gasket, and use a soft cloth to wipe off any dirt from the wiper shaft and turbidity sensor attachment. If parts are very dirty, use a soft cloth soaked in neutral detergent or alcohol.
7. Replace the rubber wiper and gasket with new ones. Coat the gasket with a thin layer of grease (No. 3014017718).
8. Attach the new turbidity sensor and fasten it in place with the three screws.
9. Perform four-point calibration before using the sensor.

Note

Do not mistake the combination of sensor probe and turbidity sensor. If the combination is not correct, sensor and sensor probe might be broken. #7800 has to be connected to U-52/U-52G. #7801 has to be connected to U-53/U-53G. #7802 has to be connected to U-54/U-54G.



4.6 Replacing the membrane cap

● Replacement procedure

1. Prepare the DO sensor.

- Take a DO sensor out of pack (newly purchasing).
- Remove a DO sensor from the sensor probe (after use).



Newly purchasing

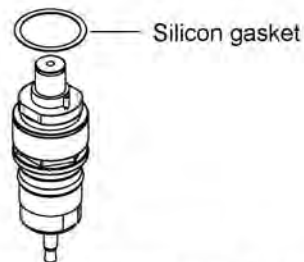


Undo a DO sensor from the sensor probe

- Twist a membrane cap from DO sensor.
- Wash the gold electrode and silver electrode parts with water.

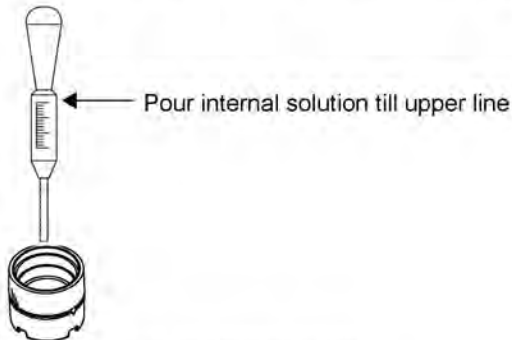
2. Replace the silicone gasket with a new one.

Replace with new silicon gasket.



Silicon gasket

3. Pour internal solution (#306) into a membrane cap with a dropper.



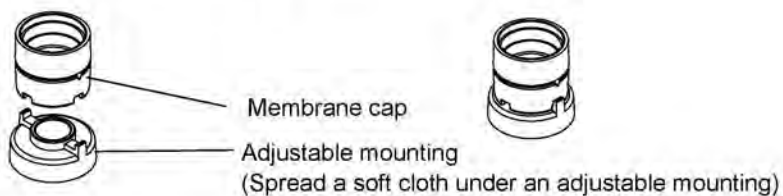
Pour internal solution till upper line

- Check air bubbles in a membrane cap.



Pick a Cap up and drop it down, if there is air bubbles in internal solution of it.

4. Set up a membrane cap on an adjustable mounting.



Membrane cap

Adjustable mounting

(Spread a soft cloth under an adjustable mounting)

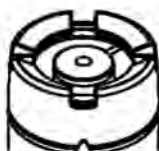
5. Attach a membrane cap to DO sensor



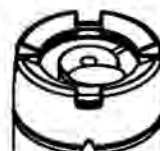
Twist a DO sensor
with holding a membrane cap tight.

6. Check for membrane surface

Attach the membrane cap and check the membrane buoyancy and bubbles.



Good: Limited air bubbles



NG: Air bubbles of more than 5 mm in diameter

- NG → Replace a membrane cap again.
- Check that span calibration can be performed.

Note

If the membrane cap is not attached correctly, sensitivity may be lost or response speed may decrease.

4.7 Troubleshooting

Note

If the sensor probe is removed while the control unit is indicating an error, errors cannot be canceled by using the ESC key. Either reconnect the sensor probe or restart the control unit.

4.7.1 Error displays

Error	Cause	Solution
Probe ADC error	Internal IC failure	Contact your nearest sales outlet to have the sensor probe repaired.
Probe EEPROM error/Factory	Internal IC failure	Turn the power OFF, then restart the system. If the error persists, initialize the system from the "System" menu. If the error still persists, contact your nearest sales outlet to have the sensor probe repaired.
Probe EEPROM error/User	Internal IC failure	Turn the power OFF, then restart the system. If the error persists, initialize the system from the "System" menu. If the error still persists, contact your nearest sales outlet to have the sensor probe repaired.
Turbidity sensor light source error	Turbidity sensor light source failure	Turn the power OFF, wipe off any water droplets on the probe, then remove the turbidity sensor. Check there are no water droplets around the turbidity sensor connector, then mount the sensor again. If the error persists, replace the turbidity sensor.
Turbidity sensor wiper motor error	The turbidity sensor wiper is not operating.	Press the ESC key. Check there are no obstacles near the wiper, then perform the measurement again. If the error persists, the motor will need to be replaced. Contact your nearest sales outlet to have the sensor probe repaired.
Probe capacitor error	Low battery voltage or internal IC failure	Turn the power OFF. Replace the display's batteries. If the error persists, contact your nearest sales outlet to have the sensor probe repaired.
Probe EEPROM error	Internal IC failure	Press the ESC key, then redo the operation. If the error persists, turn the power OFF, then restart the system (the current data will not be saved). If the error still persists, contact your nearest sales outlet to have the display repaired.
Probe board error	Probe board failure	Turn the power OFF. Contact your nearest sales outlet to have the sensor probe repaired.

Error	Cause	Solution
Zero-point calibration error	<p>pH sensor</p> <ol style="list-style-type: none"> 1. The pH standard solution is contaminated. 2. The pH-responsive membrane is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The pH-responsive membrane is torn. 	<p>pH sensor</p> <ol style="list-style-type: none"> 1. Replace the standard solution with new solution. 2. Clean the pH-responsive membrane. 3. Refill the reference electrode's internal solution. 4. Replace the sensor.
	<p>COND sensor</p> <ol style="list-style-type: none"> 1. There is moisture on the sensor. 2. The sensor is dirty. 3. The COND sensor has failed. 	<p>COND sensor</p> <ol style="list-style-type: none"> 1. Blow-dry the moisture off the sensor. 2. Clean the sensor. 3. Contact your nearest sales outlet.
	<p>TURB sensor</p> <ol style="list-style-type: none"> 1. There are air bubbles on the cell. 2. The cell window is dirty. 3. The sensor is being affected by ambient light. 4. The solution is dirty. 5. The TURB sensor has failed. 	<p>TURB sensor</p> <ol style="list-style-type: none"> 1. Shake the sensor probe vigorously. 2. Clean the cell window. 3. Calibrate using the calibration cup provided. 4. Replace the solution with new solution. 5. Replace the TURB sensor.
	<p>DO sensor</p> <ol style="list-style-type: none"> 1. There are air bubbles in the internal solution. 2. The DO sensor has failed. 	<p>DO sensor</p> <ol style="list-style-type: none"> 1. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 2. Replace the DO sensor.
	<p>Water depth sensor</p> <ol style="list-style-type: none"> 1. The water depth sensor is dirty. 2. The water depth sensor has failed. 	<p>Water depth sensor</p> <ol style="list-style-type: none"> 1. Clean the water depth sensor. 2. Contact your nearest sales outlet.

Error	Cause	Solution
Span calibration error	<p>pH sensor</p> <ol style="list-style-type: none"> 1. The pH standard solution is contaminated. 2. The pH-responsive membrane is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The pH-responsive membrane is torn. 	<p>pH sensor</p> <ol style="list-style-type: none"> 1. Replace the standard solution with new solution. 2. Clean the pH-responsive membrane. 3. Refill the reference electrode's internal solution. 4. Replace the sensor.
	<p>ORP sensor</p> <ol style="list-style-type: none"> 1. The ORP standard solution is contaminated. 2. The ORP electrode is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The ORP electrode has failed. 	<p>ORP sensor</p> <ol style="list-style-type: none"> 1. Replace the standard solution with new solution. 2. Clean the ORP electrode. 3. Refill the reference electrode's internal solution. 4. Replace the ORP electrode.
	<p>COND sensor</p> <ol style="list-style-type: none"> 1. The calibration solution is not correct. 2. The sensor is dirty. 3. The COND sensor has failed. 	<p>COND sensor</p> <ol style="list-style-type: none"> 1. Use the correct calibration solution for calibration. 2. Clean the sensor. 3. Contact your nearest sales outlet.
	<p>TURB sensor</p> <ol style="list-style-type: none"> 1. There are air bubbles on the cell. 2. The cell window is dirty. 3. The sensor is being affected by ambient light. 4. The solution is dirty. 5. The TURB sensor has failed. 	<p>TURB sensor</p> <ol style="list-style-type: none"> 1. Shake the sensor probe vigorously. 2. Clean the cell window. 3. Calibrate using the calibration cup provided. 4. Replace the solution with new solution. 5. Replace the TURB sensor.
	<p>DO sensor</p> <ol style="list-style-type: none"> 1. The diaphragm is torn. 2. There are air bubbles in the internal solution. 3. The DO sensor has failed. 	<p>DO sensor</p> <ol style="list-style-type: none"> 1. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 2. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 3. Replace the DO sensor.
	<p>Temperature sensor</p> <p>The temperature sensor has failed.</p>	<p>Temperature sensor</p> <p>Contact your nearest sales outlet.</p>
Calibration stability error	<p>The calibration value of an individual parameter is not stable.</p> <ol style="list-style-type: none"> 1. The sensor is dirty. 2. The sensor has not adjusted to the standard solution. 3. The temperature was unstable during calibration. 	<ol style="list-style-type: none"> 1. Clean the sensor. 2. Fill the transparent calibration cup with pH 4 standard solution, and wait for at least 20 minutes of conditioning before starting calibration. 3. Start calibration after the temperature has stabilized.
Turbidity calibration error	Error in turbidity measurement sequence	Turbidity calibration failed. Redo calibration after removing the displayed error.
Wet check	The cable connector is submerged.	Turn the power OFF and disconnect the cable connector. Wipe or blow-dry off all the water droplets on the probe. If the error persists, contact your nearest sales outlet to have the display and sensor probe repaired.
Power voltage error	The display's power board has failed.	This error could also be caused by poor cable contact. Turn the power OFF and disconnect the cable connector. Reconnect the connector and turn the power ON. If the error persists, contact your nearest sales outlet to have the display and sensor probe repaired.

Error	Cause	Solution
Turbidity lamp power voltage error	The remaining battery level is low.	Turn the power OFF and replace the display's batteries with new ones.
Display RTC error	The time display is incorrect.	Replace the coin battery.
Display FROM error	Internal IC failure	Contact your nearest sales outlet to have the control unit repaired.
Display EEPROM error	Internal IC failure	Contact your nearest sales outlet to have the control unit repaired.
Display save error	Insufficient memory space	Move data from the display, use the data operations screen to delete data, then redo the measurement.
Measurement sequence error	<ul style="list-style-type: none"> ● When the measurement item is turbidity <ol style="list-style-type: none"> 1. The battery power is low. 2. The wiper is not operating normally. 3. The light source lamp is not lit. ● If items other than turbidity are also displayed <ol style="list-style-type: none"> 4. Board failure 	<ol style="list-style-type: none"> 1. Replace the batteries with new ones. 2. Check there are no obstacles near the wiper, then redo the measurement. If the error persists, the motor will need to be replaced. Contact your nearest sales outlet to have the sensor probe repaired. 3. Wipe off any water droplets on the probe, then remove the turbidity sensor. Check there are no water droplets around the turbidity sensor connector, then mount the sensor again. If the error persists, replace the turbidity sensor. 4. Contact your nearest sales outlet to have the sensor probe repaired.
Out of measurement range	The attempted measurement is outside the measurement range supported for that item.	The system must be used within its supported measurement ranges.
Last zero-point calibration invalid	<p>pH sensor</p> <ol style="list-style-type: none"> 1. The pH standard solution is contaminated. 2. The pH-responsive membrane is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The pH-responsive membrane is torn. 	<p>pH sensor</p> <ol style="list-style-type: none"> 1. Replace the standard solution with new solution. 2. Clean the pH-responsive membrane. 3. Refill the reference electrode's internal solution. 4. Replace the sensor.
	<p>COND sensor</p> <ol style="list-style-type: none"> 1. There is moisture on the sensor. 2. The sensor is dirty. 3. The COND sensor has failed. 	<p>COND sensor</p> <ol style="list-style-type: none"> 1. Blow-dry the moisture off the sensor. 2. Clean the sensor. 3. Contact your nearest sales outlet.
	<p>TURB sensor</p> <ol style="list-style-type: none"> 1. There are air bubbles on the cell. 2. The cell window is dirty. 3. The sensor is being affected by ambient light. 4. The solution is dirty. 5. The TURB sensor has failed. 	<p>TURB sensor</p> <ol style="list-style-type: none"> 1. Shake the sensor probe vigorously. 2. Clean the cell window. 3. Calibrate using the calibration cup provided. 4. Replace the solution with new solution. 5. Replace the TURB sensor.
	<p>DO sensor</p> <ol style="list-style-type: none"> 1. There are air bubbles in the internal solution. 2. The DO sensor has failed. 	<p>DO sensor</p> <ol style="list-style-type: none"> 1. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 2. Replace the DO sensor.
	<p>Water depth sensor</p> <ol style="list-style-type: none"> 1. The water depth sensor is dirty. 2. The water depth sensor has failed. 	<p>Water depth sensor</p> <ol style="list-style-type: none"> 1. Clean the water depth sensor. 2. Contact your nearest sales outlet.
Out of measurement range	[See above.]	[See above.]
Last zero-point calibration invalid	[See above.]	[See above.]

4 Maintenance

Error	Cause	Solution
Last span calibration invalid	<p>pH sensor</p> <ol style="list-style-type: none"> 1. The pH standard solution is contaminated. 2. The pH-responsive membrane is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The pH-responsive membrane is torn. 	<p>pH sensor</p> <ol style="list-style-type: none"> 1. Replace the standard solution with new solution. 2. Clean the pH-responsive membrane. 3. Refill the reference electrode's internal solution. 4. Replace the sensor.
	<p>ORP sensor</p> <ol style="list-style-type: none"> 1. The ORP standard solution is contaminated. 2. The ORP electrode is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The ORP sensor glass is broken. 	<p>ORP sensor</p> <ol style="list-style-type: none"> 1. Replace the standard solution with new solution. 2. Clean the ORP electrode. 3. Refill the reference electrode's internal solution. 4. Replace the sensor.
	<p>COND sensor</p> <ol style="list-style-type: none"> 1. The calibration solution is not correct. 2. The sensor is dirty. 3. The COND sensor has failed. 	<p>COND sensor</p> <ol style="list-style-type: none"> 1. Use the correct calibration solution for calibration. 2. Clean the sensor. 3. Contact your nearest sales outlet.
	<p>TURB sensor</p> <ol style="list-style-type: none"> 1. There are air bubbles on the cell. 2. The cell window is dirty. 3. The sensor is being affected by ambient light. 4. The solution is dirty. 5. The TURB sensor has failed. 	<p>TURB sensor</p> <ol style="list-style-type: none"> 1. Shake the sensor probe vigorously. 2. Clean the cell window. 3. Calibrate using the calibration cup provided. 4. Replace the solution with new solution. 5. Replace the TURB sensor.
	<p>DO sensor</p> <ol style="list-style-type: none"> 1. The diaphragm is torn. 2. There are air bubbles in the internal solution. 3. The DO sensor has failed. 	<p>DO sensor</p> <ol style="list-style-type: none"> 1. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 2. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 3. Replace the DO sensor.
	<p>Temperature sensor</p> <ul style="list-style-type: none"> ● The temperature sensor has failed. 	<p>Temperature sensor</p> <ul style="list-style-type: none"> ● Contact your nearest sales outlet.
Out of measurement range	[See above.]	[See above.]
Last zero-point calibration invalid		
Last span calibration invalid	<p>The calibration value of an individual parameter is not stable.</p> <ol style="list-style-type: none"> 1. The sensor is dirty. 2. The sensor has not adjusted to the standard solution. 3. The temperature was unstable during calibration. 	<ol style="list-style-type: none"> 1. Clean the sensors. 2. Fill the transparent calibration cup with pH 4 standard solution, and wait for at least 20 minutes of conditioning before starting calibration. 3. Start calibration after the temperature has stabilized.
Out of measurement range	[See above.]	[See above.]
Last zero-point calibration invalid		
Calibration value is factory default value.	Internal IC failure	Turn the power OFF, then restart the system. If the error persists, initialize the system from the "System" menu. If the error still persists, contact your nearest sales outlet to have the sensor probe repaired.

Error	Cause	Solution
Sample is unstable.	<ol style="list-style-type: none"> 1. The concentration of the sample is unstable. 2. External light disturbance has affected the sensor. 3. Water has entered the turbidity sensor's connector. 	<ol style="list-style-type: none"> 1. Use a stirrer to agitate the sample during measurement. 2. Perform measurement away from direct sunlight. 3. Turn the power OFF, wipe off any water droplets on the probe, then remove the turbidity sensor. Check there are no water droplets around the turbidity sensor connector, then mount the sensor again. If the error persists, replace the turbidity sensor.

4.7.2 Error displays in sensor information

Error display	Cause	Solution
Measurement sequence error	Measurement sequence error	Turn the power OFF, then restart the system. If the error persists, have the probe repaired.
Out of measurement range	The measurement value is outside the measurement range.	Samples for measurement must be within the measurement range.
Last calibration invalid	The last calibration failed.	Redo calibration.
Calibration invalid	The calibration value is the factory default value.	Redo calibration.
Background unstable	The U-53 turbidity sensor is exposed to direct light.	Mount the guard cap and sensor guard and perform measurement away from direct sunlight.
	The turbidity value changed rapidly during measurement.	Measure a sample that has stable turbidity.

5 Specifications

Specification		Basic value	Model						
			U-51	U-52	U-52G	U-53	U-53G	U-54	U-54G
Sensor probe	Measurement temperature range	-10°C to 55°C							
	Maximum sensor outer diameter	Approx. 96 mm							
	Sensor length	Approx. 340 mm	✓	✓	✓	✓	✓	✓	✓
	Cable length	2 m (standard) 10 m/30 m (options)							
	Mass	Approx. 1800 g							
	Auto calibration function	Uses pH 4 standard solution.							
	Measurement depth	30 m max.							
	Wet-part materials *3	PPS, glass, SUS316L, SUS304, FKM, PEEK, Q, titanium, FEP membrane, POM	✓	✓	✓	✓	✓	✓	✓
Waterproofing standard	IP-68								
Control unit	Outer dimensions (W × D × H)	115 mm × 66 mm × 283 mm	✓	✓	—	✓	—	✓	—
		115 mm × 66 mm × 335 mm	—	—	✓	—	✓	—	✓
	Mass	Approx. 800 g	✓	✓	✓	✓	✓	✓	✓
	LCD	320 × 240 mm graphic LCD (monochrome) with backlight	✓	✓	✓	✓	✓	✓	✓
	Memory data items	10000	✓	✓	✓	✓	✓	✓	✓
	Communication interface	USB peripheral	✓	✓	✓	✓	✓	✓	✓
	Batteries	C-size dry cells (×4)	✓	✓	✓	✓	✓	✓	✓
	Waterproofing standard	IP-67	✓	✓	✓	✓	✓	✓	✓
	GPS unit	<ul style="list-style-type: none"> ● Reception method (12 channel parallel) ● Measurement precision [With PDOP (high precision): 30 m or less (2 drms)] 	—	—	✓	—	✓	—	✓
	Estimated battery life *1	—	70 hours (for dark backlight)			500 measurements (for dark backlight)		70 hours (for dark backlight)	
	Storage temperature range	-10°C to 60°C	✓	✓	✓	✓	✓	✓	✓
Ambient temperature range	-5°C to 45°C								

Specification		Basic value	Model						
			U-51	U-52	U-52G	U-53	U-53G	U-54	U-54G
pH measurement Two calibration	Measurement method	Glass electrode method							
	Range	pH 0 to 14	✓	✓	✓	✓	✓	✓	✓
	Resolution	0.01 pH							
	Precision *2	±0.1 pH							
Dissolved oxygen measurement ● Salinity conversion (0 to 70 PPT, automatic) ● Automatic temperature compensation	Measurement method	Polarographic method							
	Film thickness	25 µm							
	Range	0 mg/L to 50.0 mg/L							
	Resolution	0.01 mg/L	✓	✓	✓	✓	✓	✓	✓
Precision *2	0 mg/L to 20 mg/L: ±0.2 mg/L 20 mg/L to 50 mg/L: ±0.5 mg/L								
Electrical conductivity measurement ● Auto range ● Automatic temperature conversion (25°C)	Measurement method	Four-AC-electrode method							
	Range	0 S/m to 10 S/m (0 mS/cm to 100 mS/cm)							
	Resolution	0.000 mS/cm to 0.999 mS/cm: 0.001 1.00 mS/cm to 9.99 mS/cm: 0.01 10.0 mS/cm to 99.9 mS/cm: 0.1 0.0 mS/m to 99.9 mS/m: 0.1 0.100 S/m to 0.999 S/m: 0.001 1.00 S/m to 9.99 S/m: 0.01	✓	✓	✓	✓	✓	✓	✓
	Precision *2	1% of full-scale (midpoint of two calibration points)							
Salinity measurement	Measurement method	Electrical conductivity conversion							
	Range	0 PPT to 70 PPT (parts per thousand)	✓	✓	✓	✓	✓	✓	✓
	Resolution	0.01 PPT							
	Precision	±3 PPT							
TDS (total dissolved solid) measurement ● Conversion coefficient setting	Measurement method	Electrical conductivity conversion							
	Range	0 g/L to 100 g/L	✓	✓	✓	✓	✓	✓	✓
	Resolution	0.1% of full-scale							
	Repeatability	±2 g/L							
Precision	±5 g/L								
Seawater specific gravity measurement ● σt, σ0, σ15 display	Measurement method	Electrical conductivity conversion							
	Range	0 σt to 50 σt	✓	✓	✓	✓	✓	✓	✓
	Resolution	0.1 σt							
	Precision	±5 σt							

5 Specifications

Specification		Basic value	Model						
			U-51	U-52	U-52G	U-53	U-53G	U-54	U-54G
Temperature measurement	Measurement method	Platinum temperature sensor	✓	✓	✓	✓	✓	✓	✓
	Range	-10°C to 55°C							
	Resolution	0.01°C							
	Sensor	Platinum temperature sensor, JIS Class B (0.3 + 0.005 (t))							
Turbidity measurement	Measurement method		-	LED forward 30° transmission/scattering method	Tungsten lamp 90° transmission/scattering method	LED 90° scattering method			
	Range			0 NTU to 800 NTU	0 NTU to 1000 NTU	0 NTU to 1000 NTU			
	Resolution			0.1 NTU	0.01 NTU	0.01 NTU			
	Precision ^{*2}			±5% of read-out or ±1 NTU, whichever is larger	<ul style="list-style-type: none"> ● ±0.5 NTU (for 0 NTU to 10 NTU measurement range) ● 3% of readout or 1 NTU, whichever is larger (for 10 NTU to 1000 NTU measurement range) 	±5% of read-out or ±1 NTU, whichever is larger			
	Turbidity sensor wiper			-	✓	-			
Water depth measurement	Measurement method	Pressure method	-	-	✓	✓	✓	2 m: - 10 m, 30 m: ✓	
	Range	0 m to 30 m							
	Resolution	0.05 m							
	Precision ^{*2}	±0.3 m							
ORP (oxidation reduction potential) measurement	Measurement method	Platinum electrode method	✓	✓	✓	✓	✓	✓	
	Range	-2000 mV to +2000 mV							
	Resolution	1 mV							
	Precision ^{*2}	±15 mV							

*1: This battery life is an estimate for battery life when C-size alkaline dry cell batteries are used continuously with the control unit temperature at 20°C or greater, with dark backlight.

*2: Accuracy is displayed for measurement with standard solution after calibrating for turbidity and electrical conductivity in four places, pH and DO in two places, and water depth and ORP in one place.

*3: Stainless steel is utilized for the metal areas, but depending on the state of samples such as seawater, rust may form on the surface.

6 Reference

6.1 Consumable parts

● Sensor

Name	Model	No.	Description
pH sensor	#7112	3014057312	Standard type pH sensor
pH sensor ToupH	#7113	3200170923	Tough glass type pH sensor
ORP sensor	#7313	3200170920	
DO sensor	#7543	3200170924	
Reference electrode	#7210	3200043582	
R bush unit	—	3200043587	Reference electrode liquid junction
Turbidity sensor	#7800	3200172803	For U-52/U-52G
Turbidity sensor	#7801	3200172800	For U-53/U-53G
TURB sensor U-54	#7802	3200318188	For U-54/U-54G
Membrane cap	—	3200170194	For DO sensor

● Standard solution and inner solution

Name	Model	No.	Description
pH 4 (For automatic calibration) 500 mL	#100-4	3200043638	Standard solution for auto calibration. Also used for manual pH span calibration.
pH 4 (For automatic calibration) 4 L	#140-4	3200174430	
pH 7 500 mL	#100-7	3200043637	Standard solution for pH zero-point calibration. Actual pH value is 6.86 at 25°C
pH 9 500 mL	#100-9	3200043636	Standard solution for pH manual span calibration.
Powder for ORP standard solution 10 packs	#160-51	3200043618	ORP standard solution powder ORP calibration 250 ml 10 bags/pack
Powder for ORP standard solution 10 packs	#160-22	3200043617	
Inner solution for DO sensor, 50 mL	#306	3200170938	Internal solution for DO sensor.
Internal solution for pH, 250 mL	#330	3200043641	Supplementary internal solution for pH reference electrode.

● Others

Name	Model	No.	Description
Silicone grease	—	3014017718	Silicone grease for coating sensor O-ring.
Sponge brush unit	—	3200169531	Brush for cleaning sensor probe.
O-ring set for reference electrode	—	3200169376	O-rings for reference electrode.
O-ring set for DO sensor	—	3200169426	O-rings for DO sensor.
Rubber cap set for sensor guard	—	3200169428	Rubber caps used between sensor guard and sensor probe.
O-ring set for pH and ORP sensor	—	3200169520	O-rings for pH and ORP sensors.
Wiper unit	—	3200169789	Rubber wiper for U-53/U-53G turbidity sensors.
Protective cap (blk) for pH sensor	—	3200175019	Cap attached to tip of pH sensor for sensor probe storage.
Rubber cap (whit) for DO sensor	—	3200175020	Cap attached to tip of DO sensor for sensor probe storage.

6.2 Options sold separately

Name	Model	No.	Description
Bag	U-5030	3200174772	Storage bag for sensor probes and flow cell. Can be carried in one hand.
Flow cell	—	3200156570	Used when collecting measurement samples by pump.
Probe guard	—	3200167002	Used for taking measurements in locations where there is a current or where there is a thick layer of sludge.
Communication cable	—	3200174823	A PC connection cable. Comes with data collection software.

6.3 pH measurement

6.3.1 Principle of pH measurement

U-50 series use the glass electrode method for pH measurements. The glass electrode method measures a potential difference between the glass film for pH and the reference electrode. For more information, refer to "JIS Z 8802 pH measurement method".

6.3.2 Temperature compensation

The electromotive force generated by the glass electrode changes depending on the temperature of the solution.

Temperature compensation is used to compensate for the change in electromotive force caused by temperature.

This function does not compensate the change in pH caused by the temperature of the solution. When pH is to be measured, the temperature of the solution must be recorded along with that pH value, even if a pH meter has automatic temperature compensation function. If the solution temperature is not recorded, the results of the pH measurement may be meaningless.

6.3.3 Standard solutions

When measuring pH, the pH meter must be calibrated using standard solution. There are five kinds of standard solutions specified in "JIS Z 8802 pH measurement". For normal measurement, two of standard solutions with pH of 4, 7, and 9 are sufficient to accurately calibrate the meter.

For standard solutions, refer to "JIS Z 8802 pH measurement".

- pH 4 standard solution: 0.05 mol/L potassium hydrogen phthalate aqueous solution (Phthalate)
 pH 6.86 standard solution: 0.025 mol/L potassium dihydrogenphosphate, 0.025 mol/L disodium hydrogenphosphate aqueous solution (Neutral phosphate)
 pH 9 standard solution: 0.01 mol/L sodium tetraborate aqueous solution (Borate)

Table 4 pH values of HORIBA pH standard solutions at various temperatures settings

Temp. (°C)	pH 4 standard solution Phthalate	pH 6.86 standard solution Neutral phosphate	pH 9 standard solution Borate
0	4.01	6.98	9.46
5	4.01	6.95	9.39
10	4.00	6.92	9.33
15	4.00	6.90	9.27
20	4.00	6.88	9.22
25	4.01	6.86	9.18
30	4.01	6.85	9.14
35	4.02	6.84	9.10
40	4.03	6.84	9.07
45	4.04	6.84	9.04

Table 5 Indicated value of other pH standard solutions at various temperatures (pH)

Temp. (°C)	pH 7 standard solution Neutral phosphate	pH 10 standard solution Carbonate
0	7.12	10.32
5	7.09	10.25
10	7.06	10.18
15	7.04	10.12
20	7.02	10.06
25	7.00	10.01
30	6.99	9.97
35	6.98	9.93
40	6.97	9.89
45	6.97	9.86

6.4 DO measurement

6.4.1 Principle of DO measurement

Dissolved oxygen (DO) refers to the amount of oxygen that is contained in water.

The concentration of dissolved oxygen is generally given as mg/L or as a percentage value (the dissolved oxygen saturation ratio).

Dissolved oxygen is essential for maintaining the self-purifying ability of rivers and seas and also for fish to live. The concentration of dissolved oxygen acts as an indicator of water quality. It is often measured when processing waste water and managing water quality. Fig. 1 provides an overview of the principles behind dissolved oxygen sensor measurement.

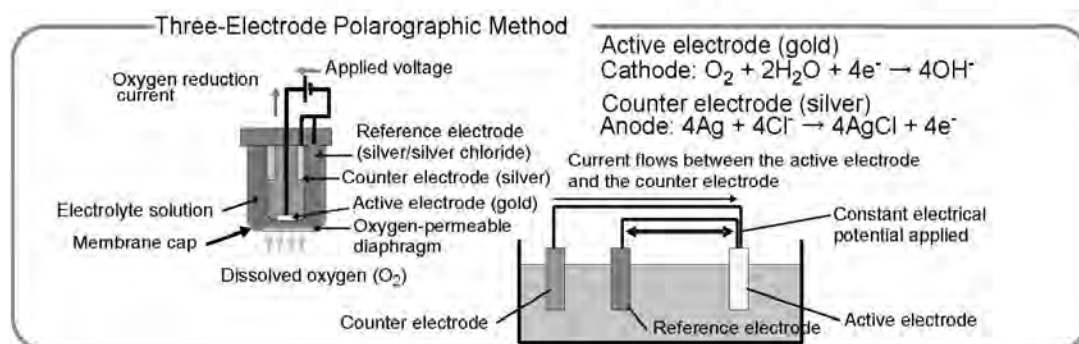


Fig. 1 Overview of principles behind dissolved oxygen sensor

The polarographic oxygen sensor is an enclosed sensor wherein voltage is applied to a cathode made of a precious metal (such as gold or platinum) and an anode also made of a precious metal (such as silver) via an external circuit, and a cap with an oxygen permeable diaphragm (membrane) is filled with electrolyte solution. As indicated in Fig. 1, the concentration of dissolved oxygen can be measured by measuring the current proportional to the amount of reduced oxygen when oxygen that has dispersed through the oxygen permeable diaphragm produces a reductive reaction on the surface of the active electrode (gold). The method of measuring dissolved oxygen based on the above principle is called the Membrane Electrode Method. Compared to the Chemical Analysis Method, which requires complicated pre-processing to alleviate the effect of reduced materials and oxidizing materials, this method allows dissolved oxygen to be measured very easily. It is also easy to remove undesired buildup from the silver electrode by polishing and cleaning if an insulator forms on it due to oxidation, making the method reusable.

6.4.2 Conditioning of DO sensor

Oxygen goes into membrane cap of DO sensor through membrane without being consumed by the sensor while U-50's power is off, although polarographic DO sensor consumes oxygen during the measurement. DO value is higher than usual after turning U-50's power on because DO sensor is measuring and consuming extra oxygen.

For the easy maintenance, U-50's DO sensor has a big membrane cap and space for oxygen, so conditioning time is a little long.

6.4.3 Salinity calibration

When the solution and air come into contact and form an equilibrium (i.e. saturation), the relationship between the concentration of dissolved oxygen in the solution, C , [mol/L], and the partial pressure of oxygen in the air, P_s , [MPa/(mg/L)], can be represented by the following formula:

$$C = P_s/H$$

Where H [MPa/(mg/L)] is the Henry constant, a value that changes according to the composition of the solution. As H typically becomes larger as the salinity of the water increases, C becomes smaller.

The DO sensor detects the partial pressure of oxygen (P_s) in the above formula. Accordingly, if the DO sensor is immersed in deionized water saturated with air, or in an aqueous solution containing salt, the output current does not change, resulting in an erroneous measurement. For example, when salt is added to a sample, the amount of oxygen that can be dissolved in the solution decreases, but because the partial pressure of oxygen does not change, the value displayed by the control unit stays the same regardless of salt content. This concept is indicated in graph form below. (Fig. 2)

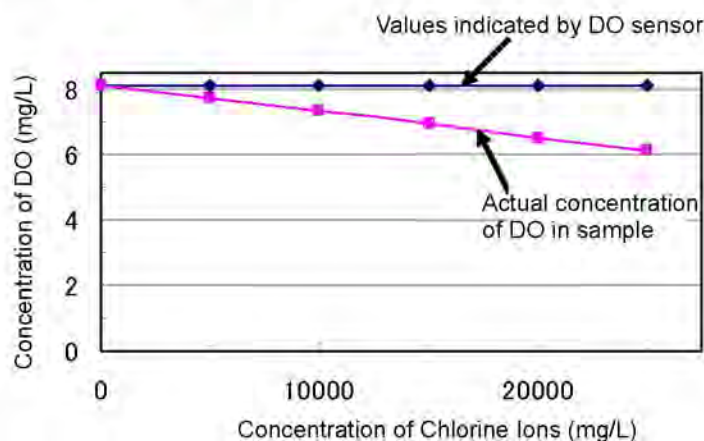


Fig. 2 Relationship between chlorine ion concentration and dissolved oxygen concentration

In samples with a high salt concentration, the solubility of oxygen is lower, but as the partial pressure of oxygen does not change, the value actually indicated on the control unit is higher than the actual value. In order to obtain a measurement of the concentration of dissolved oxygen in an aqueous solution that contains salt, it is therefore necessary to first perform salinity compensation. Conventionally, dissolved oxygen sensors have performed salinity compensation by inputting the salinity of the sample. This is fine as long as the salinity is already known. However, in most cases salinity is unknown, so even if dissolved oxygen sensors contained a salinity compensation function, it was of no practical use.

The U-50 Series can calculate and measure salinity in samples from electrical conductivity values, and can thus be used to automatically compensate for salinity.

Technical information

Japanese testing method for industrial water, JIS K0101, was revised in October 2017. Before the revision, in JIS K0101:1998, formula of Truesdale:1955 had been adopted for saturated dissolved oxygen. In JIS K0101:2017, formula of Benson:1984 is adopted so that it conforms to ISO 5814:2012. There is 3% difference at the maximum between before and after the revision.

6.4.4 Atmospheric pressure compensation (DO) - Relation of altitude and air pressure

General relation of altitude and air pressure is shown below.

Table 6 Relation of altitude and air pressure (m)

Altitude (m)	Air pressure (Torr)	Air pressure (bar)	Air pressure (atm)	Air pressure (hPa)
0	760	1.013	1.000	1013
100	751	1.001	0.988	1001
200	742	0.990	0.977	990
300	733	0.978	0.965	978
400	725	0.966	0.953	966
500	716	0.955	0.942	955
600	707	0.943	0.931	943
700	699	0.932	0.920	932
800	691	0.921	0.909	921
900	682	0.910	0.898	910
1000	674	0.899	0.887	899
1100	666	0.888	0.876	888
1200	658	0.877	0.866	877
1300	650	0.867	0.855	867
1400	642	0.856	0.845	856
1500	634	0.846	0.834	846
1600	626	0.835	0.824	835
1700	619	0.825	0.814	825
1800	611	0.815	0.804	815
1900	604	0.805	0.794	805
2000	596	0.795	0.785	795
2100	589	0.785	0.775	785
2200	582	0.776	0.765	776
2300	574	0.766	0.756	766
2400	567	0.756	0.746	756
2500	560	0.747	0.737	747
2600	553	0.738	0.728	738
2700	546	0.728	0.719	728
2800	540	0.720	0.710	720
2900	532	0.710	0.701	710
3000	526	0.701	0.692	701
3200	513	0.684	0.675	684
3400	500	0.667	0.658	667
3600	487	0.649	0.641	649
3800	475	0.633	0.624	633
4000	462	0.617	0.608	617
4200	450	0.601	0.593	601
4400	439	0.585	0.577	585
4600	427	0.569	0.562	569

Table 7 Relation of altitude and air pressure (ft)

Altitude (ft)	Air pressure (psia)	Air pressure (inHg)	Air pressure (hPa)
0	14.70	29.92	1013
100	14.64	29.81	1009
200	14.59	29.70	1006
300	14.53	29.60	1002
400	14.48	29.49	998
500	14.42	29.38	994
600	14.37	29.28	991
700	14.32	29.17	987
800	14.26	29.07	983
900	14.21	28.96	980
1000	14.16	28.86	976
1100	14.11	28.75	973
1200	14.06	28.65	969
1300	14.01	28.54	966
1400	13.96	28.44	962
1500	13.91	28.33	959
1600	13.86	28.23	956
1700	13.81	28.13	952
1800	13.76	28.02	949
1900	13.71	27.92	945
2000	13.66	27.82	942
2100	13.61	27.72	938
2200	13.56	27.62	935
2300	13.51	27.51	931
2400	13.46	27.41	928
2500	13.41	27.31	924
2600	13.36	27.21	921
2700	13.31	27.11	918
2800	13.26	27.01	914
2900	13.21	26.91	911
3000	13.16	26.81	907
3100	13.11	26.71	904
3200	13.06	26.61	900
3300	13.02	26.52	898
3400	12.97	26.42	894
3500	12.92	26.32	891
3600	12.87	26.22	887
3700	12.82	26.13	884
3800	12.78	26.03	881
3900	12.73	25.94	878
4000	12.68	25.84	874
4100	12.63	25.74	871
4200	12.59	25.65	868

Altitude (ft)	Air pressure (psia)	Air pressure (inHg)	Air pressure (hPa)
4300	12.54	25.55	865
4400	12.50	25.46	862
4500	12.45	25.36	858
4600	12.40	25.27	855
4700	12.36	25.17	852
4800	12.31	25.08	849
4900	12.27	24.98	846
5000	12.22	24.89	842
5100	12.17	24.80	839
5200	12.13	24.71	836
5300	12.08	24.61	833
5400	12.04	24.52	830
5500	11.99	24.43	827
5600	11.95	24.34	824
5700	11.90	24.25	820
5800	11.86	24.16	818
5900	11.81	24.07	814
6000	11.77	23.98	811
7000	11.33	23.09	781
8000	10.91	22.22	752
9000	10.50	21.38	724
10000	10.10	20.58	696
11000	9.71	19.75	669

6.5 Conductivity (COND) measurement

6.5.1 Four-AC-electrode method

Conductivity is an index of the flow of electrical current in a substance.

Salts dissolved in water are separated into cations and anions. Such solution is called electrolytic solution.

Electrolytic solution has the property of allowing the flow of current according to Ohm's law. This property is referred

to as ionic conductivity, since current flow is caused by ion movement in electrolytic solution.

Metals, on the other hand, allow the flow of current by means of electrons. This property is called electronic conductivity,

which is distinguished from ionic conductivity.

A cube with 1 m on each side, as shown in Fig. 3, is used to demonstrate an electrolytic solution. Two electrode plates are placed on opposite sides, and the cube is filled with solution. If the resistance between these two electrode plates is represented by $r(\Omega)$, the conductivity of the solution $L(\text{S}\cdot\text{m}^{-1})$ is represented as $L=1/r$. S stands for Siemens, a unit of measurement of conductance.

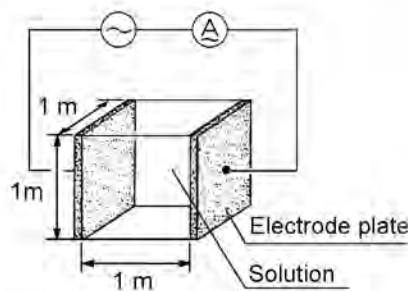


Fig. 3 Definition of conductivity

The most general method for measuring conductivity is based on the above principle, and is called the 2-electrode method.

In the 2-electrode method the influence of polarization cannot be ignored for solutions with high conductivity and conductivity cannot be measured accurately. In addition, contamination on the surface of the electrode increases apparent resistance, resulting in inaccurate measurement of conductivity.

The U-50 series has adopted the 4-electrode method to overcome these disadvantages of the 2-electrode method.

As shown in Fig. 4, the U-50 series uses two voltage-detecting electrodes and two voltage-applying electrodes, for a total of four electrodes. The voltage-detecting electrodes are for detecting AC voltage, and the voltage-applying electrodes are for applying AC voltage.

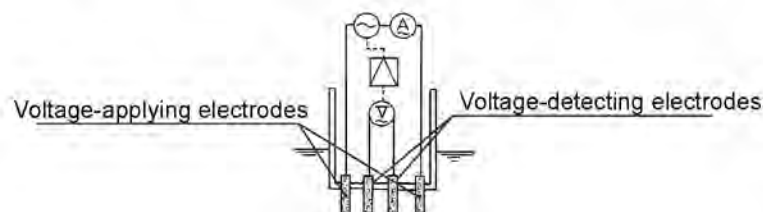


Fig. 4 Principle of the 4-electrode method

Let us assume that the current, $I(A)$, flows in a sample of conductivity L – under automatic control of the voltage-applying electrodes – so that the voltage at the voltage-detecting-electrodes, $E(V)$, remains constant at all times.

Then, the resistance of the sample, $R(\Omega)$, across the voltage-detecting electrodes is represented as $R=E/I$. The resistance, R , of the sample is inversely proportional to its conductivity, L . Accordingly, a measurement of current, I_s ,

of a standard solution of known conductivity, L_s , enables calculation of conductivity of a sample according to the formula $L = L_s (I/I_s)$ from the ratio $L : L_s = I : I_s$.

Even in the 4-electrode method, polarization occurs, since AC current flows in the voltage-applying electrodes. The voltage-detecting electrodes are, however, free from the effects of polarization, since they are separated from the voltage-applying electrodes, and furthermore, current flow is negligible. Therefore, the 4-electrode method is an excellent method to enable measurement of conductivity covering a very high range.

6.5.2 SI units

New measurement units, called SI units, have been in use from 1996. Accordingly, the U-50 series also uses SI units. The following conversion table is provided for people who use the conventional kind of conductivity meter.

Note that along with the change in unit systems, the measurement values and cell counts have also changed.

	Former units	→	SI unit
Measurement value	0.1 mS/cm	→	0.01 S/m
	1 mS/cm	→	0.1 S/m
	100 mS/cm	→	10 S/m

6.5.3 Temperature coefficient

In general, the conductivity of a solution varies largely with its temperature.

The conductivity of a solution depends on the ionic conductivity, described earlier. As the temperature rises, conductivity becomes higher since the movement of the ions becomes more active.

The temperature coefficient shows the change in % of conductivity per °C, with a certain temperature taken as the reference temperature. This is expressed in units of %/°C. The temperature coefficient assumes the premise that the conductivity of a sample changes linearly according to temperature.

Strictly speaking, with actual samples, however, conductivity changes along a curve. Furthermore, the curve varies with the type of sample. In the ranges of smaller temperature changes, however, samples are said to have the temperature coefficient of 2%/°C (at reference temperature 25°C); this holds for most samples, except in certain special cases.

(The temperature coefficients for various types of solutions are listed on the next page.)

The U-50 series uses an automatic temperature conversion function to calculate conductivity at 25°C at a temperature

coefficient of 2 %/°C based on the measured value of the temperature. Results are displayed on the readout.

The U-50 series temperature conversion function is based on the following formula.

$$L_{25} = L_t / \{ 1 + K (t - 25) \}$$

L_{25} : Conductivity of solution converted to 25°C

t : Temperature of solution at time of measurement (°C)

L_t : Conductivity of solution at t (°C)

K : Temperature coefficient (%/°C)

● **Conductivity and temperature coefficient for various solutions**

Conductivity and related temperature coefficients of representative substances (at 25°C) are shown in the table below.

Substance	Temp. (°C)	Conc. (wt%)	Cond. (S/m)	Temp.coef. (%/°C)	Substance	Temp. (°C)	Conc. (wt%)	Cond. (S/m)	Temp.coef. (%/°C)
NaOH	15	5	19.69	2.01	NaCl	18	5	6.72	2.17
		10	31.24	2.17			10	12.11	2.14
		15	34.63	2.49			15	16.42	2.12
		20	32.70	2.99			20	19.57	2.16
		30	20.22	4.50			25	21.35	2.27
		40	11.64	6.48			5	4.09	2.36
KOH	15	25.2	54.03	2.09	Na ₂ SO ₄	18	10	6.87	2.49
		29.4	54.34	2.21			15	8.86	2.56
		33.6	52.21	2.36			Na ₂ CO ₃	18	5
		42	42.12	2.83	10	7.05			2.71
NH ₃	15	0.1	0.0251	2.46	KCl	18	15	8.36	2.94
		1.6	0.0867	2.38			5	6.90	2.01
		4.01	0.1095	2.50			10	13.59	1.88
		8.03	0.1038	2.62			15	20.20	1.79
		16.15	0.0632	3.01			20	26.77	1.68
HCl	18	5	39.48	1.58	KBr	15	21	28.10	1.66
		10	63.02	1.56			5	4.65	2.06
		20	76.15	1.54			10	9.28	1.94
		30	66.20	1.52			20	19.07	1.77
H ₂ SO ₄	18	5	20.85	1.21	KCN	15	3.25	5.07	2.07
		10	39.15	1.28			6.5	10.26	1.93
		20	65.27	1.45			—	—	—
		40	68.00	1.78	NH ₄ Cl	18	5	9.18	1.98
		50	54.05	1.93			10	17.76	1.86
		60	37.26	2.13			15	25.86	1.71
		80	11.05	3.49			20	33.65	1.61
		100.14	1.87	0.30			25	40.25	1.54
HNO ₃	18	6.2	31.23	1.47	NH ₄ NO ₃	15	5	5.90	2.03
		12.4	54.18	1.42			10	11.17	1.94
		31	78.19	1.39			30	28.41	1.68
		49.6	63.41	1.57			50	36.22	1.56
		62	49.64	1.57			2.5	10.90	2.13
H ₃ PO ₄	15	10	5.66	1.04	CuSO ₄	18	5	18.90	2.16
		20	11.29	1.14			10	32.00	2.18
		40	20.70	1.50			15	42.10	2.31
		45	20.87	1.61	CH ₃ COOH	18	10	15.26	1.69
		50	20.73	1.74			15	16.19	1.74
			20	16.05			1.79		
			30	14.01			1.86		
			40	10.81			1.96		
			60	4.56	2.06				

6.6 Salinity (SAL) conversion

The U-50 series is designed to calculate salinity as well as the other parameters.

Note that the "salinity" here is the salinity of sea water. There is a constant relation between conductivity and salinity at certain temperatures.

Therefore, if data on the conductivity and temperature are available, the corresponding salinity can be known. In other words, the salinity measurement of the U-50 series is based on the principle of calculating the salt content, making use of the measured values of conductivity and temperature.

Note therefore, that measured results of all substances whose conductivity is detected are displayed as salinity. For example, the measured result is displayed as NaCl concentration, even if in fact the sample component is, hydrochloric acid (HCl).

6.7 TDS conversion

TDS is short for Total Dissolved Solids and means the total dissolved solid amount.

The conductivity of a solution is affected by the amount of salinity, minerals, and dissolved gases. That is, conductivity is an index that shows the total amount of all substances in the solution. Of these substances, TDS indicates only the amount of dissolved solids.

TDS can be used for a comparison of the state of substances composed of a single component such as NaCl. However, the use of TDS for the comparison of solutions of different types causes serious errors.

Conductivity and TDS are expressed by the following formulas.

Conductivity in SI units (S/m) TDS(g/L) = L (S/m) \times K \times 10

TDS(g/L) = L (mS/m) \times K \div 100

Conductivity in the old units (mS/cm) TDS(g/L) = L (mS/cm) \times K

K = TDS coefficient

Initial settings use the values listed in the table (Page 80) that generally uses TDS coefficients. For accurate TDS comparisons, find the TDS coefficient from measured conductivity values. Then set the value thus obtained and make measurements.

6.8 σ_t conversion

● Specific gravity of seawater

The density and specific gravity of seawater are equal numerically and generally are not distinguished strictly. Since seawater density ρ is between 1.000 and 1.031, 1 is subtracted from ρ and σ is obtained by multiplying the value by 1000.

The resultant value is used as the specific gravity of seawater.

$$\sigma = (\rho - 1) \times 1000$$

The density of seawater ρ is expressed by function of temperature, hydraulic pressure, and salinity. The density of seawater under the atmospheric pressure is expressed as σ_t . The density of seawater under the atmospheric pressure is determined by temperature and salinity.

The U-50 Series models make salinity measurement through temperature measurements and conductivity conversion and find σ_t through calculations.

In Japan σ_{15} at 15°C is called a standard specific gravity and widely used while in foreign countries σ_0 at 0°C is employed. σ_{15} and σ_0 are determined by the function of salinity.

In ocean surveys, in particular, these values σ_t , σ_{15} , and σ_0 are more widely used than conductivity and salinity and, in the U-50 Series models, newly added as measurement components.

6.9 Turbidity (TURB) measurement

6.9.1 Principle of turbidity measurement

U-52 and U-53 sensors measure turbidity using the Transmitting and Scattering Method. U-52 sensors use a pulse light LED (infra-red emitting diode) as a light source, and detect scattered light from a 30° angle off center. U-53 sensors use a tungsten lamp as a light source and detect scattered light from a 90° angle. Both models display turbidity as a ratio of scattered light to transmitted light to reduce the affect of the color of the sample. The U-53 method conforms to EPA Method 180.1, and employs wipers to reduce the affect of air bubbles.

U-54 uses a pulse light LED (infra-red diode) as a light source, and detect scattered light from a 90° angle. The U-54 method conforms to EN ISO 7027.

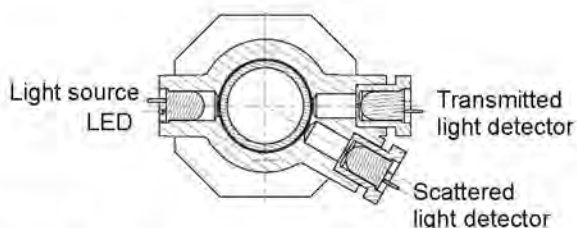


Fig. 5 U-52 turbidity sensor

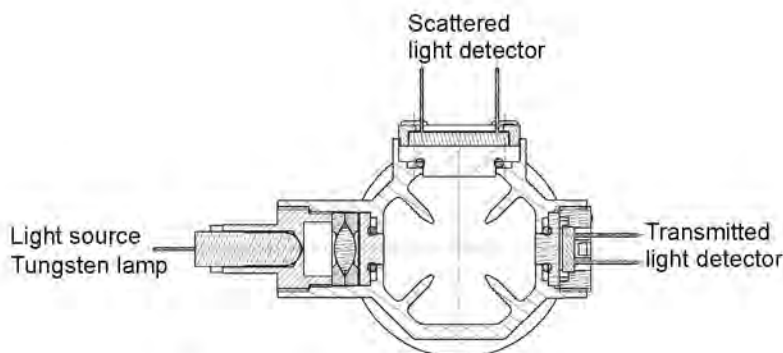


Fig. 6 U-53 turbidity sensor

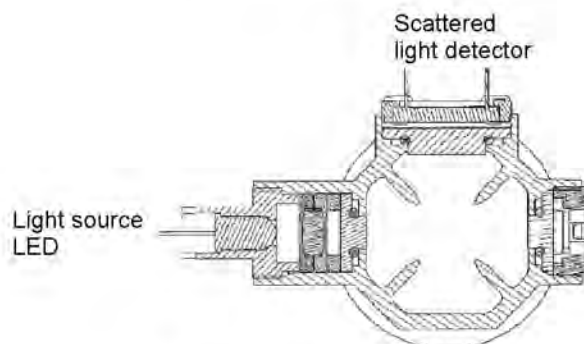


Fig. 7 U-54 turbidity sensor

6.9.2 Standard solution

U-50 series can perform calibration using formazin (NTU) or kaolin standard solutions as a turbidity standard solution. However, units for the solution used for calibration should be displayed in measurements. Do not use more than 400 mg/L of kaolin standard solution because it increases precipitation speed, resulting in measurement error.

6.10 Depth (DEPTH) measurement

6.10.1 Principle of depth measurement

For the U-50 series, depth measurement can be made through use of a pressure gauge. The principle of the depth measurement uses the relation between depth and pressure.

Although the measurement with the depth sensor is affected by atmospheric pressure, the depth sensor, however, makes zero-point adjustments through the automatic calibration before measurements.

6.10.2 Influence of temperature and calibration

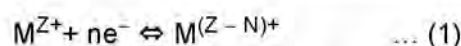
The depth sensor depends greatly on temperature. For a wide difference between the temperature at which the sensor has been automatically calibrated and the temperature of the measurement sample, the sensor can make depth measurements with a higher accuracy by the following method:

1. Immerse the depth sensor of the sensor probe in the sample.
2. Keep the sensor immersed in the sample for about 30 minutes until the temperatures of the sensor and the sample are the same.
3. Then make the zero calibration of the sensor manually.

6.11 Oxidation reduction potential (ORP) measurement

6.11.1 Principle of ORP measurement

ORP is an abbreviation for oxidation-reduction potential. ORP is the energy level (potential) determined according to the state of equilibrium between the oxidants (M^{Z+}) and reductants $M^{(Z-N)+}$ that coexist within a solution.



If only the solution, forming the ORP measuring system shown in Fig. 8. The difference of potential between two electrodes is generally expressed by the following equation,

$$E = E_0 - \frac{RT}{nF} \ln \frac{a_M^{(z-n)+}}{a_M^{z+}} \quad \dots (2)$$

E: Electric potential E_0 : Constant R: Gas constant T: Absolute temperature
n: Electron count F: Faraday constant a: Activity

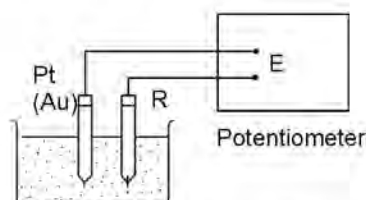
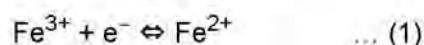


Fig. 8 Measuring mV

For example, for a solution in which trivalent iron ions coexist with bivalent iron ions, equations 1 and 2 would be as follows.



$$E = E_0 - \frac{RT}{F} \ln \frac{a_{Fe^{2+}}}{a_{Fe^{3+}}} \quad \dots (2)$$

When only one type of state of equilibrium uniquely by equation (Fe^{3+}) and the reductant (Fe^{2+}) (using the equation $a_{\text{Fe}^{2+}}/a_{\text{Fe}^{3+}}$). Actually, however many kinds of states of equilibrium exist simultaneously between various kinds of ions, in most solutions. This means that under actual circumstances, ORP cannot be expressed using the simple equation shown above and that the physical and chemical significance with respect to the solution is not very clear.

In this respect, the value of ORP must be understood to be only one indicator of the property of a solution. The measurement of ORP is widely used, however, as an important index in the analysis of solutions (potentiometric titration) and in the waste water treatment.

6.11.2 Standard electrode (reference electrode) types and ORP

The ORP is obtained comparing with corresponding reference electrode employed.

If different kinds of reference electrodes are used for measurement, the ORP value of the same solution may appear to be different. HORIBA Advanced Techno's reference electrode uses Ag/AgCl with 3.33 mol/L KCl as inner solution. According to general technical literature, normal hydrogen electrodes (N.H.E.) are often used as the standard electrode.

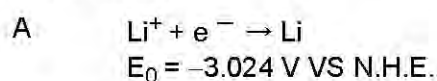
The relationship between N.H.E. and the ORP that is measured using an Ag/AgCl with 3.33 mol/L KCl electrode is expressed by the following equation.

$$E_{\text{N.H.E.}} = E + 206 - 0.7(t - 25) \text{ mV} \quad t = 0 - 60^\circ\text{C}$$

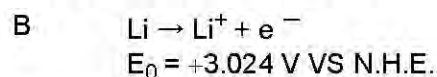
$E_{\text{N.H.E.}}$: Measured ORP value using N.H.E. as the reference electrode

E: Measured ORP value using Ag/AgCl with 3.33 mol/L KCl as the reference electrode
Potential sign

Standard ORP is expressed in the following way, in literature related to electrochemistry and analytical chemistry.



However, in some literature, the "+" and "-" signs are reversed.



In expressions like B, above, the reaction is just reversed and there is no essential difference. But this kind of expression does invite confusion. The majority of the world, today, is consistent in its use of the signs as they are used in A, above.

For this reason, HORIBA Advanced Techno, too, uses signs concerning ORP that are consistent with A, above.

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Warning: Limitation of Liability

The ultimate responsibility of the consequences of use of toxic compounds rests with the user. PerkinElmer's role is as a supplier of instrumentation to assist in the early detection of hazardous conditions involving such compounds.

MicroFID represents a major advance in this field and, as with all complex instruments, it is vitally important to ensure that MicroFID is maintained in accordance with PerkinElmer's instructions and that proper calibration is regularly performed.

As with any complex device, MicroFID is subject to failure and, while PerkinElmer has taken, and continues to take, all possible precautions to (a) reduce the possibility of failure, and (b) warn the user in the event of failure, circumstances may occasionally occur in which there is a failure despite such precautions on PerkinElmer's part. PerkinElmer regrets that it cannot accept liability for damages of any kind caused as a result of either failure of the user to follow instructions or of MicroFID to perform.

Photovac MicroFID

Portable Flame Ionization Detector

Release History

Part Number	Release	Publication Date
396003	G	February 2000
396003	F	August 1997

User Assistance

PerkinElmer
761 Main Avenue
Norwalk, CT
06859-0010 U.S.A.

Printed in Singapore

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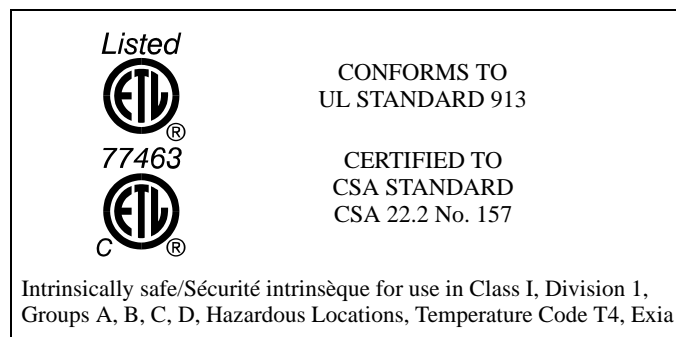
Notices and Warnings



FCC Warning

This equipment has been tested and found to comply with the limits for a Class B Digital Device, pursuant to Subpart B, Class B of Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

MicroFID I/S & I/SC Notice



MICROFID I/S IS CLASSIFIED FOR USE IN CLASS I, DIVISION 1, GROUPS A, B, C, D HAZARDOUS LOCATIONS.

It has been listed by ETL® to comply with Underwriters Laboratories® Inc. UL® 913 *Standard for Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, Division 1, Groups A, B, C, D Hazardous (Classified) Locations*, Fourth Edition.

MICROFID I/SC IS CLASSIFIED FOR USE IN CLASS I,
DIVISION 1, GROUPS A, B, C, D HAZARDOUS LOCATIONS.
T4 (135°C) RATING.

It has been listed by ETL to comply with *CSA Standard 22.2 No. 157-92 Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations*.

MICROFID I/S AND I/SC ARE NOT INTENDED TO DETECT
COMBUSTIBLE LEVELS OF GASES. MICROFID I/S AND I/SC
ARE CLASSIFIED FOR USE IN ATMOSPHERES
CONTAINING COMBUSTIBLE LEVELS OF GASES.

These accessories are for use with MicroFID I/S and IS/C in a
hazardous location:

MX395002	Shoulder Strap
MX396001	Short Sample Probe
MX396007	Carrying Case
MX396011	Calibration Kit
MX396018	Long Sample Probe
MX396021	Charcoal Filters (2 pieces)
MX396022	Charcoal Filters (10 pieces)
MX396053	Headset
MX396054	Bar Code Reader and Interface Module (I/S)

Do not use any other accessories with MicroFID I/S or I/SC in a
hazardous location.

Substitution of components may affect safety rating.

To reduce the risk of fire or injury to persons, read and follow these instructions:

CAUTION

- 1. All calibration, maintenance and servicing of this device, including battery charging, must be performed in a safe area away from hazardous locations.*
- 2. For replacement battery pack use only Part No. MX396005 (I/S), MX396006 (I/SC).*
- 3. Do not dispose of the battery pack in a fire. The cell may explode. Check with local codes for possible special disposal instructions.*
- 4. Do not open or mutilate the battery pack. Released electrolyte is corrosive and may cause damage to the eyes or skin. It may be toxic if swallowed.*
- 5. Exercise care in handling battery packs in order not to short the terminals with conducting materials such as rings, bracelets and keys. The battery or conductor may overheat and cause burns.*
- 6. Do not defeat proper polarity orientation between the battery pack and battery charger.*
- 7. Charge the battery pack using the charger provided with or identified for use with this product only in accordance with the instructions and limitations specified in this manual. For battery charger use only Part No. MX396014 (110 Volts AC), MX396013 (220 Volts AC).*

NOTICE

MICROFID I/SC EST CLASSIFIÉ POUR USAGE DANS LES EMBLEMES DANGEREUX DE CLASSE I, DIVISION 1, GROUPES A, B, C, D. ÉVALUATION T4 (135°C).

MicroFID I/SC est conforme à la norme de CSA Standard 22.2 No. 157-92 - Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations.

MICROFID I/SC C'EST NE PAS INTENDER POUR DÉTECTER DES NIVEAUX DE COMBUSTION DES GAZ. CET APPAREIL EST CLASSIFIÉ POUR USAGE DANS DES ATMOSPHÈRES CONTENANT DES NIVEAUX DE COMBUSTION DES GAZ.

Les accessoires PerkinElmer suivants peuvent également être utilisés avec l'appareil dans un emplacement dangereux:

MX395002	Bandoulière
MX396001	Petite Gamme d'échantillons
MX396007	Étui de Transport
MX396011	Equipment de Calibration
MX396018	Gamme d'échantillons
MX396021	Filtres de Charbon (2 pièces)
MX396022	Filtres de Charbon (10 pièces)
MX396054	Lecteur de Codes à Barres et Module d'Interface (I/S)
MX396053	Casque telephonique

Ne pas utiliser d'autres accessoires avec cet appareil dans un emplacement dangereux.

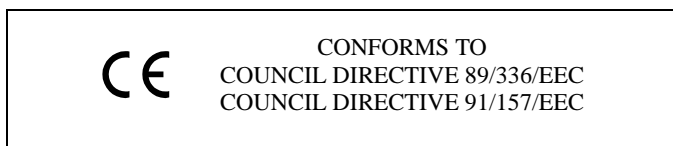
La substitution des composantes peut nuire à la sécurité d'emploi.

**MISE EN
GARDE**

Afin de réduire les risques d'incendie et les blessures, lire et suivre ces instructions:

- 1. Tout étalonnage, entretien et réparation de cet appareil, y compris le chargement de la pile, doit être effectué dans un endroit sûr, à l'écart des zones dangereuses.*
- 2. N'utiliser que la pièce PerkinElmer numéro MX396006 (I/SC) lorsqu'il faut remplacer le bloc-pile.*
- 3. Ne pas jeter la pile dans un feu. La cellule pourrait exploser. Vérifier les codes locaux, qui peuvent comporter des instructions de mise au rebut particulières.*
- 4. Ne pas ouvrir et ne pas abîmer le bloc-pile. L'acide sulfurique qui risque de s'en échapper est corrosif et peut causer des lésions aux yeux et à la peau. Cet acide est toxique lorsqu'avalé.*
- 5. Manipuler le bloc-pile avec soin, afin de ne pas court-circuiter les bornes avec des matériels conducteurs tels qu'une bague, un bracelet ou des clés. La pile ou le conducteur pourraient surchauffer et causer des brûlures.*
- 6. Ne pas modifier l'orientation de la polarité appropriée entre le bloc-pile et le chargeur.*
- 7. Charger le bloc-pile fourni avec ou reconnu pour usage avec ce produit seulement conformément aux instructions et restrictions spécifiées dans ce manuel. Pour le chargeur, n'utiliser que la pièce numéro MX396014 (110 Volts AC), MX396013 (220 Volts AC).*

CE Directive



Council Directive 89/336/EEC - Electromagnetic Compatibility and the Applicable Standards. MicroFID complies with EN50082-01 Generic Immunity Standard for Electromagnetic Compatibility Part 1: Light Industrial Environment. MicroFID has been tested and conforms to the guidelines specified in EN50082-02 Generic Immunity Standard for Electromagnetic Compatibility Part 2: Industrial Environment

Council Directive 91/157/EEC - Recovery and Disposal of Spent Batteries

You must use the 220 V battery charger (Part No. MX396013) in order to comply with the requirements of the applicable Council Directives.

Introduction **1**



About this Manual

This manual provides detailed instructions for the setup, operation and maintenance of the MicroFID™ Portable Flame Ionization Detector.

Before unpacking the instrument, please read *Warnings and Safety Practices* on page 22. This section describes possible hazards that may injure the user, damage the instrument or compromise its operation. Some general safety information is also provided.

To help you learn to use MicroFID quickly this manual is organized by tasks beginning with a tutorial in Chapter 2. More detailed operational instructions are provided in Chapter 3. Connecting accessories is covered in Chapter 4. Routine maintenance is covered in Chapter 5. Troubleshooting techniques are covered in Chapter 6. Chapter 7 provides a technical description of MicroFID.

The MicroFID manual uses a few conventions for key names on the keypad and for text that is shown on the display.

UPPERCASE	Key names are denoted by uppercase text. ARROW keys is the collective name for the UP ARROW and DOWN ARROW keys.
“Display Text”	Text that appears on the MicroFID display is in quotation marks.
<Angle Brackets>	Computer keyboard names are denoted by angle brackets, e.g. <Ctrl>.
<i>MD FID</i>	Text that must be typed in using the computer keyboard is shown in italics.

In the text you will find various warnings and notes.



A warning indicates an operation that could cause personal injury if precautions are not followed.

WARNING

A caution indicates an operation that could cause damage to the instrument if precautions are not followed.

CAUTION

NOTE: *A note indicates significant information.*

Warnings and Safety Practices

Please read this section before operating MicroFID.

Approved Models of MicroFID

This manual provides operational information for all models of MicroFID. The MicroFID I/S and the MicroFID I/SC are intrinsically safe and approved for use in hazardous locations. Refer to the manual introduction for details of each approval.

Throughout the manual, notes are provided to inform you of the limitations of usage for the MicroFID I/S and MicroFID I/SC models.



If the MicroFID you are using is not specifically identified as intrinsically safe, do not use it in a location where flammable concentrations of gases and vapors may exist.

WARNING

Compressed Gases

Cylinders of compressed gas, such as hydrogen and calibration gas, must be handled with extreme care. When using the calibration gas bag adapter, take care not to kink or stress the tubing. For safety, the hydrogen and calibration gas cylinders must be secured before use.

Please observe the following handling procedures:

- Do not mutilate cylinders.
- Do not expose the cylinders to direct sunlight.
- Do not heat the cylinders. The cylinders may rupture at high temperatures.
- Use only the specified regulator for the calibration gas. Confirm regulator type and material with your specialty gas supplier. Use only the MicroFID refill adapter for the hydrogen (Part No. MX396004).
- Always secure cylinders before removing the cylinder valve protection cap
- Do not drag or roll cylinders. Use a cylinder hand truck to move large cylinders.
- Wear safety glasses when working with compressed gases.
- Store cylinders in an upright position.
- Do not store cylinders in a hazardous location.
- Store cylinders away from possible sources of ignition.
- Keep regulators and related equipment in the same gas service. Do not change service or adapt equipment without consulting your gas supplier.

Regulators for Compressed Gases

When connecting a regulator to a large cylinder:

- Ensure cylinder valve and regulator connection match.
- Ensure regulator construction materials are compatible with the gas, and that the cylinder pressure gauge will withstand the cylinder pressure.
- Never use the regulator as a shut-off valve. Close the cylinder when it is not in use.
- Do not subject the regulator to an inlet pressure greater than recommended.
- Do not move or detach the regulator when it is pressurized or when it is in use.
- Before connection, ensure the gas cylinder valve and the regulator CGA connection are clean.
- Turn the pressure control valve on the cylinder all the way out (close the cylinder). Turn the regulator outlet to off. Open the gas cylinder valve slowly and check for leaks. Adjust the delivery pressure and then open the regulator outlet valve.

Hydrogen Gas

Hydrogen gas is a fire and explosion hazard when exposed to heat or flame. The lower explosive limit (LEL) is 4%. The lower explosive limit is the minimum concentration of gas or vapor in air that will ignite in the presence of a source of heat or sparks.

Refer to the Material Safety Data Sheet (MSDS) before handling this gas. You will receive the MSDS from your gas supplier when you order the gas.

Calibration Gas

Adequate ventilation must be provided when MicroFID is being calibrated.

If compound threshold limit values (TLV™) are exceeded, you should use a gas bag for sampling and calibration.

To determine the TLV of the compounds contained in the calibration gas, refer to the Material Safety Data Sheet (MSDS) supplied with your calibration gas cylinder. See *Calibration* on page 65 for details of calibration using a gas bag.

Battery Pack Care

Do not leave battery packs uncharged for an extended period of time. This will result in damage to the battery packs and possible loss of logged data.

Leaving MicroFID for more than 3 months, without turning it on, may result in the loss of recorded data and setup parameters. If MicroFID is not used for long periods of time, turn the instrument on for a few hours every month to avoid loss of data. See *Battery Charging* on page 30 for instructions on charging the battery.

Please observe the following:

1. For replacement battery pack use only Part No. MX396005 or MX396006.
2. Do not dispose of the battery pack in a fire. The cell may explode. Check with local codes for possible special disposal instructions.
3. The battery pack is 57% lead (Pb) by weight. This battery pack must be disposed of properly. Check with local codes for special disposal instructions.
4. Do not open or mutilate the battery pack. Released electrolyte is corrosive and may cause damage to the eyes or skin. It may be toxic if swallowed.
5. Exercise care in handling battery packs in order not to short the terminals with conducting materials such as rings, bracelets and keys. The battery or conduct or may overheat and cause burns.

6. Do not defeat proper polarity orientation between the battery pack and battery charger.
7. Charge the battery pack using the charger provided with or identified for use with this product only in accordance with the instructions and limitations specified in this manual. For battery charger use only Part No. MX396014 (110 V AC), MX369013 (220 V AC).

Excessive Heat and Cold

Do not expose the instrument to intense sunlight for prolonged periods.

Exposure to excessive heat may result in erroneous readings.

At low temperatures, water vapor, a by-product of the hydrogen flame, may condense at the exhaust port. At sub-zero temperatures the water vapor will freeze and obstruct the exhaust port. If the exhaust port becomes obstructed, pump operation will be inhibited. Flame out may also result.

Transporting MicroFID

When you transport MicroFID, you should empty the internal hydrogen cylinder and then refill it when you arrive at your destination.

If you are transporting MicroFID in the carry case or in any enclosed container, you must empty the hydrogen cylinder and fill it when you arrive at your destination

If you are traveling by passenger aircraft, you must empty the cylinder. You cannot transport MicroFID by passenger aircraft with hydrogen in the cylinder. Refer to *Emptying the Hydrogen Cylinder* on page 110 for more details.

Oxygen Concentration Limits

A minimum of 17% oxygen is required to start the hydrogen flame. The oxygen is supplied from the sample as it is drawn in by the pump. A minimum of 10% oxygen is required to maintain the hydrogen flame. An oxygen deficiency will reduce the height of the

flame or cause the flame to be extinguished and may affect the displayed reading.

If you will be using the MicroFID in a highly contaminated area where it is possible that the oxygen content is below 10%, watch for indications of reduced flame height such as lowered detection limits or a flame out fault.

Flammable Gases

High concentrations of flammable gases (gases within their flammable range) can act as an additional fuel source. When this happens, the flame height may increase beyond the confines of the combustion chamber. The hydrogen supply will then be cut off and the flame will go out.

Flame out may also occur when the concentration of sample gas is so great that it causes an oxygen deficiency. This may occur when sampling enclosed or confined spaces where vapors and gases cannot escape. Watch for indications of increased flame height such as erratic readings or sudden high concentrations followed by a flame out fault.

Unpacking

The following accessories are included with your MicroFID:

1. Shoulder Strap
2. Sample Probe
3. MicroFID Instrument Manual
4. Hydrogen Refill Adapter
5. MicroFID Multi-Tool
6. Battery Charger with AC Line Cord
7. Replacement Sample Inlet Filters (10 pieces)

Ensure all of these accessories have been included with the instrument. If any items are missing or damaged, contact PerkinElmer immediately.

Support Equipment and Consumables

Hydrogen Fuel

You must obtain a tank of hydrogen from which you can fill the internal cylinder. When ordering hydrogen specify ultra high purity hydrogen, 99.999% pure. This grade of hydrogen is also referred to as Grade 5 or zero zero grade. The hydrogen must have less than 1 ppm hydrocarbon contamination.

You can obtain the hydrogen in various size cylinders. Regardless of the cylinder size, the cylinder must have a fill pressure of at least 1800 psig in order to completely fill the MicroFID internal cylinder. Specify a tank with no more than 2400 psig.

The hydrogen cylinder must also have CGA 350, male outlet.

The MicroFID refill adapter (Part No. MX396004) is shipped with the instrument. You cannot fill the MicroFID hydrogen cylinder without the refill adapter.

If the hydrogen supply tank is more than 6 months old it should be replaced with a new cylinder.

Calibration

For normal operation these items are required:

1. Calibration Kit (Part No. MX396011). The calibration kit contains a regulator, a gas sampling bag and a gas bag adapter.
2. Calibration gas containing the appropriate concentration of methane. The exact concentration of the calibration gas will depend on your application. 500 ppm methane in air is available from PerkinElmer. (Part No. MX396028)

Some applications may require calibration gas at more than one concentration. When ordering calibration gas, specify methane in hydrocarbon free air. Air should have not more than 0.1 ppm total hydrocarbons (THC).

Method 21 protocol requires that commercial cylinders of calibration gas be analyzed and certified to be within +/- 2% accuracy and a shelf life must be specified on the cylinder. At the end of the shelf life, the cylinder must be replaced or re-analyzed.

If you will be using a portable cylinder, specify a regulator with a C-10, 5/8" - 18 UNF valve inlet and a 1/4" parallel, compression fitting outlet. A regulator, matching this specification, is included in the calibration kit.

If you will be using large tanks of gas, specify a single stage, high purity regulator with a CGA 590 connection at the inlet. The regulator should also have a 1/4" parallel, compression fitting outlet with which to connect the regulator to the gas bag adapter. The delivery pressure must be adjustable to approximately 40 psig (275 kPa).

3. Zero air. Occasionally, clean, ambient air is suitable for calibration. If you are unsure about the quality of ambient air, you can connect a charcoal filter (Part No. MX396021 or MX396022) to MicroFID during the first step of calibration.

Alternatively you can use an additional gas sampling bag and a source of hydrocarbon free air. Air should have not more than 0.1 ppm total hydrocarbons (THC).

If you will be using large tanks of gas, specify a single stage, high purity regulator with a CGA 590 connection at the inlet. The regulator should also have a 1/4" parallel, compression fitting with which to connect the regulator to the gas bag adapter. The delivery pressure must be adjustable to approximately 40 psig (275 kPa). You should obtain an additional gas bag and gas bag adapter. (Part No. MX396017 - gas bag, MX396010 - gas bag adapter)

Field Operation

For field operation a MicroFID Field Kit (Part No. MX396058) is available. The field kit includes a printer cable, a long sample probe, a carrying case and a calibration kit.

Refer to the check list in *Preparing for Field Operation* on page 82. Ensure you have all the necessary accessories and equipment before beginning field operation.

Printer

MicroFID may be used with a serial printer. The printer must have a print width of at least 65 characters and a proportionally spaced font. A serial printer with an RS-232 port, can be connected directly to MicroFID. See *Printer* on page 87 for details of connecting a printer to MicroFID.

If you are using a parallel printer, you will need the serial to parallel converter (Part No. MX380145). See *Serial to Parallel Converter* on page 98 for details.

NOTE: *MicroFID is not classified for use in hazardous locations with a printer.*

Computer

MicroFID may also be connected to a computer. The computer must be 100% compatible with an IBM PC. You can use the printer cable to connect MicroFID to the computer.

You will also need terminal emulation software. If you are using Microsoft® Windows™ you do not need to purchase any separate software. If you are already using another type of communication or terminal emulation software package, it is not necessary to purchase separate software for MicroFID. See *Computer* on page 88 for details.

NOTE: *MicroFID is not classified for use in hazardous locations with a computer.*

Battery Charging

Before beginning operation of MicroFID, the battery pack must be charged. You can connect the battery charger to the battery pack while the battery pack is still attached to MicroFID. You can also remove the battery pack and replace it with a fully charged, spare pack (Part No. MX396005 or MX396006) and charge the battery pack independently of the instrument.

Removing and Replacing the Battery Pack

NOTE: *Do not remove or recharge the battery pack in a hazardous location.*

To remove the battery pack:

1. Stop the flow of hydrogen gas by turning the hydrogen shut-off valve fully clockwise. See *Figure 1*. If the instrument has been turned on, turn it off by pressing the On/Off switch twice.
2. Use the MicroFID multi-tool to loosen the two captive screws in the bottom of the battery pack.
3. A retainer at the rear of the instrument helps to secure the battery pack to the instrument. Free the battery pack from the instrument.

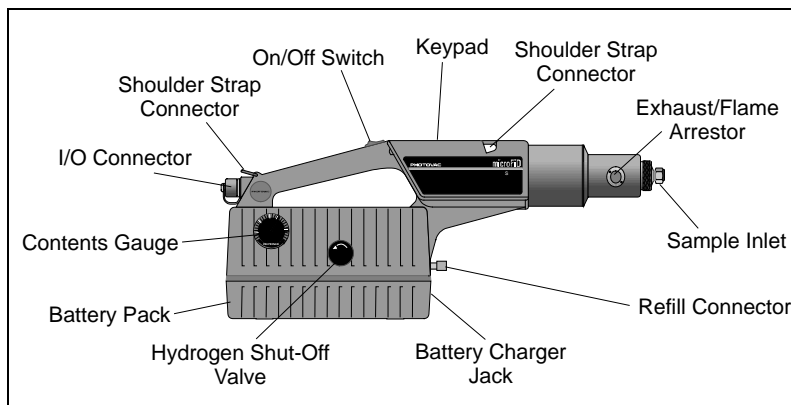


Figure 1 **MicroFID Layout**

4. Connect the charged battery pack to the retainer at the rear of the instrument.
5. Use the MicroFID multi-tool to tighten the two captive screws into the bottom of the battery pack. Do not over-tighten the screws.

Charging the Battery Pack

To charge the battery pack:

1. Ensure the correct plug is installed on the line cord of the battery charger. If it is not correct for the wall outlet in your area, then it must be replaced. See *Installing Alternate AC Plug on the Battery Charger* on page 147.

NOTE: *Do not charge the battery pack in a hazardous location. Use only a MicroFID battery charger.*

2. Plug the charger into the jack located on the front of the battery pack.
3. Plug the charger into an AC outlet.

The LED, on the battery pack, indicates the charge state. Red indicates the battery is being charged. Green indicates the battery is fully charged and ready for use.

It is normal for a fully charged battery to indicate it is charging (red light) when first plugged in. The LED will turn green as the battery charges.

4. When the battery pack is fully charged remove the charger, first from the wall outlet then from the battery pack.
5. If you removed the battery pack from the instrument to recharge it, you can replace the battery pack now or when necessary.

Charging a fully discharged battery pack will take approximately 8 hours. Leaving the charger connected to a charged battery pack will not harm the battery or the charger in any way. If a battery pack is

to be left indefinitely, leave it connected to the charger so that it will be fully charged and ready for operation.

On average a fully charged battery pack will provide 15 hours of continuous operation. Battery life is shorter if the instrument is turned off and then on again repeatedly.

Filling the Hydrogen Cylinder

The Refill Adapter



DO NOT attempt to fill the hydrogen cylinder without a refill adapter!

WARNING

The refill adapter (Part No. MX396004) consists of an adapter fitting with a left handed thread for cylinder attachment, a three-way valve and a flexible hose. The three-way valve can be positioned to deliver gas from the cylinder to the port on the MicroFID. Alternatively, the valve can be turned to release gas held in the hose, after filling. A flow restrictor is also incorporated in line with the hose in order to limit the rate of gas flow.



DO NOT MODIFY OR DISASSEMBLE THE REFILL ADAPTER! If you have any problems, the unit must be returned for repair or replacement.

WARNING

Connecting the Refill Adapter to the Hydrogen Tank

NOTE: *Read through this section before filling the internal cylinder.*

Store the hydrogen tank in a well ventilated area, well away from heat or possible ignition sources.



WARNING

Hydrogen gas is a fire and explosion hazard when exposed to heat or flame. The lower explosive limit is 4%.

1. Connect the refill adapter to the tank of hydrogen. Hydrogen is usually supplied with a CGA 350 cylinder valve outlet. The refill adapter is supplied with the matching fitting for ease of connection.

NOTE: *Do not force the connection.*

Do not use Teflon tape with CGA fittings. In general, these fittings are designed for metal to metal sealing.

Do not use adapters to connect one CGA fitting to another type of CGA fitting. If the refill adapter does not match the outlet on your hydrogen tank contact PerkinElmer.

2. Tighten the refill adapter onto the tank with a wrench. Do not over tighten.
3. Hold the flexible hose and open the cylinder. Ensure there are no leaks. Use soap solution to leak test the connection.



DO NOT use an open flame to test for leaks!

WARNING

Filling the Internal Hydrogen Cylinder



Do not fill the hydrogen cylinder in a hazardous location.

WARNING

1. Turn MicroFID off.
2. Place MicroFID on a sturdy, flat surface within easy reach of the flexible filling hose.
3. Turn the refill adapter 3-way valve so that it points away from the cylinder. See *Figure 3*.
4. Hold the delivery hose and turn the 3-way valve on the refill adapter so that it points towards the cylinder. Open the cylinder valve. A steady flow of gas will be heard escaping from the end of the flexible hose. This serves to purge the hose of any impurities. Return the 3-way valve to point away from the cylinder.

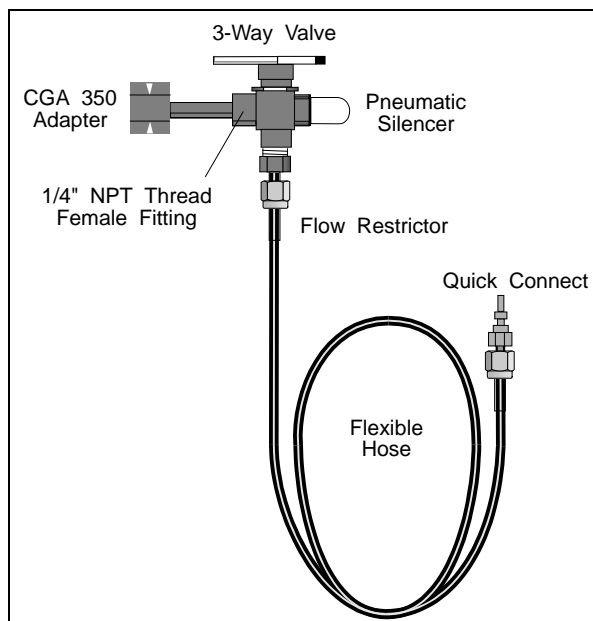


Figure 2 MicroFID Refill Adapter

5. Hold the knurled collar of the MicroFID refill connector and slide it in towards the instrument.

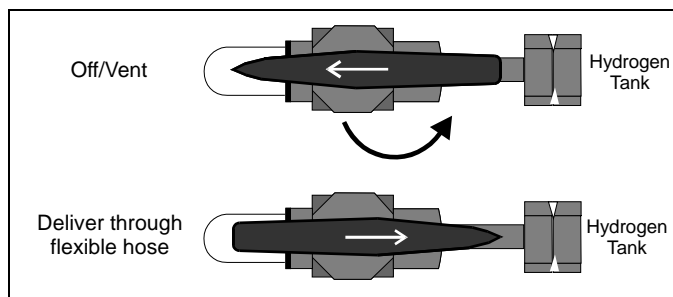


Figure 3 Refill Adapter 3-Way Valve

6. Insert the fitting at the end of the flexible hose into the port until it seats against the port. You will hear a click.
7. Release the knurled collar and allow it to slide up to its original position.

8. Turn the 3-way valve on the refill adapter so that it once again points towards the cylinder and watch the pressure increase on the MicroFID Contents Gauge.



DO NOT leave the MicroFID unattended during the filling procedure! It is possible to overfill the cylinder and damage MicroFID.

WARNING

9. The contents pressure **MUST NOT** exceed 2400 psig and the cylinder valve must be closed before this occurs.
10. When the contents gauge on MicroFID indicates Full (approximately 1600-1800 psig), turn the 3-way valve to point away from the cylinder. This will stop the flow of gas to MicroFID. High pressure gas trapped in the flexible hose will be vented. A check valve in the MicroFID prevents gas in the reservoir from escaping.
11. Close the cylinder valve on the tank of hydrogen.
12. **AFTER** relieving the gas pressure in the hose, disconnect it from MicroFID. Pull the knurled collar down and extract the fitting.

The internal cylinder is now full and will provide approximately 11 hours of operation.

If you have not used MicroFID for six months or longer, empty the hydrogen cylinder and refill it before beginning operation. See *Emptying the Hydrogen Cylinder* on page 110 for more details.

Overview

MicroFID measures the concentration of airborne organic, combustible gases and vapors and automatically displays and records these concentrations. It does not distinguish between

individual pollutants. The reading displayed represents the total concentration of all ionizable chemicals present in the sample. MicroFID does not distinguish between individual pollutants.

MicroFID operates automatically. The user reads concentrations directly from the display. The display updates itself twice per second.

MicroFID has many datalogging options. You can select an averaging interval, you can log all data with no averaging or you can use the Method 21 mode. If you select an averaging interval, the minimum, maximum, and average concentrations measured in each period are automatically recorded in MicroFID's datalogging memory, if the datalogger is turned on. If you are recording all data with no averaging you will only be able to log data for a short time before the datalogger becomes full. If you are averaging data you can log data for a longer period of time. The exact duration will depend on the averaging interval.

The Method 21 mode prompts you to locate a site and then to record a background and sample reading for the site. You can record up to 750 such entries. There is no averaging of data in Method 21 operation.

Recorded data can be played back from memory on MicroFID's display, sent to a printer in either tabular or graphical format or sent to a computer. Data are recorded by date, time, and by an event name. Event names can be entered using the MicroFID keypad, an external bar code reader or a computer. Data are played back by specifying the start event name.

The keypad is used to set up and calibrate MicroFID, and allows you to manipulate the concentrations measured and recorded by MicroFID in various ways. MicroFID has 16 keys for direct numeric entry and for using MicroFID's functions.

All information entered from the keypad, the bar code reader or the computer and stored in MicroFID's memory is retained when the instrument is switched off. The clock and calendar continue to operate and do not need to be reset each time MicroFID is used.

***Tutorial Session* 2**



Beginning Operation

To print or review logged data, you can operate MicroFID without the flame. You conserve the hydrogen this way.

If you choose to start the flame, MicroFID will attempt to ignite the flame once you have turned on the flow of hydrogen gas. If MicroFID has been unused for a while it is possible that the gas supply lines are filled with air. If the flame cannot be started, MicroFID will begin a 30 second purge cycle. During the purge cycle it will flush the gas supply lines with hydrogen. After the purge cycle it will attempt to light the flame again. If it fails again, another purge cycle will be performed and MicroFID will try a third time to ignite the flame.

To operate MicroFID:

1. Turn the instrument on by pressing the front of the On/Off switch. When the instrument is powered up, the version number and creation date of the instrument software are displayed. Press ENTER.
2. You will be prompted to start the flame. If you do not want to start the flame, use the ARROW keys to select “No Flame Needed” and press ENTER. To start the flame use the ARROW keys to select Start Flame and press ENTER.
3. If you selected “Start Flame”, MicroFID will prompt you to start the flow of hydrogen. Turn the shut-off valve counterclockwise to start the flow of hydrogen and press ENTER. See *Figure 1* for the location of the shut-off valve.
4. The pump will start and MicroFID will then ignite the flame. You will hear a small pop when the flame has been ignited. Once the flame has been started the message “Detector flame has been started OK” will be displayed followed by the default display, shown in *Figure 4*.

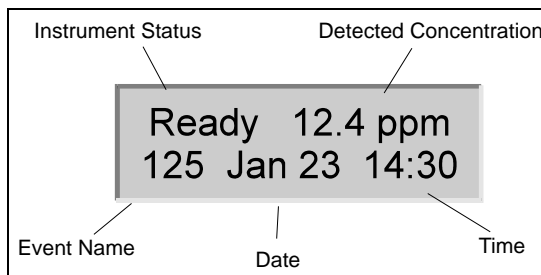


Figure 4 Default Display

The default display provides the following information: instrument status, current detected concentration, Event name (if the datalogger is on), time, and date. If an event name is longer than three characters the bottom line of the display will scroll through the information.

The instrument status appears at the left of the upper line of the display and on the Print and Graph outputs. Each status has a priority assigned to it. If more than one status is in effect, then the status with the highest priority is displayed until the condition is corrected or until the option is turned off.

When the bar graph is selected, the instrument status is reduced to a one-letter code.

Status	Code	Priority	Description
NoFlm	N	1	Flame has not been ignited.
Check	K	2	One of 4 faults is occurring. Press the TUTOR key for details.
Over	O	3	Detector electronics have been saturated.

Table 1 Instrument Status

Status	Code	Priority	Description
Cal	C	4	This status will never be observed on the display during normal operation as various calibration prompt messages are displayed while MicroFID is calibrating. If the instrument is turned off during calibration, Cal will appear on the display when MicroFID is turned on again indicating the last calibration was incomplete. "Cal" status is also shown on printed and graphed output.
Alarm	A	5	Detected concentration exceeds the set alarm level.
LoBatt	L	6	Battery pack power is low. Connect MicroFID to AC supply or replace the battery pack.
Play	P	7	The instrument is playing back previously recorded data.
Endlog	E	8	The datalogger is full.
Sniff	S	9	High Sensitivity operation.
Ready	R	10	Normal operation.
Locate	L	11	Locate site. Used for Method 21 operation
BkGnd	B	12	Record background reading. Used for Method 21 operation
Sample	S	13	Record sample reading. Used for Method 21 operation
Max	M	14	Displays maximum detected concentration.

Table 1 Instrument Status - continued

To turn the instrument off:

1. To turn the instrument off, press the front of the On/Off switch. You will then be prompted to turn off the flow of hydrogen.
2. Stop the flow of hydrogen gas by turning the hydrogen shut-off valve fully clockwise.
3. Pressing the On/Off switch twice to power down the instrument.

Tutorial Session

TUTOR Key

To assist you in learning the key functions, MicroFID has a built-in tutorial session that displays a two-line description of the function of each key. Pressing the TUTOR key begins a tutorial session and pressing the EXIT key after any other key, ends the session. While in the tutorial session, key presses have no effect on MicroFID's operation.

To begin a tutorial session:

1. Turn on MicroFID and select the "No Flame" option.
2. Press the TUTOR key and begin a tutorial session.
3. Press each key and read the display. The tutorial display for each key is provided in *Table 2*.

If a fault is encountered during normal operation, press the TUTOR key to display a description of the fault. If more than one fault is occurring at the same time, press the TUTOR key to see each of the faults in turn. When all the faults have been viewed, press EXIT to return to the normal display.

Key	Tutor Description	Key	Tutor Description
BATT	Shows battery V normally 6-8.9V	ALARM	Shows set-point for conc alarm
DISPLAY	Displays conc as graph or numeral	SETUP	Sets date time & options for keys
LIGHT	Shows detector flame status	MAX	Displays highest conc measured
AUDIO	Selects alarm or tone or no audio	EVENT	Sets options for recording data
PRINT	Prints table of recorded data	TUTOR	Press a key then read explanation
GRAPH	Prints graph of recorded data	CLEAR	Erases the last number pressed
PLAY	Replays recorded data on display	EXIT	Exits from tutorial session
CAL	Calibrates with zero & span gas	ENTER	Confirms display then continues

Table 2 TUTOR Displays

Key Functions

Press a key to execute a function. If there are no options to the key function, the key acts immediately. The BATT key is one example. If there are options, the current option is displayed. You are prompted to display the other options by pressing the ARROW keys. Pressing ENTER confirms that the displayed value is correct and moves to the next option.

If the function requires numeric input, the current value is displayed. You can change the value using the numeric keys on the

keypad. Pressing ENTER confirms that the displayed value is correct and moves to the next key option.

Some functions have multiple steps for options and/or numeric inputs. These are arranged so that the most frequently changed inputs are displayed first. Once the desired changes have been made you can bypass the rest of the steps by pressing EXIT.

Each key function is described in more detail in the following sections. Leave MicroFID on and try each key in turn.

BATT Key

Press the BATT key to open a window that displays the battery voltage. The voltage will be 9 volts when the instrument is fully charged. When the voltage drops below 7.2 volts, a “LoBatt” status will be displayed and the battery pack must be recharged. See *Battery Charging* on page 30.

NOTE: *Do not remove or recharge the battery pack in a hazardous location.*

An audio signal will be generated when “LoBatt” occurs. The signal will not clear until you connect the battery pack to an AC supply or replace the battery pack with a fully charged one.

NOTE: *Do not leave the battery pack uncharged for an extended period of time. This will result in damage to the battery pack.*

DISPLAY Key

If a numerical display is shown, pressing DISPLAY will change it to a bar graph. If the bar graph is shown, pressing DISPLAY changes it to a numerical display. The top line of the bar graph display shows the instrument status and the concentration range. The bar graph range is selected with the SETUP key.

In the bar graph display, the instrument status becomes a one-letter code. See *Table 1* for a description of the instrument status codes.

The bottom line of the display remains unchanged in bar graph mode and will continue to scroll and display data.

LIGHT Key

Press the LIGHT key to display the flame status. If the flame has been ignited and is burning, the status will be Detector flame is lit. If you are not analyzing, the flame status will be “Detector Flame is not lit”.

EXIT Key

The EXIT key terminates all MicroFID functions. When you press the EXIT key the display reverts to the default display. Most functions exit automatically if no key is pressed for 15 seconds.

When EXIT is pressed during printing, MicroFID stops sending information to the printer. The printer will continue to print until its buffer is empty.

CLEAR Key

CLEAR erases the last entry. If a value is entered in error, press CLEAR to erase the entry and then re-enter the correct number.

CLEAR used in conjunction with the MAX key clears the Max register.

MAX Key

Press the MAX key. The maximum concentration, the event during which it was encountered and the time and date of the occurrence will be displayed. Max is shown for 15 seconds and then the display reverts to the default display.

Press MAX then press CLEAR twice to reset the Max register. “Max Cleared” will be displayed with the current date and time. After 15 seconds the display reverts to the default display.

Recording of real time data is not interrupted when the MAX key is pressed or when the Max register is cleared.

AUDIO Key

If an “Alarm” status, “LoBatt” status or a flame out fault occurs, an audio signal will be generated. Under these conditions you will hear the audio signal even if a headset is not connected.

If you have a “LoBatt” status, the audio signal will not clear until you connect the battery pack to an AC supply or replace the battery pack with a fully charged one.

If a flame out fault has occurred, the audio signal will not stop until the flame has been re-started or you turn MicroFID off.

In the case of an alarm condition, an audio signal will be generated when an alarm is encountered.

To turn off the audio signal on alarm:

1. Press the AUDIO key.
2. Select “Audio Off” with the ARROW keys and press ENTER.

ALARM Key

Press the ALARM key to display the current alarm level or to enter a new alarm level. The displayed alarm level is specific to the current Cal Memory. When the Cal Memory is changed, the alarm level associated with the newly loaded Cal Memory will be displayed and used during sampling.

To display the current alarm level or to enter a new alarm level:

1. Press CAL and select the desired Cal Memory. Press ENTER and then press EXIT. You do not want to calibrate MicroFID at this point.

2. Press ALARM to display the current alarm level. If this value is correct, press EXIT to return to the normal display.
3. If a new value is to be set, enter the new value, and press ENTER. This alarm level is specific to the current Cal Memory.

When an alarm condition is detected, the instrument status changes to “Alarm” and an audio signal is generated. The “Alarm” status will not clear until the detected concentration falls below the set alarm level.

PLAY Key

The PLAY key plays back previously recorded data.

To play back previously recorded data:

1. Press PLAY. Two options are available. Pressing ENTER begins playback where it was last stopped. Press the SETUP (*) key to set the playback options.
2. Select the start Event. MicroFID will display a list of available events. Use the ARROW keys to scroll through the list. When the start event you want is displayed, press ENTER.

NOTE: *An event name may not be available if it has been deleted.*

3. If data has been averaged over an interval, select which value is to be displayed, either the Minimum, the Average, or the Maximum, and press ENTER. If you are playing back Method 21 data select Background, Sample or Difference to be displayed.
4. The data can be played back in either numerical or bar graph display. Press the DISPLAY key to select the desired option.
5. Press the ARROW keys to play back the data. You can move forward or backward through the datalogger.
6. Press EXIT at any time to return to normal operation.

If the flame is on, MicroFID is measuring and recording real time concentrations when the instrument status is “Play”. If, during playback, an instrument status with a priority higher than that of “Play” is encountered in real time, it will be displayed. MicroFID will however, continue to play back recorded data.

The PLAY function provides a speed search to review data or to find the desired start and stop event names for printing or graphing.

SETUP Key

The setup key is used to enter analysis information. Press SETUP and step through the options. Press ENTER to accept the displayed data or enter a numerical value using the keypad and then press ENTER. If no values are entered the display reverts to the default display after 15 seconds.

To enter analysis information:

1. The first option is for the detector. If you have been using the instrument with no flame and you now need to start the flame, use this option. You can also use this option to start the flame after a flame out fault. If you do not want to change the status of the detector use the ARROW keys to select “No Change”. Press ENTER to move to the next option.
2. The next option is Repair. Use Repair to record the state of repair. You must define the repair codes and ensure all users are aware of the codes. This option is most useful for Method 21 monitoring.

For example, a code of 0 may represent no repair under way, 1 may represent first attempt at repair with 5 days, 2 may represent final repair attempt within 15 days, 3 may indicate irreparable damage, and a 4 may represent a state in which a repair can not be attempted until the next scheduled shut down.

3. Next, select the operating range. This option sets the full-scale range for the bar graph display, the graph output. Use the ARROW keys to select a Range of 20, 200, 2000, 10000,

50000 ppm. This does not affect MicroFID's numeric display and datalogging.

4. Select the Interval next. You can average data over intervals of 1 second (s) 5 s, 10 s, 15 s, 30 s, 1 minute (m), 2 m, or 5 m. You may also select Method 21 mode.

If you select Method 21, the datalogger will be cleared. If you do not want to lose your previously recorded data, press EXIT. Then print or save the data to disk before changing the interval to Method 21. See *PRINT Key* on page 55, *GRAPH Key Mode* on page 58 and *Computer* on page 88 for more information on printing and saving logged data.

NOTE: *The datalogger will be cleared when you change from Interval mode to Method 21.*

Method 21 mode first prompts you to locate a specific sampling site and then allows you to record both a background and sample entry in the datalogger. Method 21 mode will be covered in more detail on page 72.

5. The date option is next. Enter the current day, month and year. Press ENTER to confirm the entry. The date is retained when the instrument is turned off. You do not need to enter this information every time you use MicroFID.
6. Next enter the correct time. Press ENTER.

EVENT Key

Events may be used to identify a particular sample or sampling location in memory. An event name is used in Method 21 operation to identify a sampling location. Recorded data are played, printed and removed from the datalogger by specifying a start and stop event name.

The EVENT key controls MicroFID's datalogger. Press the EVENT key to see the event options.

To display or add events:

1. Press the ARROW keys until the “Insert” option is displayed.
2. To insert an event, press ENTER. You will be prompted to enter an event name. You can enter a numerical name directly from the MicroFID keypad or you can connect MicroFID to a computer and enter the event name using the STAR 21 Software (Part No. MX396027). An event name may be up to 16 characters long. Refer to the Software Manual for the STAR 21 software for details of using the software with MicroFID.
3. Press the ARROW keys to move to the next option.

If you want to delete a range of events you must select a start and stop event. Use the ARROW keys to scroll through the list of events to select the start event and then to select the stop event.

NOTE: *Deleted information cannot be recovered. You should play back and print or download the contents of the datalogger before deleting any information.*

4. You can delete the current event, all recorded events or a range of events. Press ENTER then use the ARROW keys to select the desired option.
5. You can turn the datalogger off by selecting Stop. MicroFID will continue to analyze, but no data will be stored. To turn the datalogger on again press the EVENT key and use the ARROW keys to select Start. MicroFID will begin logging data again.
6. You can find a specific event in the datalogger using the “Find” option. Use the ARROW keys to scroll through the list of events to select the desired event. When you press ENTER, the selected event will be displayed. Use this option in Method 21 operation to find an event for monitoring or re-monitoring.
7. The next option is “Scan”. You can use a bar code reader (Part No. MX396054) to scan a bar coded event name. See *Bar Code Reader* on page 103 for details of connecting the bar code reader to MicroFID.

8. To activate the bar code reader, use the ARROW keys to select "Scan". Press ENTER to activate the bar code reader. It will remain activated until you scan a code. If no bar code is scanned within 15 seconds the bar code reader will be deactivated. This is done to conserve battery life. "Scan", when used with the bar code reader has the same function as the "Insert" option.

MicroFID can record continuously until the datalogger is full. When the datalogger is full the instrument status will change to "Endlog". The datalogger will stop logging data when it is full.

If it is necessary to retain a copy of recorded data, the data should be printed or stored in a computer when "Endlog" is displayed. This will prevent loss of information.

CAL Key

The CAL key is used to calibrate MicroFID. Calibration has been automated for ease of operation. Before beginning calibration ensure you have a reliable source of zero air and calibration gas. A brief description of the functions under the CAL key will be provided here. For more information on calibrating MicroFID, see *Calibration* on page 65.

When you press the CAL key you will first be prompted to select a Cal Memory. Each Cal Memory stores a unique zero point, sensitivity setting, response factor and alarm level.

You will then be prompted to enter a response factor. Refer to *Response Factors* on page 148 for a list of response factors. If the compound is not in this list or you are measuring gas mixtures, enter a value of 1.00. The concentration detected by MicroFID will be multiplied by the response factor before it is displayed and logged.

Next select Low Range or High Range operation. Use Low Range if you are sampling concentrations between 0.5 and 2000 ppm (methane equivalents). Use High Range if you are sampling concentrations between 10 and 50,000 ppm (methane equivalents).

You will now be prompted to connect a supply of zero air. You can use ambient air, a charcoal filter (Part No. MX396021, MX396022) to clean ambient air or, for best results, use a clean sampling bag filled with zero grade air.

After MicroFID has set its zero point, you then enter the concentration of the calibration gas and then connect the calibration gas. MicroFID sets its sensitivity for the specified Cal Memory. You must have a supply of calibration gas ready before calibrating MicroFID. See *Calibration* on page 28 for detailed calibration instructions.

When calibrating MicroFID, ensure the instrument is level. If MicroFID is tilted from side to side, gravity will affect the flame height and cause erroneous readings.

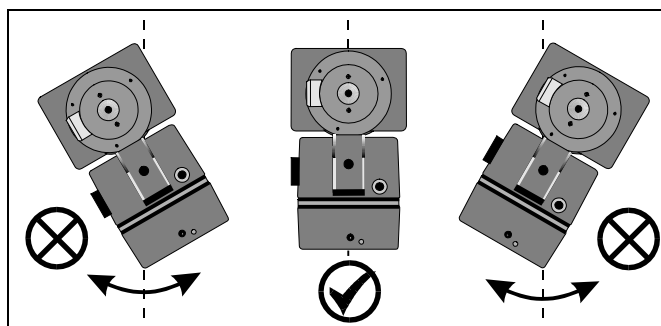


Figure 5 **Keep MicroFID Level**

PRINT Key

MicroFID has been designed for use with a serial printer. The printer must have a print width of at least 65 characters and a proportionally spaced font. If you are using a parallel printer, you will also need the serial to parallel converter (Part No. MX380145).

See *Printer* on page 87 for instructions on connecting and configuring a printer for use with MicroFID. See *Serial to Parallel Converter* on page 98 for instructions on connecting the serial to parallel converter to MicroFID and to the printer.

When MicroFID is printing data it is still measuring real time concentrations.

NOTE: *MicroFID is not classified for use in hazardous locations with a printer.*

To print data:

1. Turn MicroFID off.
2. Use the MicroFID printer cable (Part No. MX396051) to connect the MicroFID I/O connector to the printer.
3. Turn MicroFID on and press the PRINT key and then the SETUP (*) key to select the desired setup options.
4. MicroFID will ask for the start and stop Events. Use the ARROW keys to scroll through the list of events to select the start event and then to select the stop event.
5. Enter an ID number if desired. Any number up to 16 digits long may be entered as an ID number.

The ID number can be used, for example, to differentiate between users or instruments. If more than one person is using a single instrument, each person can use an individual number for printed reports. If more than one MicroFID is

being used, each instrument can have its own ID number on printed reports.

If an ID number is not required, leave this option blank and move to the next option by pressing ENTER.

6. Enter the baud rate. This value is specific to the printer being used and must be set correctly. Refer to the printer user's manual to determine the correct baud rate
7. Enter the parity. The parity is specific to the printer being used and must be set correctly. Most printers will have parity set to none.
8. When the setup is correct, ensure the printer is on-line and press ENTER.

MicroFID stores one set of readings (Min, Avg and Max) each interval. In each averaging interval the printed minimum is the minimum of all the stored readings in that interval. The printed Avg is the average of all the recorded average readings and the Max is the maximum of all the recorded maximum readings. In Method 21 operation, the background, sample and the difference are stored.

When you are using interval mode, the date and time are printed along with the event name, repair code and the minimum, average and maximum concentration of each interval. The date, time, event name, and repair code are only printed when they change.

Photovac MicroFID Analysis Report
 (All units are PPM)
 ID: 100

Date	Time	Event	REP	Stat	Min	Avg	Max	
Nov 28,94	16:06				0.0	1.1	22.6	
	16:07				0.0	11.6	91.7	
				Ready	1.7	22.5	50.1	
				Cal	8.0	16.0	22.0	
					1.2	3.7	7.6	
					0.0	0.4	1.2	
					0.0	0.0	0.0	
		16:08			0.0	0.0	0.0	
			112		HiSens	0.0	6.7	128.0
						2.9	173.0	503.1
						17.4	417.9	520.5
					Cal	485.5	515.0	519.5
						489.8	505.2	518.9

Figure 6 Printed Output for Interval Mode

When you are using Method 21 mode, the date and time are printed along with the event name, repair code and the background, difference and sample concentration of each interval. The date, time, event name, and repair code are only printed when they change. See *Figure 7*.

While the information is being printed, the display shows that printing is in progress. The keypad will not accept commands until the present print job has been completed.

Pressing EXIT during printing stops the job. The printer will continue to print until its buffer is empty.

Photovac MicroFID Analysis Report
(All units are PPM)

ID:100781

Date	Time	Event	REP	Stat	BkGnd	Diff	Sample
Nov 30, 94	13:29	100		Ready	1.7	15.4	17.2
	13:35	101			1.7	15.8	17.6
	13:48	102			0.8	0.0	0.8
	14:13	103			1.6	8.2	9.8
	14:53	104	3	Alarm	6.0	2464	2470
	15:54	105		Ready	0.1	0.0	0.1
	16:05	106			0.2	20.9	21.2
	16:12	107			0.2	0.0	0.2
	16:56	108			1.5	19.6	21.1
	Dec 1, 94	10:39	109			0.2	0.0
10:57		110			0.1	98.6	98.8
11:13		111			122.0	215.7	337.8
11:29		112	2	Alarm	55.8	2474	2530
11:35		113	2		13.9	809.3	823.2
12:00		114		Ready	0.2	154.5	154.8
12:21		115			0.2	20.8	21.0
12:32		116			0.2	0.0	0.2

Figure 7 Printed Output for Method 21 Mode

GRAPH Key Mode

Pressing the GRAPH key prints the recorded data in graphical format. When MicroFID is graphing recorded data it is also measuring real time concentrations.

NOTE: *MicroFID is not classified for use in hazardous locations with a printer.*

To graph logged data:

1. Turn MicroFID off.
2. Use the MicroFID printer cable (Part No. MX396051) to connect the MicroFID I/O connector to the printer.

3. Turn MicroFID on and press the SETUP key to set the range for the graph. Use the ARROW keys to select the 20, 200, 2000, 10,000 or 50,000 ppm range.
4. Press the GRAPH key and then the SETUP (*) key to select the desired setup options.
5. MicroFID will ask for the start and stop events. Enter the desired event and press ENTER. Use the ARROW keys to scroll through the list of events to select the start event and then to select the stop event.
6. Enter an ID number if desired. Any number up to 16 digits long may be entered as an ID number.

The ID number can be used, for example, to differentiate between users or instruments. If more than one person is using a single instrument, each person can use an individual number for printed reports. If more than one MicroFID is being used, each instrument can have its own ID number on printed reports.

If an ID number is not required, leave this option blank and move onto the next option by pressing ENTER.

7. Enter the baud rate. This value is specific to the printer being used and must be set correctly. Refer to the printer user's manual to determine the correct baud rate.
8. Enter the parity. The parity is specific to the printer being used and must be set correctly. Most printers will have parity set to none.
9. When the setup is correct, ensure the printer is on-line and press ENTER.

MicroFID stores one set of readings (Min, Avg and Max) for each averaging interval. In each averaging interval the graphed minimum is the minimum of all the stored readings in that interval. The graphed Avg is the average of all the recorded average readings and the Max is the maximum of all the recorded maximum readings. In

Method 21 operation, the background, sample and the difference are stored.

In Interval mode the date and time are printed along with the event name and the repair code. The date, time, event name, and repair code are only printed when they change. See *Figure 8*.

A minus sign is used to draw the graph from the minimum to the average. Plus signs are used to graph the area between average and maximum.

In Method 21 mode the date and time are printed along with the event name and the repair code. The date, time, event name, and repair code are only printed when they change. See *Figure 9*.

A minus sign is used to draw the graph from the background to the difference. Plus signs are used to graph the area between difference and sample. Difference is calculated by subtracting the background from the sample.

Photovac MicroFID Analysis Report
 (All units are PPM)

```

ID:100
Date  Time   Event  REP Stat  [0-----2000]
Nov 29,94  13:36  10     Ready  -
          13:37                -+
          13:38                -
          13:38                -+
          13:38                -----+
          13:39                -----+
          13:40                -
          13:40                -
          13:40                -
          13:41                -++
          13:41                -----+
          13:41                -----+
          13:42                -
          13:42                -
          13:42                -----+
          13:43  11     HiSens  -----+
-----+
  
```

Figure 8 Graphed Output for Interval Mode

While the information is being printed, the display shows that printing is in progress. The keypad will not accept commands until the present print job has been completed.

Pressing EXIT during printing stops the job. The printer will continue to print until its buffer is empty.

Photovac MicroFID Analysis Report
(All units are PPM)

ID: 100781

Date	Time	Event	REP	Stat	[0----- 2000]
Nov 30,95	13:29	100		Ready	-
	13:35	101			-
	13:48	102			-
	14:13	103			-
	14:53	104	3	Alarm	-----+
	15:54	105		Ready	-
	16:05	106			-
	16:12	107			-
Dec 1,94	16:56	108			-
	10:39	109			-
	10:57	110			-+
	11:13	111			---++
	11:29	112	2	Alarm	-----+
	11:35	113	2		-----+

Figure 9 **Graphed Output for Method 21 Mode**

Detailed **3**
Operation



Calibration

General Information

MicroFID must be calibrated in order to display concentration in ppm units equivalent to the calibration gas. First a supply of zero air, which contains no ionizable gases or vapors, is used to set MicroFID's zero point. Then, calibration gas, containing a known concentration of an ionizable gas or vapor, is used to set the sensitivity.

Occasionally clean ambient air will be suitable as zero air. Due to MicroFID's sensitivity, outdoor air is usually unsuitable for calibration. A charcoal filter (Part No. MX396021, MX396022) may be connected to the instrument to produce clean air from otherwise unsuitable ambient air. For best results, use a commercial source of zero grade air and a second sampling bag. Zero air should have not more than 0.1 ppm total hydrocarbons (THC).

Methane in air is recommended as span gas. The concentration of the calibration gas will depend on your application. When ordering calibration gas, specify methane in hydrocarbon free air. Balance air should have not more than 0.1 ppm total hydrocarbons (THC).

Method 21 protocol requires that commercial cylinders of calibration gas be analyzed and certified to be within +/- 2% accuracy and that a shelf life must be specified on the cylinder. At the end of the shelf life, the cylinder must be replaced or re-analyzed.

Preparing the Calibration Gas Bag and the Zero Air Bag

Use the calibration kit (Part No. MX396011) as follows:



Observe proper handling techniques for all gases! See Warnings and Safety Practices on page 22.

WARNING

1. Connect the regulator to the calibration gas cylinder.

If you are using a portable tank of calibration gas, connect the regulator supplied with the calibration kit.

If you are using a large cylinder of calibration gas, you must obtain a high purity regulator as specified in *Support Equipment and Consumables* on page 28. Methane in air is usually supplied with a standard CGA 590 cylinder valve outlet. Obtain a regulator with the matching fitting. Connect the regulator to the tank of calibration gas.

NOTE: *Do not force the connection.*

Do not use Teflon tape with CGA fittings. In general, these fittings are designed for metal to metal sealing.

Do not use adapters to connect one CGA fitting to another type of CGA fitting. If the regulator does not match the outlet on your calibration tank, contact your specialty gas supplier.

2. Tighten the regulator onto the tank with a wrench. Do not over-tighten.
3. Attach the knurled nut on the gas bag adapter to the regulator. Finger-tighten the fitting.

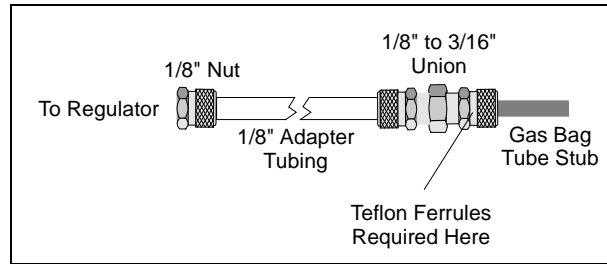


Figure 10 Gas Bag Adapter

4. Loosen the knurled nut on the reducing union of the gas bag adapter.

NOTE: *Do not remove the nut from the union, as the Teflon ferrules contained inside the nut may be lost. See Figure 10.*

5. Insert the tube stub from the gas bag into the knurled nut. Tighten the knurled nut and ensure the tube stub is secure. If the gas bag is not secure, ensure you have inserted the tube stub far enough into the knurled nut. Do not over tighten the fitting.

Over-tightening the Teflon ferrules will result in damage to the ferrules.

CAUTION

6. The union should be connected to the gas bag adapter. If it is not, then tighten the nut on the adapter tube to the union.
7. Open the gas bag valve. Turn the knurled plastic knob counter clockwise to loosen it, then use the knurled collar on the valve tube to gently push the valve tube toward the bag.

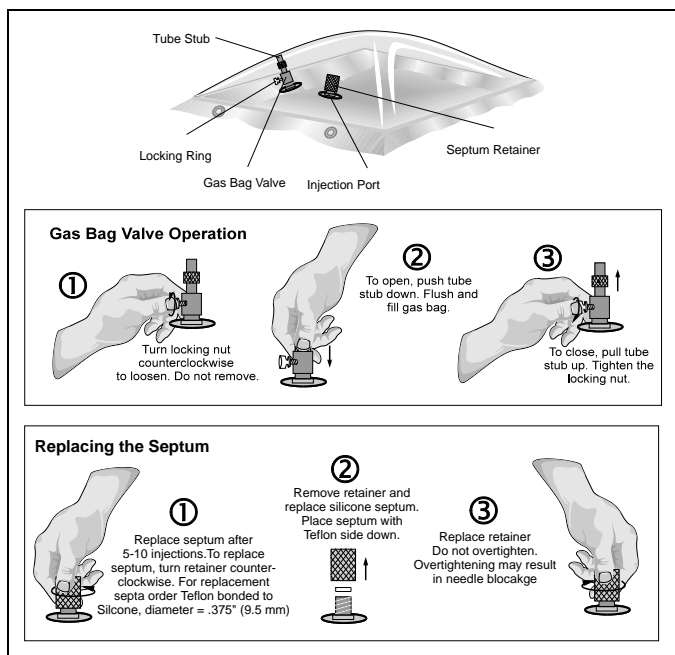


Figure 11 Using the Gas Bag

8. Turn the regulator knob counter clockwise about half a turn to start the flow of gas. Fill the gas bag about half full and then close the regulator.
9. Disconnect the gas bag from the gas bag adapter and empty the bag. Flush the bag a few times with the calibration gas and then fill it.
10. Close the gas bag valve. Gently pull the valve tube away from the bag, and then turn the knurled plastic knob clockwise to tighten it against the valve tube.
11. Remove the knurled nut on the adapter tube from the regulator.
12. Repeat this procedure, if necessary, to prepare a bag of zero air.

NOTE: Do not use the same gas bag or gas bag adapter for the bag of zero air. You will contaminate the bag of zero air.

Calibrating MicroFID

To calibrate MicroFID:

1. Press CAL and select the desired Cal Memory. MicroFID has 10 Cal Memories and can be calibrated with 10 different span gases or response factors if desired. Only one Cal Memory can be used at a time. Each Cal Memory stores a different response factor, zero point, sensitivity, and alarm level
2. Enter the desired response factor and press ENTER. Refer to *Response Factors* on page 148 for a list of Response Factors. If the compound is not in this list or you measuring gas mixtures then enter a value of 1.00. The concentration detected by MicroFID will be multiplied by the response factor before it is displayed and logged.
3. Select Low Range or High Range and press ENTER. Use Low Range if you are sampling concentrations between 0.5 and 2000 ppm (methane equivalents). Use High Range if you are sampling concentrations between 10 and 50,000 ppm (methane equivalents)
4. Connect the supply of zero air. If you are using room air press ENTER.
5. If you are using a charcoal filter, connect the filter as outlined in *Charcoal Filters* on page 95. Press ENTER and MicroFID will set its zero point.

NOTE: *The charcoal filter does not filter methane or ethane. If these compounds are present, use a gas bag with a supply of commercial zero air.*

6. If you are using a gas bag with zero air, connect the gas bag adapter to the inlet. Open the bag and press ENTER. MicroFID sets its zero point.
7. MicroFID then asks for the span gas concentration. Enter the known span gas concentration and then connect the gas bag adapter to the inlet. Open the bag.

8. Press ENTER and MicroFID sets its sensitivity.

NOTE: *Readings may fluctuate slightly as the gas bag empties. Do not allow the MicroFID to evacuate the bag completely.*

9. When MicroFID's display reverts to normal, it is calibrated and ready for use. Remove the span gas bag from the inlet.
10. Press the ALARM key and enter the alarm level for the selected Cal Memory.

Programming the Cal Memories

MicroFID has 10 Cal Memories and can be calibrated with 10 different span gases or response factors if desired.

To program the Cal Memories:

1. Prepare the bags of calibration gas as outlined in *Preparing the Calibration Gas Bag and the Zero Air Bag* on page 66. Use a different gas bag and gas bag adapter for each concentration and for each type of calibration gas.

You can use the same gas bag to zero all the Cal Memories; however, you must refill the bag for each Cal Memory.

2. Press CAL and select the desired Cal Memory (1 to 10) with the ARROW keys.
3. Enter the desired response factor and press ENTER. See *Response Factors* on page 148.

NOTE: *It does not matter which Cal Memory is selected or which response factor is entered, MicroFID's response is not specific to any one compound. The reading displayed represents the total concentration of all ionizable compounds in the sample.*

4. Select the Low Range or High Range and press ENTER. The range will depend on the concentration of the calibration gas. Use Low range if you are sampling

concentrations between 0.5 and 2000 ppm (methane equivalents). Use High Range if you are sampling concentrations between 10 and 50,000 ppm (methane equivalents).

5. You will now be prompted to connect a supply of zero air. You can use ambient air, a charcoal filter (Part No. MX396021, MX396022) to clean ambient air or, for best results, use a clean sampling bag filled with zero grade air.
6. After MicroFID has set its zero point, you then enter the concentration of the calibration gas and then connect the calibration gas. MicroFID sets its sensitivity for the specified Cal Memory. The span gas concentration, response factor and alarm level entered here are specific to the selected Cal Memory only.

When the calibration is completed it is automatically stored in the selected Cal Memory.

7. Press the ALARM key and enter the alarm level for the selected Cal Memory.
8. Repeat this procedure for each Cal Memory you need.

When calibrating MicroFID, ensure the instrument is level. If MicroFID is tilted side to side, gravity will affect the flame height and cause erroneous readings

Whenever the instrument is calibrated, MicroFID updates the selected Cal Memory only. Each Cal Memory must be calibrated at least once a day. Frequency of calibration will depend on ambient conditions and instrument response. If ambient conditions change or the response has drifted, a calibration must be performed for each Cal Memory to ensure reliable operation.

High Sensitivity Operation

MicroFID can be used as a high sensitivity leak detector. In high sensitivity operation, MicroFID does not read in ppm units

equivalent to the calibration gas, but displays a reading proportional to the total concentration of ionizable gases and vapors detected.

During calibration, no span gas is required. MicroFID zeros its reading with zero air and then sets itself to maximum sensitivity.

To use the High Sensitivity option:

1. Press SETUP. Select the 0-20 ppm display range with the ARROW keys and press ENTER.
2. Press CAL. Under Cal Memory, use the ARROW keys to select High Sensitivity and press ENTER.
3. Press EXIT. Select the bar graph with the DISPLAY key.
4. Press CAL and calibrate MicroFID with zero air. You should use a supply of commercial zero grade air and a gas sampling bag when zeroing MicroFID for high sensitivity operation.

As MicroFID samples air closer to the leak, the length of the shaded area on the display increases.

MicroFID's 3 second response time and detection limit of 0.5 ppm methane permit fast detection of small leaks.

Method 21 Operation

Method 21 is a US EPA protocol for the determination of volatile organic compound (VOC) leaks in process equipment. MicroFID has a Method 21 mode that facilitates Method 21 measurements. The STAR 21 Software (Part No. MX396027) provides more comprehensive data management consistent with the Method 21 protocol. Contact PerkinElmer for more information.

You must be familiar with the Method 21 protocol to use MicroFID for Method 21 monitoring. You must use the specifications outlined in the Method 21 documentation for programming MicroFID's Cal Memories and monitoring the sites.

As part of Method 21 operation, you must setup MicroFID to monitor various locations. Since each location may contain different compounds and concentration ranges you will store a Cal Memory and the associated response factor and alarm level as part of each event. In this way you can sample numerous locations without having to re-calibrate MicroFID at each location.

You can enter the monitoring schedule in one of two methods. Regardless of the method you use to enter the monitoring schedule; you must calibrate the required Cal Memories before you enter the monitoring schedule.

Calibration

You must determine the number of calibration standards that will be required to perform Method 21 monitoring for your site. Refer to the Method 21 documentation for details.

To program your cal memories:

1. Prepare the bags of calibration gas as outlined in *Preparing the Calibration Gas Bag and the Zero Air Bag* on page 66. Use a different gas bag and gas bag adapter for each concentration and for each type of calibration gas.

You can use the same gas bag to zero all the Cal Memories; however, you must refill the bag for each Cal Memory.

2. Press CAL and select the desired Cal Memory (1 to 10) with the ARROW keys.
3. Enter the desired response factor and press ENTER. See *Response Factors* on page 148.

NOTE: *It does not matter which Cal Memory is selected or which response factor is entered, MicroFID's response is not specific to any one compound. The displayed reading represents the total concentration of all ionizable compounds in the sample.*

4. Select the Low Range or High Range and press ENTER. The range will depend on the concentration of the

calibration gas. Use Low Range if you are sampling concentrations between 0.5 and 2000 ppm (methane equivalents). Use High Range if you are sampling concentrations between 10 and 50,000 ppm (methane equivalents).

5. Follow the displayed calibration instructions. When the calibration is completed it is automatically stored in the selected Cal Memory. The span gas concentration and response factor entered here are specific to the selected Cal Memory only.
6. Press the ALARM key and enter the alarm level for the selected Cal Memory.

Whenever the instrument is calibrated, MicroFID updates the selected Cal Memory only. Each Cal Memory must be calibrated at least once a day. Frequency of calibration will depend on ambient conditions and instrument response. If ambient conditions change or the response has drifted, a calibration must be performed for each Cal Memory to ensure reliable operation.

Programming the Monitoring Schedule in the Field

The easiest way of entering the Method 21 information is to go to each site and enter the required information. In this way, the schedule will be entered into the instrument in the exact manner in which it will be used.

To program the monitoring schedule:

1. Press the SETUP key. Press ENTER until “Interval” is displayed. Use the ARROW keys to select Method 21 as the Interval. Press ENTER.
2. You will be prompted to clear the datalogger. If you want to save the contents of the datalogger, press EXIT. You must print or save the data to disk. See *PRINT Key* on page 55, *GRAPH Key Mode* on page 58 or *Computer* on page 88 for details of printing or saving your data. Press ENTER to clear the datalogger.

3. Go to the first site to be monitored. You can enter the sites in any order; however, using the schedule after it has been stored is easier if the sites are stored in the order in which they will be monitored.
4. Press the EVENT key. Use the ARROW keys to select "Insert". Press ENTER. Use the keypad to enter an event name up to 16 characters long. To obtain alphabetic characters you must use the STAR 21 software (Part No. MX396027).

If your site is bar coded, use the ARROW keys to select "Scan". Press ENTER to activate the bar code reader. The bar code reader will remain activated until you scan a code. If no bar code is scanned within 15 seconds the bar code reader will be deactivated. See *Bar Code Reader* on page 103 for details of connecting the bar code reader to MicroFID.

It is possible to enter an event name that already exists in the datalogger. When you select "Insert" or "Scan" you can enter the name of an event that already exists in the datalogger. MicroFID will not overwrite the existing event. It will insert an event with the same name. In this way you can create multiple copies of the same schedule in the datalogger. You can see the duplicate events when you print the contents of the datalogger.

5. Press the CAL key and select the calibration memory to be used for this site. Press ENTER and then press EXIT.
6. Press SETUP and enter a 2-digit repair code for this location. See *SETUP Key* on page 50 for a description of Repair code. This step is optional.
7. When you return to the default display, the instrument status will be "Locate". You should be at the site. If not, locate the site. If the event name is greater than 3 characters the bottom line of the display will scroll from right to left.
8. Once you have located the designated site, press ENTER. The instrument status will change to "BkGnd". A background measurement must be made as specified in the Method 21 protocol. When you have an accurate

background, press ENTER. MicroFID will record the maximum background concentration when you press the ENTER key.

9. The instrument status will now be “Sample”. Take a sample measurement, as specified in the Method 21 protocol. When you have an accurate sample, press ENTER. MicroFID will record the maximum sample concentration when you press the ENTER key.
10. The instrument status will again be Locate. At this time, since there are no other locations stored in the datalogger the same event will be displayed.
11. Press EXIT at anytime to return to the beginning of the current event and repeat the readings.
12. To store the next location, go the next site and press the EVENT key. Select “Insert” or “Scan” to enter an event name.
13. Press the CAL key and select the calibration memory to be used for this site.
14. Press SETUP and enter a repair code for this location.
15. When you return to the default display, the instrument status will be “Locate”. Record a background and sample reading for this site. You will now have two events recorded in the datalogger.
16. Repeat this procedure for all sites that must be monitored. You can record data for up to 250 sites.
17. Once all event entries have been recorded in the datalogger, you may want to download them to a computer to perform your own calculations.

Programming the Monitoring Schedule before Field Operation

Use this method of programming the schedule if you are unable to go into the field. You will create a monitoring schedule with placeholders for the data.

To preprogram your monitoring schedule:

1. Press the SETUP key. Press ENTER until “Interval” is displayed. Use the ARROW keys to select Method 21 as the Interval. Press ENTER.
2. You will be prompted to clear the datalogger. If you want to save the contents of the datalogger, press EXIT. You must print or save the data to disk. See *PRINT Key* on page 55, *GRAPH Key Mode* on page 58 or *Computer* on page 88 for details of printing or saving your data. Press ENTER to clear the datalogger.
3. You can enter the sites in any order; however, using the schedule after it has been stored is easier if the sites are stored in the order in which they will be monitored.
4. Press the EVENT key. Use the ARROW keys to select “Insert”. Press ENTER. Use the keypad to enter an event name up to 16 characters long. To obtain alphabetic characters you must use the STAR 21 software. (Part No. MX396027)

If your site is bar coded and you have a list of the bar codes, use the ARROW keys to select “Scan”. Press ENTER to activate the bar code reader. The bar code reader will remain activated until you scan a code. If no bar code is scanned within 15 seconds the bar code reader will be deactivated. See *Bar Code Reader* on page 103 for details of connecting the bar code reader to MicroFID.

It is possible to enter an event name that already exists in the datalogger. When you select “Insert” or “Scan” you can enter the name of an event that already exists in the datalogger. MicroFID will not overwrite the existing event. It will insert an event with the same name. In this way you

can create multiple copies of the same schedule in the datalogger. You can see the duplicate events when you print the contents of the datalogger.

5. Press the CAL key and select the calibration memory to be used for this site. Press ENTER and then press EXIT.
6. Press SETUP and enter a 2 digit repair code for this location. See *SETUP Key* on page 50 for a description of Repair code. This step is optional.
7. When you return to the default display, the instrument status will be "Locate". If the event name is greater than 3 characters the bottom line of the display will scroll from right to left.
8. Press ENTER. The instrument status will change to "BkGnd". Press ENTER to create a placeholder and to move to the next step.
9. The instrument status will now be "Sample". Press ENTER to create a placeholder and to move to the next step. The instrument status will again be Locate. At this time, since there are no other locations stored in the datalogger the same event will be displayed.
10. Press EXIT at any time to return to the beginning of the current event.
11. To store the next location, press the EVENT key. Select "Insert" or "Scan" to enter an event name.
12. Press the CAL key and select the Cal Memory to be used for this site.
13. Press SETUP and enter a repair code for this location.
14. Press ENTER. The instrument status will change to "BkGnd". Press ENTER to create a placeholder and to move to the next step.

15. The instrument status will now be “Sample”. Press ENTER to create a placeholder and to move to the next step. The instrument status will again be “Locate”.
16. Repeat this procedure for all sites that must be monitored. You can record data for up to 250 sites.

Once all event entries have been recorded in the datalogger, you are ready to use the schedule for monitoring the sites. You may want to print the schedule to ensure all your sites have been entered correctly.

Using the Schedule

Once you have programmed the schedule you can use it at any time to perform Method 21 monitoring. Frequency of monitoring is determined from percentage leaker calculations. Refer to the Method 21 documentation for details.

To use the schedule:

1. Calibrate MicroFID as outlined in *Calibration* on page 65.
2. If the first event of the schedule is not displayed, you can find a specific event in the datalogger using the “Find” option. Press SETUP and use the ARROW keys to scroll through the list of events. Select the desired event. When you press ENTER, the selected event will be displayed.
3. Locate the specified site and press ENTER.
4. The instrument status will change to “BkGnd”. A background measurement must be made as specified in the Method 21 protocol. When you have an accurate background, press ENTER. MicroFID will record the displayed concentration when you press the ENTER key.
5. The instrument status will now be “Sample”. Take a sample measurement, as specified in the Method 21 protocol. When you have an accurate sample, press ENTER. MicroFID will record the displayed concentration when you press the ENTER key.

6. The instrument status will again be “Locate”. If you recorded the sites in order, the next site will be displayed. You can move through the stored list. If the sites were not entered in order or the order of sites has changed, use the “Find” option to locate the next site.
7. Press EXIT at any time to return to the beginning of the current event and repeat the readings.
8. To repeat a measurement recorded previously in the datalogger, press the EVENT key and use the ARROW keys to select “Find”. Select the event you need to repeat and press ENTER.

If you change from Method 21 operation to a set averaging interval, you will lose your Method 21 schedule and associated programming. Print or save the data to disk before changing the interval. See *PRINT Key* on page 55, *GRAPH Key Mode* on page 58 or *Computer* on page 88 for details of printing or saving your data.

NOTE: *The datalogger will be cleared when you change from Method 21 to Interval mode.*

Response Factors for Gases and Vapors

In situations where only a single pure compound is present in air, MicroFID should be calibrated with a standard of that specific compound as span gas. MicroFID’s 10 Cal Memories can be used to store calibration information for 10 different span gases.

MicroFID’s reading will always be influenced by any other ionizable compounds present in the air sample. Even if MicroFID has been calibrated with a specific compound, its response is not specific and the presence of another ionizable impurity may render the numerical result invalid.

It is often impractical to carry a range of different standards into the field. Approximate results can be obtained by calibrating MicroFID with the recommended span gas and entering the appropriate response factor. The response factor is based on the ratio of the

response of the specific compound to the response of the span gas. The response factor multiplies MicroFID's reading then displays and records it (if the datalogger is on).

Response Factors on page 148 provides a list of response factors from which approximations can be made for guidance purposes. Data extrapolated from the use of response factors must be regarded as interim and approximate only. The response factors in the list should be used only for concentrations up to 500 ppm of the specific compound, as response factors change with concentration.

To use the response factors:

1. Press the CAL key and enter the response factor for the specific compound.
2. Calibrate MicroFID with zero air and 500 ppm methane as described in *Calibration* on page 65.
3. Expose MicroFID to the sample. The displayed reading is the approximate concentration of the specific compound.

The response factors on page 148 serve as a guide to concentrations measured by MicroFID.

Results are expected to be accurate to within +/-10 ppm or +/-25% of result, whichever is greater. Accuracy of response factors to other gases and vapors may differ from that stated.

NOTE: *It does not matter which Cal Memory is selected or which response factor is entered, MicroFID's response is not specific to any one compound. The displayed reading represents the total concentration of all ionizable compounds in the sample.*

Preparing for Field Operation

Field Check List

The following items should be carried into the field to reduce or eliminate instrument down time. If you will be in the field for a single 8-10 hour day, you should include the following accessories:

- Spare battery pack (Part No. MX396005 or MX396006)
- Long sample probe (Part No. MX396018)
- Calibration kit(s) (Part No. MX396011)
- Tank(s) of calibration gas (Part No. MX396028)
- Spare gas bag for zero air (Part No. MX396017)
- Gas bag adapter for zero air (Part No. MX396010)
- Supply of commercial zero air
- Charcoal filters (Part No. MX396021, MX396022)
- Shoulder strap (Part No. MX395002)
- Spare inlet filters (Part No. MX396020 or MX396015)
- Bar code reader and interface module (Part No. MX396054)
- Spare 9 volt battery for bar code reader
- Carrying case (Part No. MX396007)
- Headset (Part No. MX396053)
- MicroFID Instrument Manual (Part No. MX396003)

Table 3 Check List for Field Operation

If you will be in the field for more than one day you should include the following additional items:

- Battery chargers (Part No. MX396013 or MX396014).
Take one charger for each battery pack.
- Hydrogen and refill adapter (Part No. MX396004)
- Printer cable (Part No. MX396051)
- Computer and associated cables

Table 4 Additional Field Items

Operational Check List

Before beginning field work, set up and calibrate MicroFID for your particular application. Ensure the instrument is in working order before heading into the field.

To prepare MicroFID for field work:

1. Ideally, you should not transport MicroFID with the hydrogen cylinder filled. If it is possible to fill the internal hydrogen cylinder when you arrive at your destination then do so. If not, then you must fill the cylinder before you leave and observe all precautions for handling compressed, flammable gases. See *Warnings and Safety Practices* on page 22.

If you are travelling by passenger aircraft, you must make arrangements to fill the hydrogen cylinder when you arrive at your destination. You cannot transport MicroFID by passenger aircraft unless the internal hydrogen cylinder is empty. See *Emptying the Hydrogen Cylinder* on page 110 more information.

2. Press the BATT key and ensure the battery pack is fully charged. The voltage should be 9 volts.
3. Press the SETUP key and ensure the correct date and time are entered.

4. Program and calibrate all the Cal Memories you will be using. See *Calibration* on page 65. After calibration is complete, sample the bag of calibration gas and the bag of zero air to ensure MicroFID has been calibrated correctly.
5. Press the MAX key and clear the Max register if necessary.
6. If you are using an averaging interval, you may also want to delete all events from the datalogger to avoid confusion between different days' data and to avoid running out of space in the datalogger. See *EVENT Key* on page 51.
7. If you are performing Method 21 monitoring ensure you have programmed and calibrated all the Cal Memories. You must also program your monitoring schedule. See *Method 21 Operation* on page 72 for more information.

***Accessories* 4**



Printer

MicroFID has been designed for use with a serial printer. The printer must have a print width of at least 65 characters and a proportionally spaced font. The printer cable (Part No. MX396051) has been configured for this application only. If the printer does not have an RS-232 serial interface you will need to use the serial to parallel converter (Part No. MX380145). See *Serial to Parallel Converter* on page 98 for details.

If you are unsure of the compatibility of the printer, refer to the printer user's manual or contact the printer's manufacturer.

Ensure the printer is set to 8 data bits and 1 stop bit, parity has been set to none and that the appropriate baud rate has been selected.

NOTE: *MicroFID is not classified for use in hazardous locations with a printer.*

To connect a printer:

1. Turn MicroFID off.
2. Connect the RS-232 printer cable (Part No. MX396051) to the I/O port on the back of the MicroFID and then to the serial port on the printer. See *Figure 12*.
3. Turn MicroFID on.
4. Determine the baud rate for your printer. Refer to the printer user's manual for details.

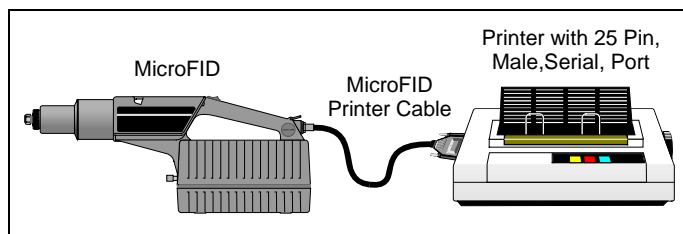


Figure 12 Connecting MicroFID to a Serial Printer

5. Press the SETUP key and select the Baud Rate option. Use the ARROW keys to select the baud rate corresponding to the printer. The baud rate in the SETUP option must match the baud rate of the printer.
6. Use the PRINT and GRAPH keys as detailed on pages 55 and 58.
7. Turn MicroFID off before disconnecting the printer cable from the I/O port.

If this arrangement does not produce the desired results, see *Printer Troubleshooting* on page 124.

Computer

MicroFID will send information stored in its datalogger to a computer. This option may be used if you need to prepare reports based on MicroFID's recorded data. This feature may also be used if you need the recorded data in a format that can be imported into a spreadsheet or database for further calculations.

NOTE: *MicroFID is not classified for use in hazardous locations with computers.*

You may need to keep more data than can be logged by MicroFID. If this is the case you have two options: you may print the data before they are deleted from the datalogger and keep the printed reports, or you may store the data on disk for later use. You may

not, however, load data that has been stored on disk back into MicroFID.

In order to establish communication with MicroFID and send data stored in the datalogger to a computer, the computer must be set up to emulate a terminal. In order to do this you will need a communications software package that will allow you to transfer data from MicroFID to a computer. If you are using Microsoft Windows, you do not need to purchase any separate software. Instructions for downloading information to Windows' HyperTerminal are provided below.

If you are already using another type of communication or terminal emulation software package it is not necessary to use HyperTerminal. Use your communications package to set up the computer to receive data with 8 data bits, 1 stop bit and no parity at the desired baud rate. Refer to the manual, provided with your software, for specific details.

Once the data have been transferred to HyperTerminal, it must be saved to a floppy disk or a hard disk. In order to manipulate the data you must import the data either as a text file into a spreadsheet, where it may be parsed and converted to numeric data, or into a text editor or word processor where it may be viewed and edited.

Refer to the computer setup options to determine the baud rate, as this value will depend on the computer. MicroFID's baud rate can be set from 1200 to 19200 to match the computer's setting.

The instructions below will provide you with the most basic information for using MicroFID with communications software. Please refer to the software user's manual for specific details of operation.

If you are using Microsoft Windows you do not need to purchase any separate software. You can use the HyperTerminal program that is shipped with Windows.

In order to use these instructions, you must be familiar with Microsoft Windows and it must be installed and running on your computer. These instructions are based on HyperTerminal Version 1.1.

NOTE: *As newer versions of HyperTerminal and Windows are released, the exact names and contents of dialog boxes may change. Use these instructions as a general guideline.*

To initiate communications between MicroFID and Windows:

1. Turn MicroFID off.

NOTE: *You must turn the instrument off before connecting or disconnecting the printer cable.*

2. MicroFID must be connected to a serial port. Use the printer cable (Part No. MX396051) to connect MicroFID to one of the computer's serial ports. Remember which serial port you are using as you will need this information when you set up HyperTerminal. Normally you will use Com1 or Com2.
3. If the MicroFID printer cable plugs directly into the port on the computer without the gender changer or the 9 to 25 pin adapter, you are most probably connected to a parallel port. You will need at least one of the adapter cables to connect MicroFID to a serial port. To communicate with a parallel port, you will need to use the serial to parallel converter (Part No. MX380145).
4. Once all connections have been made, turn on the computer and the instrument.
5. Start Windows and then start the HyperTerminal. HyperTerminal will most likely be in the may be in the Accessories Program Group. Its location will depend on how you have set up Windows. Refer to your Windows documentation for details.

6. HyperTerminal may prompt you to connect a modem. You do not need a modem for this application, so press No, to close the pop up window.
7. The Connection Description dialog box will open. Enter the instrument name and select an icon. If you choose to save the session after you have completed downloading the data, this icon will then appear in the HyperTerminal group.

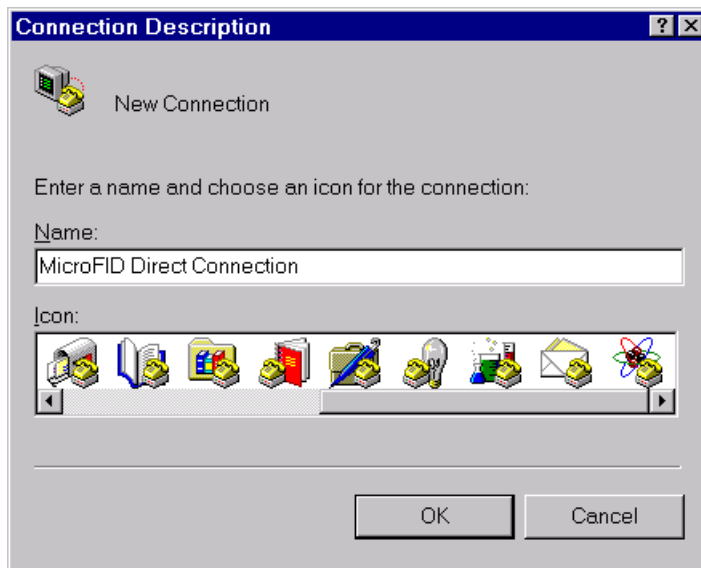


Figure 13 Connection Description Dialog Box

8. Press OK to accept the information.
9. The Connect To dialog box opens next. Select the serial port to which you connected MicroFID Press OK to move to the next dialog box.



Figure 14 **Connect To Dialog Box**

10. The current properties of the selected serial port will be displayed. Enter 9600 as the baud rate (bits per second). This sets the baud rate at which the computer will receive data from MicroFID.

NOTE: *The baud rate setting of 9600 is being used here as an example. In order for this setting to work, your computer serial port must be set to send/receive at 9600 baud. If your computer serial port is set to send/receive at a different baud rate, set the Speed command and MicroFID accordingly.*

11. On MicroFID the number of data bits has been fixed at 8, stop bits has been fixed at 1. Parity has been set at None and the Flow control is Xon/Xoff. Enter these values and then press OK.

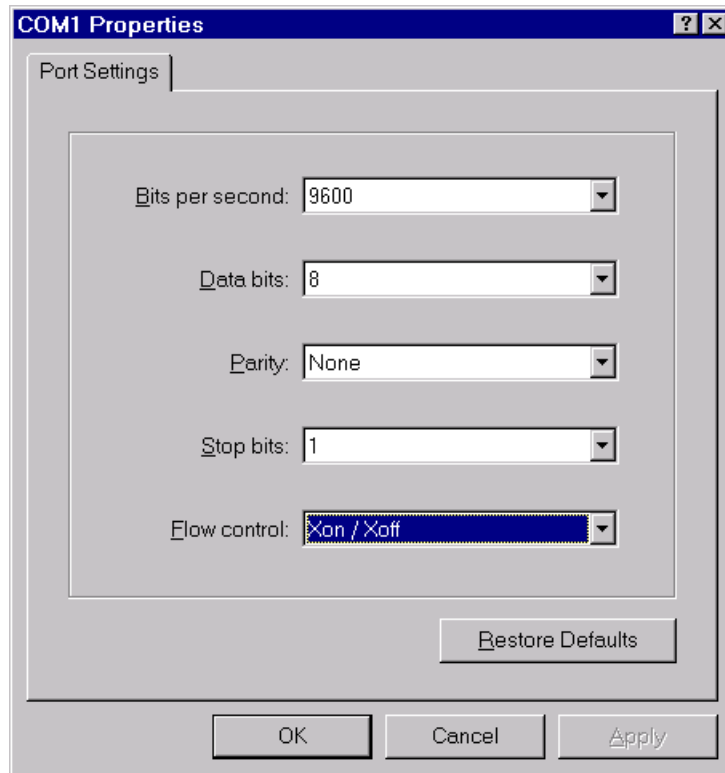


Figure 15 Properties Dialog Box

12. Select the correct Baud Rate, Data Bits, Stop Bits, Parity. Select Xon/Xoff for the Flow Control option. Leave the Parity Check and Carrier Detect options off. Select OK to close the dialog box and accept the settings.
13. Open the Transfer menu and select Capture Text. A "Capture Text" dialog box will appear. Type in the desired path and filename for the data that are to be downloaded. Ensure the path is correct.

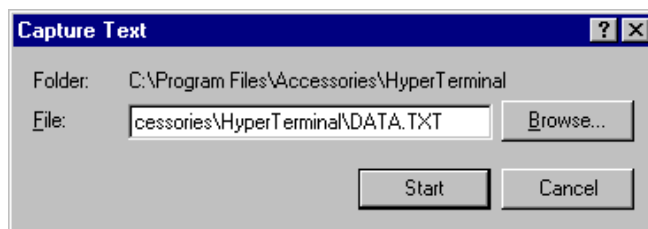


Figure 16 Properties Dialog Box

14. Ensure the file name has a .txt extension. The .txt extension will make it easier to use the downloaded data later.
15. Press Start. Select the Table Format option and then select OK. At the bottom of the screen the message, "Receiving Data" is displayed.
16. On MicroFID, ensure the same baud rate is entered under the PRINT key. The number of Data Bits has been fixed at 8, the number of Stop Bits is fixed at one. Parity has been set to none. The settings in the Properties dialog box must match these settings.
17. Press the MicroFID PRINT or GRAPH key. Press SETUP (*) and set the start and stop run numbers. Press ENTER (on MicroFID). The logged data will begin to appear on the computer screen. It will be saved to the specified file as it appears on the screen.
18. To terminate communications select Stop from the bottom of the screen. This will close the text file.

The logged data can now be copied or cut to the Windows Clipboard and pasted into a text editor, such as Windows' Notepad, or into a spreadsheet for analysis.

Refer to the Microsoft Windows User's Guide for detailed instruction on operation of HyperTerminal.

Chart Recorder

MicroFID's output can be displayed as a 0 to 1 volt analog voltage on a chart recorder in real time.

NOTE: *MicroFID is not classified for use in hazardous locations with a chart recorder.*

To connect MicroFID to a chart recorder:

1. Set the chart recorder to 1 volt full scale.
2. Turn MicroFID off and connect the analog output cable (Part No. MX396052) to the I/O port.
3. Connect the analog output cable to the chart recorder.
4. Turn MicroFID on.

The analog output has been fixed at 50000 ppm as full scale.

Gas Sampling Bag

A gas sampling bag is required for calibration of MicroFID. If you are unsure of the quality of ambient air you should use an additional gas bag filled with zero air. Connect the sample bag to the inlet fitting with the gas bag adapter. See *Calibration* on page 65 for details.

One sampling bag is included in the calibration kit. Additional gas bags are also available (Part No. MX396017).

Charcoal Filters

A charcoal filter (Part No. MX396021 or MX396022) may be connected to MicroFID during calibration to provide clean air to MicroFID. The filter will remove hydrocarbon contamination from room air to provide zero grade air to MicroFID.

NOTE: *The charcoal filter does not filter methane or ethane. If these compounds are present, you should use a gas bag with a supply of commercial zero air.*

To connect a charcoal filter:

1. Load the Teflon ferrules into the nut. The nut and ferrules are supplied with the filter. See *Figure 17*.
2. Connect the nut to MicroFID's inlet. Do not tighten the nut.

Over-tightening the Teflon ferrules will result in damage to the ferrules.

CAUTION

3. Remove the charcoal filter from its plastic bag and insert it into the nut. Finger-tighten the nut onto the inlet. If the filter is not secure, ensure you have inserted the tube stub far enough into nut. Do not over-tighten the fitting.

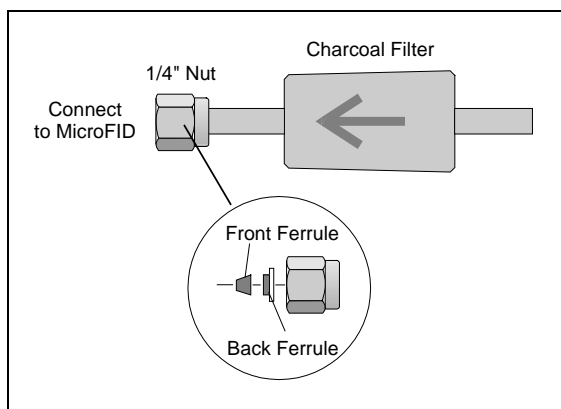


Figure 17 **Connecting Charcoal Filter**

The charcoal filter will remove hydrocarbon contaminants for up to 4000 ppm hours. This means that the filter will be good for 1 hour

removing 4000 ppm of hydrocarbon contaminants or will last for 4 hours removing 1000 ppm. The exact time will be determined by the operating environment. You will notice an increased hydrocarbon background when the filter requires replacement.

To replace the charcoal filter:

1. Loosen the nut on MicroFID's inlet.
2. Remove the used filter.
3. Insert the new charcoal filter into the nut and finger-tighten the nut onto the inlet. Do not over-tighten the fitting.

When the charcoal filter is not in use, place it in its plastic bag and store it in a clean, dry place.

Installing the Coalescing Filter

To install the Coalescing filter:

1. Load the Teflon® ferrules into the nut. The nut and ferrules are supplied with the filter.
2. Connect the nut to MicroFID's inlet. Do not tighten the nut.

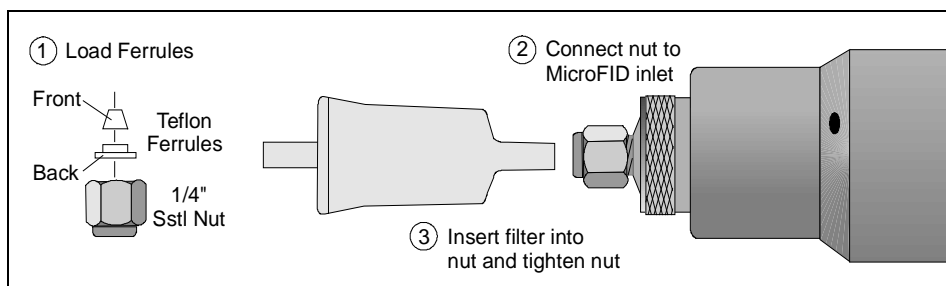


Figure 18 **Connecting the Coalescing Filter**

3. Remove the filter from its plastic bag and insert it into the nut.
4. Finger-tighten the nut onto the inlet. If the filter is not secure, ensure you have inserted the tube stub far enough into nut. Do not over-tighten the fitting.

Over-tightening the Teflon ferrules will result in damage to the ferrules.

CAUTION

5. Calibrate all Cal Memories, that you are using, before continuing operation.

The coalescing filter will remove particulates for up to 5 days of operation. The exact duration will be determined by the operating environment. MicroFID's inlet flow rate and sensitivity decrease when the filter is full.

Serial to Parallel Converter

This device allows MicroFID, which is only capable of serial communication, to communicate with a parallel device. This will be most useful for printing, as most printers utilize parallel communication. Your printer must have a print width of at least 65 characters and a proportionally spaced font.

DIP Switch Settings

The DIP switch settings are very important and must be set correctly in order to correctly communicate with MicroFID. MicroFID will always be the serial device so the data flow direction will be serial to parallel.

To configure the serial port of the converter:

1. Locate the DIP switches located on the side of the converter.

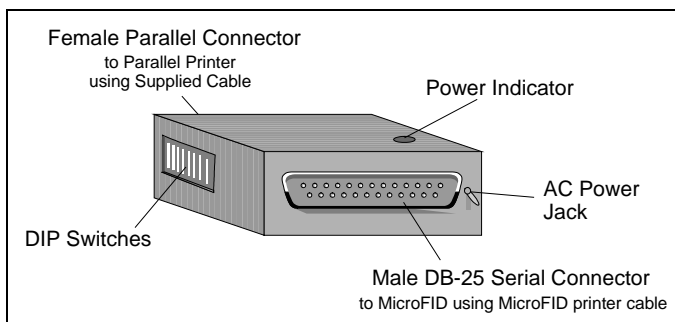


Figure 19 Serial to Parallel Converter

2. Determine the baud rate at which the converter will be receiving data from the instrument. The value you set here must match the value you enter on MicroFID.
3. Use the first three DIP switches to set the baud rate. See *Table 5*.
4. Switch 4 sets the data bits. Off = 7 Bits. On = 8 Bits. Set the data bits to 8.
5. Use Switches 5 and 6 to set the parity. Set Parity = none. See *Table 6*.

Baud Rate	SW1	SW2	SW3
38400	On	On	On
19200	Off	On	On
9600	On	Off	On
4800	Off	Off	On
2400	On	On	Off
1200	Off	On	Off
600	On	Off	Off
300	Off	Off	Off

Table 5 DIP Switch Settings for Baud Rate

Parity	SW5	SW6
None	Off	Off
Odd	On	Off
Even	Off	On
Not Used	Off	Off

Table 6 DIP Switch Settings for Parity

6. Switch 7 sets the Handshake mode. Off = Xon/Xoff. On = DTR Mode. Set the Handshake mode to Xon/Xoff.
7. Use switch 8 to set the data flow direction to serial to parallel. Off = Serial to Parallel. On = Parallel to Serial.

8. Check your settings. It is imperative that you have the correct settings or you will be unable to establish communications. Your settings should match those in *Table 7*.

SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
On	Off	On	On	Off	Off	Off	Off

Table 7 **DIP Switch Settings**

Using MicroFID with the Serial to Parallel Converter

NOTE: *MicroFID is not classified for use in hazardous locations with printers or with the serial to parallel converter.*

To connect MicroFID to the serial to parallel converter:

1. Turn MicroFID off.
2. Unplug the converter from the AC outlet.
3. Use the printer cable and suitable adapter (Part No. MX396051) to connect the MicroFID I/O connector to the converter.
4. Connect the parallel cable to the converter and then to the printer. Use the parallel cable supplied with the converter. If this cable is not suitable, see *Serial to Parallel Converter Troubleshooting* on page 127 for the cable requirements.

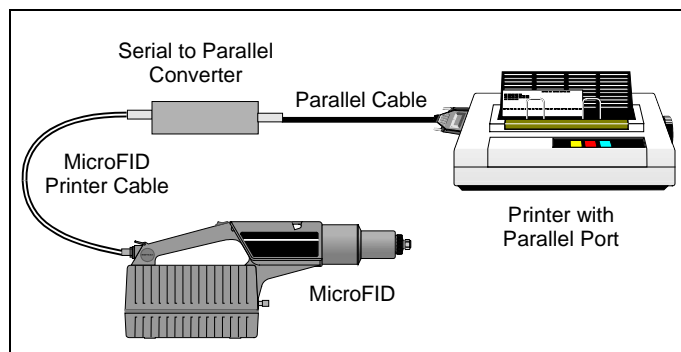


Figure 20 Connecting MicroFID to the Serial to Parallel Converter

5. Plug the converter into an AC outlet.
6. Turn MicroFID on.
7. Ensure the printer has been set up correctly. It must be on-line. Ensure paper is available and has been aligned properly.
8. Press the PRINT or GRAPH key and then the SETUP (*) key to select the desired setup options. See *Tutorial Session* on page 43.

Headset

Use the headset when operating MicroFID in a noisy environment. Audio signals for “LoBatt”, “Alarm” and “NoFlm” will be heard through the headset.

To connect the headset:

1. Turn MicroFID off and remove the dust cap.
2. Connect the headset (Part No. MX396053) to the I/O port and tighten the locking nut.

3. Turn MicroFID on and start the flame. Use the volume control on the headset to adjust the volume.

Bar Code Reader

Connecting the Bar Code Reader

You can use a bar code reader to scan bar coded event names or site locations. Use the bar code reader in Method 21 operation to insert location names into the datalogger. This option may only be used if your sites have been bar coded.

The bar code reader must be used with the bar code reader interface module (Part No. MX396056). You cannot connect the bar code reader directly to MicroFID.

To connect the bar code reader:

1. Turn MicroFID off and remove the dust cap.
2. Connect the interface module to the MicroFID I/O port and tighten the locking nut.
3. Connect the bar code reader to the interface module.

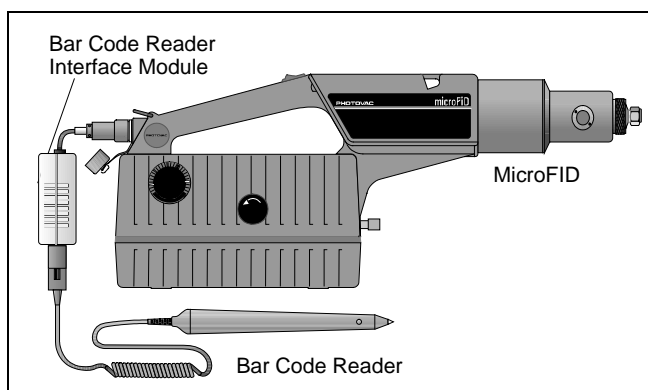


Figure 21 Bar Code Reader and Interface Module

The bar code reader is activated by MicroFID when it is ready to scan a bar code. Operation of the bar code reader is covered in *Bar Code Reader* on page 103.

Replacing the Battery in the Bar Code Reader Interface Module

The bar code reader uses a separate 9 volt battery. Normally, the battery will provide one year of operation. Battery life will depend on usage.

To replace the battery:

1. Remove the four screws in the bottom of the interface unit. Lift the bottom cover off.
2. Remove the 9 V battery and replace it with a new one. The replacement battery must be one of four types: Energizer® No. En22, Kodak® SupraLife, Duracell®, Eveready® Energizer, or Radio Shack® Enercell®. See *Bar Code Reader Control Drawing* on page 152 for details.
3. Replace the bottom cover. The cover incorporates a tongue and groove design. If it does not fit flush, then rotate it 180° and place it on the top cover.
4. Replace the four screws in the bottom cover.

Shoulder Strap

Use the shoulder strap for field operation to facilitate single-handed operation.

To use the shoulder strap:

1. Snap one end of the shoulder strap to the connector on MicroFID's handle. See *Figure 1* for the location of the connectors.

2. Snap the other end to one of the shoulder strap connectors beside the display. The connection point is selectable for right or left handed operation.
3. Adjust the shoulder pad and strap length for comfort.

Long Sample Probe

A two meter (6') extension probe (Part No. MX396018) may be connected to the MicroFID inlet for remote sampling.

If a sampling location is difficult to reach, use the long sample probe. Ensure MicroFID is level. If MicroFID is tilted from side to side, gravity will affect the flame height and cause erroneous readings.

To use the long sample probe:

1. Connect the long sample probe to MicroFID's inlet.
2. To extend the probe, loosen the knurled nut at the top of the wand. Pull the extension out and then tighten the knurled nut down to lock the extension in place.
3. To lengthen the probe further, loosen the lower knurled nut. Pull the second extension out and then tighten the knurled nut down to lock the extension in place.
4. When you are using the probe, allow at least 10 seconds for the sample to travel through the probe and reach the detector.

NOTE: *When using the long probe, be especially careful not to aspirate liquids or solids as they will damage MicroFID.*

5. To reduce the probe, loosen both knurled nuts and push the extensions back into the probe. Tighten the knurled nuts down to lock the extensions in place.



Routine **5**
Maintenance



Battery Charging

A fully charged battery powers MicroFID for approximately 15 hours. If the instrument is to be used for more than 15 hours, carry a spare battery pack (Part No. MX396005 or MX396006). When the first one has been discharged, replace it with the spare. Battery life is reduced if the instrument is turned off and then on again repeatedly.

When the instrument status displays “LoBatt”, the battery pack requires charging. When the “LoBatt” status is displayed, you have a few minutes of operation left. MicroFID will turn itself off before the battery pack becomes critically low.

NOTE: *Do not remove the battery pack in a hazardous location.*

Do not connect the battery charger to MicroFID in a hazardous location.

Upon return from field work, charge the battery packs as outlined in Chapter 1. You will need one charger for each battery pack. Use only the MicroFID battery charger.

You can connect the charger to the battery pack without removing the battery pack from the instrument. If you do not require portable operation, you can use MicroFID while the battery pack is connected to the battery charger

NOTE: *Do not leave battery packs uncharged for an extended period of time. This will result in damage to the battery packs.*

The charger automatically charges at a high charge rate until the battery pack is fully charged. It then maintains the full charge with a low continuous charge rate indefinitely so there is no danger of over-charging. A red LED on the battery pack indicates that the battery is charging. When the LED turns green, the battery is fully charged and ready for use.

NOTE: *Leaving MicroFID for more than 3 months without turning it on may result in the loss of recorded data and setup parameters. If MicroFID is not used for long periods of time, turn the instrument on for a few hours every month to avoid loss of data.*

The battery pack is 57% lead. (Pb) by weight. This battery pack must be disposed of properly. Check with local codes for special disposal instructions.

Emptying the Hydrogen Cylinder

When you transport MicroFID, you should empty the internal hydrogen cylinder and then refill it when you arrive at your destination.

If you are traveling by passenger aircraft, you must empty the cylinder.



WARNING

Do not vent the hydrogen cylinder in a hazardous location. Move to an open, well ventilated area away from possible ignition sources before emptying the cylinder.

Hydrogen gas is a fire and explosion hazard when exposed to heat or flame. The lower explosive limit is 4%.

To empty the cylinder:

1. Turn MicroFID off and open the hydrogen shut-off valve.
2. Remove the battery pack as outlined in Chapter 1.
3. Locate the purge outlet. It is located on the underside of the instrument.
4. Use the MicroFID multi-tool to turn the screw counter clockwise. Loosen the screw but do not remove it.

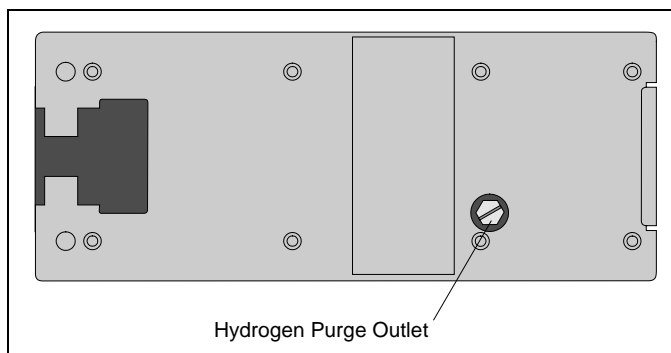


Figure 22 Hydrogen Purge Outlet

5. Leave the instrument so that the purge outlet is facing up. If the purge outlet is facing down, hydrogen will vent into MicroFID's case.
6. If the cylinder is full, it will take approximately 15 minutes to empty.
7. Watch the Contents Gauge. When the cylinder is empty, close the purge outlet. Use the MicroFID multi-tool to turn the screw clockwise.
8. Replace the battery pack as outlined in Chapter 1.

Replacing the Sample Inlet Filter

MicroFID is equipped with a combined dust and water filter to reduce detector contamination. As the filter collects dust, MicroFID's inlet flow rate and sensitivity decrease. The filter will not allow water to pass through, but the filter will not stop all solvents.

NOTE: *Do not aspirate liquid samples with MicroFID!*

Replace the filter on a weekly basis, or more frequently if MicroFID is used in a dusty or wet environment. You must replace the filter if MicroFID has been exposed to liquid water. The pump will sound labored when the filter requires replacement.

NOTE: Do not replace the inlet filter in a hazardous location.

1. Turn the instrument off. Unscrew the filter housing from the detector housing. Be careful not to lose the O-ring seal. See *Figure 23*.

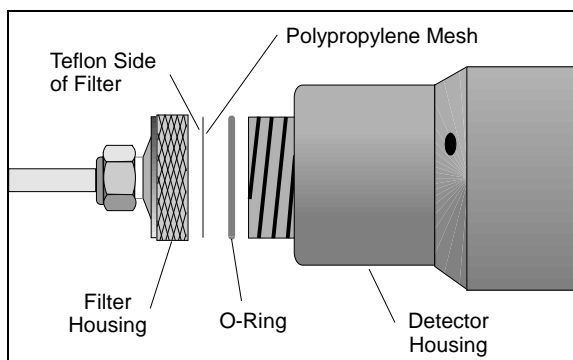


Figure 23 **Inlet Filter**

2. Remove the Teflon/Polypropylene filter and install the new filter (Part No. MX396020 or MX396015). Place the filter in the filter housing with the Teflon side facing down in the filter housing and the mesh side facing the MicroFID. Handle the filter disk only by the edges. The mesh may be damaged or contaminated by excessive handling. Use forceps if possible.

NOTE: Each filter is protected by a piece of blue plastic. Remove the plastic before installing the filter in MicroFID.

3. Replace the filter housing.
4. Calibrate all Cal Memories, that you are using, before continuing operation.

NOTE: Do not operate MicroFID without an inlet filter.

Troubleshooting **6**



General Information

If you have a service related question about MicroFID, consult this manual first. If you cannot find the answer in this documentation, contact the Service Department.

When you call you should have your MicroFID in front of you. You should also have this manual at hand.

Lastly, please have the following information ready:

1. A description of what happened and what you were doing when the problem occurred.
2. Any corrective action that has been taken.
3. The exact wording of any messages that appeared on the display.

NOTE: *Do not service MicroFID in a hazardous location.*

MicroFID Fault Messages

When the “Check” status is displayed, MicroFID’s operation is compromised. Press the TUTOR key for a two-line description of the fault. One exception is the flame out fault. When a Flame out fault occurs, the instrument status changes to “NoFlm”.

Fault: Detector flame has gone out.

Cause: The hydrogen gas has run out.

Action: Ensure the shut-off valve is open.

Action. Check the hydrogen Contents Gauge on the side of the instrument and refill the hydrogen cylinder if necessary. See *Filling the Hydrogen Cylinder* on page 33.

Action: Ensure the cylinder purge outlet has been closed. See *Emptying the Hydrogen Cylinder* on page 110.

Cause: Oxygen supply is deficient.

Action: Ensure there is an adequate supply of oxygen, If you are sampling very high concentrations it is possible you are sampling above the flame out concentration. The flame out concentration for methane is approximately 52,000 ppm (5.2% methane in air).

A minimum of 17% oxygen is required to start the hydrogen flame. The oxygen is supplied from the sample as it is drawn in by the pump. A minimum of 10% oxygen is required to maintain the hydrogen flame

Flame out may also occur when sampling enclosed or confined spaces where vapors and gases cannot escape. Watch for indications of increased flame height such as erratic readings or sudden high concentrations followed by a flame out fault.

If you will be using the MicroFID in a highly contaminated area where it is possible that the oxygen content is below 10%, watch for indications of reduced flame height such as lowered detection limits or a flame out fault.

Cause: High concentrations of flammable gases (gases within their flammable range) are present. High concentrations of flammable gases can act as an additional fuel source. When this happens, the flame height may increase beyond the confines of the combustion chamber. The hydrogen supply will then be cut off and the flame will go out.

Action: Move to a location where there is an adequate supply of air and restart the flame. See the information above. Watch for indications of increased flame height such as erratic readings

or sudden high concentrations followed by a flame out fault.

Cause: Exhaust port is blocked.

Action: At low temperatures, water vapor, a by-product of the hydrogen flame, may condense at the exhaust port. At sub-zero temperatures the water vapor will freeze and obstruct the exhaust port. If the exhaust port becomes obstructed, pump operation will be inhibited. Flame out may also result. Operate MicroFID within the operating temperature range 5 to 40°C (41 to 104°F).

Action: The flame arrestor has become plugged. Contact the Service Department.

Cause: Sample line is blocked.

Action: Ensure the sample line is not obstructed in any way. If you are using the long sample probe, ensure flow is maintained through the entire length of tubing.

Cause: Inlet filter is plugged.

Action: Replace inlet filter. See *Replacing the Sample Inlet Filter* on page 111.

Fault: Signal from zero gas is too high.

Cause: Contamination of sample line or fittings before the detector.

Action: Clean or replace the sample line or the inlet filter. See *Replacing the Sample Inlet Filter* on page 111.

Cause: Span gas and zero air mixed up.

Action: Ensure clean gas is used to zero MicroFID. Mark the calibration and zero gas bags clearly.

Cause: Ambient air is contaminated.

Action: If you are unsure about the quality of the ambient air, use a charcoal filter or a supply of commercial zero grade air.

Cause: Hydrogen supply is contaminated

Action: Hydrogen may react with the carbon, in the steel, inside the tank to produce methane. This will only occur if the cylinder is in poor condition and if the hydrogen has a high moisture content. Replace the hydrogen tank. Empty and refill the MicroFID internal cylinder with fresh hydrogen.

Fault: Signal from span gas is too small.

Cause: Span gas and zero air mixed up.

Action: Ensure calibration gas is used to calibrate MicroFID. Mark the calibration and zero gas bags clearly.

Action: Ensure the span gas is of a reliable concentration.

Fault: Detector field voltage is low

Cause: Internal fault in the electronics.

Action: Contact the Service Department.

Troubleshooting

Problem: No instrument response detected, yet compounds are known to be present.

Cause: MicroFID has not been calibrated properly.

Action: Ensure calibration gas is of a reliable concentration and then calibrate the instrument as outlined in Chapter 3. After the instrument has been calibrated, sample the bag of calibration gas. A reading equivalent to the calibration gas should be displayed. If not, contact the Service Department.

Action: When calibrating MicroFID, ensure the instrument is level. If MicroFID is tilted side to side, gravity will affect the flame height and cause erroneous readings. See *CAL Key* on page 53.

If a sampling location is difficult to reach without tilting the instrument, use the long sample probe to reach the sample and ensure MicroFID is level.

Cause: Background contamination from the hydrogen.

Action: It is possible that the hydrogen has become contaminated and is contributing a high background signal. If the hydrogen supply tank is more than 6 months old it should be replaced with a new cylinder. When ordering hydrogen specify ultra high purity hydrogen, 99.999% pure. Empty the MicroFID hydrogen cylinder and then refill it with hydrogen from a new tank.

Cause: There is an undetermined problem.

Action: Contact the Service Department.

Problem: Date and time settings are not retained.

Cause: MicroFID has not been used for 3 months or more and the internal battery (not the external battery pack) has been discharged.

Action: Turn MicroFID on and allow it to run until a “LoBatt” status appears. This will take approximately 15 to 16 hours. Remove the battery pack and recharge it overnight. Repeat this procedure for 3 or 4 days. While MicroFID is running the internal battery is charging.

Problem: Cannot fill the internal hydrogen cylinder to 1800 psig.

Cause: Supply tank has less than 1800 psig of pressure.
You can only fill the internal cylinder to a pressure of less than or equal to the tank pressure.

Action: Fill the internal cylinder to the pressure of the tank or replace the tank with a full one.

Cause: The hydrogen purge outlet is open.

Action: Close the outlet and fill the cylinder. See *Emptying the Hydrogen Cylinder* on page 110 for details.

Cause: There is a problem with the refill adapter.

Action: Contact the Service Department.



DO NOT modify or disassemble the refill adapter! If you have any problems, the unit must be returned for repair or replacement.

WARNING

Problem: Instrument status shows “Over”.

Cause: Rapid change in signal level. The detector electronics have been momentarily saturated.

Action: Wait a few seconds for the status to return to “Ready”.

Cause: The detector has become saturated.

Action: Move MicroFID to a location where it can sample clean air. Sample zero air until the reading stabilizes around 0. If you were using Low Range, switch to High Range. Calibrate the Cal Memory you were using when the “Over” status appeared.

Action: If you were using High Range, there may be an electronic problem. Contact the Service Department.

Problem: Display contrast bars are on or display is blank

Cause: Battery pack is critically low.

Action: Recharge battery pack or connect MicroFID to the battery charger.

Cause: The battery pack is not connected to the instrument properly.

Action: Ensure the battery pack has been aligned correctly. Ensure the battery pack is secured by the retainer at the rear of the instrument. Check the screws holding the battery pack to the instrument. See Chapter 1.

Problem: Sample flow rate varies from 600 ml/min. +/- 10%.

Cause: Inlet filter has not been installed.

Action: Install an inlet filter into the inlet filter cap. See *Replacing the Sample Inlet Filter* on page 111.

Cause: Inlet filter cap has not been tightened onto the detector cap.

Action: Finger-tighten the filter cap. See *Replacing the Sample Inlet Filter* on page 111.

Cause: Inlet filter is plugged.

Action: Replace the inlet filter See *Replacing the Sample Inlet Filter* on page 111.

Cause: Pump has been damaged.

Action: Contact the Service Department.

Cause: Exhaust port is blocked.

Action: At low temperatures, water vapor, a by-product of the hydrogen flame, may condense at the exhaust port. At sub zero temperatures the water vapor will freeze and obstruct the exhaust port. If the exhaust port becomes obstructed, pump operation will be inhibited. Flame out may also result. Operate MicroFID within the

operating temperature range 5° to 40°C
(41° to 104°F).

Action: The flame arrestor has become plugged.
Contact the Service Department.

Problem: Flame will not ignite.

Cause: The hydrogen gas has run out.

Action: Ensure the shut-off valve is open.

Action. Check the hydrogen contents gauge on the side of the instrument and refill the hydrogen cylinder if necessary. See *Filling the Hydrogen Cylinder* on page 33.

Action: Ensure the hydrogen purge outlet is closed. See *Emptying the Hydrogen Cylinder* on page 110. Refill the hydrogen cylinder if necessary. See *Filling the Hydrogen Cylinder* on page 33.

Cause: Oxygen supply is deficient.

Action: Ensure there is an adequate supply of oxygen, Do not attempt to ignite the flame in a location where there is greater than 10,000 ppm methane or the equivalent concentration of a flammable gas. Move to a location where there are lower concentrations and start the flame and then begin sampling higher concentrations.

If the flame goes out while you are sampling very high concentrations, it is possible that you are sampling above the flame out concentration. The flame out concentration for methane is approximately 52,000 ppm (5.2% methane in air).

A minimum of 17% oxygen is required to start the hydrogen flame. Oxygen is supplied from the sample as it is drawn in by the pump. A minimum of 10% oxygen is required to maintain the hydrogen flame.

If you will be using the MicroFID in a highly contaminated area where it is possible that the oxygen content is below 10%, watch for indications of reduced flame height such as lowered detection limits or a flame out fault.

Cause: Exhaust port is blocked.

Action: At low temperatures, water vapor, a by-product of the hydrogen flame, may condense at the exhaust port. At sub zero temperatures the water vapor will freeze and obstruct the exhaust port. If the exhaust port becomes obstructed, pump operation will be inhibited. Flame out may also result. Operate MicroFID within the operating temperature range 5° to 40°C (41° to 104°F).

Action: The flame arrestor has become plugged. Contact the Service Department.

Cause: Hydrogen supply lines are full of air.

Action: If MicroFID has not been used for some time, it is possible that the hydrogen supply lines contain air. Fill the hydrogen cylinder and then open the hydrogen shut-off valve. Allow the hydrogen to purge the system for about 5 minutes and then turn MicroFID on and start the flame.

Cause: Hydrogen supply lines are blocked.

Action: Contact the Service Department.

Problem: Liquid has been aspirated.

Cause: MicroFID has been exposed to a solvent that can pass through the Teflon/Polypropylene filter.

Action: Contact the Service Department.

Problem: In Method 21 operation, the next event is not displayed after you have recorded background and sample readings for the current event.

Cause: Duplicate events are present in the datalogger.

Action: Print the contents of the datalogger to ensure the duplicate events are unused. Use the “Delete” option under the EVENT key to remove the duplicate event from the datalogger.

Printer Troubleshooting

Problem: Printer will not print.

Cause: Printer is not connected properly.

Action: Make sure that you have the correct cable for your instrument. Ensure that the printer and instrument cables are properly connected. If you are using the serial to parallel converter ensure the cables are properly connected to the converter, the instrument and to the printer. Turn the converter and the instrument off before connecting the cables.

Cause: Mechanical problem with the printer.

Action: Make sure that the printer is plugged in and turned on.

Action: Make sure that the printer is on-line, as shown on its control panel.

Action: Check the ribbon, the print wheel or cartridge, and the paper supply.

Cause: The serial to parallel converter is not turned on.

Action: Ensure the serial to parallel converter is connected to the AC adapter and the adapter is plugged into an AC outlet. The red LED on the top of the converter will be on.

Cause: Printer cable is not configured correctly.

Action: If you are sure that you have set up your printer is correctly, then you may have to

modify the cable. In order to modify the existing printer cable, the pinout information for the printer connector is required. Refer to the printer user's manual for specific details. The pinouts for the MicroFID printer cable are listed in *Table 8*. If modifying the cable is not possible, take the electrical and pinout information to a computer store where a suitable adapter may be obtained.

I/O Connector (8 pin) Pin #	Signal	MicroFID Printer Cable (DB-25) Pin #
1	Analog	—
2	Audio	—
3	Analog GND	20
4	GND	1 & 7
5	RXD	5
6	TXD	3
7	CTS	2
8	Audio GND	—

Table 8 MicroFID I/O Port Pinouts

Cause: Printer is not configured properly.

Action: Ensure your printer has a print width of at least 65 characters and you are using a proportionally spaced font.

Action: Many printers have a set of configuration (DIP) switches. Generally, these instruments expect these switches to be set in the factory default settings.

Many printers have switches for enabling automatic line feeds when receiving a carriage return. These switches should be set to carriage returns only, which is normally the factory default setting.

Some printers have switches or control panels that enable you to set the printer for different modes, such as sans serif, letter quality, or compressed text. Do not use these controls. If you do use them, you may cause your tabular or graphed output to be printed incorrectly.

The baud rate and parity options on the printer are not used for parallel communication. However, you must ensure the baud rate and parity options on the serial to parallel converter match the settings of your instrument.

Cause: Serial card is installed in the printer.

Action: If a serial card is installed in your printer, you do not need the serial to parallel converter. Disconnect the converter and connect the instrument directly to the printer.

Problem: Data are printed or downloaded correctly at first but become garbled.

Cause: Baud rate may be set too high.

Action: Ensure the baud rate set on your instrument matches the baud rate of the converter.

Action: If the baud rate is correct it is possible that the transfer rate is too high and information is being lost. Lower the baud rate of the instrument and the serial to parallel converter (DIP switch settings).

Serial to Parallel Converter Troubleshooting

You must use the correct type of cable to ensure trouble free data transmission. The length of the cable at the parallel side must not exceed 15 feet. On the serial side, use the MicroFID printer cable.

When you are connecting the parallel side of the converter to a Centronics 36 pin, female connector, use a straight wired cable with 36 conductors and a Centronics 36-pin, male connector at each end. This cable is supplied with the converter.

When you are connecting the parallel side of the converter to a Centronics 36 pin, male connector, use a straight wired cable with 36 conductors and a Centronics 36 pin, female connector at one end and a Centronics 36-pin, male connector at the other end.

If you are connecting the parallel side of the converter to a female DB-25 pin connector use a straight wired cable with a DB-25 pin, male connector on one end and a 36-pin, Centronics, male connector on the other end. The pin assignments for all parallel port signals are listed below.

Pin #	Name	I/O Parallel to Serial	I/O Serial to Parallel
1	/Strobe	In	Out
2-9	Data0-Data7	In	Out
10	/Acknlg	Out	Not Used
11	Busy	Out	—
12	PE	Pull Low	Pull High
13	Select	Pull High	Pull Low
14	/Auto FF	Not Used	Not Used
15	NC	Not Used	Not Used
16	Ground	—	—
17	NC	Not Used	Not Used
18	NC	Not Used	Not Used
19-30	Ground	—	—
31	/Init	Not Used	Out
32	/Error	Pull High	Pull High
33	Ground	—	—
34	NC	Not Used	Not Used
35	NC	Not Used	Not Used
36	/Slct In	Not Used	Not Used

Table 9 Parallel Port Signals

The pin assignments for all serial port signals are listed below.

Pin #	Name	I/O Parallel to Serial	I/O Serial to Parallel
1	Frame Gnd	—	—
2	TXD	Out	Out
3	RXD	In	In
6	DSR	In	—
7	GND	—	—
20	DTR	—	Out

Table 10 Serial Port Signals

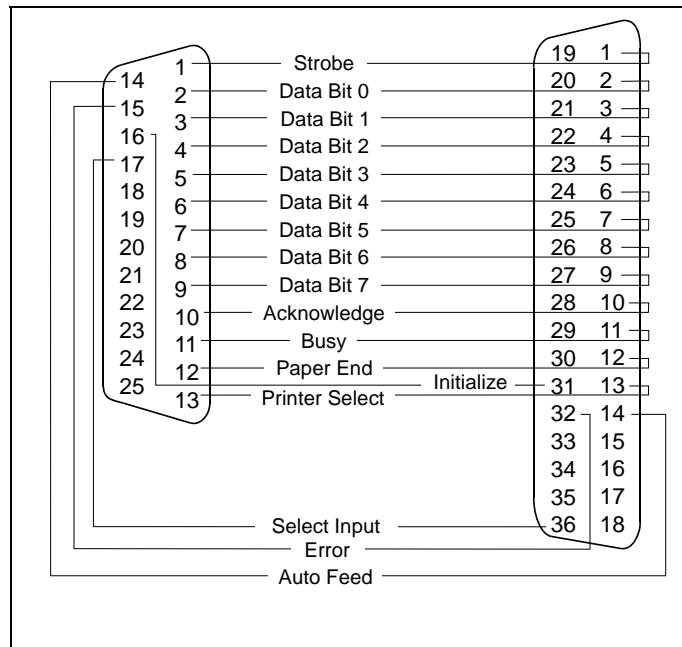


Figure 24 Parallel Port Signals

Establishing Computer Communications

If, after having followed the procedure in *Computer* on page 88, communications cannot be established with a computer, the problem may lie with the hardware connections or the printer cable configuration.

To connect MicroFID to your computer:

1. Ensure MicroFID is connected to the serial port of the computer.

The serial port will usually be a male connector, typically 9 pins on most computers. The serial port may also be a 25 pin connector on computers

The 25 (or more) pin female connector is usually a parallel port. However, there are exceptions to this rule. MicroFID cannot be connected to a parallel port unless you are using the serial to parallel converter.

If you do not have a free serial port on you computer and you want to connect MicroFID to the parallel port you will need the serial to parallel converter. Connect MicroFID to the serial port on the converter and then connect the printer to the parallel port. If the port on computer is anything other than a female, 36-pin Centronics connector you will need an adapter in order to use the cable supplied with the converter. See *Serial to Parallel Converter* on page 98 for more details.

2. Ensure the cable being used is compatible with the device.

A computer with a 9 pin serial connector will first require a null modem to switch pins 2 and 3. Next a gender changer that converts the male DB-25 connector on the printer cable from male 25 pins to female 9 pins is required. These two adapters have been combined into one, which is supplied with the MicroFID printer cable.

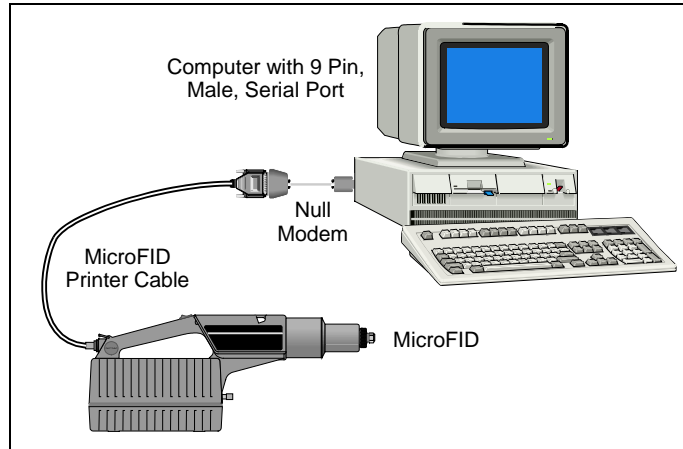


Figure 25 Connecting MicroFID Using the Null Modem Cable

A computer with a 25 pin serial port should not require a null modem but will require a gender changer. A gender changer will convert the male DB-25 connector on the printer cable to a female connector. A gender changer is supplied with the MicroFID printer cable.

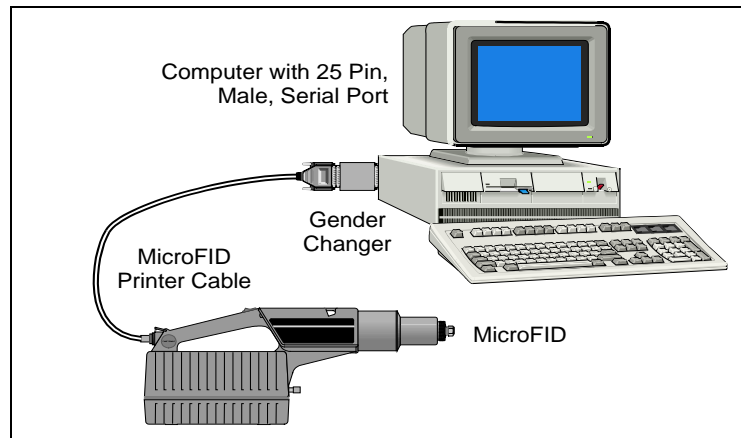


Figure 26 Connecting MicroFID Using the Gender Changer Cable

The pin definitions of interest are listed in *Table 11*. Only pins 2 and 3 are shown since these are the problem pins:

Pin #	MicroFID	9-pin	25-pin
2	RXD	RXD	TXD
3	TXD	TXD	RXD

Table 11 Pin Definitions

Pins 2 and 3 should be mismatched between MicroFID and the computer. Ensure this is the case. It is also possible that the cable being used may switch pins 2 and 3, even if it is not necessary. The cable may be a null modem.

3. Ensure all hardware is working properly.

Use a printer to test both MicroFID and the computer. Connect MicroFID to the printer and ensure that this arrangement produces the desired results. If the correct printout is obtained, then the MicroFID and the printer cable are okay.

Now connect the computer to the printer and ensure this works. If the desired printout is obtained this ensures the computer is sending data correctly.

Technical 7
Description



Flame Ionization Detector

The MicroFID uses a flame ionization detector for the measurement of combustible organic compounds in air at parts-per million levels. The permanent air gases (argon, carbon dioxide, nitrogen, oxygen, water vapor, etc.) are not ionized by the flame.

When MicroFID is turned on, the display prompts you to turn on the hydrogen. The internal pump draws air in through MicroFID's inlet. This sample air provides the oxygen necessary for combustion in the hydrogen fed flame.

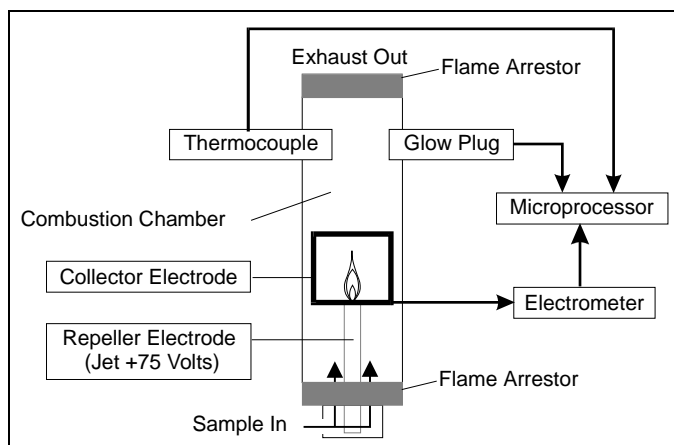


Figure 27 Flame Ionization Detector

When the proper ratio of hydrogen to air is present in the combustion chamber, the flame is started automatically with a glow plug. A thermocouple is used to monitor the status of the flame.

When the sample passes through the flame the combustible organic compounds in the sample will be ionized. After the compounds have been ionized by the flame, the ionized particles are subjected to a continuous electric field between the repeller electrode at the jet (+75V) and the collector electrode.

The ions move in the electric field, generating a current, which is proportional to the concentration of the ionized molecules in the ionization chamber. An electrometer circuit converts the current to a voltage that is then fed to the microprocessor.

After the sample passes through the flame and has become ionized it is vented from the detector through a flame arrestor. The flame arrestor prevents the flame from igniting any flammable gases present in the sampling location.

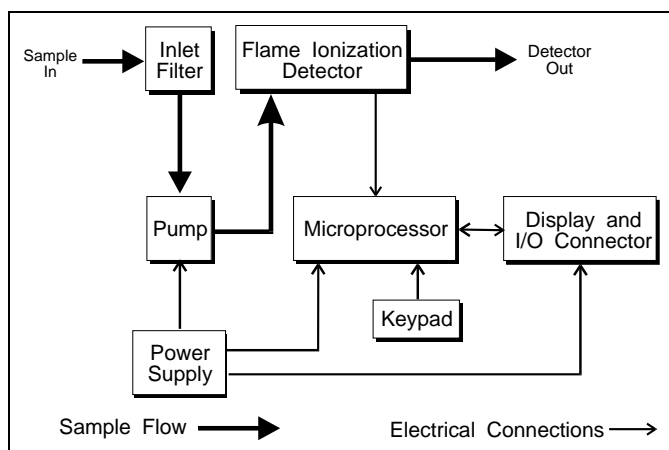


Figure 28 Block Diagram

Detector Response

MicroFID is strictly an organic compound detector. It does not respond to inorganic compounds. MicroFID's sensitivity is highly dependent on chemical structure and bonding characteristics. The combustion efficiency of a compound determines its sensitivity.

Simple saturated hydrocarbons (methane, ethane etc.) possess high combustion efficiencies and are among the compounds that produce the highest MicroFID response. Organic fuels (acetylene, refined petroleum products), burn easily and are also extremely well detected.

The presence of substituted functional groups (amino, hydroxyl, halogens) on a simple hydrocarbon reduces its combustion efficiency and thus MicroFID's sensitivity to the compound. Methanol and chloromethane, for example are detectable with MicroFID but not as well as methane. A greater number of carbon atoms can offset this loss of sensitivity due to substitution. For example, MicroFID is more sensitive to n-butanol than it is to methanol. See *Response Factors* on page 148 for a list of the response factors of compounds detectable with MicroFID. The information in this list is not a complete list of detectable compounds. Contact the Applications Group for more information.

Calibration

Periodic calibration is required to compensate for FID output changes due to inlet filter restriction, ionization chamber cleanliness, sample pump wear and other factors.

During calibration, MicroFID is first exposed to zero air. A small signal is generated. This zero signal is stored by the microprocessor.

MicroFID is next exposed to span gas. This span gas signal is stored by the microprocessor. The microprocessor subtracts the zero signal from the span gas signal and divides the difference by the user-entered span gas concentration. The resulting sensitivity is stored in the selected Cal Memory with the zero signal and the alarm level. This number is then multiplied by the response factor and displayed.

In High Sensitivity or sniff operation, you calibrate MicroFID with zero gas only. The microprocessor subtracts the zero signal from the MicroFID signal, and multiplies the difference by 1000. This number is then displayed.

MicroFID readings are always relative to the calibration gas. After calibration with methane, MicroFID will respond directly in units equivalent to methane. Almost all combustible organic compounds will be detected by MicroFID. It cannot distinguish between methane and other ionizable compounds. A reading of 10 ppm indicates all ionizable compounds that are present have generated

an ion current proportional to 10 ppm of methane. The reading is actually 10 ppm methane equivalent units. MicroFID readings give an indication of the total ionizables present and their concentration relative the calibration gas.

Datalogging

Interval Operation

The microprocessor accumulates all readings in an averaging interval, that you select, and determines the minimum, average and maximum readings. It stores these numbers along with the highest priority instrument status and the most recent time, date and Event that occurred during the interval. MicroFID records these results when the datalogger is turned on. The number of events that are stored in the datalogger will depend on the averaging interval you have selected.

These recorded data can now be played back on MicroFID's display. The display is identical to the numeric or bar graph display, but the instrument status is "Play" indicating that recorded data, not real-time data, are being displayed. During playback MicroFID continues to analyze and record new data.

Recorded data can also be printed as either a table or a graph. For each averaging interval, MicroFID prints the minimum of all the minima, the average of all the averages and the maximum of all the maxima.

Method 21 Mode

In Method 21 operation you log data manually. You must program a monitoring schedule into the instrument and then monitor sites according to the Method 21 documentation.

The Method 21 option first prompts you to locate a specific sampling site and then allows you to record both a background and sample entry in the datalogger. MicroFID stores these numbers along the difference between sample and background, the highest priority instrument status and the most recent time, date and Event name.

Recorded data can now be played back on MicroFID's display. The instrument status is "Play" indicating that recorded data, not real-time data, are being displayed.

Recorded data can also be printed as either a table or a graph. The difference between the sample and background is calculated and shown on the print and graph output.



Appendices **8**



Specifications

Size:	43.5 cm (17.1") long, 9.8 cm (3.85") wide, 18.8 cm (7.4") high
Weight:	3.7 kg (8.1 lb.)
Detector:	Flame ionization
Keypad:	16-key silicone with tactile feedback
Display:	2-line, 16-character dot-matrix, liquid crystal, for alphanumeric and bar graph readouts
Datalogger memory:	30 kilobytes or 750 entries
Chart recorder output:	0 to 1 volt full scale
Serial output:	RS-232, 1200-19200 baud with no parity, for tabular and graphic printouts and connection to an IBM compatible computer
Audio output:	On Alarm, LoBatt and NoFlm
Inlet connection:	1/4" stainless steel compression fitting
Battery type:	Sealed lead-acid, field-replaceable pack
Battery pack lead content:	57% Lead (Pb) by weight.
Charge/discharge time:	8 hr/15 hr
Battery charger:	Automatically charges and maintains full charge in battery pack
Hydrogen cylinder	

capacity:	9.2 liters at 1800 psig
Hydrogen cylinder discharge time:	12 hours
Materials in sample stream:	Stainless steel, Teflon®, Viton®, polypropylene, PEEK, nitrile chorobutadiene rubber
Inlet filter:	Replaceable 1 µm Teflon/Polypropylene,
Inlet flow rate:	600 mL/min. +/- 10%
Operating temperature range:	5° to 40°C (41° to 104°F)
Storage temperature range:	5° to 40°C (41° to 104°F)
Operating humidity range:	0 to 100% relative humidity (non-condensing)
Operating concentration range:	0.5 to 2000 ppm methane equivalent (Low Range), 10 to 50,000 ppm methane equivalent (High Range)
Accuracy:	Methane: (after calibration with zero air and 500 ppm methane span gas): within +/-0.5 ppm or +/-10% of actual methane concentration. (0.5 to 2000 ppm range)
Precision:	+/-0.3 ppm or +/-5% (0.5 to 2000 ppm methane range) and +/-3 or +/-5% (10 to 50000 ppm methane range)
Response time:	Less than 3 seconds (to 90% of full scale response)
Detection limit:	0.5 ppm methane

Warranty

MicroFID is warranted for one year against defects in materials and workmanship.

PerkinElmer warrants that its manufactured product will be free from defects in materials and workmanship for a period of one (1) year from the date of receipt by the Customer. This may be voided if, in the opinion of PerkinElmer, the product has been abused or treated in a negligent manner so as to cause damage or failure. Negligent use includes, but is not limited to, exposure of the internal parts of the equipment to water. Damage caused thereby is expressly excluded from this Warranty. Consumable supplies and parts routinely replaced are not warranted.

PerkinElmer and its vendors disclaim any implied warranty of merchantability or fitness for a particular purpose. PerkinElmer and its vendors will not be liable for any indirect, special, incidental, or consequential damages, irrespective of whether PerkinElmer or the vendor has advance notice of the possibility of such damages.

PerkinElmer's sole liability under this warranty is limited to the repair or replacement of the product at its Service/Repair facility and return to the Customer.

When PerkinElmer is made aware of a problem, which would be eligible for remedy under Warranty, it will issue a Return Authorization Number to the Customer. No return will be accepted unless such authorization has been obtained. The customer is responsible for insurance and shipping to the designated Service/Repair facility.

Contacting PerkinElmer

To place an order, check the status of an order, obtain current pricing and availability	1-800-762-4002 (US) 1-800-561-4646 (Canada)
Service and repair of your instrument	1-800-762-4002 (US) 1-800-561-4646 (Canada)
Applications Department	1-800-762-4002 (US) 1-800-561-4646 (Canada)
Customer Service	1-800-762-4002 (US) 1-800-561-4646 (Canada)
In the Canada and the USA	PerkinElmer Photovac 761 Main Avenue Norwalk, CT 06859-0010 U.S.A. Tel.: 800-762-4000 or (+1) 203-761-5330 Fax.: (+1) 203-761-4228
In Europe	Photovac Europa Sjælsø Allé 7 A P.O. Box 79 DK-3450 Allerød, Denmark Tel.: +45-48-100-400 Fax.: +45-48-100-401
In all other areas contact your representative.	

Table 12 Contact Information

Installing Alternate AC Plug on the Battery Charger

In most cases MicroFID will be shipped with an AC line cord that will fit the AC wall outlet in your area. If this cannot be done, you may need to obtain an AC line cord suitable for the AC receptacle in your area.

The AC line cord, attached plug and receptacle must be marked with your country's certification mark and the cord must have a Harmonization (HAR) mark.

The line cord must be rated for either 100 to 120 VAC at 60 Hz or 220 to 240 VAC at 50 Hz. The voltage rating will depend on the voltage in your area.

Contact your PerkinElmer representative to obtain more information.

Calibration Gas Supplier

The MicroFID calibration kit includes the following items:

1. Gas pressure regulator to fit a calibration gas cylinder with C-10 5/8"-18 UNF fitting.
2. Gas sampling bag.
3. Gas bag adapter to fit gas bag and MicroFID inlet.

The kit does not include a tank of span gas. The recommended span gas is methane in air. 500 ppm methane in air is available from PerkinElmer (Part No. MX396028).

The exact concentration of calibration gas will be determined by your application. Span gases of various concentrations and compounds may be obtained from:

Scott Specialty Gases Inc.
1290 Combermere Street
Troy, Michigan 48083
Telephone (within the USA): 1-800-774-9447
Telephone (outside USA): (810) 589-2950
Fax: (810) 589-2134

If you order your calibration gas from Scott Specialty Gases Inc., specify a Scotty® V Cylinder.

Response Factors

This list of response factors was determined at (nominally) 500 ppm, based on 500 ppm methane calibration gas. Methane will have a response factor of 1.0. The following formula was used for calculation of the response factors:

$$\text{Response Factor} = \frac{\text{Actual Concentration}}{\text{MicroFID Response}}$$

A response factor less than 1.0 indicates a compound response better than that of methane. A response factor greater than 1.0 indicates a lower response than that of methane.

NOTE: *It does not matter which Cal Memory is selected or which response factor is entered, MicroFID's response is not specific to any one compound. The displayed reading represents the total concentration of all ionizable compounds in the sample.*

When using response factors, results are expected to be accurate to +/- 10 ppm or +/- 25%, whichever is greater.

Compound	Response Factor
Acetaldehyde	6.9 \mathbf{c}
Acetone	2.7 \mathbf{e}
Acetonitrile (Methyl Cyanide)	1.0 \mathbf{c}
Acrolein (2-Propenal)	6.9 \mathbf{c}
Acrylonitrile (Vinyl Cyanide)	1.3 \mathbf{c}
Allyl Chloride (3-Chloro-1-Propene)	2.7 \mathbf{c}
Aniline (Benzenamine)	3.0 \mathbf{L}
Benzene	0.7 \mathbf{c}
Benzyl Chloride (Chloromethyl Benzene)	1.2 \mathbf{L}
Bromoform (Tribromomethane)	7.2 \mathbf{L}
1,3-Butadiene	2.7 \mathbf{c}
iso-Butane	1.8 \mathbf{e}
n-Butane	1.9 \mathbf{e}
n-Butanol	2.6 \mathbf{L}
n-Butyl Mercaptan (Butanethiol)	2.6 \mathbf{L}
Carbon Tetrachloride	25.9 \mathbf{c}
Chlorobenzene	0.8 \mathbf{c}
Chloroform (Trichloromethane)	3.5 \mathbf{L}
Cumene (Isopropyl Benzene)	1.0 \mathbf{L}
Cyclohexane	1.4 \mathbf{c}
1,2-Dichlorobenzene (ortho-)	0.7 \mathbf{L}
cis-1,2-Dichloroethylene	2.6 \mathbf{c}
trans-1,2-Dichloroethylene	2.7 \mathbf{c}
N,N-Dimethylformamide (DMF)	2.3 \mathbf{L}
1,4-Dioxane	4.6 \mathbf{c}
Epichlorohydrin	2.4 \mathbf{L}
Ethane	1.9 \mathbf{e}
Ethanol	5.2 \mathbf{c}

Ethyl Acrylate	2.7 c
Ethylbenzene	1.0 L
Ethyl Cellusolve (2-Ethoxyethanol)	4.3 L
Ethyl Chloride (Chloroethane)	1.9 c
Ethyl Mercaptan (Ethanethiol)	3.7 L
Ethylene	2.2 g
Ethylene Dibromide (1,2-Dibromoethane)	2.0 L
Ethylene Dichloride (1,2-Dichloroethane)	1.7 c
n-Heptane	1.3 L
n-Hexane	1.6 g
Isobutylene	2.2 c
Isoprene (2-Methyl-1,3-Butadiene)	2.2 L
Isopropanol	2.4 L
Methanol	23.8 L
Methyl Bromide (Bromomethane)	3.9 c
Methyl Ethyl Ketone (2-Butanone)	1.9 c
Methyl Isobutyl Ketone	1.9 L
Methyl Methacrylate	2.8 L
Methyl tert-Butyl Ether (MTBE)	2.0 c
Methyl Cellusolve (2-Methoxyethanol)	9.1 L
Methylene Chloride (Dichloromethane)	1.4 c
n-Nonane	1.1 L
iso-Octane (2,2,4-Trimethylpentane)	1.2 L
n-Pentane	1.6 L
Propane	1.8 g
Propionaldehyde (Propanal)	3.6 c
Propylene	2.6 g

Propylene Dichloride (1,2-DCP)	2.0 \mathbf{c}
Propylene Oxide	2.5 \mathbf{c}
Styrene	1.2 \mathbf{l}
1,1,2,2-Tetrachloroethane	1.8 \mathbf{l}
Tetrachloroethylene (Perchloroethylene)	2.9 \mathbf{c}
Toluene	0.9 \mathbf{c}
1,1,1-Trichloroethane	1.4 \mathbf{c}
1,2,4 Trichlorobenzene	1.1
1,1,2-Trichloroethane	1.7 \mathbf{l}
Trichloroethylene (TCE)	2.8 \mathbf{c}
Triethylamine	1.1 \mathbf{l}
Vinyl Acetate	4.4 \mathbf{l}
Vinyl Bromide	1.5 \mathbf{c}
Vinyl Chloride (Chloroethylene)	2.1 \mathbf{c}
Vinylidene Chloride (1,1-DCE)	2.6 \mathbf{c}
ortho-Xylene	1.1 \mathbf{l}
meta-Xylene	1.2 \mathbf{l}
para-Xylene	1.2 \mathbf{l}

Table 13 MicroFID Response Factors

Standards used for determination of these response factors were derived from a variety of sources:

- \mathbf{c} Certified gas cylinder, +/- 2% analytical accuracy
(Isobutylene +/- 5% analytical accuracy)
- \mathbf{c} Standard prepared by dilution of pure gas into zero air,
accuracy unknown
- \mathbf{l} Standard prepared by addition of pure liquid to zero air,
accuracy unknown

Bar Code Reader Control Drawing

1. Intrinsically safe for use in Class I, Division 1, Groups A, B, C, D, Hazardous Locations when used in accordance with control drawing 890047, when powered by Energizer No. EN22, Kodak Supralife, Duracell, Energizer, Radio Shack Enercell, 9.0 V alkaline battery.
2. Read this manual before operating.

3. Sécurité Intrinsèque.?



Substitution of components may impair intrinsic safety.

WARNING



La substitution de composants peut compromettre la sécurité intrinsèque

Avertissement

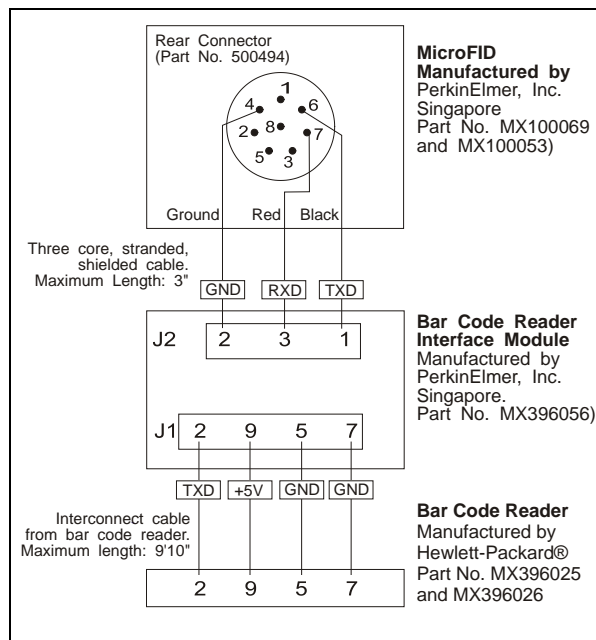


Figure 29 Bar Code Reader Control Drawing 890047

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1. Maslansky, Carol J. and Steven P. Maslansky. *Air Monitoring Instrumentation*. New York: Van Nostrand Reinhold, 1993.
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Handheld PID Monitors User's Guide



Handheld PID Monitors User's Guide

Product Registration

Register your product online by visiting:

<https://www.raesystems.com/customer-care>

By registering your product, you can:

- Receive notification of product upgrades or enhancements
- Be alerted to Training classes in your area
- Take advantage of Honeywell RAE Systems special offers and promotions

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This Manual must be carefully read by all individuals who have or will have the responsibility of using, maintaining, or servicing this product. The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions. The user should understand how to set the correct parameters and interpret the obtained results.

For safety reasons, this equipment must be operated and serviced by qualified personnel only. Read and understand the instruction manual completely before operating or servicing.

AVERTISSEMENT

Pour des raisons de sécurité, cet équipement doit être utilisé, entretenu et réparé uniquement par un personnel qualifié. Étudier le manuel d'instructions en entier avant d'utiliser, d'entretenir ou de réparer l'équipement.

Read Before Operating

This manual must be carefully read by all individuals who have or will have the responsibility of using, maintaining, or servicing this product. The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions. The user should understand how to set the correct parameters and interpret the obtained results.

CAUTION!

To reduce the risk of electric shock, turn the power off before opening this instrument or performing service. Never operate the instrument when the instrument is open. Service this product only in an area known to be non-hazardous.

ATEX WARNING!

To reduce the risk of electrostatic ignition, do not use the instrument without the rubber boot in place.

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WARNINGS

STATIC HAZARD: Clean only with a damp cloth.

For safety reasons, this equipment must be operated and serviced by qualified personnel only. Read and understand instruction manual completely before operating or servicing.

USE ONLY RAE SYSTEMS BATTERY PACKS, PART NUMBERS 059-3051-000, 059-3052-000, AND 059-3054-000. THIS INSTRUMENT HAS NOT BEEN TESTED IN AN EXPLOSIVE GAS/AIR ATMOSPHERE HAVING AN OXYGEN CONCENTRATION GREATER THAN 21%. SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY. RECHARGE BATTERIES ONLY IN NON-HAZARDOUS LOCATIONS.

DO NOT MIX OLD AND NEW BATTERIES OR BATTERIES FROM DIFFERENT MANUFACTURERS.

THE CALIBRATION OF ALL NEWLY PURCHASED RAE SYSTEMS INSTRUMENTS SHOULD BE TESTED BY EXPOSING THE SENSOR(S) TO KNOWN CONCENTRATION CALIBRATION GAS BEFORE THE INSTRUMENT IS PUT INTO SERVICE.

FOR MAXIMUM SAFETY, THE ACCURACY OF THE INSTRUMENT SHOULD BE CHECKED BY EXPOSING IT TO A KNOWN CONCENTRATION CALIBRATION GAS BEFORE EACH DAY'S USE.

DO NOT USE USB/PC COMMUNICATION IN HAZARDOUS LOCATIONS.

AVERTISSEMENT

DANGER RISQUE D'ORIGINE ELECTROSTATIQUE: Nettoyer uniquement avec un chiffon humide.

Pour des raisons de sécurité, cet équipement doit être utilisé, entretenu et réparé uniquement par un personnel qualifié. Étudier le manuel d'instructions en entier avant d'utiliser, d'entretenir ou de réparer l'équipement.

Utiliser seulement l'ensemble de batterie RAE Systems, la référence 059-3051-000 au 059-3052-000 au 059-3054-000. Cet instrument n'a pas été essayé dans une atmosphère de gaz/air explosive ayant une concentration d'oxygène plus élevée que 21%. La substitution de composants peut compromettre la sécurité intrinsèque. Ne charger les batteries que dans emplacements désignés non-dangereuse.

Ne pas mélanger les anciennes et les nouvelles batteries, ou bien encore les batteries de différents fabricants.

La calibration de toute instruments de RAE Systems doivent être testé en exposant l'instrument a une concentration de gaz connue par une procédure diétalonnage avant de mettre en service l'instrument pour la première fois.

Pour une securite maximale, la sensibilité du l'instrument doit être verifier en exposant l'instrument a une concentration de gaz connue par une procédure diétalonnage avant chaque utilisation journalière.

Ne pas utiliser de connection USB/PC en zone dangereuse.

Proper Product Disposal At End Of Life



EU Directive 2012/19/EU: Waste Electrical and Electronic Equipment (WEEE)

This symbol indicates that the product must not be disposed of as general industrial or domestic waste. This product should be disposed of through suitable WEEE disposal facilities. For more information about disposal of this product, contact your local authority, distributor, or the manufacturer

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Caution

This device complies with Part 15 of the FCC Rules / Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Handheld PID Monitors User's Guide

IMPORTANT! BUMP TEST THE MONITOR BEFORE EACH DAY'S USE

Prior to each day's use, every gas detection monitor should be bump tested to confirm the response of all sensors and activation of all alarms by exposing the monitor to a concentration of target gas that exceeds the low alarm set point. A bump test is also recommended if the monitor has been subjected to physical impact, liquid immersion, an Over Limit alarm event, or custody changes, or anytime the monitor's performance is in doubt.

To ensure greatest accuracy and safety, only bump test and calibrate in a fresh air environment. The monitor should be calibrated every time it does not pass a bump test, but no less frequently than every six months, depending on use and exposure to gas and contamination, and its operational mode.

- Calibration intervals and bump test procedures may vary due to national legislation.
- Honeywell recommends using calibration gas cylinders containing the gas that is appropriate to the sensor you are using, and in the correct concentration.

Special Notes



When the instrument is taken out of the transport case and turned on for the first time, there may be some residual organic or inorganic vapor trapped inside the detector chamber. The initial PID sensor reading may indicate a few ppm. Enter an area known to be free of any organic vapor and turn on the instrument. After running for several minutes, the residual vapor in the detector chamber will be cleared and the reading should return to zero.



The battery of the instrument discharges slowly even if it is turned off. If the instrument has not been charged for 5 to 7 days, the battery voltage will be low. Therefore, it is a good practice to always charge the instrument before using it. It is also recommended to fully charge the instrument for *at least 10 hours* before first use. Refer to this User Guide's section on battery charging for more information on battery charging and replacement.

Handheld PID Monitors User's Guide

1. Standard Contents

- Instrument
- Calibration Kit
- Charger Stand
- AC/DC Adapter
- Alkaline Battery Adapter
- Data Cable
- CD-ROM With User's Guide, Quick Start Guide, and related materials

2. General Information

The compact instrument is designed as a broadband VOC gas monitor and datalogger for work in hazardous environments. It monitors Volatile Organic Compounds (VOC) using a photoionization detector (PID) with a 9.8 eV, 10.6 eV, or 11.7eV gas-discharge lamp. The instrument consists of a PID with associated microcomputer and electronic circuit. The unit is housed in a rugged case with a backlit LCD and 3 keys to provide easy user interface. It also has a built-in flashlight for operational ease in dark locations.

Key Features

Lightweight and Compact

- Compact, lightweight, rugged design
- Built-in sample draw pump

Dependable and Accurate

- Up to 16 hours of continuous monitoring with rechargeable battery pack
- Designed to continuously monitor VOC vapor at parts-per-million (ppm) and/or parts-per-billion (ppb) levels

User-friendly

- Preset alarm thresholds for STEL, TWA, low- and high-level peak values.
- Audio buzzer and flashing LED display are activated when the limits are exceeded.

Datalogging Capabilities

- 260,000-point datalogging storage capacity for data download to PC

3. Physical Description

The main components of the portable VOC monitoring instrument include:

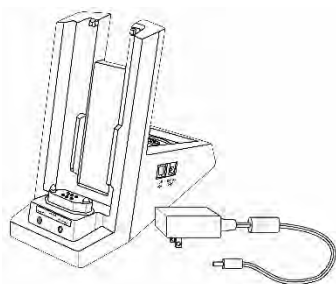
- Three keys for user interaction with the instrument: 3 operation/programming keys for normal operation or programming
- LCD display with back light for direct readout and calculated measurements
- Built-in flashlight for illuminating testing points in dark environments
- Buzzer and red LEDs for alarm signaling whenever exposures exceed preset limits
- Charge contacts for plugging directly to its charging station
- Gas entry and exit ports
- USB communication port for PC interface
- Protective rubber cover

Easy-to-use separation tube holder (UltraRAE 3000+)

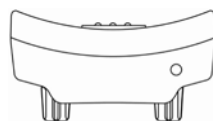
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4. Charging The Battery

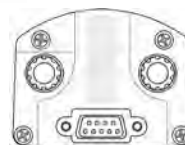
Always fully charge the battery before using the instrument. The instrument's Li-ion battery is charged by attaching the instrument to the Travel Charger (or by placing the instrument in the optional Charger Stand). Contacts on the bottom of the instrument meet the Travel Charger's (or Charger Stand's) contacts, transferring power without other connections.



Charger Stand



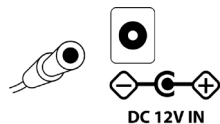
Travel
Charger



Note: Before connecting the charger to the instrument, visually inspect the contacts to make sure they are clean. If they are not, wipe them with a soft cloth. Do not use solvents or cleaners.

Follow this procedure to charge the instrument:

1. Plug the AC/DC adapter's barrel connector into the instrument's Charger Stand or Travel Charger.



2. Plug the AC/DC adapter into the wall outlet.
3. Connect the AC/DC adapter to the Travel Charger (or Charger Stand).
4. Place the instrument into the Travel Charger or Charger Stand. The LED in the Travel Charger (or Charger Stand) should glow.

The instrument begins charging automatically. (If the optional Charger Stand is used, the "Primary" LED blinks green to indicate charging.) During charging, the diagonal lines in the battery icon on the instrument's display are animated and you see the message "Charging..."



Note: If the Li-ion battery has been discharged below a certain threshold, the "Charging..." message does not display immediately. The charging LED blinks to indicate that it is charging, and after it has been charging for a while, the "Charging..." message appears.

When the instrument's battery is fully charged, the battery icon is no longer animated and shows a full battery. The message "Fully charged!" is shown. (If the Charger Stand or Travel Charger is used, its LED glows continuously green.)

Note: If you see the "Battery Charging Error" icon (a battery outline with an exclamation mark inside), check that the instrument or rechargeable battery has been properly set into the Travel Charger (or Charger Stand). If you still receive the message, check the Troubleshooting section of this guide.



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Note: If the instrument or battery has been charging for more than 10 hours and you see the "Battery Charging Error" icon and a message that says, "Charging Too Long," this indicates that the battery is not reaching a full charge. Try changing the battery and make sure the contacts on the instrument are meeting the Travel Charger's (or Charger Stand's) contacts. If the message is still shown, consult your distributor or RAE Systems Technical Services.

4.1. Charging A Spare Rechargeable Battery

A rechargeable Li-ion battery can be charged when it is not inside the monitor. The Charger Stand is designed to accommodate both types of charging. Contacts on the bottom of the battery meet the contacts on the cradle, transferring power without other connections, and a spring-loaded capture holds the battery in place during charging.

1. Plug the AC/DC adapter into the monitor's cradle.
2. Place the battery into the cradle, with the gold-plated contacts on top of the six matching charging pins.
3. Plug the AC/DC adapter into the wall outlet.

The battery begins charging automatically. During charging, the Secondary LED in the cradle blinks green. When charging is complete, it glows steady green.

Release the battery from the cradle by pulling it back toward the rear of the cradle and tilting it out of its slot.

Note: If you need to replace the Li-ion battery pack, replacements are available from RAE Systems. The part number is 059-3051-000.

Note: An Alkaline Battery Adapter (part number 059-3052-000), which uses four AA alkaline batteries (Duracell MN1500), may be substituted for the Li-Ion battery.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge and replace batteries only in areas known to be non-hazardous. Remove and replace batteries only in areas known to be non-hazardous.

4.2. Low Voltage Warning

When the battery's charge falls below a preset voltage, the instrument warns you by beeping once and flashing once every minute, and the "empty battery" icon blinks on and off once per second. You should turn off the instrument within 10 minutes and either recharge the battery by placing the instrument in its cradle, or replace the battery with a fresh one with a full charge.



4.3. Clock Battery

An internal clock battery is mounted on one of the instrument's printed circuit boards. This long-life battery keeps settings in memory from being lost whenever the Li-ion battery or alkaline batteries are removed. This backup battery should last approximately five years, and must be replaced by an authorized Honeywell service technician. It is not user-replaceable.

4.4. Data Protection While Power Is Off

When the instrument is turned off, all the current real-time data including last measured values are erased. However, the datalog data is preserved in non-volatile memory. Even if the battery is disconnected, the datalog data will not be lost.

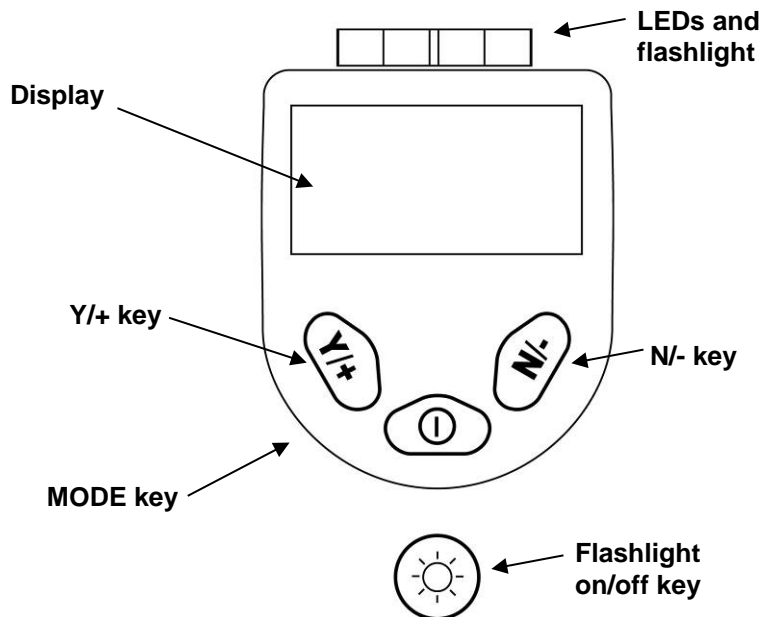
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5. User Interface

The instrument's user interface consists of the display, LEDs, an alarm transducer, and four keys. The keys are:

- Y/+
- MODE
- N/-
- Flashlight on/off

The LCD display provides visual feedback that includes the reading, time, battery condition, and other functions.

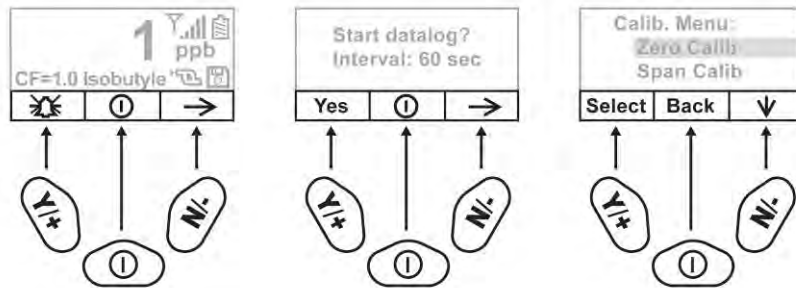


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In addition to their labeled functions, the keys labeled Y/+, MODE, and N/- act as “soft keys” that control different parameters and make different selections within the instrument's menus. From menu to menu, each key controls a different parameter or makes a different selection. Three panes along the bottom of the display are “mapped” to the keys. These change as menus change, but at all times the left pane corresponds to the [Y/+] key, the center pane corresponds to the [MODE] key, and the right pane corresponds to the [N/-] key. Here are three examples of different menus with the relationships of the keys clearly shown:

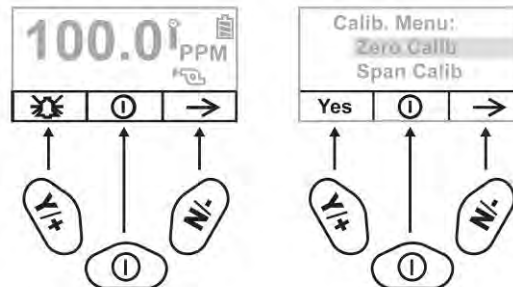
MiniRAE 3000+, ppbRAE 3000+, UltraRAE 3000+

RELATIONSHIP OF BUTTONS TO CONTROL FUNCTIONS



MiniRAE Lite+

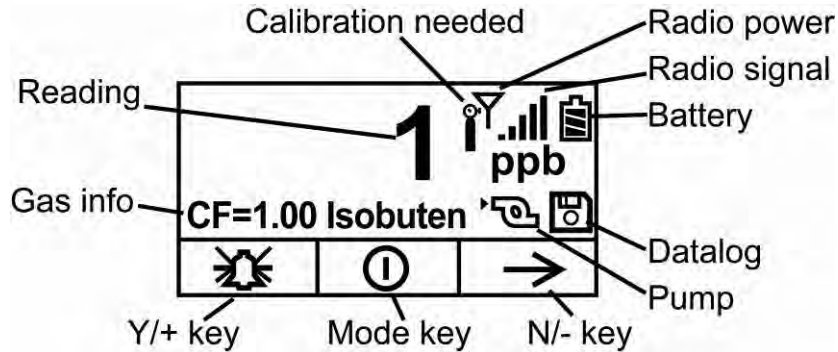
RELATIONSHIP OF BUTTONS TO CONTROL FUNCTIONS



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6. Display

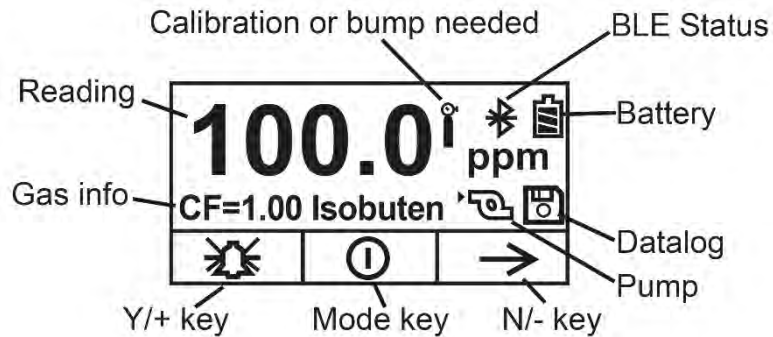
The display shows the following information:



Gas info	Tells the Correction Factor and type of calibration gas
Reading	Concentration of gas as measured by the instrument
Calibration needed	Indicates that calibration should be performed
Calibration (or bump) needed	Dark icon indicates that calibration should be performed; light icon indicates bump should be performed
Radio power	Indicates whether Mesh radio connection is on or off
Radio signal	Indicates signal strength (more bars = greater strength)
Battery	Indicates level in 3 bars
Pump	Indicates that pump is working
Datalog	Indicates whether datalog is on or off
Y/+	Y/+ key's function for this screen
MODE	MODE key's function for this screen
N/-	N/- key's function for this screen

Note:The "Radio power" icon and "Radio signal" icon are only shown if a Mesh radio is installed in the instrument. If the instrument has a BLE radio, the Bluetooth icons shown on the next page are used.









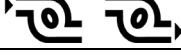


If the instrument is equipped with BLE instead of other wireless, the BLE Status icon is shown:



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6.1. Icons

These are the icons shown on the display to indicate functions or status.

	The instrument has been bump tested and calibrated in compliance with the policy settings
	Battery level
	Charging error
	Calibration required
	Bump test required
	Datalog on
	Radio Power
	Radio signal
	Pump operational
	Pump blocked or stalled
	BLE status: Installed, Connected, Turned Off

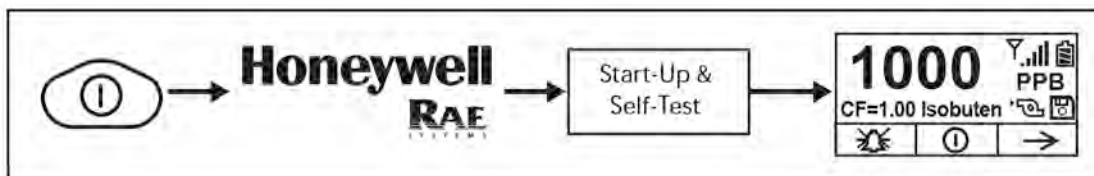
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7. Operating The Instrument

The instrument is designed as a broadband VOC gas monitor and datalogger for work in hazardous environments. It gives real-time measurements and activates alarm signals whenever the exposure exceeds preset limits. Prior to factory shipment, the instrument is preset with default alarm limits and the sensor is pre-calibrated with standard calibration gas. However, you should test the instrument and verify the calibration before the first use. After the instrument is fully charged and calibrated, it is ready for immediate operation.

7.1. Turning The Instrument On

1. With the instrument turned off, press and hold [MODE].
2. When the display turns on, release the [MODE] key.



Note: The main display may show ppb or ppm and other features, depending on the instrument. The Honeywell logo should appear first. (If the logo does not appear, there is likely a problem and you should contact your distributor or Honeywell RAE Systems Technical Support.) The instrument is now operating and performs self tests. If any tests (including sensor and memory tests fail), refer to the Troubleshooting section of this guide.

Once the startup procedure is complete, the instrument shows a numerical reading screen with icons. This indicates that the instrument is fully functional and ready to use.

7.2. Turning The Instrument Off

1. Press and hold the Mode key for 3 seconds. A 5-second countdown to shutoff begins.
2. Once the countdown stops, the instrument is off. Release the Mode key.
3. When you see "Unit off..." release your finger from the [MODE] key. The instrument is now off.

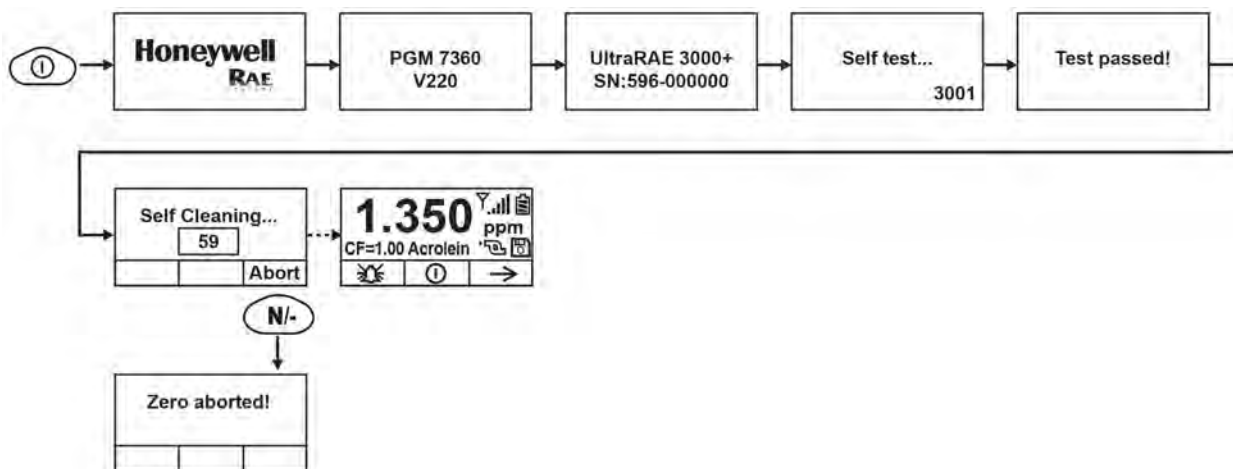
Note: You must hold your finger on the key for the entire shutoff process. If you remove your finger from the key during the countdown, the shutoff operation is canceled and the instrument continues normal operation.

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7.3. Auto-Zero At Startup Option

Using ProRAE Studio II (version 1.11.4 and above) or Honeywell™ Safety Suite Device Configurator, the instrument can be programmed to automatically perform a zero calibration after self-testing during startup.

Note: The option is disabled by default. If it is disabled, the instrument performs its self-test and then goes directly to reading mode.



The zeroing process can be aborted by pressing the [N/-] key at any time during the process, and the instrument will go directly to normal reading mode.

Notes:

- When a ppbRAE 3000+ is in normal reading mode and is not in system alarm (Low Alarm or High Alarm), zero calibration is triggered in a locked interval (1 hour). If the instrument is in low alarm, Auto Zero is skipped until the alarm clears.
- We do not recommend using this function on the UltraRAE3000+ and ppbRAE3000+.
- We highly recommend that you make sure the instrument is in a clean air environment during startup and zeroing.

7.4. Operating The Built-In Flashlight

The instrument has a built-in flashlight that helps you point the probe in dark places. Press the flashlight key to turn it on. Press it again to turn it off.



Note: Using the flashlight for extended periods shortens the battery's operating time before it needs recharging.

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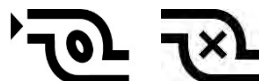
7.5. Pump Status

IMPORTANT!

During operation, make sure the probe inlet and the gas outlet are free of obstructions. Obstructions can cause premature wear on the pump, false readings, or pump stalling. During normal operation, the pump icon alternately shows inflow and outflow as shown here:



During duty cycling (PID lamp cleaning), the display shows these icons in alternation:



If there is a pump failure or obstruction that disrupts the pump, you will see this icon blinking on and off:



If you see this blinking icon, consult the Troubleshooting section of this guide.

7.6. Calibration Status

The instrument displays this icon if it requires calibration:



Calibration is required (and indicated by this icon) if:

- The lamp type has been changed (for example, from 10.6 eV to 9.8 eV).
- The sensor has been replaced.
- It has been 30 days or more since the instrument was last calibrated.
- If you have changed the calibration gas type without recalibrating the instrument.
- If the instrument fails a bump test.

7.7. Bump Status

The instrument displays this icon if it requires a bump test:



A bump test is required (and indicated by this icon) if:

- The defined period between bump tests has been exceeded (bump test overdue).
- The sensor has failed a previous bump test.
- The sensor(s) should be challenged on a periodic basis.

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7.8. Glance Mode

Glance Mode allows you to get vital information without turning on the instrument. You can check information such as the instrument's model and serial number, installed sensor types, wireless modules installed, etc., which may help when taking inventory of instruments and their sensors or when working with service or support personnel. Glance Mode can be enabled/disabled via ProRAE Studio II or Honeywell Safety Suite Device Configurator.

7.8.1. Enter Glance Mode

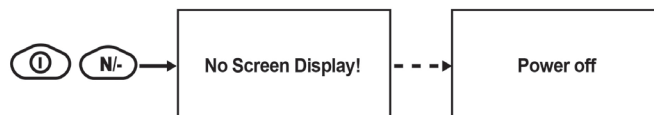
Note: The instrument must be configured so that Glance Mode is turned on (the default mode is "Off"). This can be done in ProRAE Studio II or Honeywell Safety Suite Device Configurator. In ProRAE Studio II or Honeywell Safety Suite Device Configurator, Glance Mode can be enabled or disabled by checking or unchecking the box labeled "Enable Glance Mode." You can also set which screens will be displayed, as well as their order.

With the instrument turned off, press and hold [MODE] and [N/-] simultaneously for 2 seconds to enter Glance Mode. If you see the message "GLANCE DISABLED," you must configure the instrument to use Glance Mode.



If Glance Mode is enabled, the first screen, with the Honeywell Logo, is displayed. Release the [MODE] and [N/-] keys, and the first screen with information about the instrument is shown.

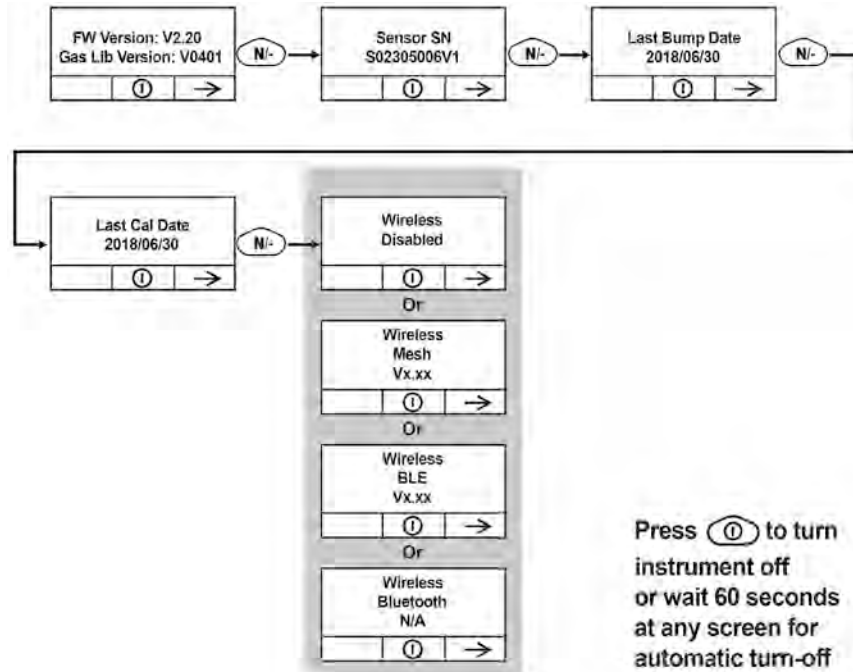
Note: If there is no information to show, the instrument will display "No Screen Display!" and turn itself off.



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7.8.2. Glance Mode Screens

Every screen displayed in sequence as configuration. Press [N/-] to advance to the next screen. If the Wireless modem is turned off, the screen shows "Disabled". Otherwise, the type of wireless is shown. When the last screen is shown, pressing [N/-] "loops" to the first screen.



7.8.3. Exit Glance Mode

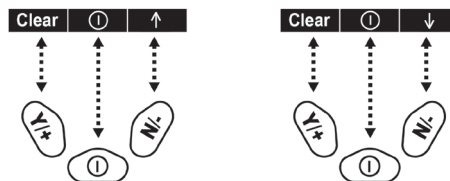
The instrument exits Glance Mode and turns off when you press the [MODE] key. The display shows "Power Off", and after 3 seconds, it turns off. In addition, if you do not press either key in 60 seconds, the instrument automatically exits Glance Mode and shuts off.

7.9. Reverse Direction – Main Navigation

Sometimes you want to go back to a previous screen rather than advance through an entire set of screens before "wrapping around" to that screen again.

To reverse direction:

1. Press and hold [N/-] for 3 seconds.
2. When the arrow changes from pointing up to pointing down, release your finger.



Now when you press [N/-], you step back through the screens.

To change direction again: Press and hold [N/-] for 3 seconds and then release.

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Note: Changing direction does not work with all screens. It works primarily in submenus.

7.10. Policy Enforcement

The instrument can be configured to enforce a facility/company's requirements that calibration and/or bump testing be performed at specified intervals, and to explicitly prompt the user that calibration/bump testing is required. Depending on how Policy Enforcement features are configured, the user may be required to perform a bump test or calibration prior to being able to use the instrument. That is, it can be set to not allow normal operation of the instrument unless calibration or bump testing is performed.

If the instrument has been bump tested and calibrated in compliance with the policy settings, a check-mark icon is included along the top of the instrument screen:



If Policy Enforcement is enabled, then after startup the instrument displays a screen that informs the user that the instrument requires either a bump test or a calibration. If both are required, then they are shown in sequence.

Note: Policy enforcement features are disabled by default.

7.10.1. Setting Policy Enforcement

You must use ProRAE Studio II or Honeywell Safety Suite Device Configurator to make changes to Policy Enforcement settings. You must use an AutoRAE 2 Cradle, a Travel Charger, or a Charger Stand. Policy violations are captured in the datalog.

Using The Travel Charger, Charger Stand, or AutoRAE 2 Automatic Test And Calibration System

To program an instrument via an AutoRAE 2, you need ProRAE Studio II Instrument Configuration and Data Management Software, the AutoRAE 2 connected to a power source, and a USB PC communications cable. Here are directions for using ProRAE Studio II. (For Device Configurator, consult its manual.)

1. Connect a USB cable between a PC with ProRAE Studio II and the AutoRAE 2 Cradle, Travel Charger, or Charger Stand.
2. Apply power to the AutoRAE 2 Cradle, Travel Charger, or Charger Stand.
3. Turn off the instrument (or put it into AutoRAE 2 Mode or Communication Mode) and set it in the cradle.
4. Start ProRAE Studio II software on the PC.
5. Select "Administrator" and input the password (the default is "rae").
6. Click "Detect the instruments automatically" (the magnifying glass icon with the letter "A" in it). After a few seconds, the AutoRAE 2 Cradle is found and it is shown, along with its serial number.
7. Click on the icon to highlight it, and then click "Select."
8. In ProRAE Studio II, the instrument or AutoRAE 2 Cradle is shown, including its Serial Number, under "Online."
9. Expand the view to show the instrument or to show the instrument in the AutoRAE 2 Cradle by clicking the "+" to the left of the image of the AutoRAE 2 Cradle.
10. Double-click on the icon representing the instrument
11. Click "Setup."

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12. In the menu that now appears on the left side, click "Policy Enforcement." It is highlighted, and the Policy Enforcement pane is shown. For "Must Calibrate" and "Must Bump," you have the options of no enforcement or enforcement (including "Can't Bypass," and "Can Bypass").

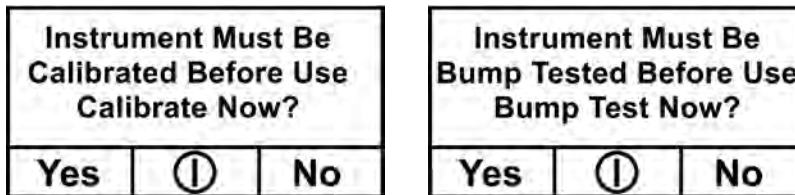
Must Calibrate. The user is prompted to calibrate the instrument when calibration is due (as set by the calibration interval). There are two programmable options:

- **Can't Bypass.** Unless calibration is performed, the instrument cannot be used, and the only option is to turn off the instrument.
- **Can Bypass.** If calibration is due but the user does not want to perform a calibration, the instrument can still be used. In this case, the instrument records that the user has bypassed the calibration requirement in a Policy Violation report.

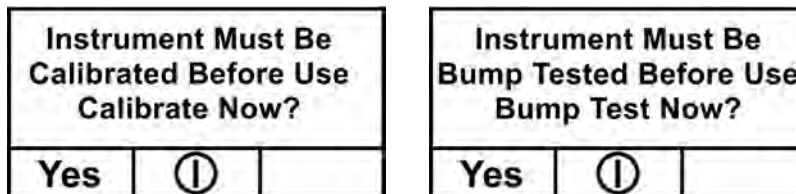
Must Bump. The user is prompted to bump test the instrument when a bump test is due (as set by the bump test interval). There are two programmable options:

- **Can't Bypass.** Unless a bump test is performed, the instrument cannot be used, and the only option is to turn off the instrument.
- **Can Bypass.** If a bump test is due but the user does not want to perform one, the instrument can still be used. In this case, the instrument records that the user has bypassed the bump testing requirement in a Policy Violation report.

These are the screens that are shown on the instrument after startup if "Can Bypass" is selected:



If "Can't Bypass" is selected, the display looks like this, and only allows the options of performing the test or shutting down:



16. Once you have made your selections in ProRAE Studio II, you must upload the changes to the instrument. Click the icon labeled "Upload all settings to the instrument."

17. A confirmation screen is shown. Click "Yes" to perform the upload, or "No" to abort. Uploading takes a few seconds, and a progress bar is shown. You can abort the upload by clicking "Cancel."

18. Exit ProRAE Studio II.

19. Press [Y/+] on the instrument to exit Communication Mode.

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8. Operating Modes – MiniRAE 3000+ & ppbRAE 3000+

Your instrument operates in different modes, depending on the model and its factory default settings. In some cases, you can change modes using a password and the instrument's navigation. In other cases, you must use ProRAE Studio II or Honeywell Safety Suite Device Configurator software.

The default setting for your instrument is:

User Level: Basic
Operation Mode: Hygiene

This is outlined in detail on page 73.

The other options, covered later in this guide, are:

User Level: Advanced (page 75)
Operation Mode: Hygiene

User Level: Advanced (page 75)
Operation Mode: Search

Using ProRAE Studio II or Honeywell Safety Suite Device Configurator allows access to other options. In addition, Diagnostic Mode (page 79) is available for service technicians.

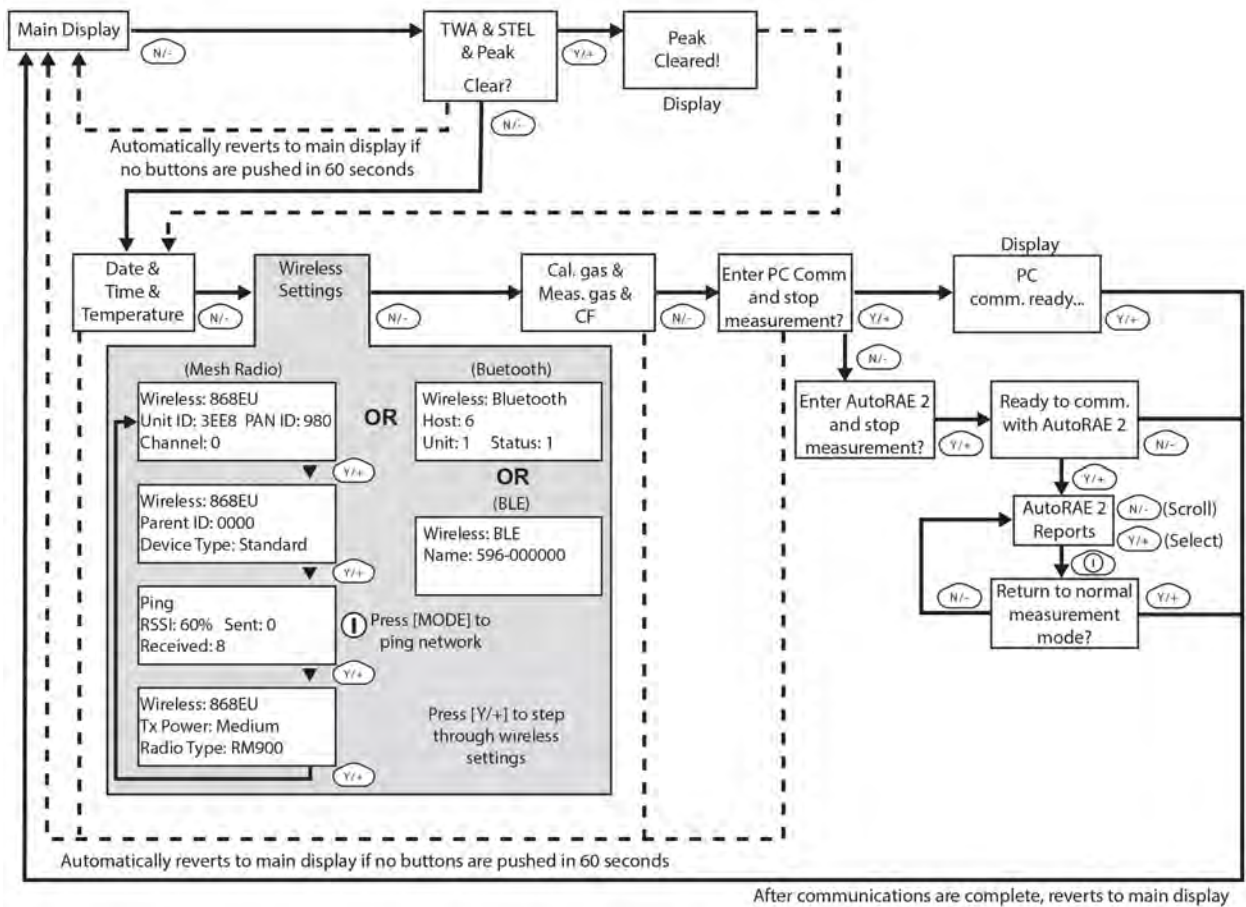
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8.1. Basic User Level/Hygiene Mode (Default Settings) – MiniRAE 3000+ & ppbRAE 3000+

The instrument is programmed to operate in Basic User Level/Hygiene Mode as its default. This gives you the most commonly needed features while requiring the fewest parameter adjustments.

Pressing [N/-] steps you from one screen to the next, and eventually return to the main display. If you do not press a key within 60 seconds after entering a display, the instrument reverts to its main display.

Note: While viewing any of these screens, you can shut off your instrument by pressing [MODE].



Note: At the Average & Peak, Date & Time & Temperature, Calibration Gas & Measurement Gas & Correction Factor, and PC Communications screens, the instrument automatically goes to the main display after 60 seconds if you do not push a key to make a selection.

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9. Operating Modes – UltraRAE 3000+

The UltraRAE is actually two monitors in one:

- Compound-specific monitor
- VOC monitor

As a compound-specific monitor, it takes timed measurements and uses a separation tube in conjunction with software that enables the UltraRAE 3000+ to give specific readings on one particular type of compound, such as benzene or butadiene.

As a VOC monitor, the UltraRAE 3000+ operates in different modes. In some cases, you can change modes using a password and using the instrument's navigation. In other cases, you must use ProRAE Studio II or Honeywell Safety Suite Device Configurator software.

The following two sections cover operation in the two modes.

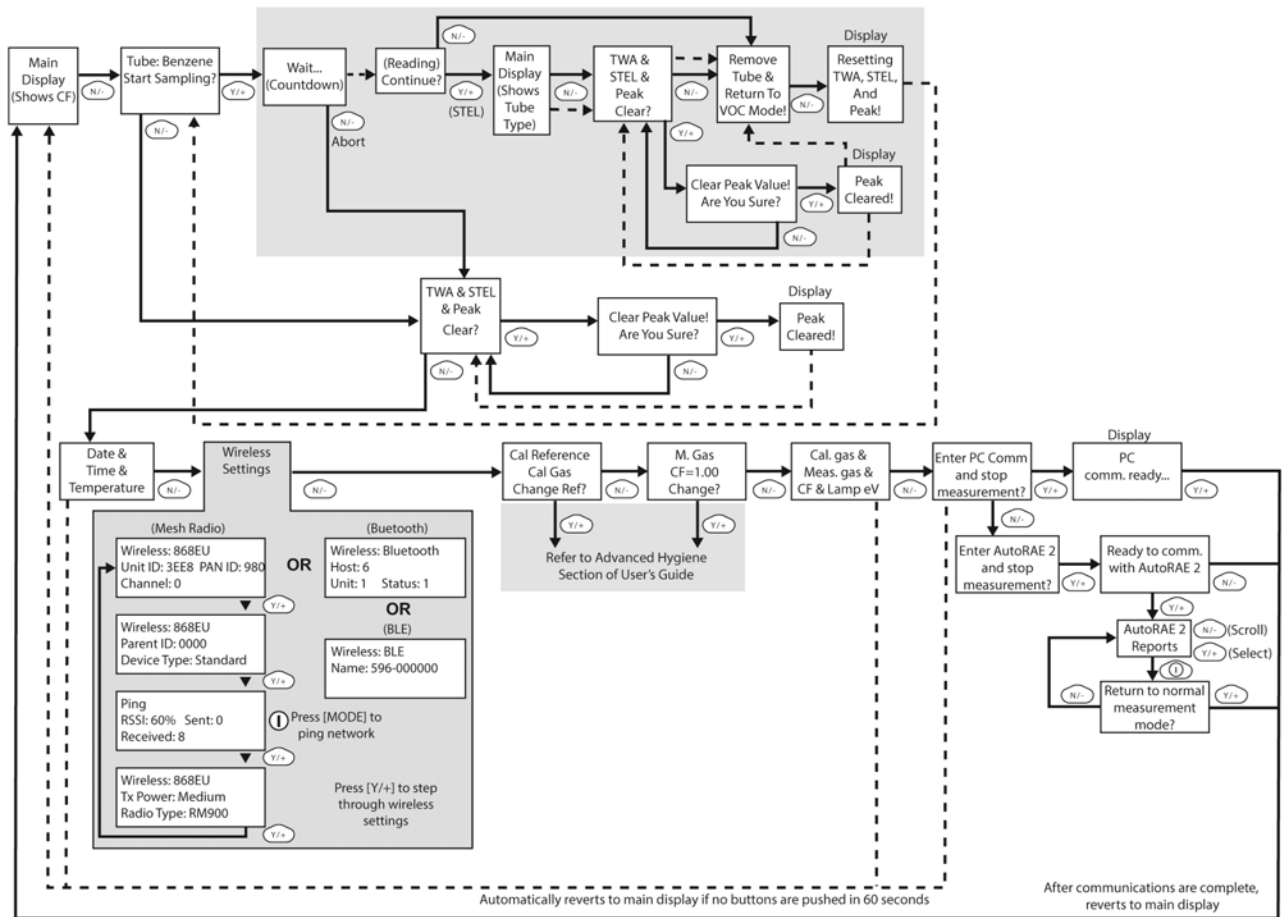
- Compound Specific, page 29.
- VOC, page 35.

The diagram on the next page shows the basic flow of the UltraRAE 3000+'s functions. The area with the gray field is the compound-specific (tube) mode, while the rest shows VOC mode. Navigate through the steps by using the [Y/+] and [N/-] keys as shown in the diagram.

Note: If you use a password to access Programming Mode (see page 19), then the navigation changes slightly, entering part of Advanced Hygiene Mode's settings, as shown on page 75.

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Compound-Specific (Tube)



Note: Dashed line indicates automatic progression.

The default setting for your instrument is:

User Level: Basic
Operation Mode: Hygiene

This is outlined in detail on page 73.

The other options, covered later in this guide, are:

User Level: Advanced (page 75)
Operation Mode: Hygiene

User Level: Advanced (page 75)
Operation Mode: Search

Using ProRAE Studio II or Honeywell Safety Suite Device Configurator allows access to other options. In addition, Diagnostic Mode (page 79) is available for service technicians.

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10. Compound-Specific Operation – UltraRAE 3000+

10.1. Compound-Specific Measurement

The UltraRAE 3000+ can perform compound-specific measurement in addition to general VOC measurement. This requires using a RAE-Sep separation tube (butadiene or benzene) and having the UltraRAE 3000+ in Tube Mode, operating with a 9.8eV lamp.

10.2. Measurement Phases

To perform a compound-specific measurement, follow this order:

1. UltraRAE 3000+ is ready for sampling
2. Prepare the separation tube
3. Insert the separation tube
4. Start measurement
5. UltraRAE 3000+ displays and logs measurement
6. Remove the separation tube

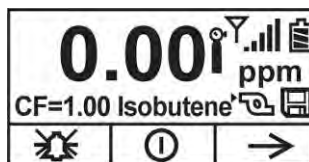
10.3. Performing A Measurement – UltraRAE 3000+

Before performing a compound-specific measurement for Benzene or Butadiene using a RAE-Sep™ separation tube, make sure the UltraRAE 3000+ is in Tube Mode and that the appropriate tube type is selected. The UltraRAE 3000+ only acts as a compound-specific measurement device when it is equipped with a 9.8eV lamp. The UltraRAE 3000+ is designed to auto-sense the lamp type. It can also be manually set to default to a 9.8eV lamp type.

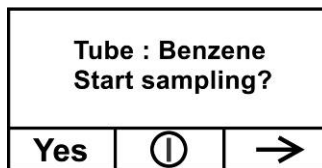
Make sure the UltraRAE 3000+ is set to operate with your selected tube:

1. Enter Programming Mode.
2. Select Measurement.
3. Select Tube Selection.
4. Make a choice of Benzene or Butadiene.
5. Save your choice.

To begin measuring, turn on the UltraRAE 3000+. This screen is shown, which includes the CF (correction factor) and measurement gas type for calibration reference:



Press [N/-] to advance. You will see this screen:



Do not begin sampling yet!

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Before you start sampling, you must insert a RAE-Sep separation tube into the inlet/holder. Follow the Separation Tube Preparation and Placing A Tube Into The UltraRAE 3000+ instructions before pressing any buttons on the UltraRAE 3000+. Once the tube is in place, then proceed to measuring.

IMPORTANT!

Once a tube's ends are broken off, the material inside is exposed. Therefore, use the tube for sampling as soon as possible.

10.4. Separation Tube Preparation

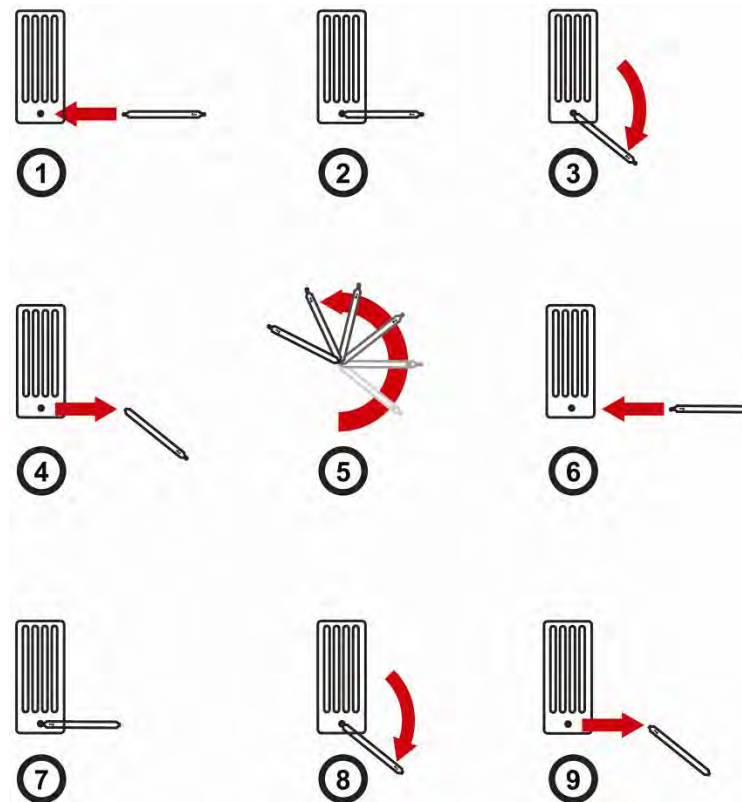
CAUTION!

Wear hand and eye protection when breaking tube tips. Use caution in handling tubes with broken ends. Keep away from children. RAE-Sep tubes should be disposed of according to local regulations. See footnotes of data sheets for disposal information.

1. Open a package of RAE-Sep separation tubes and remove one.
2. Place the tip in the package's tube tip breaker (the small hole on the front) and snap off the tip.
3. Turn the tube around and snap off the other end.

CAUTION!

Only use Honeywell RAE Systems tubes.



CAUTION!

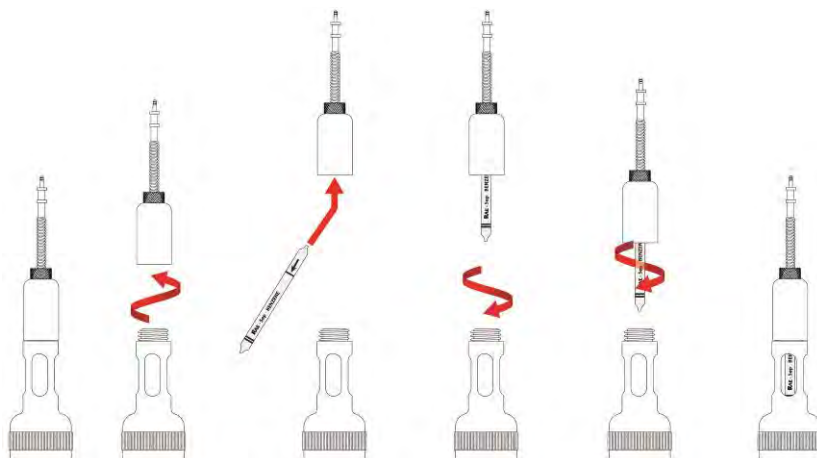
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Handle tubes with care. Tube ends are sharp after ends are broken off.

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10.5. Inserting The Separation Tube

1. Unscrew the front of the sampling probe from the base.
2. Slip the tube into the rubber holder in the front portion. Make sure the arrow on the side of the tube points toward the instrument.
3. Insert the other end of the tube into the middle of the base while turning the front portion to tighten it onto the base's threads.



IMPORTANT!

Do not overtighten any portion of the sampling assembly.

Note: When the UltraRAE 3000+ is used for VOC monitoring, no tube is inserted.

IMPORTANT!

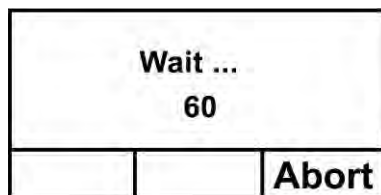
To ensure that there are no leaks, periodically test the seals:

With the UltraRAE 3000+ running, place your finger over the end of the inlet probe. The alarm should sound and the pump-stall icon should flash on the display. This indicates that all seals are good. Stop the alarm by pressing [Y/+]. If the pump does not alarm or show the stalled-pump icon, then check that all inlet parts are tight and inspect the O-ring for damage (replace it if necessary).

10.6. Measuring

Once the tube is in place, begin measuring by pressing [Y/+].

The display shows a countdown (60 seconds is shown here, but sampling time depends on the type of separation tube selected and the temperature):



Note: You can abort the sampling by pressing [N/-] at any time.

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Once the countdown is complete, the reading is shown:

Benzene= 0.00 ppm Continue and establish STEL?		
Yes		No

Press [Y/+] to continue sampling with the tube for 15 minutes to establish a STEL reading, or press [N/-] to return to the main menu.

WARNING!

At least 1/4 of the tube should still be yellow-orange at the bottom. If not, the STEL value is not valid. Abort the measurement and change the tube. Then do a snapshot test instead of a STEL test. **Note:** If the STEL is exceeded, the UltraRAE 3000+ goes into alarm.

If you press [N/-] to return to the main menu, which shows the tube type instead of the CF (correction factor):

0.00 ppm Tube = Benzene		

Press [N/-] to advance to this screen:

TWA: - - - - ppm		
STEL: - - - - ppm		
Peak: 0.00 ppm		
Clear		

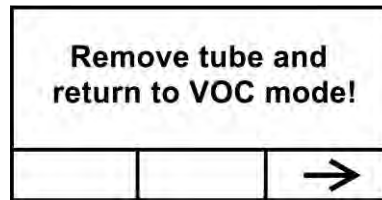
If you press [Y/+] you are asked, "Clear peak value! Are You Sure?" to confirm:

Clear peak value! Are you sure?		
Yes		No

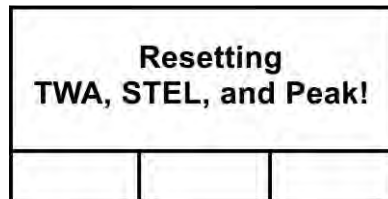
Press [Y/+] to clear the Peak value and exit to VOC operation.

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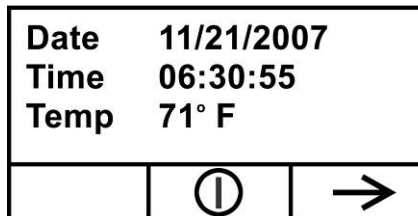
If you press [N/-], this display is shown:



Remove the tube and put the inlet back together. Then press [N/-]. This display is shown:



After a few seconds, the UltraRAE 3000+ enters VOC mode and shows this display:



You can step through the rest of the steps by pressing [N/-] repeatedly until you reach the main menu again.

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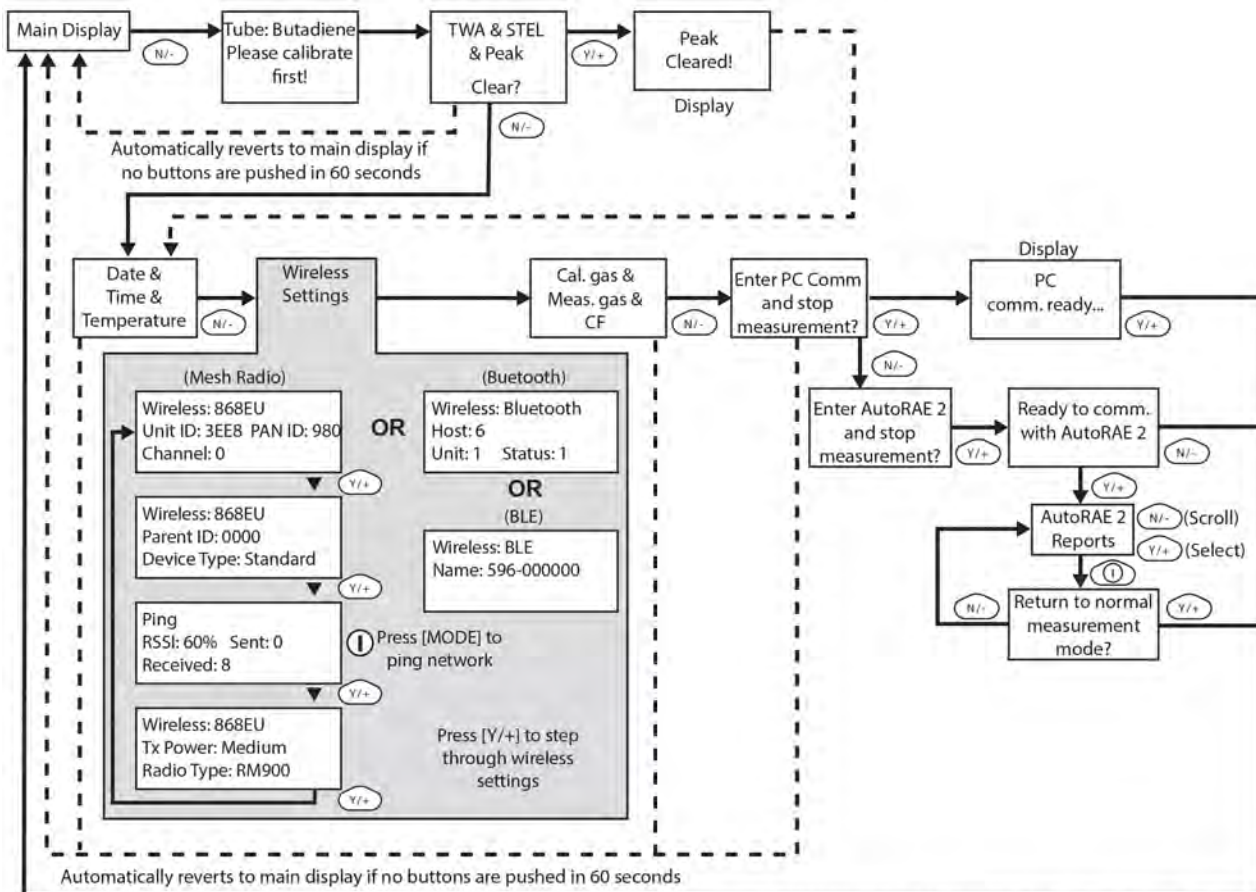
11. VOC Operation – UltraRAE 3000+

11.1. Basic User Level/Hygiene Mode (Default Settings)

The instrument is programmed to operate in Basic User Level/Hygiene Mode as its default. This gives you the most commonly needed features while requiring the fewest parameter adjustments.

Pressing [N/-] steps you from one screen to the next, and eventually return to the main display. If you do not press a key within 60 seconds after entering a display, the instrument reverts to its main display.

Note: While viewing any of these screens, you can shut off your instrument by pressing [MODE].



Note: Dashed line indicates automatic progression.

After communications are complete, reverts to main display

Note: At the Average & Peak, Date & Time & Temperature, Calibration Gas & Measurement Gas & Correction Factor, and PC Communications screens, the instrument automatically goes to the main display after 60 seconds if you do not push a key to make a selection.

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11.2. Basic Operation – MiniRAE 3000+

The instrument is programmed to give you the most commonly needed information quickly.

Pressing [N/-] steps you from one screen to the next, and eventually return to the main display. If you do not press a key within 60 seconds after entering a display, the instrument reverts to its main display.

Note: While viewing any of these screens, you can shut off your instrument by pressing [MODE].

Note: At the Average & Peak, Date & Time & Temperature, Calibration Gas & Measurement Gas & Correction Factor, and PC Communications screens, the instrument automatically goes to the main display after 60 seconds if you do not push a key to make a selection.

12. Alarm Signals

During each measurement period, the gas concentration is compared with the programmed alarm limits (gas concentration alarm limit settings). If the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn you of the alarm condition. In addition, the instrument alarms if one of the following conditions occurs: battery voltage falls below a preset voltage level, failure of the UV lamp, or pump stall.

12.1. Alarm Signal Summary

Message	Condition	Alarm Signal
HIGH	Gas exceeds "High Alarm" limit	3 beeps/flashes per second*
OVR	Gas exceeds measurement range	3 beeps/flashes per second*
MAX	Gas exceeds electronics' maximum range	3 beeps/flashes per second*
LOW	Gas exceeds "Low Alarm" limit	2 beeps/flashes per second*
TWA	Gas exceeds "TWA" limit	1 Beep/flash per second*
STEL	Gas exceeds "STEL" limit	1 Beep/flash per second*
Pump icon flashes	Pump failure	3 beeps/flashes per second
Lamp	PID lamp failure	3 beeps/flashes per second plus "Lamp" message on display
Battery icon flashes	Low battery	1 flash, 1 beep per minute plus battery icon flashes on display
CAL	Calibration failed, or needs calibration	1 beep/flash per second
NEG	Gas reading measures less than number stored in calibration	1 beep/flash per second

* MiniRAE 3000+, ppbRAE 3000+, and UltraRAE 3000+: Hygiene mode only. In Search mode, the number of beeps per second (1 to 7) depends upon the concentration of the sampled gas. Faster rates indicate higher concentrations.

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12.2. Preset Alarm Limits & Calibration

The instrument is factory calibrated with standard calibration gas, and is programmed with default alarm limits. These settings can be changed in Programming Mode to align more precisely with your standards.

MiniRAE Lite+

Cal Gas (Isobutylene)	Cal Span	Unit	Low	High
MiniRAE Lite+	100	ppm	50	100

MiniRAE 3000+

Cal Gas (Isobutylene)	Cal Span	Unit	Low	High	TWA	STEL
MiniRAE 3000+	100	ppm	50	100	10	25

ppbRAE 3000+

Cal Gas (Isobutylene)	Cal Span	Unit	Low	High	TWA	STEL
ppbRAE 3000+	10	ppm	10	25	10	25
MiniRAE 3000+	100	ppm	50	100	10	25
MiniRAE Lite+	100	ppm	50	100	10	25

UltraRAE 3000+

Cal Gas	Cal Span	Unit	Low	High	TWA	STEL
Isobutylene	100	ppm	50	100	10	25
Benzene	5	ppm	2	5	0.5	2.5
Butadiene	10	ppm	5	10	2	5

12.3. Testing The Alarm

You can test the alarm whenever the main (Reading) display is shown. Press [Y/+], and the audible and visible alarms are tested.

12.4. Integrated Sampling Pump

The instrument includes an integrated sampling pump. This diaphragm-type pump that provides a 450 to 550 cc per minute flow rate. Connecting a Teflon or metal tubing with 1/8" inside diameter to the gas inlet port of the instrument, this pump can pull in air samples from 100' (30 m) horizontally or vertically.

Note: In Search Mode, the pump turns on when a sample measurement is started, and turns off when the sample is manually stopped.

If liquid or other objects are pulled into the inlet port filter, the instrument detects the obstruction and immediately shuts down the pump. The alarm is activated and a flashing pump icon is displayed. You should acknowledge the pump shutoff condition by clearing the obstruction and pressing the [Y/+] key while in the main reading display to restart the pump.

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12.5. Backlight

The LCD display is equipped with an LED backlight to assist in reading the display under poor lighting conditions.

12.6. Datalogging

During datalogging, the instrument displays a disk icon to indicate that datalogging is enabled. The instrument stores the measured gas concentration at the end of every sample period (when data logging is enabled). In addition, the following information is stored: user ID, site ID, serial number, last calibration date, and alarm limits. All data are retained (even after the unit is turned off) in non-volatile memory so that it can be down-loaded later to a PC.

12.6.1. Datalogging event

When Datalogging is enabled, measurement readings are being saved. These data are stored in "groups" or "events." A new event is created and stored each time the instrument is turned on and is set to automatic datalogging, or a configuration parameter is changed, or datalogging is interrupted. The maximum time for one event is 24 hours or 28,800 points. If an event exceeds 24 hours, a new event is automatically created. Information, such as start time, user ID, site ID, gas name, serial number, last calibration date, and alarm limits are recorded.

12.6.2. Datalogging sample

After an event is recorded, the unit records a shorter form of the data. When transferred to a PC running ProRAE Studio II or Honeywell Safety Suite Device Configurator, this data is arranged with a sample number, time, date, gas concentration, and other related information.

12.6.3. Auto/Manual/Snapshot Datalogging

The instrument has three datalog types:

Auto	Default mode. Collects datalog information when the instrument is sampling.
Manual	Datalogging occurs only when the instrument's datalogging is manually started (see page 65 for details).
Snapshot	Datalogs only during snapshot (single-event capture, initiated by pressing [MODE]) sampling. See page 66 for details.

Note: You can only choose one datalog type to be active at a time.

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13. Accessories

MiniRAE Lite+

The following accessories are included with the instrument:

- 10.6 eV lamp
- Flex-I-Probe
- External filter
- Green rubber boot
- Alkaline battery adapter
- Lamp cleaning kit
- Tool Kit
- Lithium-Ion (Li-Ion) battery, if specified
- Travel Charger, if specified
- Universal wall adapter, if specified
- Quick Start Guide
- Soft leather carrying case

MiniRAE 3000+ & ppbRAE 3000+

The following accessories are included with the instrument:

- AC Adapter (Battery Charger)
- Alkaline battery adapter
- External Filter

Hard-case kits also include these accessories:

- Calibration adapter
- Calibration regulator and Flow controller

UltraRAE 3000+

The following accessories are included with the instrument:

- AC Adapter (Battery Charger)
- Travel Charger
- Alkaline battery adapter
- External Filter

Hard-case kits also include these accessories:

- Calibration gas, if specified
- Calibration adapter
- Calibration regulator and flow controller
- Charger Stand (instead of Travel Charger)

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14. Standard Kit & Accessories

14.1. AC Adapter (Battery Charger)

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non-hazardous. Remove and replace battery only in area known to be non-hazardous.

Ne charger les batteries que dans emplacements designés non-dangereuses.

A battery charging circuit is built into the instrument cradle. It only needs a regular AC to 12 VDC adapter (wall-mount transformer, part number 500-0114-000) to charge the instrument.

To charge the battery inside the instrument:

1. Power off the instrument.
2. Connect the AC adapter to the DC jack on the instrument's cradle. If the instrument is off, it automatically turns on.
3. While charging, the display message shows "Charging." The Primary LED on the cradle flashes green when charging.
4. When the battery is fully charged, the LED changes to glowing green continuously, and the message "Fully charged" appears on the display. If there is a charging error, the LED glows red continuously.

A completely discharged instrument can be charged to full capacity within 8 hours. Batteries drain slowly even if an instrument is off. Therefore, if the instrument has been in storage or has not been charged for several days or longer, check the charge before using it.

The factory-supplied battery is designed to last for 16 hours of normal operation (no alarm), for a new battery under the optimum circumstances. As the battery becomes older or is subject to adverse conditions (such as cold ambient temperature), its capacity will be significantly reduced.

14.2. Alkaline Battery Adapter

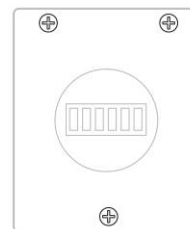
An alkaline battery adapter is supplied with each instrument. The adapter (part number 059-3052-000) accepts four AA alkaline batteries (use only Duracell MN1500) and provides approximately 12 hours of operation. The adapter is intended to be used in emergency situations when there is no time to charge the Li-ion battery pack.

To insert batteries into the adapter:

1. Remove the three Philips-head screws to open the compartment in the adapter.
2. Insert four fresh AA batteries as indicated by the polarity (+/-) markings.
3. Replace the cover. Replace the three screws.

To install the adapter in the instrument:

1. Remove the Li-ion battery pack from the instrument by sliding the tab and tilting out the battery.
2. Replace it with the alkaline battery adapter
3. Slide the tab back into place to secure the battery adapter.



IMPORTANT!

Alkaline batteries cannot be recharged. The instrument's internal circuit detects alkaline batteries and will not allow recharging. If you place the instrument in its cradle, the alkaline battery will not be

Handheld PID Monitors User's Guide

recharged. The internal charging circuit is designed to prevent damage to alkaline batteries and the charging circuit when alkaline batteries are installed inside the instrument. If you try to charge an alkaline batteries installed in the instrument, the instrument's display will say, "Alkaline Battery," indicating that it will not charge the alkaline batteries.

Note: When replacing alkaline batteries, dispose of old ones properly.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge the battery only in areas known to be non-hazardous. Remove and replace the battery only in areas known to be non-hazardous.

14.3. External Filter

WARNING!

Always use an external filter on the instrument. This prevents contaminants and debris from clogging the sample pathway and protects the sensor from damage.

The external filter is made of PTFE (Teflon®) membrane with a 0.45 micron pore size to prevent dust or other particles from being sucked into the sensor manifold, which would cause extensive damage to the instrument. It prolongs the operating life of the sensor. To install the external filter, simply connect it to the instrument's inlet tube.

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15. Optional Accessories

15.1. Calibration Adapter

The calibration adapter for the instrument is a simple 6-inch Tygon tubing with a metal adapter on one end. During calibration, simply insert the metal adapter into the regular gas inlet probe of the instrument and the tubing to the gas regulator on the gas bottle.

15.2. Calibration Regulator

The Calibration Regulator is used in the calibration process. It regulates the gas flow rate from the Span gas cylinder into the gas inlet of the instrument during calibration process. The maximum flow rate allowed by the flow controller is about 0.5L/min (500 cc per min.). Alternatively, a demand-flow regulator or a Tedlar gas bag may be used to match the pump flow precisely.

15.3. Organic Vapor Zeroing Kit

The Organic Vapor Zeroing Kit is used for filtering organic air contaminants that may affect the zero calibration reading. To use the Organic Vapor Zeroing Kit, simply connect the filter to the inlet port of the instrument.

15.4. AutoRAE 2 Automatic Test & Calibration System

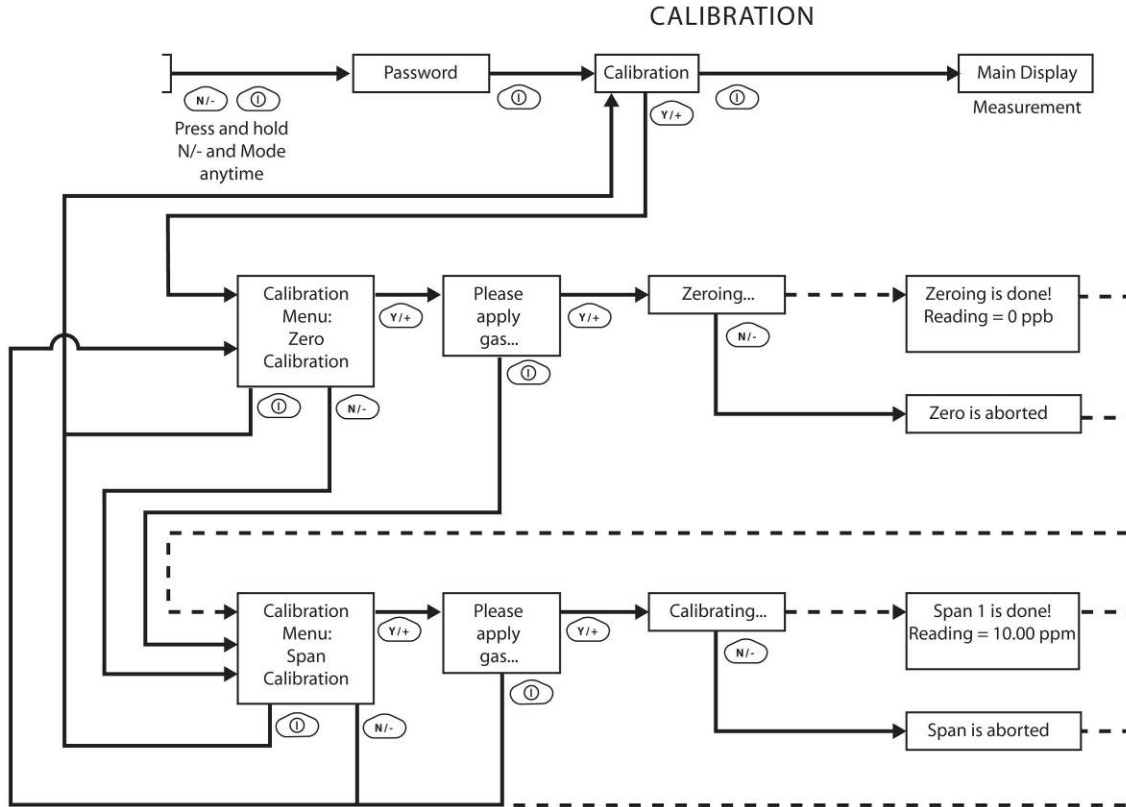
The AutoRAE 2 Automatic Test and Calibration System \ portable gas monitors makes compliance with monitor test and calibration requirements as easy as pressing a button. Simply cradle the monitor and the system will take care of all calibration, testing, and recharging.

The AutoRAE 2 is a flexible, modular system that can be configured to meet your calibration requirements effectively and efficiently. An AutoRAE 2 system can be as simple as a single cradle deployed in standalone mode to calibrate one instrument at a time, or as powerful as a networked, controller-based system supporting ten monitors and five distinct calibration gas cylinders.

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16. Standard Two-Point Calibration (Zero & Span)

The following diagram shows the instrument's calibrations in Basic/Hygiene mode.

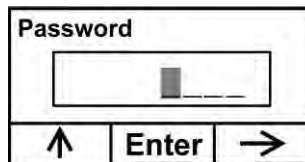


Note: Dashed line indicates automatic progression.

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Entering Calibration

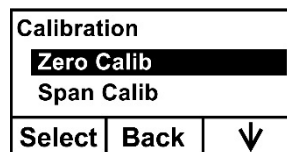
1. Press and hold [MODE] and [N/-] until you see the Password screen.



2. In Basic User Level, you do not need a password to perform calibrations. Instead of inputting a password, enter calibration by pressing [MODE].

Note: If you inadvertently press [Y/+] and change any of the numbers, simply press [MODE] and you will be directed to the calibration menu.

The Calibration screen is now visible with Zero Calibration highlighted.



These are your options:

- Press [Y/+] to select the highlighted calibration (Zero Calib or Span Calib).
- Press [MODE] to exit calibration and return to the main display and resume measurement.
- Press [N/-] to toggle the highlighted calibration type.

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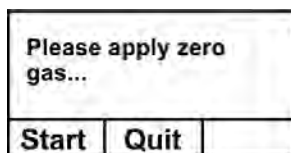
16.1.Zero (Fresh Air) Calibration

This procedure determines the zero point of the sensor calibration curve. To perform a fresh air calibration, use the calibration adapter to connect the instrument to a "fresh" air source such as from a cylinder or Tedlar bag (optional accessory). The "fresh" air is clean, dry air without organic impurities and an oxygen value of 20.9%. If such an air cylinder is not available, any clean ambient air without detectable contaminants or a charcoal filter can be used.

At the Zero Calibration menu, you can proceed to perform a Zero calibration or bypass Zero calibration and perform a Span calibration. You may also go back to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to start calibration.
- Press [MODE] to quit and return to the main calibration display.

If you have pressed [Y/+] to enter Zero calibration, then you will see this message:



1. Start the flow of Zero calibration gas.
2. Press [Y/+] to start calibration.

Note: At this point, you may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu, highlighted for Span calibration.

3. Zero calibration starts a 60-second countdown and displays this message:

Zeroing...

During the zeroing process, the instrument performs the Zero calibration automatically and does not require any action on your part.

Note: To abort the zeroing process at any time and proceed to Span calibration, press [N/-] at any time while zeroing is being performed. You will see a confirmation message that says "Zero aborted!" and then the Span calibration menu appears.

When Zero calibration is complete, you see this message:

Zeroing is done! Or Zeroing is done!
Reading = 0 ppb Reading = 0 ppm

The instrument will then show the Calibration menu on its display, with Span Calib highlighted.

16.1.1. Reflex PID Technology™

All handheld PID monitors after firmware version 2.20 benefit from our patented Reflex PID Technology™. It provides several benefits, including enhanced stability and accuracy, particularly at very low levels. One time each hour, Reflex PID™ Technology adjusts the zero point automatically to ensure greater uniformity in readings, especially when detecting ultra-low levels (ppb range) of VOCs. This one-minute operation is performed automatically, so precise readings are assured without requiring the user to perform zeroing.

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Reflex PID technology is automatically enabled during each zero calibration process. For the ppbRAE3000+, it performs a sensor noise level assessment to re-baseline zeroing of the instrument and provide ultimate performance at sub-ppm level.

The instrument's user can decide to abort this operation by pressing [N/-], should this process need to be interrupted for a measurement.

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16.2.Span Calibration

This procedure determines the second point of the sensor calibration curve for the sensor. A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure. Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:

C. Gas = Isobutene		
Span = 10 ppm		
Please apply gas 1...		
Start	Quit	

MiniRAE 3000+, ppbRAE
3000+, UltraRAE 3000+

C. Gas = Isobutene		
Span = 100 ppm		
Please apply gas 1...		
Start	Quit	

MiniRAE Lite+

1. Turn on your span calibration gas.
2. Press [Y/+] to initiate calibration.

Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will abort the span calibration and take you directly to the Calibration menu for Zero calibration.

3. Span calibration starts and displays this message:

Calibrating...

During the Span calibration process, there is a 30-second countdown and the instrument performs the Span calibration automatically. It requires no actions on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says "Span is aborted!" and then the Zero calibration menu appears. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

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When Span calibration is complete, you see a message similar to this (the value is an example only):

Span 1 is done!
Reading = 10.0 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

16.3. Exiting Two-Point Calibration In Basic User Level

When you are done performing calibrations, press [MODE], which corresponds with "Back" on the display.

You will see the following message:

Updating settings...

The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

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17. Three-Point Calibration

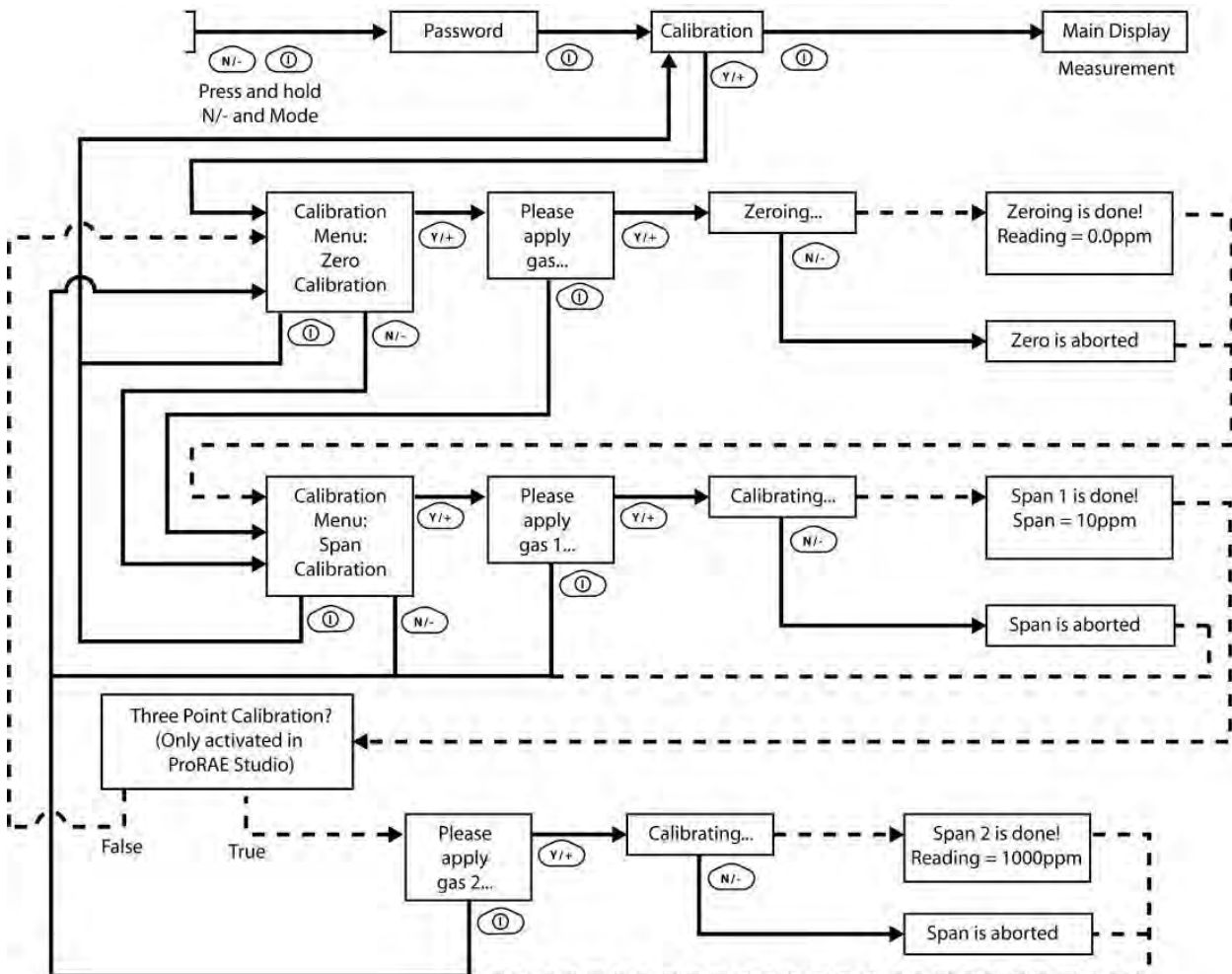
Note: This feature is not available on MiniRAE Lite+.

For enhanced accuracy, it is possible to perform a second Span calibration in addition to the Zero and Span calibrations outlined in the previous section. Your instrument first must be set to allow this third calibration. This requires using ProRAE Studio II or Honeywell Safety Suite Device Configurator software and a PC, as well as a higher concentration of calibration gas. Follow the instructions in the next section.

Note: Once the third calibration is set, you do not need to use ProRAE Studio II or Honeywell Safety Suite Device Configurator to allow future 3-point calibrations. Also, you can only disable 3-point calibration capability by using ProRAE Studio II or Honeywell Safety Suite Device Configurator again.

Perform the Zero and Span calibrations. After the first Span calibration (Span 1) is completed, the display a second Span calibration (Span 2) can be performed. The process is identical to the first calibration. As in the Span 1 calibration, you may exit and return to the Zero calibration screen if you choose not to perform this calibration or to abort it.

Note: If a bump test is available, it appears after the last calibration in the menu. See "Two-Point Calibration," page 43, for details. Also, refer to page 51 for details on how to perform a bump test.



Note: Dashed line indicates automatic progression. **49**

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Span 2 Calibration

The minimum value of Span 2 gas should be 1000 ppm. If the primary concern is accuracy at low concentration, only using the 2-point calibration process with Span 1 set to 100 ppm is adequate. The reading error at 10 ppm will be lower. If Span 1 is set to 10 ppm, the reading error under 100 ppm (or over 100ppm to 1000 ppm) will be higher. A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure.

Note: This gas should be of a higher concentration than the gas used for Span 1 calibration.

Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span 2 calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:

Please apply gas...

1. Turn on your span calibration gas.
2. Press [Y/+] to initiate calibration.

Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu for Zero calibration.

3. Span calibration starts a 30-second countdown and displays this message:

Calibrating...

During the Span calibration process, the instrument performs the Span calibration automatically and does not require any action on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says "Span is aborted!" and then the Zero calibration menu will appear. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

When Span calibration is complete, you will see a message similar to this (the value shown here is for example only):

Span 2 is done!
Reading = 1000 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

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17.1. Exiting Three-Point Calibration

When you are done performing calibrations, press [MODE], which corresponds with “Back” on the display. You will see the following message:

Updating settings...

The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

18. Bump Test

RAE Systems recommends that a bump test be conducted prior to each day's use. The purpose of a bump test is to ensure that the instrument's sensors respond to gas and all the alarms are enabled and functional.

- The ppbRAE 3000+ must be calibrated if it does not pass a bump test when a new sensor is installed, after sensor maintenance has been performed, or at least once every 180 days, depending on use and sensor exposure to poisons and contaminants.
- Calibration and bump test intervals and procedures may vary due to national legislation and company policy.

To perform a bump test (functional challenge), follow these steps:

1. Select “Bump.”
2. Install the calibration adapter and connect it to a source of calibration gas.
3. Verify that the displayed calibration value meets the concentration specified on the gas cylinder.
4. Start the flow of calibration gas.
5. Press [Y/+] to start the bump test.
6. You can abort the calibration at any time during the countdown by pressing [N/-].
7. If the calibration is not aborted, the display shows reading and then tells you whether the bump test passed or failed. If the bump test failed, then it automatically advances to the Calibration screen.

A bump test can be performed either manually or using the AutoRAE 2 Automatic Test and Calibration System. When a bump test is done manually, the instrument makes a pass/fail decision based on sensor performance, but the user still has the responsibility to make sure all the alarms are enabled and functional.

Note: Bump testing and calibration can be performed using an AutoRAE 2 Automatic Test & Calibration System. An AutoRAE 2 bump test takes care of both the sensor and alarm tests. Consult the AutoRAE 2 User's guide for details.

The same gas is used for a bump test as for calibration. The instrument must be connected to a cylinder of calibration gas with supplied tubing.

IMPORTANT!

If the instrument does not pass a bump test, perform a full calibration. If calibration also fails, the PID sensor or lamp may require cleaning or replacement. If the instrument repeatedly fails to calibrate, turn it off and refer it for servicing.

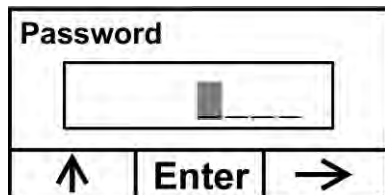
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19. Programming Mode

On the MiniRAE 3000+, ppbRAE 3000+, or UltraRAE 3000+, Programming Mode can be entered from either Hygiene Mode or Search Mode. If the current user mode is Basic, you must provide a 4-digit password to enter. On the MiniRAE Lite+, there is only one mode.

19.1. Entering Programming Mode

1. Press and hold [MODE] and [N/-] until you see the Password screen.



2. Input the 4-digit password:

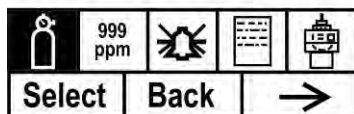
- Increase the number from 0 through 9 by pressing [Y/+].
- Step from digit to digit using [N/-].
- Press [MODE] when you are done.

If you make a mistake, you can cycle through the digits by pressing [N/-] and then using [Y/+] to change the number in each position.

Note: The default password is 0000.

When you have successfully entered Programming Mode, you see this screen:

Calibration

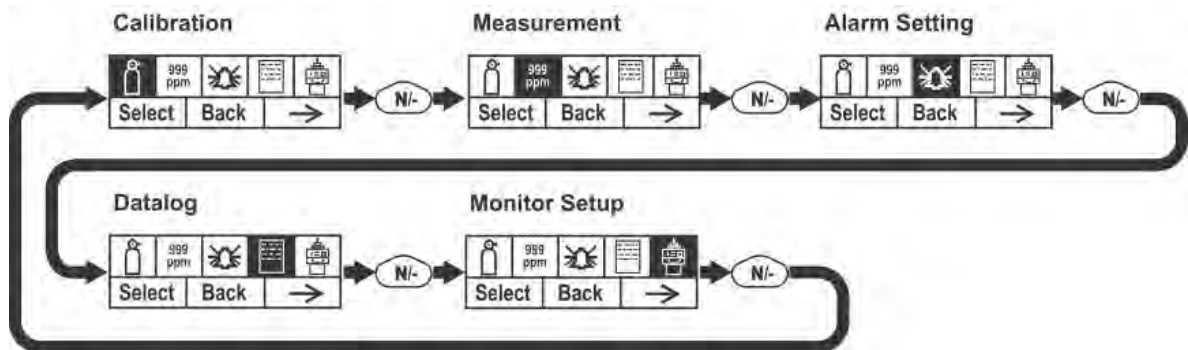


Note: The password can only be changed by connecting the instrument to a PC running ProRAE Studio II or Honeywell Safety Suite Device Configurator software. Follow the instructions in ProRAE Studio II or Honeywell Safety Suite Device Configurator to change it. The Calibration label is shown and its icon is highlighted, but you can press [N/-] to step from one programming menu to the next, with the name of the menu shown at the top of the display and the corresponding icon highlighted.

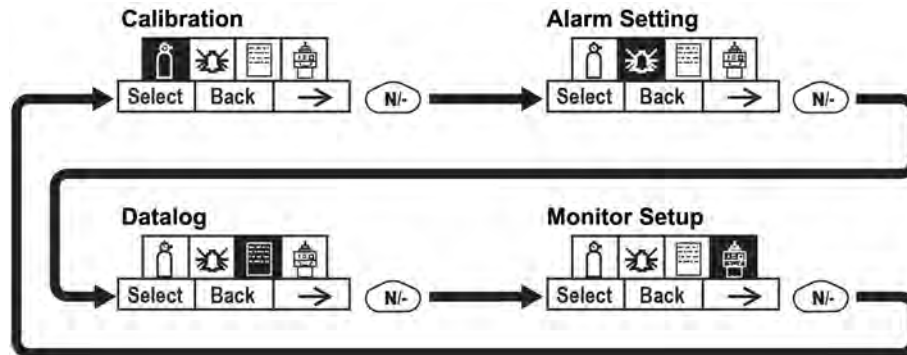
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As you repeatedly press [N/-], the selection moves from left to right, and you see these screens:

MiniRAE 3000+, ppbRAE 3000+, UltraRAE 3000+



MiniRAE Lite+



Note: When you reach Monitor Setup and press [N/-], the menu cycles back to Calibration.

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20. Programming Mode Menus

The Programming Mode allows anyone with the password to change the instrument's settings, calibrate the instrument, modify the sensor configuration, enter user information, etc. Programming Mode has five menus. Each menu includes several sub-menus to perform additional programming functions.

The table on the next shows the menus and sub-menus.

All entries are supported on MiniRAE 3000+, ppbRAE 3000+, and UltraRAE 3000+.

Entries marked with an asterisk (*) are supported on MiniRAE Lite+.

				
Calibration	Measurement	Alarm Setting	Datalog	Monitor Setup
Zero Calibration *	Meas. Gas	High Alarm *	Clear Datalog *	Radio Power*
Span Calibration *	Meas. Unit	Low Alarm *	Interval *	Op Mode
Bump *	Tube Selection	STEL Alarm	Data Selection *	Site ID
		TWA Alarm	Datalog Type *	User ID
		Alarm Mode *		User Mode
		Buzzer & Light *		Date *
				Time *
				Pump Duty Cycle
				Pump Speed
				Temperature Unit
				Language *
				Real Time Protocol
				Power On Zero
				Unit ID
				LCD Contrast
				Lamp ID
				PAN ID
				Mesh Channel
				Mesh Interval

Once you enter Programming Mode, the LCD displays the first menu, Calibration. Each subsequent menu is accessed by pressing [N/-] repeatedly until the desired menu is displayed. To enter a sub-menu of a menu, press [Y/+].

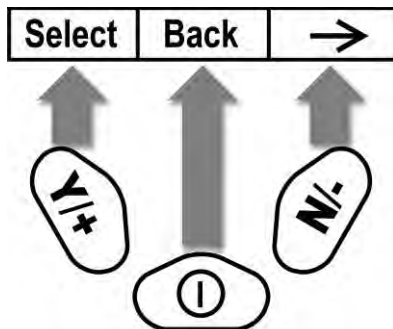
20.1. Exiting Programming Mode

To exit Programming Mode and return to normal operation, press [MODE] once at any of the programming menu displays. You will see "Updating Settings..." as changes are registered and the mode changes.

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20.2. Navigating Programming Mode Menus

Navigating through the Programming Mode menus is easy and consistent, using a single interface format of “Select,” “Back” and “Next” at the top level. The three control buttons correspond to these choices as shown:



Note: Pressing [MODE] in the Programming Mode's top level causes the instrument to exit Programming Mode and return to monitoring.

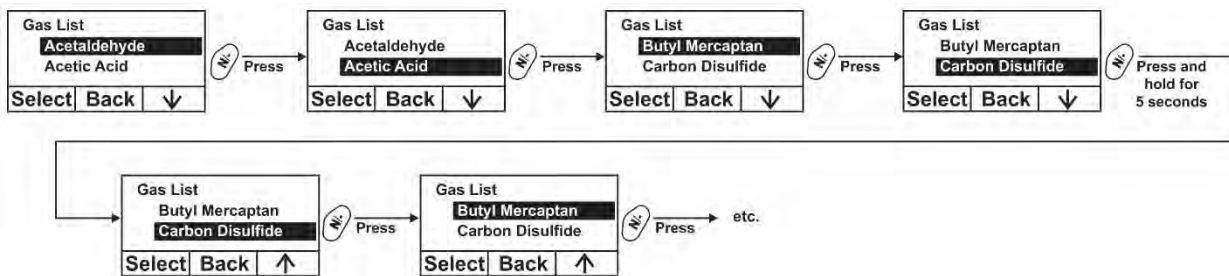
The three keys perform the following functions in Programming Mode:

Key	Function in Programming Mode
[MODE]:	Exit menu when pressed momentarily or exit data entry mode
[Y/+]:	Increase alphanumerical value for data entry or confirm (yes) for a question
[N/-]:	Provides a “no” response to a question

20.3. Reverse Direction – Menu Selection

Lists can be long, so rather than progressing in one direction through every item in the list before “looping” back to the first item, you can change the scrolling direction.

To reverse direction: Press and hold [N/-] for 5 seconds. The direction arrow changes. Now when you press [N/-], the menu items are scrolled through in the other direction.

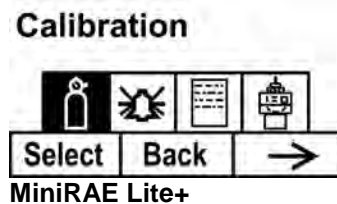
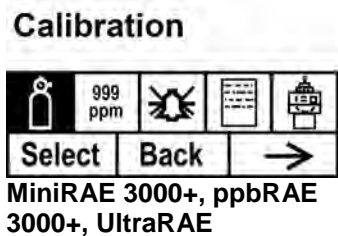


Note: You can change direction anytime by pressing and holding [N/-] for 5 seconds.

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20.4. Calibration

Two types of calibration are available: Zero (fresh air) and Span.



Select Zero or Span Calibration by pressing [N/+]. Once your choice is highlighted, press [Y/+].

20.4.1. Zero Calibration

The procedure for performing a zero calibration is covered on page 45.

Auto Zero can also be performed. Refer to page 19 for details.

20.4.2. Span Calibration

The procedure for performing a basic span calibration is covered on page 4343.

20.4.3. Bump Test

The procedure for performing a bump test is covered on page 51.

A bump test can be performed either manually or using the AutoRAE 2 Automatic Test and Calibration System. When a bump test is done manually, the instrument makes a pass/fail decision based on sensor performance, but the user still has the responsibility to make sure all the alarms are enabled and functional.

Note: Bump testing and calibration can be performed using an AutoRAE 2 Automatic Test & Calibration System. An AutoRAE 2 bump test takes care of both the sensor and alarm tests. Consult the AutoRAE 2 User's guide for details.

The same gas is used for a bump test as for calibration. The instrument must be connected to a cylinder of calibration gas with supplied tubing.

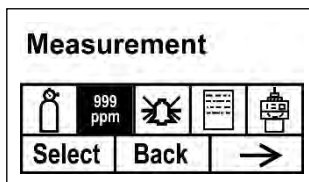
IMPORTANT!

If the instrument does not pass a bump test, perform a full calibration. If calibration also fails, the PID sensor or lamp may require cleaning or replacement. If the instrument repeatedly fails to calibrate, turn it off and refer it for servicing.

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20.5. Measurement

The sub-menus for Measurement are Measurement Gas and Measurement Unit.



20.5.1. Meas. Gas

Measurement gases are organized in four lists:

- My List is a customized list of gases that you create. It contains a maximum of 10 gases and can only be built in ProRAE Studio II or Honeywell Safety Suite Device Configurator on a PC and transferred to the instrument.

Note: The first gas in the list is always isobutylene (it cannot be removed from the list).

- Last Ten is a list of the last ten gases used by your instrument. The list is built automatically and is only updated if the gas selected from Custom Gases or Library is not already in the Last Ten. This ensures that there is no repetition.
- Gas Library is a library that consists of all the gases found in RAE Systems' Technical Note TN-106 (available online at www.raesystems.com).
- Custom Gases are gases with user-modified parameters. Using ProRAE Studio II or Honeywell Safety Suite Device Configurator, all parameters defining a gas can be modified, including the name, span value(s), correction factor, and default alarm limits.

1. Scroll through each list by pressing [N/-].
2. Press [Y/+] to select one (My List, Last Ten, Gas Library, or Custom Gases).
3. Once you are in one of the categories, press [N/-] to scroll through its list of options and [Y/+] to select one. (If you press [MODE], you exit to the next submenu.)
4. Press [Y/+] to save your choice or [N/-] to undo your selection.

Press [MODE] to leave the sub-menu and return to the Programming Mode menus.

20.5.2. Meas. Unit

Standard available measurement units include:

Abbreviation	Unit
ppm	parts per million
ppb	parts per billion
mg/m ³	milligrams per cubic meter
ug/m ³	micrograms per cubic meter

- Scroll through the list by pressing [N/-].
- Select by pressing [Y/+] .
- Save your selection by pressing [Y/+] or undo your selection by pressing [N/-].

Press [MODE] to leave the sub-menu and return to the Programming Mode menus.

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20.5.3. Tube Selection (UltraRAE 3000+ only)

When operating the UltraRAE 3000+ in Compound Specific mode, the internal computer works most effectively when it is told which type of separation tube is being used.

Tube Selection		
<input checked="" type="radio"/> Benzene		
<input type="radio"/> Butadiene		
Select	Done	↓

1. Scroll through the menu by pressing [N/-].
2. Press [Y/+] to make a selection.
3. Press [MODE] when you are done.
4. Press [Y/+] to save your choice or [N/-] to undo your selection.

Tube Selection		
<input checked="" type="radio"/> Benzene		
<input type="radio"/> Butadiene		
Save		Undo

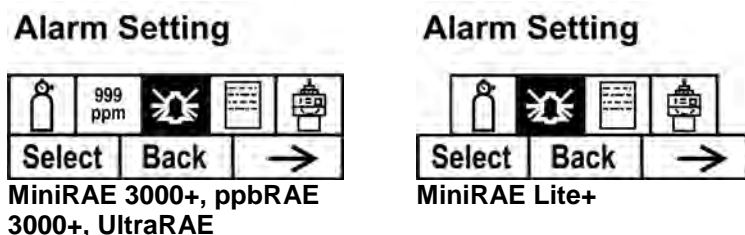
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20.5.4. Alarm Setting

During each measurement period, the gas concentration is compared with the programmed alarm limits (gas concentration alarm limit settings: Low, High, TWA and STEL). If the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn of the alarm condition.

An alarm signal summary is shown on page 36.

In this menu, you can change the High and Low alarm limits, the STEL limit, and the TWA. Press [Y/+] to enter the Alarm Setting menu. **Note:** All settings are shown in ppm (parts per million), or mg/m³ (milligrams per cubic meter), depending on your setting.



1. Scroll through the Alarm Limit sub-menu using the [N/-] key until the display shows the desired limit to be changed (High Alarm, Low Alarm, STEL Alarm, and TWA Alarm)
2. Press [Y/+] to select one of the alarm types. The display shows a flashing cursor on the left-most digit of the previously stored alarm limit.
3. Press [Y/+] to increase each digit's value.
4. Press [N/-] to advance to the next digit.
5. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.
Press [MODE] when you are done.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

When all alarm types have been changed or bypassed, press [MODE] to exit to the Programming Menu.

20.5.5. High Alarm

You can change the High Alarm limit value. The value is typically set by the instrument to match the value for the current calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the High Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

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When you have completed your selections, press [MODE]. You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

20.5.6. Low Alarm

You can change the Low Alarm limit value. The value is typically set by the instrument to match the value for the current calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the Low Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE]. You will see two choices: Save and Undo. You can register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

20.5.7. STEL Alarm

Note: This feature is not included on MiniRAE Lite+.

You can change the STEL Alarm limit value. The value is typically set by the instrument to match the value for the calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the STEL Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE]. You will see two choices: Save and Undo. You can register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

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20.5.8. TWA Alarm

Note: This feature is not included on MiniRAE Lite+.

You can change the TWA (time-weighted average) Alarm limit value. The value is typically set by the instrument to match the value for the calibration gas. It is expressed in parts per billion (ppb).

Note: The default value depends on the measurement gas.

To change the TWA Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE]. You will see two choices:

- Save
- Undo

You can register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

20.5.9. Alarm Mode

There are two selectable alarm types:

Latched When the alarm is triggered, you can manually stop the alarm.

The latched setting only controls alarms for High Alarm, Low Alarm, STEL Alarm, and TWA alarm.

Note: To clear an alarm when the instrument is set to "Latched," press [Y/+] when the main (Reading) display is shown.

Automatic Reset When the alarm condition is no longer present, the alarm stops and resets itself.

1. Press [N/-] to step from one alarm type to the other.
2. Press [Y/+] to select an alarm type.

When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

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20.5.10. Buzzer & Light

The buzzer and light alarms can be programmed to be on or off individually or in combination. Your choices are:

- Both on
- Light only
- Buzzer only
- Both off

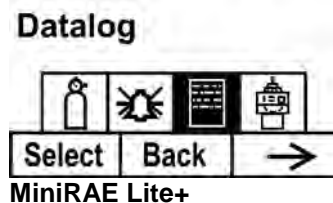
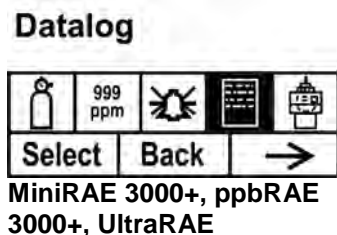
1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates your selection).
3. When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

20.6. Datalog

The instrument calculates and stores the concentration and ID of each sample taken. In the datalog sub-menu, a user can perform the tasks and functions shown below.



1. Scroll through the Datalog sub-menu using the [N/-] key until the display shows the desired parameter to be changed:

- Clear Datalog
- Interval
- Data Selection
- Datalog Type

2. Press [Y/+] to make your selection. Exit by pressing [MODE] for Back.

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20.6.1. Clear Datalog

This erases all the data stored in the datalog.

Note: Once the datalog is cleared, the data cannot be recovered.

Press [Y/+] to clear the datalog. The display asks, "Are you sure?"

- Press [Y/+] if you want to clear the datalog. When it has been cleared, the display shows "Datalog Cleared!"
- Press [N/-] if you do not want to clear the datalog.

The display changes, and you are taken to the next sub-menu, Interval.

20.6.2. Interval

Intervals are shown in seconds. The default value is 60 seconds. The maximum interval is 3600 seconds.

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You can register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

20.6.3. Data Selection

Data Selection allows you to select which types of data are stored and made available when you offload your datalog to a computer via ProRAE Studio II or Honeywell Safety Suite Device Configurator software.

You can choose any or all of three types of data (you must choose at least one):

- Average
- Maximum
- Minimum

1. Press [N/-] to step from one option to the next. The highlighter indicates your choice.
2. Press [Y/+] to toggle your selection on or off (the check box indicates "on" with an "X").
3. When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You can register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

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20.6.4. Datalog Type

The instrument has three datalog types:

Auto	Default mode. Collects datalog information when the instrument is sampling.
Manual	Datalogging occurs only when the instrument's datalogging is manually started (see below for details).
Snapshot	Datalogs only during single-event capture sampling.

Note: You can only choose one datalog type to be active at a time.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].

You will see two choices: Save and Undo. You can register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

20.6.5. Manual Datalog

When the instrument is set to Manual Datalog, you turn datalogging on and off by stepping through the displays from the Main Display, and then pressing the keys to select datalog on/off functions.

- When you reach the screen that says "Start Datalog?" press [Y/+] to start it. You see "Datalog Started," confirming that datalogging is now on.
- When you reach the screen that says "Stop Datalog?" press [Y/+] to stop it. You see "Datalog Stopped," confirming that datalogging is now off.

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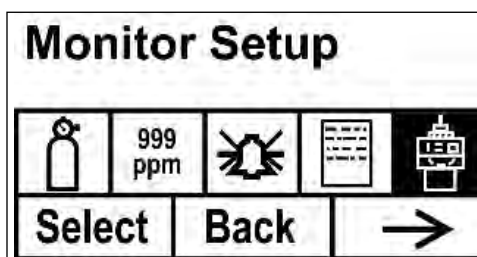
20.6.6. Snapshot Datalog

When the instrument is in Snapshot datalogging mode, it captures a single “snapshot” of the data at the moment of your choosing. Whenever the instrument is on and it is set to Snapshot, all you have to do is press [MODE] each time you want to capture a snapshot of the data at that instant.

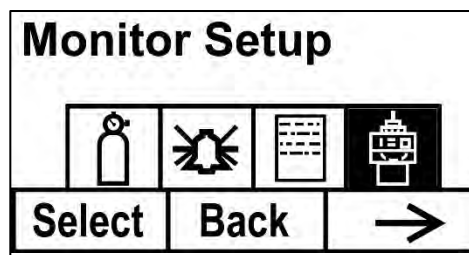
When you send the data to a computer using ProRAE Studio II or Honeywell Safety Suite Device Configurator, the data snapshots are uniquely identified by time and other parameters.

20.7. Monitor Setup

Many settings can be accessed in this menu, including setting the date and time and adjusting the pump's on/off duty cycle.



MiniRAE 3000+, ppbRAE 3000+,
UltraRAE 3000+



MiniRAE Lite+

Radio Power

The radio connection can be turned on or off. (The default value is off.)

1. Press [N/-] to step from one option to the next (on or off).
 2. Press [Y/+] to make your selection (the dark circle in the “radio button” indicates that the option is selected).
 3. When you have completed your selection, press [MODE].
- Press [Y/+] to accept the new radio setting (on or off).
 - Press [N/-] to discard the change and move to the next sub-menu.

20.7.1. Op Mode

Note: This feature is not included on MiniRAE Lite+.

Under Monitor Setup is “Op Mode.”

Press [Y/+] to select.

You see two options (one is highlighted):

Hygiene
Search

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The current mode is indicated by a dark circle within the circle in front of either Hygiene or Search.

1. Select Hygiene or Search by pressing [N/-]. The highlighting changes from one to the other each time you press [N/-].
2. Press [Y/+] to select that mode for the instrument.
3. Press [MODE] when you want to register your selection to place the instrument in the selected mode.
4. Press [Y/+] to commit the change and exit to the Monitor Setup screen, or press [N/-] to Undo (exit to the Monitor Setup screen without changing the Mode).

20.7.2. Site ID

Enter an 8-digit alphanumeric/character Site ID in the programming mode. This Site ID is included in the datalog report.

1. Press [Y/+] and the display shows the current site ID. Example: "RAE00001." Note that the left-most digit flashes to indicate it is the selected one.
2. Press [Y/+] to step through all 26 letters (A to Z) and 10 numerals (0 to 9).

Note: The last four digits must be numerals.

3. Press [N/-] to advance to the next digit. The next digit to the right flashes.
4. Repeat this process until all eight digits of the new site ID are entered.

Press [MODE] to exit.

If there is any change to the existing site ID, the display shows "Save?" Press [Y/+] to accept the new site ID. Press [N/-] to discard the change and move to the next sub-menu.

20.7.3. User ID

Enter an 8-digit alphanumeric User ID in the programming mode. This User ID is included in the datalog report.

1. Press [Y/+] and the display shows the current User ID. Example: "RAE00001." Note that the left-most digit flashes to indicate it is the selected one.
2. Press [Y/+] to step through all 26 letters (A to Z) and 10 numerals (0 to 9).
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.
4. Repeat this process until all eight digits of the new User ID are entered.

Press [MODE] to exit.

If there is any change to the existing User ID, the display shows "Save" Press [Y/+] to accept the new site ID. Press [N/-] to discard (undo) the change and move to the next sub-menu.

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20.7.4. User Mode

Note: This feature is not included on MiniRAE Lite+.

The instrument has two user modes:

- | | |
|-----------------|---|
| Basic | Basic users can only see and use a basic set of functions. |
| Advanced | Advanced users can see all screens and perform all available functions. |

Note: The default value for User Mode is Basic.

To change the User Mode:

1. Press [N/-] to step from one option to the next. The highlighting changes each time you press [N/-].
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
4. Press [Y/+] to accept the new User Mode. Press [N/-] to discard the change and move to the next sub-menu.

20.7.5. Date

The Date is expressed as Month/Day/Year, with two digits for each.

1. Press [Y/+] and the display shows the current date. Note that the left-most digit flashes to indicate it is selected.
 2. Press [Y/+] to step through all 10 numerals (0 to 9).
 3. Press [N/-] to advance to the next digit. The next digit to the right flashes.
 4. Repeat this process until all six digits of the new date are entered.
 5. Press [MODE] to exit.
- Press [Y/+] to save the new date.
 - Press [N/-] to undo the change and move to the next sub-menu.

20.7.6. Time

The Time is expressed as Hours/Minutes/Seconds, with two digits for each. The time is in 24-hour (military) format.

1. Press [Y/+] and the display shows the current time. Note that the left-most digit flashes to indicate it is selected.
 2. Press [Y/+] to step through all 10 numerals (0 to 9).
 3. Press [N/-] to advance to the next digit. The next digit to the right flashes.
 4. Repeat this process until all six digits of the new time are entered.
 5. Press [MODE] to exit.
- Press [Y/+] to save the new date.
 - Press [N/-] to undo the change and move to the next sub-menu.

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20.7.8. Duty Cycle

The pump's duty cycle is the ratio of its on time to off time. The duty cycle ranges from 50% to 100% (always on). Duty cycling is employed by the instrument to clean the PID. A lower duty cycle has a greater effect on keeping the PID clean than a higher duty cycle.

Important! Pump duty cycling is interrupted when the instrument senses a gas. The pump's duty cycle is disabled when the measurement is greater than the low-alarm threshold and is re-enabled when the reading falls below the low-alarm threshold. The range is 10 to 300 seconds, and the default value is 30.

1. Press [Y/+] to increase the value.
 2. When you have completed your selection, press [MODE].
- Press [Y/+] to save the new duty cycle value.
 - Press [N/-] to undo the change and move to the next sub-menu.

20.7.9. Temperature Unit

The temperature display can be switched between Fahrenheit and Celsius units.

1. Press [N/-] to step from one option to the next.
 2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
 3. When you have completed your selection, press [MODE].
- Press [Y/+] to save the new temperature unit.
 - Press [N/-] to undo the change and move to the next sub-menu.

20.7.10. Pump Speed

The pump can operate at two speeds, high and low. Running at low speed is quieter and conserves a small amount of power. There is almost no difference in sampling accuracy.

1. Press [N/-] to step from one option to the next.
 2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
 3. When you have completed your selection, press [MODE].
- Press [Y/+] to save the new temperature unit.
 - Press [N/-] to undo the change and move to the next sub-menu.

20.7.11. Language

English is the default language, but other languages can be selected for the instrument.

1. Press [N/-] to step from one option to the next.
 2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
 3. When you have completed your selection, press [MODE].
- Press [Y/+] to save your new language choice.
 - Press [N/-] to undo it and return to the previous language selection.

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20.7.12. Real Time Protocol

Note: This feature is not included on MiniRAE Lite+.

Real Time Protocol is the setting for data transmission.

The choices are:

P2M (cable)	Point to multipoint. Data is transferred from the instrument to multiple locations using a wired connection. Default data rate: 19200 bps.
P2P (cable)	Point to point. Data is transferred only between the instrument and one other location, such as a computer. Default data rate: 9600 bps.
Wireless	Data is transferred wirelessly and can be received by receivers.

1. Press [N/-] to step from one option to the next.
 2. Press [Y/+] to make your selection (the dark circle in the “radio button” indicates “on”).
 3. When you have completed your selection, press [MODE].
- Press [Y/+] to save the new real-time communications protocol.
 - Press [N/-] to undo the change and move to the next sub-menu.

20.7.13. Power On Zero

Note: This is not recommended for ppbRAE3000+ or UltraRAE3000+.

Always make sure the instrument is turned on in VOC-free environment..When Power On Zero is on, the instrument performs a zero calibration when it is turned on.

1. Press [N/-] to step from one option to the next.
 2. Press [Y/+] to make your selection (the dark circle in the “radio button” indicates your selection).
 3. When you have completed your selection, press [MODE].
- Press [Y/+] to save the change.
 - Press [N/-] to discard the change and move to the next sub-menu.

20.7.14. Unit ID

This three-digit number keeps data separated by instrument when more than one instrument is used in a network. If multiple sensing units are attempting to communicate with the same Host, then the units must all have a different Unit ID.

1. Press [Y/+] to step through all 10 numerals (0 to 9). If you pass the numeral you want, keep pressing [Y/+] . After it counts up to 9, it starts counting up from 0 again.
 2. Press [N/-] to advance to the next digit. The next digit to the right flashes.
 3. Repeat this process until all three digits of the Unit ID are entered.
 4. Press [MODE] when you are done.
- Press [Y/+] to save the change.
 - Press [N/-] to discard the change and move to the next sub-menu

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20.7.15. LCD Contrast

The display's contrast can be increased or decreased from its default setting. You may not need to ever change the default setting, but sometimes you can optimize the display to suit extreme temperature and ambient brightness/darkness conditions.

- The minimum value is 20.
 - The maximum value is 60.
1. Press [Y/+] to increase the value or [N/-] to decrease the value.
 2. Press [MODE] to save your selection.
- Press [Y/+] to save your new contrast value.
 - Press [N/-] to undo it and return to the previous value.

20.7.16. Lamp ID

The instrument does not automatically identify the type of lamp, so you must select a lamp type manually.

1. Scroll through the menu by pressing [N/-].
2. Press [Y/+] to make a selection.
3. Press [MODE] when you are done.
4. Press [Y/+] to save your choice or [N/-] to undo your selection.

20.7.17. PAN ID

The instrument and any other devices that you want to interconnect wirelessly must have the same PAN ID. You can set the PAN ID in the instrument or through ProRAE Studio II or Honeywell Safety Suite Device Configurator.

1. Press [N/-] to advance through the digits from left to right.
2. Press [Y/+] to advance through the numbers (1, 2, 3, etc.).
3. Press [MODE] to register your choice when you are done.

Note: PAN ID does not apply to BLE-equipped instruments.

20.7.18. Mesh Channel

Note: For mesh radio modems operating at 868MHz, only channel 0 is available. For other frequencies, channels 1 through 10 are allowed.

1. Press [Y/+] to increase the number and [N/-] to advance to the next digit.
 2. After moving to the last digit and making changes, press [MODE].
- Press [Y/+] to save the change.
 - Press [N/-] to undo the change.

Note: Mesh Channel does not apply to BLE-equipped instruments.

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20.7.19. Mesh Interval

Set the time interval at which the instrument's mesh radio sends out a signal. This can range from once every 10 seconds to once every four minutes (240 seconds). The transmission frequency is user-adjustable, but a rate of at least once every 30 seconds is recommended.

Note: Shorter intervals reduce battery life.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make a selection.
3. When you are done, press [MODE].

Note: Mesh Interval does not apply to BLE-equipped instruments.

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21. Hygiene Mode

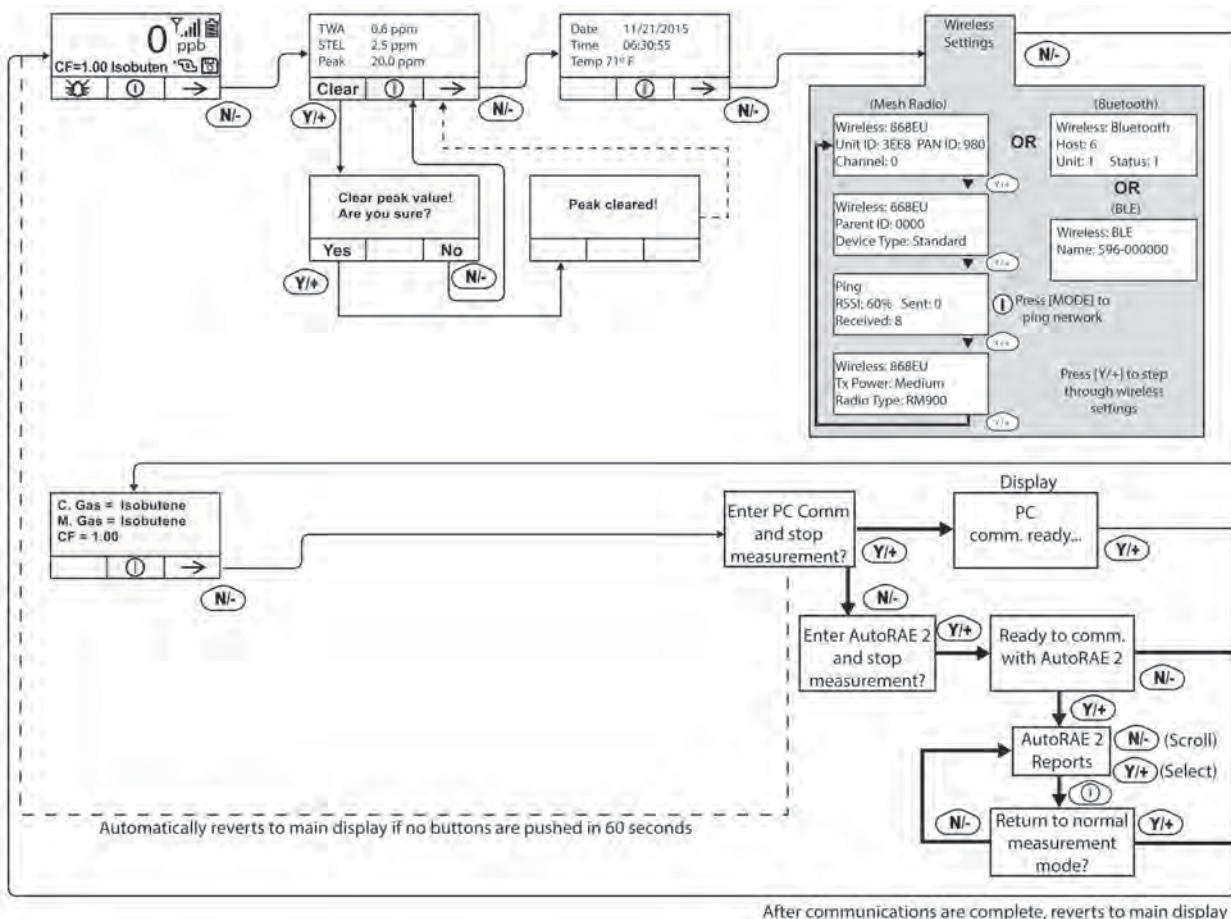
Note: This feature is not included on MiniRAE Lite+.

The instrument usually operates in Hygiene Mode, which provides basic functionality. However, it is possible to operate it in a second mode called Search Mode. Here are the primary differences:

- Hygiene Mode:** Automatic measurements, continuously running and datalogging, and calculates additional exposure values.
- Search Mode:** Manual start/stop of measurements and display of certain exposure values.

21.1. Basic User Level & Hygiene Mode

The default setting is navigated in the following way:



Note: Dashed line indicates automatic progression.

Pressing [N/-] steps you from screen to screen. Options include clearing the Peak value and turning on the instrument's PC Communications for data transfer to a PC.

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21.2. Entering Search Mode From Hygiene Mode

In order to change the instrument's operational mode from Hygiene Mode to Search Mode, you must enter the password-protected Programming Mode:

1. Hold [MODE] and [N/-] until you see the password screen.
2. Use [Y/+] to increment to the number you want for the first digit. (If you pass by the desired number, press [Y/+] until it cycles through to 0 again. Then press [Y/+] until you reach the desired number.)
3. Press [N/-] to advance to the next digit.
4. Again press [Y/+] to increment the number.
5. Press [N/-] to advance to the next digit.

Continue the process until all four numbers of the password have been input. Then press [MODE] to proceed.

The screen changes to icons with the label "Calibration."

1. Press [N/-] to advance to "Monitor Setup."
2. Press [Y/+] to select Monitor Setup.

Under Monitor Setup, you will see "Op Mode."

3. Press [Y/+] to select.

You will see:

Hygiene
Search

The current mode is indicated by a dark circle within the circle in front of either Hygiene or Search.

1. Select Hygiene or Search by pressing [N/-].
2. Press [Y/+] to place the instrument into the selected mode.
3. Press [MODE] when you want to register your selection to place the instrument in the selected mode.
4. Press [Y/+] to commit the change and exit to the Monitor Setup screen, or press [N/-] to Undo (exit to the Monitor Setup screen without changing the Mode).

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22. Advanced User Level (Hygiene Mode Or Search Mode)

The User Mode called Advanced User Level allows a greater number of parameters to be changed than Basic User Level. It can be used with either of the Operation Modes, Hygiene Mode or Search Mode.

22.1. Advanced User Level & Hygiene Mode

With the instrument in Operation Mode: Hygiene Mode, enter User Mode: Advanced User Level (refer to the section called Monitor Mode for instructions).

Once you are in Advanced User Level and Hygiene Mode together, you can change the calibration reference and measurement gas, in addition to performing normal monitoring functions.

Pressing [N/-] progresses through the screens, while pressing [Y/+] selects options. Pressing [MODE] makes menu choices when it is shown for "Done" or "Back." Pressing and holding [Mode] whenever the circle with a vertical line in the middle is shown activates the countdown to shutoff.