

TVA2020

Instruction Manual

Toxic Vapor Analyzer

Part Number 111755-00

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WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:



Thermo Fisher Scientific has contracted with one or more recycling/disposal companies in each EU Member State, and this product should be disposed of or recycled through them. Further information on Thermo Fisher Scientific's compliance with these Directives, the recyclers in your country, and information on Thermo Fisher Scientific products which may assist the detection of substances subject to the RoHS Directive are available at: www.thermoscientific.com/WEEERoHS.

About This Manual

This manual provides information about installing, maintaining, and servicing the TVA2020 Toxic Vapor Analyzer (TVA). It also contains important alerts to ensure safe operation and prevent equipment damage. The manual is organized into the following chapters and appendices to provide direct access to specific operation and service information.

- Chapter 1 “[Introduction](#)” provides an overview of the product, describes the theory of operations, and product specifications.
- Chapter 2 “[Hardware and Startup](#)” describes the setup and different instrument configurations, and provides a quick start procedure.
- Chapter 3 “[Display Menus](#)” describes the functions of the instrument keypad, and the enhanced probe display.
- Chapter 4 “[Calibration](#)” describes the calibration process and provides procedures for calibrating the instrument.
- Chapter 5 “[Preventive Maintenance](#)” provides maintenance procedures to ensure reliable and consistent instrument operation.
- Chapter 6 “[Troubleshooting](#)” provides guidelines for diagnosing analyzer problems, isolating faults, and includes recommended actions for restoring proper operation.
- Chapter 7 “[Servicing](#)” provides guidelines for diagnosing analyzer problems, isolating faults, and includes recommended actions for restoring proper operation.
- Chapter 8 “[Optional Accessories](#)” describes the optional equipment that can be used with this analyzer.
- Appendix A “[Warranty](#)” is a copy of the warranty statement.
- Appendix B “[Text Data Formats](#)” is a description of the files available for download from the instrument.
- Appendix C “[Response Factors](#)” describes response factors for monitoring different compounds and provides a list of the various gases.





Safety

Review the following information carefully before using the instrument. This manual provides specific information on how to operate the instrument, however if used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.


Safety and Equipment Damage Alerts



This manual contains important information to alert you to potential safety hazards and risks of equipment damage. Refer to the following types of alerts you may see in this manual.

Safety and Equipment Damage Alert Descriptions

Alert	Description
 DANGER	A hazard is present that will result in death or serious personal injury if the warning is ignored. ▲
 WARNING	A hazard is present or an unsafe practice can result in serious personal injury if the warning is ignored. ▲
 CAUTION	The hazard or unsafe practice could result in minor to moderate personal injury if the warning is ignored. ▲
 Equipment Damage	The hazard or unsafe practice could result in property damage if the warning is ignored. ▲


Safety and Equipment Damage Alerts in this Manual

Alert	Description
 WARNING	<p>Do not replace battery in an area classified as hazardous due to presence of flammable gases or vapors. ▲</p> <p>Do not operate battery charger in an area classified as hazardous due to presence of flammable gases or vapors. ▲</p> <p>Misusing or mishandling the battery packs can lead to fluid leakage, heat generation, fire or an explosion. ▲</p> <p>Charger and USB connections are not allowed in an area classified as hazardous due to presence of flammable gases or vapors. ▲</p> <p>To prevent a potential explosion, do not operate the instrument with the PID compartment open or FID detector cap removed. ▲</p> <p>Power down the instrument before performing any service procedures. ▲</p>

Alert	Description
	<p>Never change an electrical component in an area classified as hazardous due to presence of flammable gases or vapors. ▲</p> <p>Parts replacement and maintenance should not be performed in areas classified as hazardous due to presence of flammable gases or vapors. Use only Thermo Fisher Scientific replacement parts. (Extended Service Plans are available; contact Thermo Fisher Scientific for further information.) ▲</p> <p>A safe refill operation means there are no hydrogen leaks. Before any valves are opened, use a wrench to firmly tighten connections to the hydrogen supply tanks and the tank fill adapter. If escaping hydrogen is heard during the filling operation, close all valves and correct the leak before proceeding. Leak test with soapy water or equivalent. ▲</p> <p>Remove the hydrogen tank from the instrument before servicing. ▲</p> <p>All maintenance procedures must be performed on a clean surface using clean tools. Avoid touching the lamp's window as well as the metalized portion of the cell assembly with your bare fingers. Fingerprints left on these parts may adversely affect the sensors operation. Latex gloves are preferred, but if they are not used, your hands must be clean and free of oils, lotions, etc. It is acceptable to hold the lamp by its glass body or by the edges of the window. ▲</p>
 CAUTION	<p>If you use multipoint calibration or a gas other than methane or isobutylene and then apply response factors/curves (that have been generated with reference to a single point methane/isobutylene calibration), the resulting measurements will probably be incorrect. ▲</p> <p>Do not fill hydrogen tank to a pressure greater than 15.2 MPa (2200 psig). ▲</p> <p>Observe all hydrogen handling procedures listed below. ▲</p> <p>Do not allow any contact with the igniter coil during cleaning. ▲</p>
 Equipment Damage	<p>Do not operate the TVA2020 if its case is damaged or otherwise compromised. ▲</p>

WEEE Symbol

The following symbol and description identify the WEEE marking used on the instrument and in the associated documentation.

Symbol	Description
	Marking of electrical and electronic equipment which applies to electrical and electronic equipment falling under the Directive 2002/96/EC (WEEE) and the equipment that has been put on the market after 13 August 2005. ▲

Where to Get Help

Service is available from exclusive distributors worldwide. Contact one of the phone numbers below for product support and technical information or visit us on the web at www.thermoscientific.com/aqi.

1-866-282-0430 Toll Free

1-508-520-0430 International

We continue to support our customers with advanced online resources. Our Air Quality Instruments Online Library allows our customer's access to product documents and information on a constant basis.

Available 24-hours a day and seven-days a week, the online library provides quick access to information regardless of time zone or office hours.

To register for an account or log in, please visit www.thermoscientific.com/aqilibrary.

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Chapter 1

Introduction

The Thermo Scientific™ TVA2020 Toxic Vapor Analyzer, is an advanced-design, portable, organic/inorganic vapor monitor for the gas survey industry. The analyzer uses either a flame ionization detector (FID), or both an FID and a photoionization detector (PID).

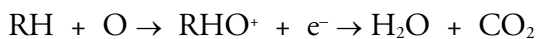
For details of the instrument's theory of operation and product specifications, see the following topics:

- “Flame Ionization Detection (FID)” on page 1-2
- “Photoionization Detection” on page 1-4
- “Dual Detectors” on page 1-6
- “Concentration Calculation and Calibration” on page 1-8
- “Standard Specifications” on page 1-9
- “External Influences” on page 1-11
- “Product Safety Specifications” on page 1-12

Thermo Fisher Scientific is pleased to supply this portable survey instrument. We are committed to the manufacture of instruments exhibiting high standards of quality, performance, and workmanship. Service personnel are available for assistance with any questions or problems that may arise in the use of this instrument. For more information on servicing, see Chapter 7, “Servicing”.

Flame Ionization Detection (FID)

A Flame Ionization Detector (FID) measures organic compounds by utilizing a flame produced by the combustion of hydrogen and air (see [Figure 1-1](#)). When hydrocarbons in the sample are introduced to the detection zone, ions are produced by the following reaction:



where:

R = carbon compound

A collector electrode with a polarizing voltage is also located within the detector chamber, and the ions produced by this reaction are attracted to it. As the ions migrate towards the collector, a current is produced which is directly proportional to the concentration of hydrocarbons introduced to the flame. This current is then amplified and sent to a microprocessor.

The FID has a wide dynamic range. The effective dynamic range can be further expanded by use of a dilutor kit which reduces very high volatile organic compound (VOC) concentrations to within the dynamic range (or even linear range) of the analyzer. The dilutor kit can also be used to enrich oxygen deficient samples by adding ambient air that is rich in oxygen (20.9% usually). Low oxygen can affect the characteristics of the hydrogen flame, causing readings to be artificially elevated and possibly extinguishing the flame. As a general rule of thumb, greater than 16% oxygen is required to support the flame. If underground gases or samples in gas bags are to be measured by an FID, it is advised that a dilutor be used to combat the problem.

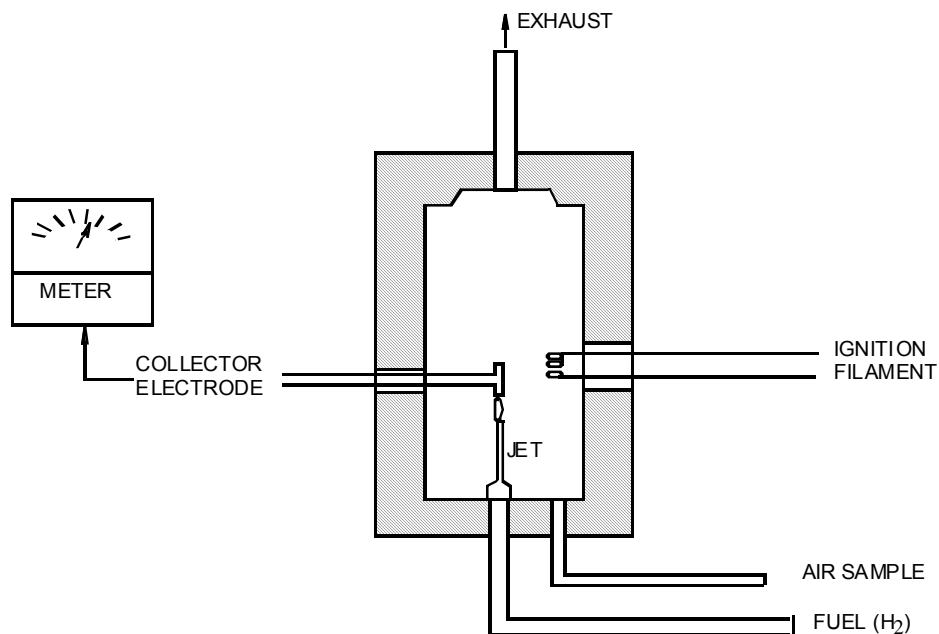


Figure 1–1. Typical Flame Ionization Detector

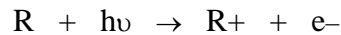
Benefits of Flame Ionization Detection

Benefits of Flame Ionization Detection include:

- Wide dynamic and linear range
- High sensitivity to hydrocarbon vapors (including methane)
- Very stable and repeatable response
- Virtually unaffected by ambient levels of CO, CO₂, and water vapor

Photoionization Detection

A Photoionization Detector (PID) consists of an ultraviolet (UV) lamp of a specific energy and an ionization chamber (see [Figure 1–2](#)). Compounds passing through the chamber are excited by photons of UV energy and ionized according to the following equation:



where:

R = most organic/inorganic compounds

These ions are attracted to a collecting electrode, producing a current proportional to the concentration of the compound.

Whether or not a compound can be detected by a PID depends upon the energy required to remove an electron from the compound (its ionization potential). If the lamp energy is greater than the compound's ionization potential, the PID will detect it. The lamp in the TVA2020 is 10.6 eV.

Because of its smaller dynamic range (0-2000 ppm), the PID is not the detector of choice for measuring high concentrations of vapors. A PID is also more susceptible to interference from water vapor than a FID. However, as a PID does not require hydrogen or oxygen, it is the detector of choice when fuel is limited or unavailable, or when ambient oxygen concentrations are low. The PID is also very sensitive to aromatic and chlorinated compounds, and can even measure some inorganic compounds that the FID does not detect at all (ammonia, carbon disulfide, carbon tetrachloride, chloroform, ethylamine, formaldehyde, and hydrogen sulfide, to name a few).

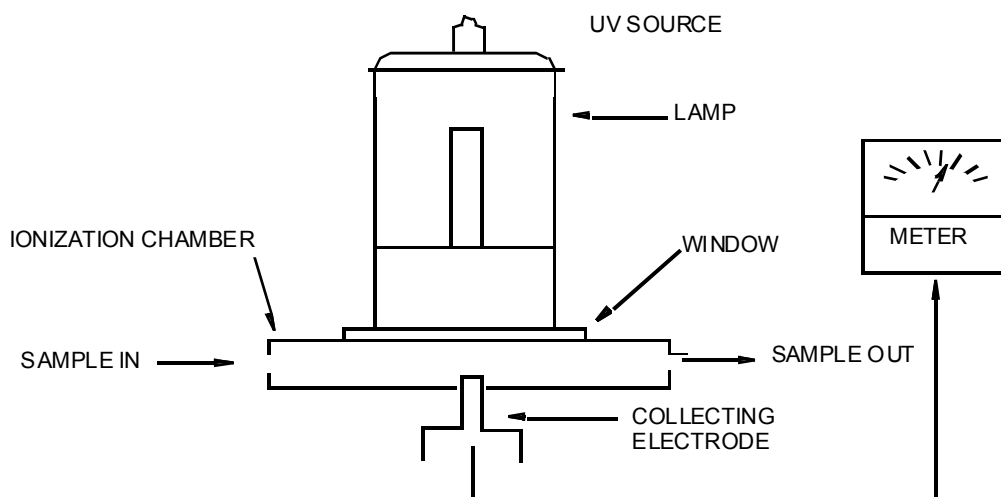


Figure 1–2. Typical Photoionization Detector

Benefits of Photoionization Detection

Benefits of Photoionization Detection:

- High sensitivity to aromatics, unsaturated hydrocarbons and chlorinated hydrocarbons
- Ability to measure some inorganic gases
- Very simple operation
- No support gases required
- Non-destructive detector allows sample to be recovered

Dual Detectors

The benefits of each individual detector are very clear: both the FID and the PID have their advantages and disadvantages. However, with either detector alone, the number of organic and inorganic vapors that one can detect is limited by the measurement capabilities of that detector.

With the TVA2020, users can obtain more complete information about organic and inorganic vapors more quickly and easily than with single detector technology alone.

Since both detectors may be displayed and logged simultaneously, the relative response of the two detectors may give some clues about the identity of the compound being measured (see [Figure 1–3](#)). For instance, the PID does not respond to methane at all, but the FID responds very well. A high FID reading with virtually no PID response might indicate the presence of methane. Consequently, PIDs respond very well to some inorganic gases that FIDs cannot detect. A high PID reading with no FID reading might suggest the presence of an inorganic compound. With readings from both detectors readily available, the TVA2020 can help a user make decisions about the type of compound present and which detector reading to use.

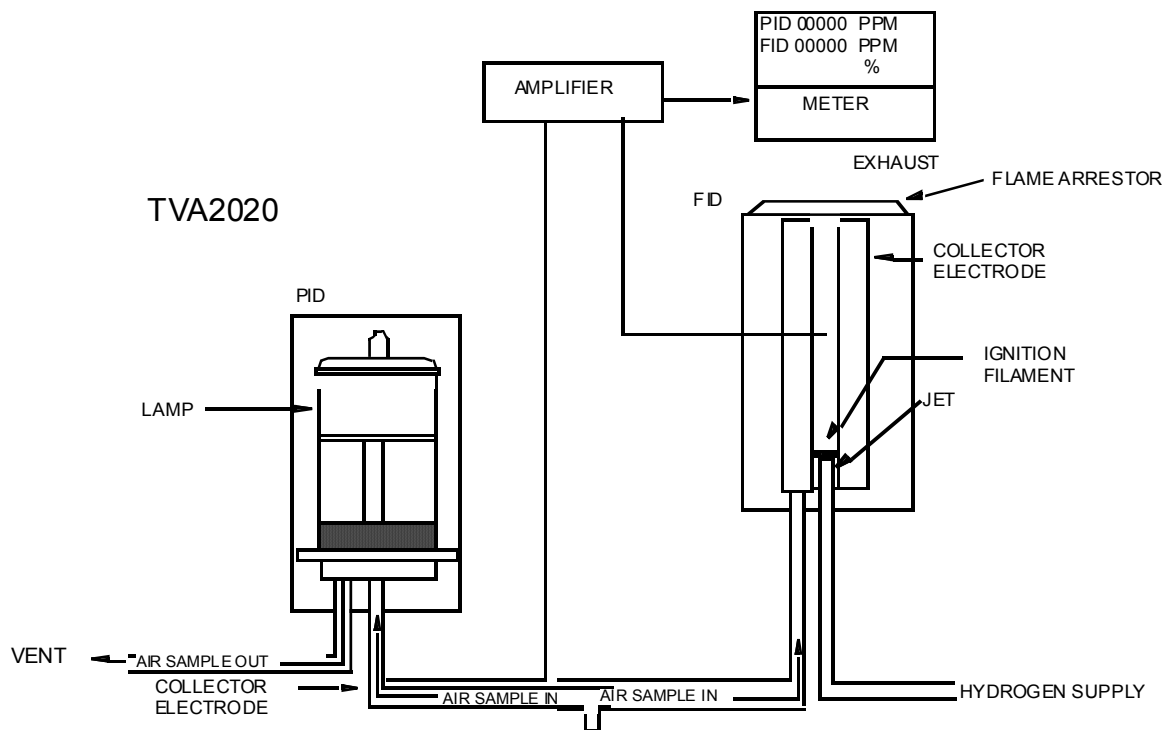


Figure 1–3. TVA2020 Dual Detector Configuration

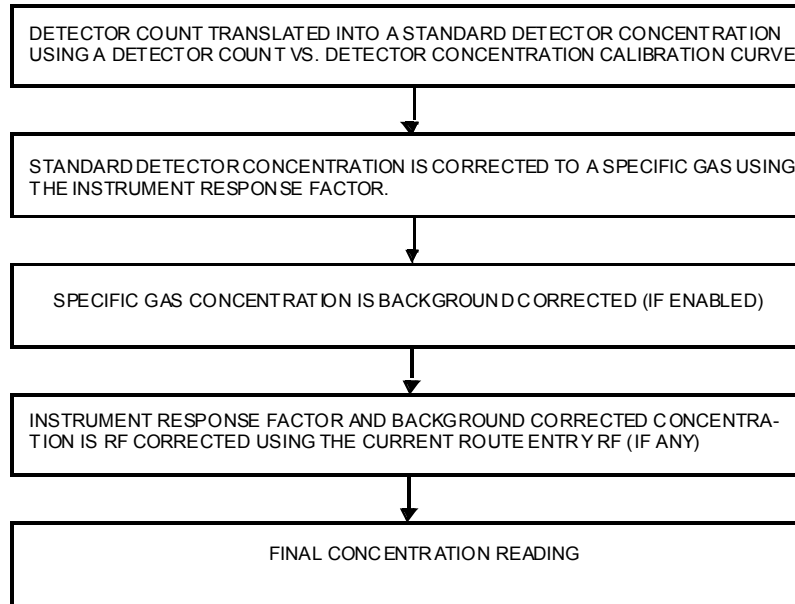
Benefits of Dual Detectors

Benefits of Dual Detectors:

- Cost-effective packaging
- Detector response ratios can help characterize compounds
- Enhanced analytical capability derived from simultaneous detection

Concentration Calculation and Calibration

The concentration calculation is defined as the process that transforms a detector count into a displayed final concentration. The process is as follows:



Standard Specifications

Table 1–1 lists the standard specifications for the TVA2020.

Table 1–1. TVA2020 Product Specifications

Item	Description
Accuracy	<p>PID Instrument—$\pm 20\%$ of reading or ± 0.5 ppm, whichever is greater, from 0.5 to 2,000 ppm. Accuracy listed is achieved using isobutylene with a 1-point calibration at 1,000 ppm (including drift) at the temperature and humidity of the calibration.</p> <p>FID Instrument—$\pm 10\%$ of reading or ± 1.0 ppm, whichever is greater, from 1.0 to 10,000 ppm. Accuracy listed is achieved using methane with a 1-point calibration in the range from 100 to 500 ppm (including drift) at the temperature and humidity of the calibration.</p> <p>$\pm 10\%$ of reading from 3,000 to 30,000 ppm with a 1-point methane calibration at 15,000 ppm.</p>
Repeatability	<p>PID Instrument—1% at 100 ppm of isobutylene</p> <p>FID Instrument—2% at 500 ppm of methane</p>
Dynamic range	<p>PID Instrument—0.5 to 2,000 ppm of isobutylene</p> <p>FID Instrument—1.0 to 30,000 ppm of methane</p>
Linear range	<p>PID Instrument—0.5 to 2,000 ppm of isobutylene</p> <p>FID Instrument—1.0 to 30,000 ppm of methane</p>
Minimum detectable level	<p>The minimum detectable level is defined as seven times the standard deviation of the peak-to-peak noise.</p> <p>PID Instrument—0.5 ppm of isobutylene</p> <p>FID Instrument—0.5 ppm of methane</p>
Response time using close area sampler	<p>PID Instrument—Less than 3.5 seconds for 90% of final value, using 500 ppm of isobutylene</p> <p>FID Instrument—Less than 3.5 seconds for 90% of final value, using 10,000 ppm of methane</p>
Recovery time using close area sampler	<p>PID Instrument—Less than 4.5 seconds to return to 10% of base line from 500 ppm of isobutylene</p> <p>FID Instrument—Less than 4.5 seconds to return to 10% of base line, using 10,000 ppm of methane</p>
Response time using charcoal filter adapter	<p>PID Instrument—Less than 15 seconds for 90% of final value, using 500 ppm of isobutylene</p> <p>FID Instrument—Less than 15 seconds for 90% of final value from 10,000 ppm of methane</p>
Recovery time using charcoal filter adapter	<p>PID Instrument—Less than 20 seconds to return to 10% of original value, using 500 ppm of isobutylene</p> <p>FID Instrument—Less than 20 seconds to return to 10% of original value, using 10,000 ppm of methane</p>

Introduction

Standard Specifications

Data storage interval	Auto Mode—1 per second to 1 per 999 minutes, user selectable VOC or FE Mode - 2 to 30 seconds, user-selectable
Item	Description
Sample flow rate	1 liter/minute, nominal, at sample probe inlet
Battery	<p>The battery can be fully charged in less than 10 hours. The battery operating time is 10 hours minimum at 0 °C (32 °F). Use of the backlight on the probe display shortens battery life. The battery is replaceable by accessing the inside of the instrument.</p> <p>WARNING: Do not replace battery in an area classified as hazardous due to presence of flammable gases or vapors.</p>
Battery charger	<p>The battery charger is a separate unit capable of operating the analyzer while simultaneously charging the internal battery. An adapter cable is provided to charge the battery separate from the analyzer. The charger can charge a fully discharged battery in a maximum of 10 hours. Charging takes 14 hours if performed while the instrument is operating. Charger capable of operation from 90 Vac to 260 Vac, 50/60Hz, with regional plugs.</p> <p>WARNING: Do not operate battery charger in an area classified as hazardous due to presence of flammable gases or vapors.</p>
PID lamp life	Greater than 2000 hours, with normal cleaning
FID life	Greater than 5000 hours
Audio output level	Greater than 90 dB at 3 feet
Gas cylinder capacity	Pressure—15.3 MPa at 25 °C (2200 psi at 77 °F) maximum Empty—85 cc (5.19in3)
Hydrogen supply operating time	10 hours of continuous operation, starting from a cylinder charged up to 15.3 MPa (2200 psi)
Instrument Enclosure Description	The analyzer enclosure and front panel are made from a chemically resistant thermoplastic material or equivalent. Can be decontaminated (10% chlorine solution)
Electrical/communication connections	<p>Probe connections are weather-tight.</p> <p>WARNING: Charger and USB connections are not allowed in an area classified as hazardous due to presence of flammable gases or vapors.</p>
Mechanical connections	A quick connect fitting is used for the sample line connection.
Portability	A removable shoulder strap is provided with the instrument.
Tool kit	An accessory tool kit is provided with each instrument. The kit contains special tools for accessing the FID and PID compartments and special flow restrictors for calibrating the pump flow.
Approximate mass	Analyzer: FID only—9.2 lb Dual—9.4 lb) Probe Assembly: Standard Probe—0.5 lb Enhanced Probe—1.5 lb

Bluetooth

Wireless communications module certified to Bluetooth® ver2.0

Support for SPP (Serial Port Profile)

Transmit Class 2 (typical range of 6')

“This device complies with Part 15 of the FCC Rules. 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 above the radiated susceptibility limits, including interference that may cause undesired operation.”

This device contains FCC-ID P00WML-C40

GPS

Frequency 1575 MHz

Channels up to 12 simultaneously

Update rate 1 Hz

External Influences

This product is intended for use in indoor and outdoor environments as a portable instrument carried by a user, as specified in [Table 1–2](#). The same environmental conditions also apply to the sample stream being monitored.

Table 1–2. TVA2020 External Influences

External Influences	Reference Operating Conditions	Normal Operating Conditions	Operative Limits	Transportation and Storage Limits
Ambient temperature	23 ± 2 °C	-10 to +45 °C	-10 and +45 °C	-20 to +60 °C -4 and 140 °F
Ambient pressure	860 to 1060 mbar	70 to 108 kPa		20 to 108 kPa
Relative humidity	50% ± 10%	FID: 20 to 95% PID: 20 to 70% noncondensing	15 and 95% noncondensing	0 to 100%
Radiated Susceptibility	None		3 V/m 80 to 2700 MHz	
Conducted susceptibility		Not applicable, battery operated		
Conducted emission		Not applicable, battery operated		
Radiated emission			See Part 15 FCC/ Bluetooth requirement	
ESD Sensitivity			>6000 Volts	
Battery charger supply voltage	120 or 230 ±1% Vac	100 to 240 Vac	100 to 240 Vac	Not applicable
Battery Charger supply frequency	50/60 Hz ±0.5 Hz	50/60 Hz	50/60 Hz	Not applicable

Product Safety Specifications

Table 1–3 lists the specifications for the TVA2020. Refer to Figure 1–4 for Interconnection Control Drawing.

Table 1–3. TVA2020 Product Safety Specifications

Testing Laboratory, Types of Protection, Conditions of Classification and Area Classification

FM: intrinsically safe for Class I, Division 1, Temperature Class T4
Groups A, B, C, and D

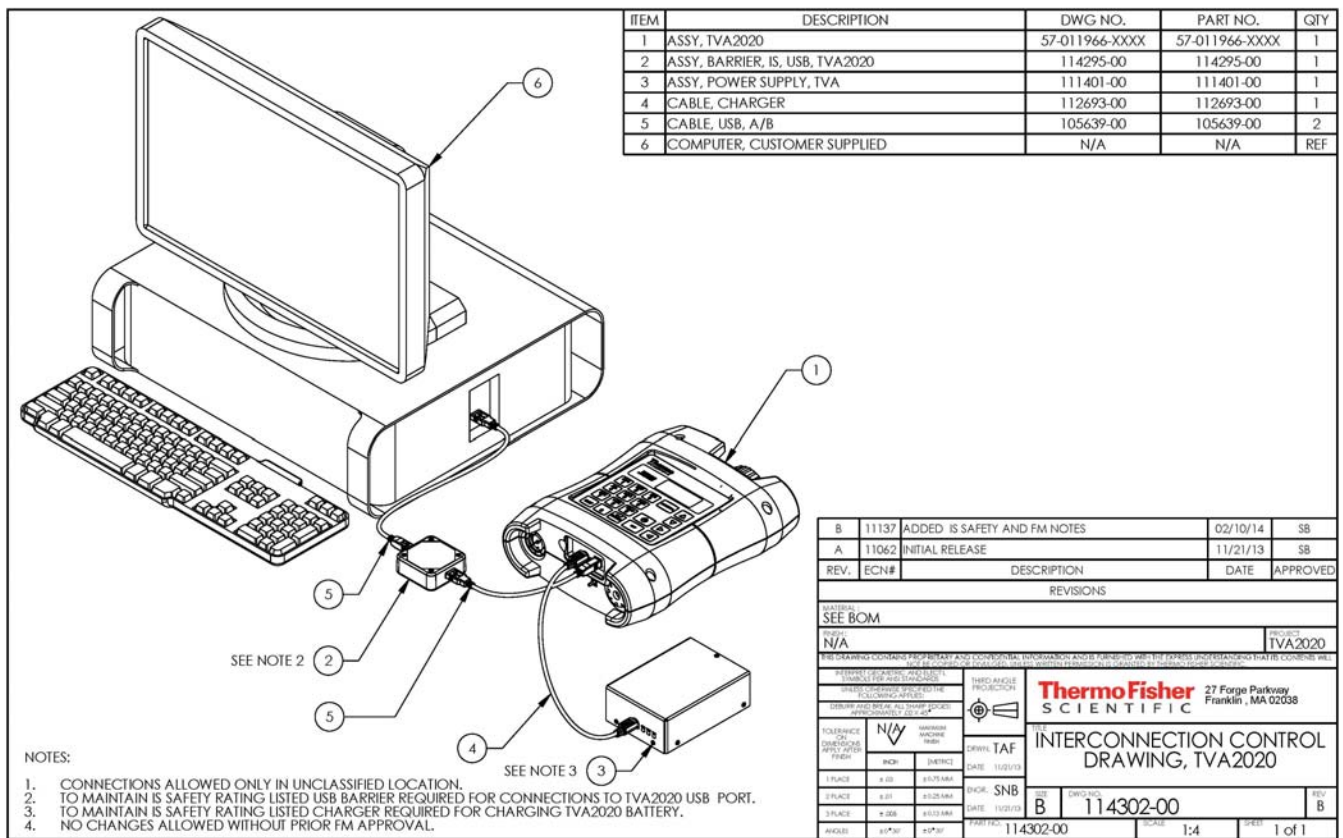


Figure 1–4. Interconnection Control Drawing

Chapter 2

Hardware and Startup

For a description of the instrument functions, instrument connections, and how to start the instrument, see the following topics:

- “Overview” on page 2-1
- “Instrument Functions” on page 2-3
- “Using the Instrument” on page 2-4
- “Instrument Connections” on page 2-4
- “Instrument Sidepack Display” on page 2-6
- “Instrument Sidepack Keypad” on page 2-7
- “Control Menu” on page 2-9
- “Quick Start Procedure” on page 2-10

Overview

The vapor concentration may be read immediately on either of two displays—one mounted directly on the optional enhanced sample probe and the other on the instrument sidepack itself (see [Figure 2–1](#)). Vapor concentration can be displayed on both displays in parts per million (ppm) or percent concentration (%). The data displayed may also be collected and saved in analyzer memory and downloaded to a personal computer for analysis. The optional Bluetooth device will continuously output the concentration data for use with a third party hand-held device.

Through the sidepack keyboard, choose the mode of operation, select concentration units for the display, set alarm thresholds, select data collection mode, and change setup (configuration) parameters.

This unit is shipped with the battery installed. The unit is ready for operation upon completion of setup, calibration, and charging.



Figure 2–1. Instrument Sidepack Display

Instrument Functions

This analyzer functions in any of four modes:

- RUN
- SETUP
- INFO
- MEMORY

In the RUN mode, the instrument automatically displays its measured values in units of ppm or %. The RUN mode may be operated either as survey only, in which the instrument displays measured values but does not store any data, or survey and log, in which the instrument displays measured values and also stores the information in memory.

In SETUP mode, you can enter or select operational parameters, such as calibration values, alarm levels, operator ID, datalogging method and interval, date, and time. This may be performed locally by using the analyzer keypad or remotely by using the USB connection to a personal computer (PC).

In INFO mode, you can review operational parameters entered or selected in SETUP mode as well as instrument serial number, Bluetooth friendly name, battery status, GPS coordinates, etc.

In MEMORY mode, you can download data stored within the TVA2020 to a PC for analysis and printing, upload route list, calibration, and configuration parameters from a PC to the TVA2020, clear data memory, and update instrument firmware.

Each of the four modes is explained in detail later in Chapter 3, “[Display Menus](#)”.

Using the Instrument

While operating this instrument in the field, you normally carry the TVA2020 at your side using the shoulder strap or in a backpack (not supplied). With the pump on, detector(s) on, and the unit warmed up, you monitor the area of concern. As soon as the instrument analyzes a sample, the sidepack displays concentration of the vapor. The display on the optional enhanced probe duplicates the vapor concentration on the sidepack display. Using the enhanced probe, you can toggle the display between detector types by pressing the SELECT button on the probe, configure to log the survey data by pressing the MENU button, and backlight the LCD display by pressing the lamp button. The concentration data is also streamed out from the optional Bluetooth device, if installed and turned on.



WARNING Charger and USB connections are not allowed in an area classified as hazardous due to presence of flammable gases or vapors. ▲



WARNING To prevent a potential explosion, do not operate the instrument with the PID compartment open or FID detector cap removed. ▲

Startup

To place the TVA2020 in Startup mode, press and hold the ON key for 2 seconds until you hear a beep. The instrument will display a Please Wait message, shortly after, the MAIN MENU screen is displayed. In this screen you may scroll to the various different menu selections.

```
MAIN MENU
  1=Run
  2=Setup  3=Info
  4=Memory
```

Instrument Connections

There are four external instrument connections on the TVA2020, as shown in [Error! Reference source not found.](#). The umbilical attached to the probe consists of two connections, an electrical cable with locking connector and a sample line with locking fitting.

Two additional connections—battery charger input and USB interface—are located on the bottom of the unit, below the keypad. All mechanical connections are keyed for easy orientation.

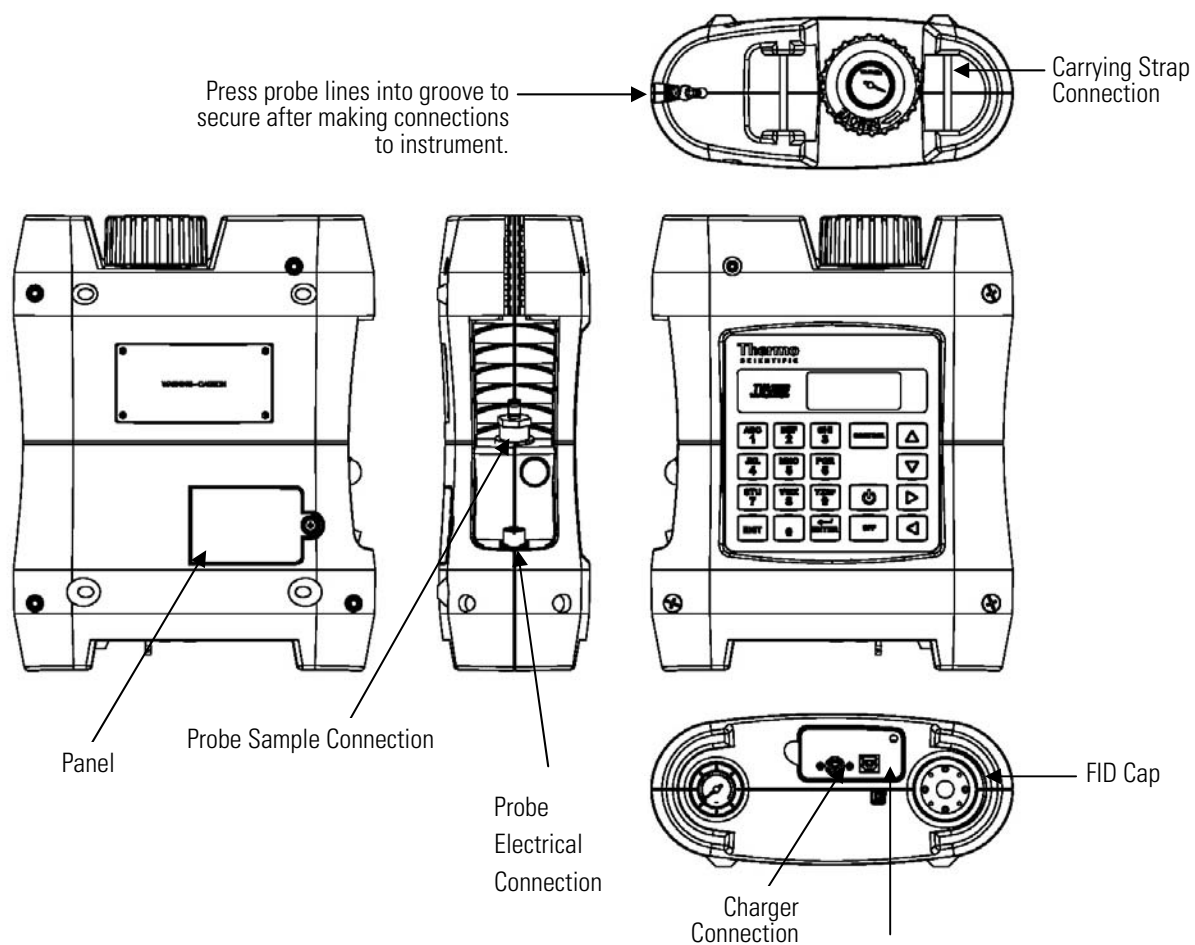


Figure 2–2. TVA2020 Instrument Connections



WARNING Charger and USB connections are not allowed in an area classified as hazardous due to presence of flammable gases or vapors. ▲



WARNING To prevent a potential explosion, do not operate the instrument with the PID compartment open or FID detector cap removed. ▲

Instrument Sidepack Display

The liquid crystal display (LCD), in the instrument sidepack, has four 16-character lines for three types of displays (MENU, ENTRY, and RUN). In *menu* displays, the whole screen is normally dedicated to the menu. In *entry* displays, the screen provides prompts and instructions for inputting new data. The normal *run* display consists of the live measurement data on lines 1 and 2 and menu items on lines 3 and 4. Other display information appears as you page through various menus.

- In Menu Display, the whole screen is normally dedicated to the menu.

```
MAIN MENU
  1=Run
  2=Setup  3=Info
  4=Memory
```

- In Entry Display, the screen provides prompts and instructions for entering new data.

```
Enter High Ceil:
P&F: 005000ppm
Up/Dn=Next unit
Enter=Accept
```

- The normal Run Display consists of the live measurement data in Lines 1 and 2 and menu items on lines 3 and 4.

```
PID: 450ppm
FID: 500ppm
BLD _____
Press char key
```

Other display information appears as you page through various menus.

Instrument Sidepack Keypad

The keypad, as shown in [Figure 2–3](#), has 19 keys, some of which are dual function. When you press a key, the screen displays the selection. When you make a selection that creates or changes a parameter, you must then press the ENTER key. The left/right arrow keys move the character entry position. The up/down keys make page selections or switch from ppm or % to another reading. [Table 2–1](#) shows the functions of all keys.



Figure 2–3. Keypad

Note To turn the instrument ON, press and hold the on ON key until the speaker sounds and display flashes. ▲

Note To activate OFF, CONTROL, EXIT, and ENTER functions, press and HOLD the key for approximately 1/2 second. ▲

Table 2–1. Keys and Functions

Key	Function
ON	The ON key enables power from the battery to the instrument.
OFF	The OFF key disables power from the battery to the instrument.
CONTROL	The CONTROL key is multi-function and is used to turn the pump, PID, and FID, Bluetooth and GPS on or off, and to ignite the FID. Note: Value displayed is opposite of existing status. If pump displays “OFF”, you would press the 1 key to turn it off.
EXIT	The EXIT key clears any entry made in error or bypasses information that you do not want to change, and clears error or warning screens.
ENTER	The ENTER key has three functions: <ol style="list-style-type: none">1. Press ENTER if you have typed one or more characters and wish to keep that information.2. Press ENTER to respond to a menu question.3. Press ENTER instead of entering the logging mode from the enhanced probe to initiate logging.
Left/Right Arrows	The left and right arrow keys move character entry positions.
Up/Down Arrows	The up and down arrow keys make page selections or scroll through options in SETUP entry screens and info screen.
Alphanumeric	The alphanumeric keys enable you to type letters or numbers into various menus. If a display asks for a number only, simply press the desired key. Two steps are required to type an alphanumeric character. First, press the key with the desired letter or number. The screen then displays a selection prompt at the bottom in which 1 = first letter, 2 = second letter, 3 = third letter, and 0 = number. Press the appropriate key to execute the selection. Three uses: <ul style="list-style-type: none">• Select menu options• Enter numbers, 0-9, using single keystroke• Enter alphanumeric data, A-Z, 0-9, SPACE, using 2 keystrokes per character

Control Menu

The Control Menu is used for turning the sampling pump on and off, turning the PID lamp and FID on and off, for initiating gas ignition of FID, and Bluetooth and GPS options.

```
CONTROL MENU
1=Pump on
2=FID on   3=Ignit
4=PID on   5=More
```

The CONTROL MENU screen has five options:

1. Turn Pump ON/OFF
2. Turn FID ON/OFF
3. Ignite FID
4. Turn PID OFF/ON
5. More (Bluetooth and GPS)

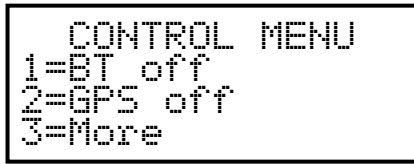
Selecting Option 1 toggles the pump on or off.

Selecting Option 2 toggles the FID on or off. In the RUN mode, when the FID is off, dashes will appear instead of a reading and all FID alarms are overridden.

Selecting Option 3 initiates the FID flame ignition sequence, which momentarily turns on the ignite coil and simultaneously reduces the pump flow.

Selecting Option 4 toggles the PID on or off. In the RUN mode, when the PID is off, dashes will appear instead of a reading, and all PID alarms are overridden.

Selecting Option 5 toggles the next screen, if Bluetooth or GPS are installed. If neither is installed, option 5 does not display.



After running the initial startup diagnostic, the Control menu can be accessed at any time.

Quick Start Procedure

Before starting the unit, perform the following steps:

1. Charge battery.
2. Connect sample probe.
3. Fill/install hydrogen tank (which starts hydrogen flowing).

To start the unit, execute the following procedure:

4. Press ON until the speaker sounds and the display flashes (approximately 1 second).
5. Press CONTROL.
6. Press 3 to ignite.
7. Press 2 = Setup.
8. Press 1 = Calibrate.
9. Press 6 = Configure.
10. Press 2 = Span Concentration.
11. Enter Span Concentration for calibration gas being used and press ENTER to accept.

Note If FID only, enter concentration of methane. If dual, enter concentration of both gases. ▲

12. Press 1 = Zero.

13. Press 1 = Both.

14. Press ENTER = start.

15. Challenge analyzer with zero gas sample.

16. Wait to stabilize.

17. Press ENTER to accept.

18. Press 2 = Span.

19. (PID 1st) Press 2 = PID.

20. Press ENTER = start.

21. Challenge analyzer with isobutylene span gas and wait for readings to stabilize.

22. Press ENTER to accept.

23. Press 2 = Span.

24. Press 3 = FID.

25. Press ENTER = Start.

26. Challenge analyzer with methane span gas and wait for readings to stabilize.

27. Press ENTER = Accept.

28. Press 4 = Response Factor.

29. Confirm that Response Factor says “RF0:DEFAULT”

30. Press EXIT 3 times to main menu.

31. Press 1 = Run.

You are now in the survey mode.

Note To perform more sophisticated operations, you will need to read the rest of the manual. ▲

To power down this instrument, simply press the OFF key. You must also unscrew the hydrogen tank to avoid depleting the tank supply.

Chapter 3

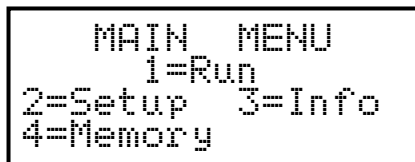
Display Menus

This chapter describes the main menu display and menu-driven software. For more detail, see the following topics:

- “Main Menu Structure” on page 3-1
- “Run Mode” on page 3-4
- “Setup Menu” on page 3-9
- “Calibration Settings” on page 3-9
- “Alarm Levels” on page 3-10
- “Log Methods” on page 3-15
- “Passcode Protection” on page 3-23
- “Other Settings” on page 3-24
- “Information Menu” on page 3-29
- “Memory” on page 3-30

Main Menu Structure

The display on the TVA2020 analyzer is a menu-driven device. The various menus prompt you to select or enter information. With various key strokes, you can accomplish all necessary setup (configuration) and operational tasks. For more detail, see the following topics:



```
MAIN MENU
  1=Run
  2=Setup  3=Info
  4=Memory
```

Whenever you turn on the TVA2020, a power-up self test is performed and warning screens are displayed if any errors are found. Please refer to “Warning Messages” on page 6-6. If errors are detected, use the EXIT key to clear error message, then MAIN MENU is displayed. When you press the corresponding number key, as described in Table 3-1, the desired menu and the associated display or menu appear automatically.

Table 3-1. Main Menu Selection and Functions

Key	Function
1 = RUN	Use this selection to assign tags to specific surveys and to view/log analysis of organic/inorganic compounds. If the optional Bluetooth module is active, the instrument must be in RUN mode to send commands and capture data. (See “Bluetooth Communications” in the Options section of this manual.)
2 = SETUP	This menu contains configuration procedures and menu structure for performing calibrations, entering ID numbers, setting alarm levels, selecting log modes, entering response multipliers and setting time/date.
3 = INFO	This is a view-only menu structure that displays various instrument diagnostic information.
4 = MEMORY	Use this menu to put instrument into USB memory device mode to download/upload information to/from a personal computer, to perform a remote setup from a personal computer, to clear memory, or to update firmware.

Once you are familiar with the various menus and know where to enter specific information, you may want to use a short cut method of tracking the menu structure. The following figure shows the complete menu structure for the TVA2020 Analyzer.

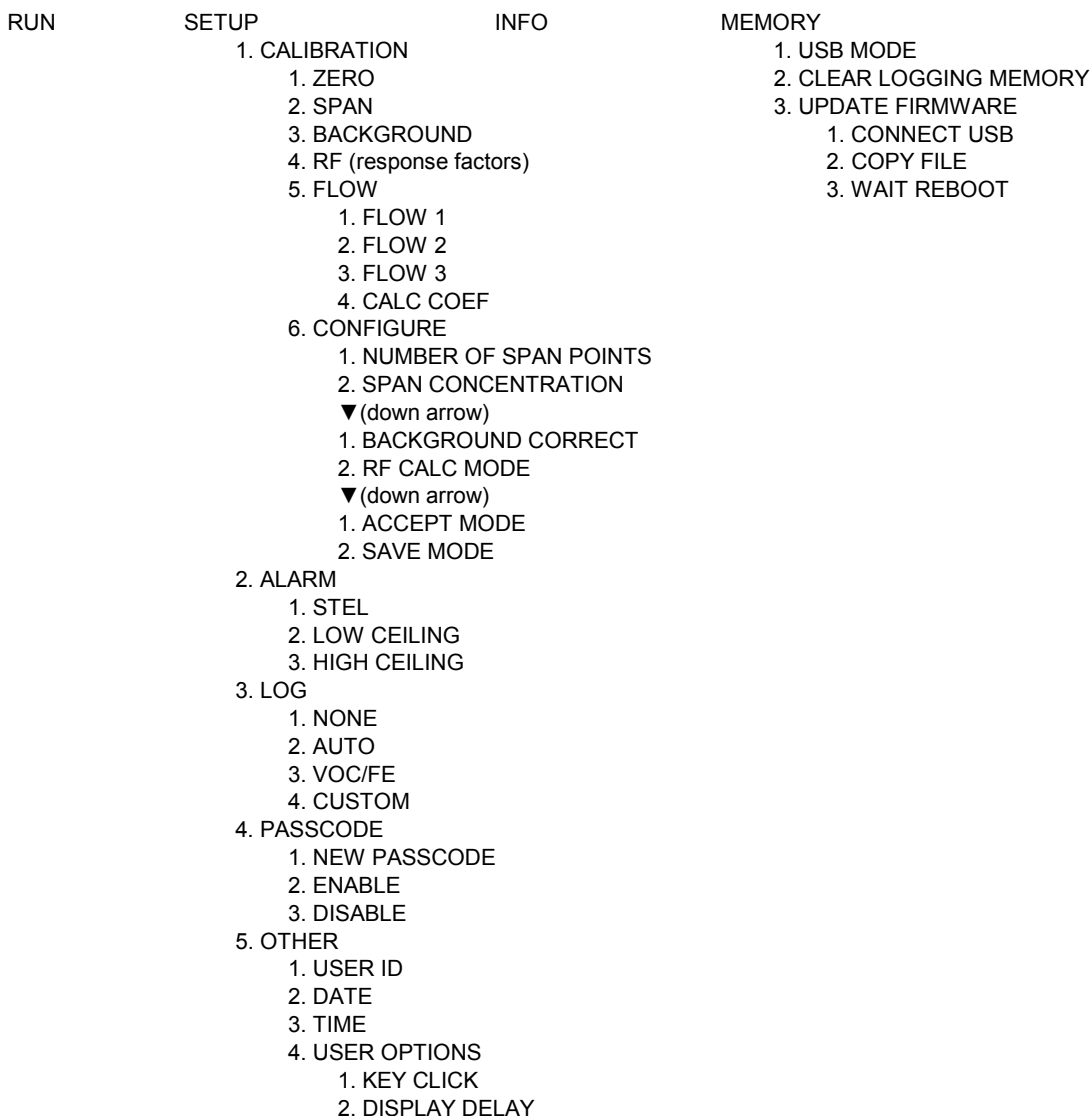


Figure 3–1. TVA2020 Menu Structure

Run Mode

How the instrument functions in the RUN mode is governed by the selection made in the SETUP/Log menu. The LOG menu selects how data is stored in the instrument memory. There are four possible choices in the LOG mode as defined in “Log Methods” on page 3-15. In addition, if the optional Bluetooth module is active, data automatically streams out continuously from the instrument. Data will only stream out of the instrument while in the RUN mode. The data will always stream at in the same format independent of the log configuration. (See “Bluetooth Communications” in the Options section for more information.)

The TVA2020 performs accurately only after it has been properly set up (configured).

The RUN mode displays (as governed by the LOG Selection) are:

FID-NONE	PID/FID-NONE
<pre>FID: 1376ppm Exit=Stop</pre>	<pre>PID: 1042ppm FID: 1376ppm Exit=Stop</pre>
FID-AUTO, VOC, or F.E.	PID/FID-AUTO, VOC, or F.E.
<pre>FID: 1376ppm Sampling: 3sec Exit=Stop</pre>	<pre>PID: 1042ppm FID: 1376ppm Sampling: 3sec Exit=Stop</pre>

You should install the hydrogen tank and wait 2-3 minutes before entering the RUN mode. Upon entering the RUN mode, the pump will automatically turn ON and the FID will ignite.

Note For best performance, the instrument must be ON and warmed up for approximately 30 minutes with the FID flame ignited throughout the warmup period. If the instrument is PID equipped and the PID is to be used, the lamp must be ON throughout the warmup period. ▲

Accessing the Run Menu

From the MAIN MENU display, press 1=Run.

Run: Log None

Whenever the TVA2020 is in the RUN mode with Log None as the logging selection, the instrument operates as a survey tool only. The readings on the probe display and instrument display show the live reading for the samples at that time. No logging action is taking place. Any alarms that are set will function normally.

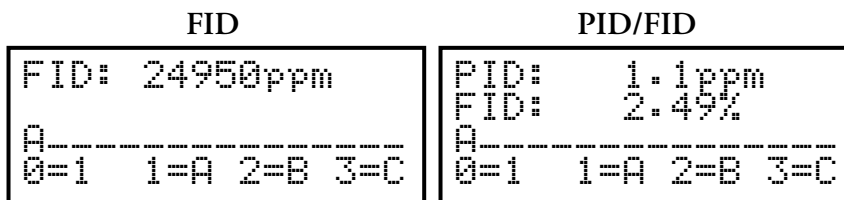
FID	PID/FID
FID: 24950ppm Exit=Stop	PID: 1.1ppm FID: 2.49% Exit=Stop

Run: Log Auto

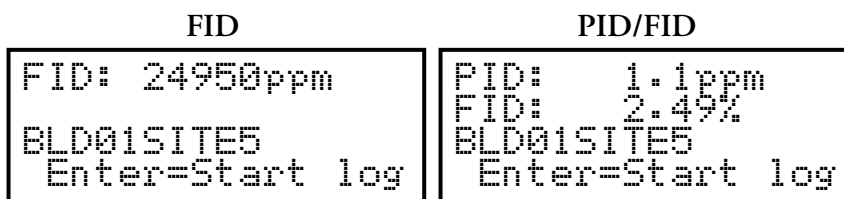
Whenever the TVA2020 is in the RUN Mode with Log Auto as the logging selection, the instrument operates as an automatic survey tool that logs its readings into memory at an interval selected in the Setup Menu. After the 1=Run key is pressed, the first screen viewed is the one shown:

FID	PID/FID
FID: 24950ppm ----- Press char key	PID: 1.1ppm FID: 2.49% ----- Press char key

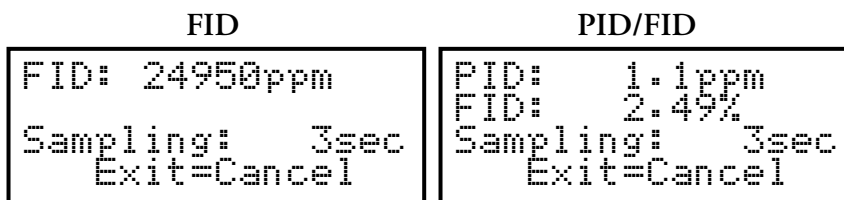
The tag information should be typed in before starting. Enter the tag information in the space provided (up to 16 characters). The tag may be left blank if desired.



Once the tag information is entered, press the ENTER key. The screen then changes to the next display. The instrument is now ready to start logging. The screen displays live readings and the tag name. However, no logging takes place until you enter the logging mode from the enhanced probe or press the ENTER key on the instrument.



Press ENTER or initiate the logging mode from the enhanced probe to start the automatic logging. The instrument counts down from the time selected in the SETUP/Log menu and stores the reading at the end of the count down. For instance, if 12 seconds was selected as the logging time, the instrument will count down from 12 and display 11,10,9,8,7,6,5,4,3,2,1,STORE. The instrument logs into memory either the highest, average, or last reading during the countdown, as configured in the SETUP/Log menu.



This action continues until the instrument shuts down due to low battery, or the EXIT key is pressed, or the log memory is full.

Run: Log VOC

Whenever the TVA2020 is in the RUN mode with Log VOC as the logging selection, the instrument operates as a manual survey tool that logs its readings into memory whenever you initiate logging. When the 1=Run

key is pressed, the first screen viewed is the one shown below. The tag information should be typed. The tag may be left blank if desired.

Note Tag information can only be entered using the sidepack keypad. ▲

FID	PID/FID
FID: 24950ppm	PID: 1.1ppm FID: 2.49%
----- Press char key	----- Press char key

The tag information should be typed in before starting. Enter the tag information in the space provided (up to 10 characters). The tag may be left blank if desired.

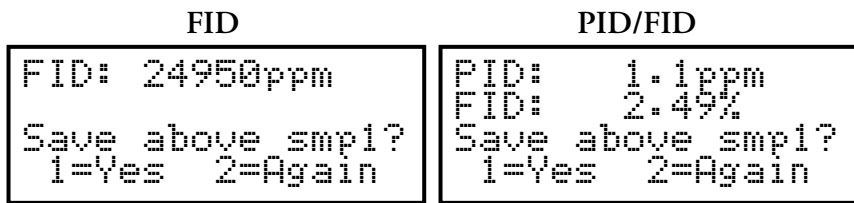
FID	PID/FID
FID: 24950ppm	PID: 1.1ppm FID: 2.49%
TA----- 0=3 1=G 2=H 3=I	TA----- 0=3 1=G 2=H 3=I

Once the tag information is entered, press the ENTER key. The screen then changes to the next display. The instrument is now ready to start logging. The screen displays live readings and the tag name but no logging takes place until you either enter the logging mode from the enhanced probe or press the ENTER key again on the instrument.

FID	PID/FID
FID: 24950ppm	PID: 1.1ppm FID: 2.49%
TAG Enter=Start log	TAG Enter=Start log



Press ENTER or initiate the logging mode from the enhanced probe to start the VOC logging sequence. After the instrument counts down for the time selected in the SETUP/Log menu, the word Save appears. When confirmed, the instrument logs into memory either the highest average or last reading achieved during the countdown sample. After the information is stored into memory, the display returns to live measurements and prompts for a new tag. Each VOC log must be done manually and individually.



Run: Log F.E.

The operation of the Log F.E. mode is menu driven from the hand-held probe display and requires the use of the optional TVA2020 Enhanced Probe. Whenever the TVA2020 is in the RUN mode with Log F.E. as the logging selection, the instrument logs its readings based on a pre-configured route file.

Use the following procedure for use with Fugitive Emissions monitoring.

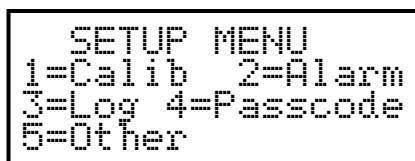
1. Create a monitoring route using a Fugitive Emissions personal computer software program as described in Appendix B, “Text Data Formats”.
2. Copy the route file to the TVA2020 by overwriting the ROUTE.TXT file in the instrument flash with the one created. It must be named ROUTE.TXT for the instrument to recognize it. After exiting the USB mode, the instrument reads the properly named files from flash into the processor memory.

3. Log readings by following the monitoring route shown on the TVA2020 display.
4. At the end of the monitoring route, copy the logged readings to the personal computer.

Setup Menu

The Setup Menu (configuration) of the TVA2020 is the most important step in obtaining accurate gas measurements. The Setup Menu contains configuration procedures and menu structure for performing calibrations, entering ID numbers, setting alarm levels, selecting log modes, entering response multipliers and setting time/date.

From the MAIN MENU display, press 1=Run.



```
SETUP MENU
1=Calib  2=Alarm
3=Log    4=Passcode
5=Other
```

During instrument setup, you must set parameters as follows:

5. Calibration Settings
6. Alarm Levels
7. Datalogging Setup
8. Passcode
9. Other

Calibration Settings

The Calibration Menu is used to calibrate the instrument. For more detailed information on calibration, see Chapter 4, “[Calibration](#)”.

From the MAIN MENU display, press 2=Setup.

From the SETUP MENU display, press 1=Calib.



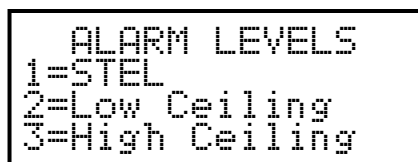
1. Zero the instrument
2. Calibrate the reference point(s) using known span gas
3. Take background reading

Note For most monitoring, background is set to zero. Use if regulations or permits require/allow background elimination. ▲

4. Set instrument response factors if necessary
5. Calibrate the flow sensor
6. Configure
 - a. Calibrate the reference point(s) using known span gases. The TVA2020 can be configured for as many as nine different span gas values (2=Span).

Alarm Levels

The TVA2020 is supplied with three user-configurable alarms — STEL (short term exposure limit), Low Ceiling, and High Ceiling. When any of these alarms is exceeded, an alarm message appears on the sidepack display and probe display and an alarm tone is generated. Press EXIT to acknowledge the alarm message and sounder. Once acknowledged, the display returns to the live measurement with an upper case letter representing the alarm or alarm combination appearing to the right of the display.



The three types of user configurable alarms are:

Table 3–2. Alarm Configurations

Alarm Type	Description
STEL:	The Short Term Exposure Limit alarm indicates that measurements averaged over a running 15-minute interval have exceeded the set alarm limit. Once this alarm is acknowledged, the letter S appears to the right of the live measurement for the appropriate detector.
Low Ceiling:	This alarm is a warning that a lowest level threshold has been exceeded. Once acknowledged, the letter L appears to the right of the live measurement for the appropriate detector.
High Ceiling:	This alarm is a warning that a second, higher level, threshold has been exceeded. Once this alarm is acknowledged, the letter H appears to the right of the live measurement for the appropriate detector. The FID maximum setting is 30000 ppm.

The three alarm messages appear on the instrument display as follows:

<pre>==== ALARM! ==== STEL alarm level alarm exceeded! Exit=Clr</pre>	<pre>FID: 1039ppm S FID: 2180ppm S Press char key</pre>
---	--

<pre>==== ALARM! ==== Low ceiling alarm exceeded! Exit=Clr</pre>	<pre>FID: 1039ppm L FID: 2180ppm L Press char key</pre>
--	--

<pre>==== ALARM! ==== High ceiling alarm exceeded! Exit=Clr</pre>	<pre>FID: 1039ppm H FID: 2180ppm H Press char key</pre>
---	--

Note To display and change the alarm menus, the instrument must be ON but does not have to be warmed up. ▲

Accessing the Alarm Menu

Use the following procedure to access the alarm menu.

1. From the MAIN MENU display, press 2=Setup.
2. From the SETUP MENU display, press 2=Alarm and follow the procedures for the appropriate alarm settings.

STEL Level Alarm

Use the following procedure to access the STEL level alarm.

1. From the ALARM LEVELS display, press 1=STEL. The previous alarm settings for STEL alarm are displayed.

FID	PID/FID
<pre>FID: 100.0ppm STEL Alarm Enter=New Value</pre>	<pre>PID: 100.0ppm FID: 100.0ppm STEL: 1=Both 2=PID 3=FID</pre>

2. To change the alarm level to a new value, press ENTER on a single detector instrument or 1, 2, or 3 on a dual detector instrument.

FID	PID/FID
<pre>Enter STEL: FID: 100.0ppm Up/Dn=Next Unit Enter=Accept</pre>	<pre>Enter STEL: P&F: 100.0ppm Up/Dn=Next Unit Enter=Accept</pre>

Use the up and down arrow keys to select ppm or %, and decimal point position, then type the numeric value for the alarm level desired.

3. Press ENTER to store new values into instrument memory.
4. Press EXIT to return to the ALARM LEVELS without making a change.

Low Ceiling Alarm Use the following procedure to access the low ceiling alarm.

1. From the ALARM LEVELS display, press 2=Low Ceiling. The previous alarm settings for the Low Ceiling alarm are displayed.

FID	PID/FID
FID: 100ppm Low Ceiling Alarm Enter=New Value	PID: 100ppm FID: 100ppm Low Ceil: 1=Both 2=PID 3=FID

2. To change the alarm level to a new value, press ENTER on a single detector instrument or 1, 2, or 3 on a dual detector instrument.

FID	PID/FID
Enter low ceil: FID: 000500ppm Up/Dn=Next Unit Enter=Accept	Enter Low ceil: P&F: 000500ppm Up/Dn=Next Unit Enter=Accept

Use the up and down arrow keys to select ppm or %, and decimal point position, and then type the numeric value for the alarm level desired.

3. Press ENTER to store the new values into instrument memory.
4. Press EXIT to return to the ALARM LEVELS without making a change.

High Ceiling Alarm

Use the following procedure to access the high ceiling alarm.

1. From the ALARM LEVELS display, press 3=High Ceiling. The previous alarm settings for the High Ceiling alarm are displayed.

FID	PID/FID
FID: 250ppm High Ceiling Alm Enter=New Value	PID: 250ppm FID: 250ppm High Ceil: 1=Both 2=PID 3=FID

2. To change the alarm level to a new value, press ENTER on a single detector instrument or 1, 2, or 3 on a dual detector instrument.

FID	PID/FID
Enter high ceil: FID: 001000ppm Up/Dn=Next Unit Enter=Accept	Enter high ceil: P&F: 001000ppm Up/Dn=Next Unit Enter=Accept

Use the up and down arrow keys to select ppm or %, and decimal point position, and then type the numeric value for the alarm level desired.

3. Press ENTER to store the new values into instrument memory.
4. Press EXIT to return to the ALARM LEVELS display without making a change.

Note The high ceiling alarm cannot be set higher than 30,000 ppm or 3%. ▲

Log Methods

Selecting the LOG mode not only identifies the way in which data is stored in instrument memory but also governs the way the RUN mode works. Four possible choices in the LOG mode are available, None, Auto, VOC/FE, and Custom.

Table 3–3. Available Log Data Types

Option	Description
1. None:	Selecting None means that no logging action takes place at all. When the instrument is in the RUN mode, you can only display readings.
2. Auto	When you select and configure the AUTO method, the RUN mode functions automatically once an action is initiated. You choose an automatic logging rate between 1 second and 999 minutes, type a tag identifier, and start the instrument. You initiate automatic sampling by either pressing the LOG key on the probe or the ENTER key on the instrument. From that point on, the instrument automatically logs the reading of the sample at the end of each countdown and continues to do so until the battery goes low, you press the EXIT key, or the logging memory is full.
3A. VOC	The VOC method of sampling is a manual means of triggering a sample/log. Once configured for VOC, the RUN mode prompts you to type a tag identifier. After you enter the tag, the instrument stands ready until you initiate the logging mode with with the enhanced probe or press the ENTER key on the instrument. Once LOG is initiated, the instrument counts down. Samples are taken over that count down and the highest reading achieved, or average (or last) reading is logged in memory and displayed on both displays. The stored values are cleared by pressing either the SELECT key on the enhanced probe or the ENTER key on the instrument. Each VOC log must be done manually and individually.
3B. F.E.	The F.E. method of sampling is a manual means of triggering a sample/log using a pre-configured monitor route file which has been downloaded and stored in instrument memory. The F.E. method requires use of the enhanced probe. You choose a sample time of between 2 and 30 seconds and you choose to log either the highest reading or average (or last) reading achieved during the sample time. Once configured for F.E. and the RUN mode entered, the FE probe menu screen guides you through the monitor route, displaying each pre-configured tag identifier in sequential order. A SEARCH function is available at the probe menu to allow you to find tags that are out of order. The probe display prompts you to confirm the tag identifier, after which the instrument stands ready until you either select LOG from the probe or press the ENTER key on the instrument. Once initiated, the instrument begins a count down, sampling over the configured sample time. The reading sampled during the countdown is displayed on both displays and you are given the option to save the reading in memory or to select LOG again. The stored values are cleared by selecting LOG on the probe display or by pressing ENTER on the instrument. Each F.E. log must be done individually and manually.
4. Custom	The Custom mode allows the user to configure all the logging parameters. Refer to the Log Custom section for a more complete description.

The RUN mode displays (as governed by the LOG selection) are:

FID-NONE	PID/FID-NONE
FID: 1376ppm Exit=Stop	PID: 1042ppm FID: 1376ppm Exit=Stop

FID-AUTO, VOC, or F.E.	PID/FID-AUTO, VOC, or F.E.
FID: 1376ppm Sampling: 3sec Exit=Stop	PID: 1042ppm FID: 1376ppm Sampling: 3sec Exit=Stop

Note To display and change the log menu, the instrument must be ON but does not have to be warmed up. ▲

Accessing the LOG Menu

Use the following procedure to access the log menu.

1. From the MAIN MENU display, press 2=Setup.
2. From the SETUP MENU display, press 3=Log.

```
LOG MODE
None
1=None 2=Auto
3=VOC/FE 4=Custm
```

The previous log selection is displayed on the second line. Follow the procedure below to set the log mode.

Log None

From the LOG MODE menu, press 1=None to display this message briefly. The screen then returns to the SETUP MENU.


```
None
-ACCEPTED-
```

Log Auto Use the following procedure to access the auto log.

1. From the LOG MODE display, press 2=Auto. The previous log selection is displayed on the second line of the screen.

```
Enter log rate:
Auto, rate=000sec
Up/Dn=Sec<->Min
Enter=Accept
```

2. Use the up and down arrow to select minutes (min) or seconds (sec). Then, type the appropriate time interval desired for the automatic sampling.
3. Press ENTER and, after a brief message of acceptance, the automatic sampling is ready to be used in the Run mode.

Note To allow for STEL calculations, the log rate value must be less than 90 seconds. If a log rate greater than 90 seconds is selected, a warning message will appear. Press EXIT to bypass this message and proceed. ▲

In the LOG Auto mode, data is logged in the format described below:

- Every time logging is initiated in the Run mode, a new header is created.
- Data is logged periodically, at the user-entered log rate, in the following format:

```

LOG.TXT - Notepad
File Edit Format View Help
LOGGED DATA
VER= 2.00
-----
AUTO DATA
DATE      TIME      PID BACKGROUND      PID CONCENTRATION      FID BACKGROUND      FID CONCENTRATION      GPS DATA
-----
20 MAR 13 17:08:23    0.0 PPM OK            0.5 PPM OK            0.0 PPM OK            7.2 PPM OK            42.08502 -71.44054 106.13 4
20 MAR 13 17:08:28    0.0 PPM OK            0.5 PPM OK            0.0 PPM OK            7.3 PPM OK            42.08524 -71.44063 111.13 4
20 MAR 13 17:08:33    0.0 PPM OK            0.5 PPM OK            0.0 PPM OK            7.3 PPM OK            42.08519 -71.44069 110.13 4
20 MAR 13 17:08:38    0.0 PPM OK            0.5 PPM OK            0.0 PPM OK            7.3 PPM OK            42.08511 -71.44066 112.13 4
20 MAR 13 17:08:43    0.0 PPM OK            0.5 PPM OK            0.0 PPM OK            7.2 PPM OK            42.08509 -71.44062 117.13 4
-----
END
  
```

- Approximately 9500 data samples may be taken with a single header.

Log VOC Use the following procedure to access the VOC Log.

1. From the LOG MODE display, press 3=VOC/FE. The previous log selection is displayed on the second line of the screen.

```

LOG MODE
None
1=VOC   2=FE
  
```

2. Press 1=VOC. The previous log selection is displayed on the second line of the screen.

```

Enter sampling:
VOC,time=03s,Max
Up/Dn=Next type
Enter=Accept
  
```

3. Press the Up/Dn arrow keys to choose the type of sampling to be used (Max, Avg, Smp).
 - a. Max=the maximum reading obtained during the log interval.
 - b. Avg=the average reading obtained during the log interval.

- c. Smp=the last reading obtained during the log interval.
4. Type the appropriate time interval desired for VOC sampling.
5. Press ENTER and, after a brief message of acceptance, the VOC method of logging is now ready to be used in the Run mode.

Note The allowable Sample Time range is 2–30 seconds. If a Sample Time of less than 2 seconds or greater than 30 seconds is selected, a warning message will appear and you will be required to re-enter the Sample Time. ▲

In the LOG VOC mode, data is logged in the format described below:

- Every time the user initiates logging, the instrument will countdown by a defined interval and will prompt the user to save the captured value. The user will need to re-initialize the logging sequence, including tag, for successive samples. Data will fall under the same heading.
- Data is logged in the following format whenever you press the LOG button:

LOGGED DATA							
VER= 2.00							
VOC DATA							
DATE	TIME	TAG	PID BACKGROUND	PID CONCENTRATION	FID BACKGROUND	FID CONCENTRATION	GPS DATA
20 MAR 13	17:09:20		0.0 PPM OK	0.0 PPM OK	0.0 PPM OK	7.4 PPM OK	42.08503 -71.44032 109 13 4
20 MAR 13	17:09:48		0.0 PPM OK	0.0 PPM OK	0.0 PPM OK	7.3 PPM OK	42.08499 -71.44047 93 13 4
20 MAR 13	17:09:17		0.0 PPM OK	0.0 PPM OK	0.0 PPM OK	7.4 PPM OK	42.08498 -71.44042 93 13 4
20 MAR 13	17:10:26	VALVE 1	0.0 PPM OK	0.0 PPM OK	0.0 PPM OK	7.4 PPM OK	42.08492 -71.44046 88 13 4
END							

- Approximately 4500 data samples may be taken.

Log F.E. Use the following procedure to access the F.E. Log.

Note The F.E. method requires use of the enhanced probe. ▲

1. From the LOG MODE menu, press 3=VOC/F.E. The previous log selection is displayed on the second line of the screen.

```
LOG MODE
Auto,rate= 10sec
1=VOC    2=FE
```

Press 2=FE to display this message.

```
Enter sampling:
FE,time=00s,Max
Up/Dn=Next type
Enter=Accept
```

2. Press the Up/Dn arrow keys to choose the type of sampling to be used (Max, Avg, Smp).
 - a. Max = the maximum reading obtained during the log interval.
 - b. Avg = the average reading obtained during the log interval.
 - c. Smp = the last reading obtained during the log interval.
3. Type the appropriate time interval desired for F.E. sampling.
4. Press Enter, and, after a brief message of acceptance, the F.E. method of logging is now ready to be used in the RUN mode.

Note The allowable Sample Time range is 2-30 seconds. If a Sample Time of less than 2 seconds or greater than 30 seconds is selected, a warning message will appear and you will be required to re-enter the Sample Time. ▲

Note If dual option, the user must use the enhanced probe to change detector type. ▲

```

LOG.TXT - Notepad
File Edit Format View Help
LOGGED DATA
VER= 2.00
FE DATA
-----
DATE      TIME      TAG      DET      BACKGROUND      CONCENTRATION      LEAK      LEAK      REPAIR      GPS DATA
-----
20 MAR 13 17:11:01  PID      0.0 PPM OK      0.0 PPM OK      OK      N/A      N/A      42.08489 -71.44041 80 13 4
20 MAR 13 17:11:14  PID      0.0 PPM OK      0.0 PPM OK      OK      N/A      N/A      42.08491 -71.44047 98 13 4
20 MAR 13 17:11:22  PID      0.0 PPM OK      0.0 PPM OK      OK      N/A      N/A      42.08490 -71.44049 104 13 4
END
  
```

- Approximately 2900 data samples may be taken.

Log Custom

The TVA2020 has several pre-designed logging methods. However, if you find that you would prefer to log data in a different fashion, you can use Custom logging to create your own log type. The TVA2020 will prompt you through a series of questions which will assist you in setting the various logging options. The end result is a logging method which collects data the way you want it to.

The following variable settings can be configured when designing a Custom log method.

1. Log data type

This setting allows you to choose the format in which data will be saved. The choices are as follows:

- None.
- Auto – Data stored in a fashion similar to Auto logging (tag, calibration information, Detector Counts, time/date, alarms).
- VOC – Data stored in a fashion similar to VOC logging (Tag, Calibration Information, Detector Counts, time/date, alarms).
- FE – Data stored in a fashion similar to FE logging.

2. Sample time

This setting allows you to adjust the sampling interval.

3. Log time units

This setting allows you to choose the units for the sample interval (seconds or minutes).

4. Log sample type

This setting allows you to choose the way in which sample readings are collected over the sample rate or interval. The choices are as follows:

- a. Last sample — the last reading obtained within the sample interval is stored
- b. Max — the maximum reading obtained within the sample interval is stored
- c. Avg — the average reading obtained over the sample interval is stored

5. Log unit lock

This setting allows you to decide whether to enable auto-ranging or lock the TVA2020 units to either ppm or %.

6. Log auto repeat

This setting allows you to determine whether the TVA2020 should automatically cycle through logging events (auto repeat ON) or pause for a user command before logging (auto repeat OFF).

7. Log save accept

This setting determines whether the TVA2020 prompts the user before saving a logged reading (Manual) or automatically saves the reading without a user prompt (Auto).

8. Tag active

This setting determines whether or not you want to assign tags to logged readings. If you wish to assign tags, choose ON. If you wish to skip tagging, choose OFF.

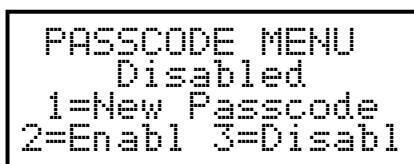
9. Route active

This setting determines whether the logging should follow a pre-loaded route list of tags. If you wish to upload a list of tags to the TVA2020 and follow that list while logging, choose ON. If you do not wish to use routing, choose OFF.

Passcode Protection

The TVA2020 Setup Menu can be passcode protected. This option allows you to protect the setup parameters from anyone who is not familiar with your 6-digit passcode. If this feature is enabled, you need to enter your passcode each time you choose to display the SETUP menu.

1. From the MAIN MENU display, press 2=Setup.
2. From the SETUP MENU display, press 4=Passcode.
3. Press ENTER to accept passcode.

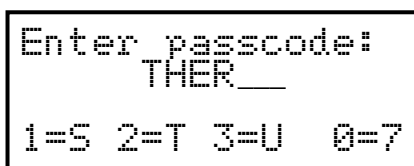


```
PASSCODE MENU
Disabled
1=New Passcode
2=Enabl 3=Disabl
```

New Passcode

New Passcode allows you to enter and/or change the 6-digit calibration passcode. You may use any characters from the alphanumeric keypad in your passcode. You must then verify the passcode to make sure you have entered it properly.

From the PASSCODE MENU display, press 1=New Passcode.



```
Enter passcode:
THER__
1=S 2=T 3=U 0=7
```

Enable

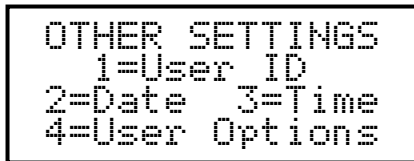
Enable allows you to activate the passcode protection feature. Once this feature is activated, you must enter your passcode whenever you request access to the SETUP MNEU. Once passcode protection has been enabled and you exit the SETUP MENU, the option can only be disabled by entering the passcode to gain access to the SETUP MENU again.

REMEMBER YOUR PASSCODE!

Disable Disable allows you to deactivate the passcode protection feature. Once this feature is deactivated, you have unlimited access to the SETUP MENU without entering a passcode.

Note In the event you inadvertently forget your passcode, contact Thermo Fisher Scientific for assistance. ▲

Other Settings Other Settings include:



```
OTHER SETTINGS
1=User ID
2=Date   3=Time
4=User Options
```

- 1=User Identification Number
- 2=Date
- 3=Time
- 4=User Options

Note Time may be set only if the date is within the valid range of 1980 to 2037. ▲

User Identification Number Use the following procedure to set the user identification number.

Note To set the User ID number, the instrument must be ON but does not have to be warmed up. ▲

1. From the MAIN MENU display, press 2=Setup.
2. From the SETUP MENU display, press 5=Other.
3. From the OTHER SETTINGS menu, press 1=User ID.


```
User ID:  
  USERID  
  
Enter=Change
```

4. From the User ID prompt, press ENTER.
5. Use the keypad to type your user ID.

```
Enter user ID:  
-----  
Press char key
```

6. Press ENTER to store the user ID into memory.

Date Use the following procedure to set the date.

Note To set the correct date, the instrument must be ON but does not have to be warmed up. Date entries earlier than Jan. 1, 1980 or later than 2037 are invalid. ▲

1. From the MAIN menu display, press 2=Setup.
2. From the SETUP menu display, press 5=Other.
3. From the OTHER SETTINGS menu, press 2=Date.

```
Enter date:
  --/--/--
Enter=Accept
```

4. The next screen reads the current date. If OK, press EXIT or ENTER to change. EXIT returns to the OTHER SETTINGS menu. ENTER prompts you to type the correct date. Do so by typing month/day/year.

```
Date:
  05/10/12
Enter=Change
```

5. Press ENTER to store the date in memory. The display then returns to OTHER SETTINGS.

Time of Day

Use the following procedure to set the time of day.

Note To set the correct time, the instrument must be ON but does not have to be warmed up. The date must be within the valid range of 1980 to 2037. ▲

1. From the MAIN MENU display, press 2=Setup.
2. From the SETUP MENU display, press 5=Other.
3. From the OTHER SETTINGS menu, press 3=Time.

```
Time:
  05:26:16
Enter=Change
```

4. The next screen reads the current time. If it is OK, press EXIT or ENTER to change. EXIT returns to the OTHER SETTINGS Menu, ENTER prompts you to type the correct time. Do so by typing hour/minute/second.

```
Enter time:
  --:--:--
Enter=Accept
```

5. Then press ENTER to store the time in memory. The display then returns to OTHER SETTINGS.

User Options

This menu contains user settable options to customize the features described below.

1. From the MAIN MENU display, press 2=Setup.
2. From the SETUP MENU display, press 5=Other.
3. From the OTHER MENU display, press 4=User Options.

```
USER OPTIONS
  1=Key Click
  2=Display Delay
```

User Options include:

- 1=Key Click
- 2=Display Delay

Key Click If the key click is on, a chirp is heard every time a key is pressed.

Note To select key click on/off, the instrument must be ON but does not have to be warmed up. ▲

1. From the MAIN MENU display, press 2=Setup.
2. From the SETUP MENU display, press 5=Other.
3. From the OTHER SETTINGS menu, press 4=User Options.
4. From the USER OPTIONS menu, press 1=Key Click.



```
Key click:
  Off
1=On    2=Off
```

5. From the Key click Menu, press 1=On or 2=Off. The screen displays the previous selection. When a new selection is made, the display returns to USER OPTIONS.

Display Delay This function determines the length of time that temporary messages remain on the screen.

Note To select the display delay, the instrument must be ON but does not have to be warmed up. ▲

1. From the MAIN MENU display, press 2=Setup.
2. From the SETUP MENU display, press 5=Other.

3. From the OTHER SETTINGS menu, press 4=User Options.
4. From the USER OPTIONS menu, press 2=Display Delay.

```
Display delay:
  Medium
  1=Short
  2=Medium 3=Long
```

5. From the Display delay menu, press 1=Short, 2=Medium or 3=Long. The screen displays the previous selection. When a new selection is made, the display returns to USER OPTIONS.

Note “Short” is approximately 0.5 sec, “Medium” is approximately 1.5 seconds, and “Long” is approximately 3.5 seconds. ▲

Information Menu

The information menu is a view-only list of 14 items/parameters existing in the instrument. No changes may be made in this menu. Enter the INFO Menu from the MAIN menu by pressing 3=Info. Use the up/down keys to page through the list.

The parameters/items you may view are:

- Model: TVA2020
- S/N DDDDDDDDDDDDD
- Date
- Time
- Det: PID, FID, or both
- Pump: On or Off and %
- Bat: Battery voltage listed, OK or low
- Memory: how much is free to use
- Ver: Current Software Version No.
- Optional Bluetooth status
- Optional GPS status
- PID zero calibration: Date and time of last calibration
- FID zero calibration: Date and time of last calibration

- PID span calibration: Date and time of last calibration
- FID span calibration: Date and time of last calibration

Note To view calibration information, you must return to the calibration menu in SETUP. Press EXIT to return to MAIN menu. ▲

Memory

This menu allows you to link the TVA2020 to a personal computer (PC) through the USB port to copy files from and into the instrument, clear data memory, and update instrument firmware.

Note The Flash memory device is erased prior to the file creation process to ensure sufficient memory exists to create the data files. Do not store any files on the instrument Flash drive as they will be lost. ▲



WARNING Charger and USB connections are not allowed in an area classified as hazardous due to presence of flammable gases or vapors. ▲

To enter the MEMORY menu from the MAIN menu, press 4=MEMORY. The following display will appear:

```
MEMORY
1=USB Mode
2=Clear Log Mem
3=UpdateFirmware
```

Choosing 1 = After choosing 1 the display will show “Creating Files Please wait” as shown below. The file creation can take up to one minute, depending on the size of the log file.

```
Creating Files
Please Wait
```

Do not connect the USB cable to the instrument until the instrument displays the screen below.

```

USB MODE
Exit=Cancel

```

The USB barrier device must be connected in line between the computer and the instrument. Two standard USB cables are provided to make this connection. If the barrier device is not used, the following message will be displayed.

```

=== WARNING! ===
Incorrect USB
cable detected
Exit=Clr

```

When first connected to a PC the TVA2020 will send the correct driver files to the computer. Administrator privileges may be needed to allow the proper files to be transferred to the PC.

Once connection has been established the files listed below will be displayed in a newly opened TVA2020 window. These files can be dragged and dropped into any user folder or directory. If the TVA2020 window does not appear, try disconnecting and reconnecting the USB cable from the PC or open Explorer and look for the TVA2020 device.

The Flash files can also be deleted without any adverse affect on the instrument. These files are backed up inside the instrument memory.

The instrument keypad is disabled while the instrument is connected to the PC via the USB cable. To resume keypad control, close the TVA2020 dialog window and eject the TVA2020 memory device using the PC controls. The following information can be saved from the TVA2020 to the PC:

- a. ROUTE.TXT (Route List)
- b. CONFIG.TXT (TVA2020 Configuration)
- c. CAL.TXT (TVA2020 Calibration Parameters)
- d. FACTORY.TXT (TVA2020 Factory Calibration)
- e. LOG.TXT (Logged Data)
- f. CAL_HIST.TXT (Calibration History)

The following information can be saved from a PC to the TVA2020:

- a. ROUTE.TXT (Route List)
- b. CONFIG.TXT (TVA2020 Configuration)
- c. CAL.TXT (TVA2020 Calibration Parameters)
- d. FACTORY.TXT (TVA2020 Factory Calibration)

Note TVA2020 only recognizes the above naming format, otherwise the file will be deleted. ▲

Upon exiting the USB MODE screen, any files that have changed will be loaded into the instrument memory. If the file format is incorrect, the following message will appear.

```
=== WARNING! ===  
File read error!  
check err file!  
Exit=Clr
```

If you choose Exit to clear, the following displays:

```
Error in files  
1=USB mode to  
fix files  
2=Revert to old
```

If you choose to fix the files, re-establish the PC USB connection and open the error file that was created to identify the line(s) of text in error.

If you choose to revert to the existing files, your changes will be lost unless they were saved on your PC. The following screen appears:

```
Reverting  
Please wait
```

Text File Formats

Messages to be uploaded and downloaded must be written in straight ASCII text and must contain blank spaces between text, not tabs.

For more information, See Appendix B, “[Text Data Formats](#)”.

Choosing 2 = Clear Logging Memory will erase any loaded logged data stored in TVA2020 memory. A warning that “You are about to clear all memory” will appear and must be acknowledged before the TVA2020 will clear its memory. Be absolutely sure that you wish to clear memory before choosing this action. **Once memory is cleared, it cannot be retrieved.**

Choosing 3 = Update Firmware allows the user to update instrument firmware upon new releases.

1. Confirm that the new firmware image is stored locally on your hard drive.
2. Before uploading the new firmware back up all the instrument files as detailed in the USB mode section. These files will remain unchanged in the instrument during the upload but a back up is recommended.
3. Press 3=UpdateFirmware.
4. Press ENTER at the first warning screen.

```
=== WARNING! ===  
Press Enter to  
Start fw update  
Exit=Cancel
```

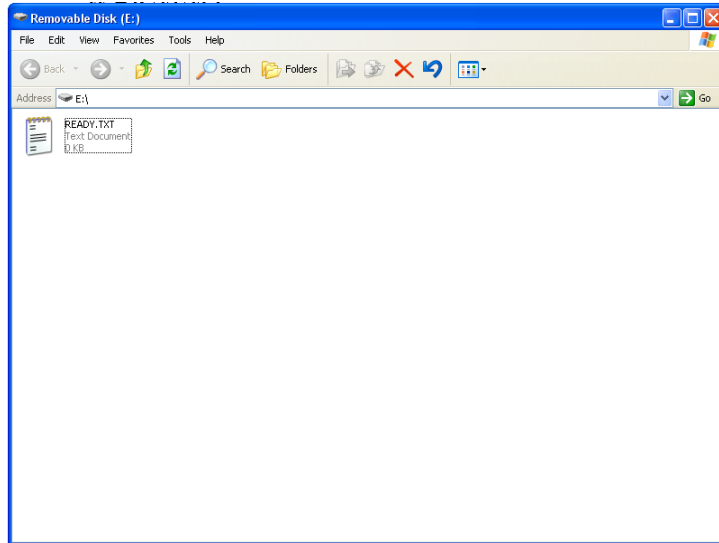
5. Press ENTER at the second warning screen. Please note that pressing ‘Enter’ will delete the current firmware installed in the instrument.

```
=== WARNING! ===  
Continuing will  
Erase the FW  
Exit=Cancel
```

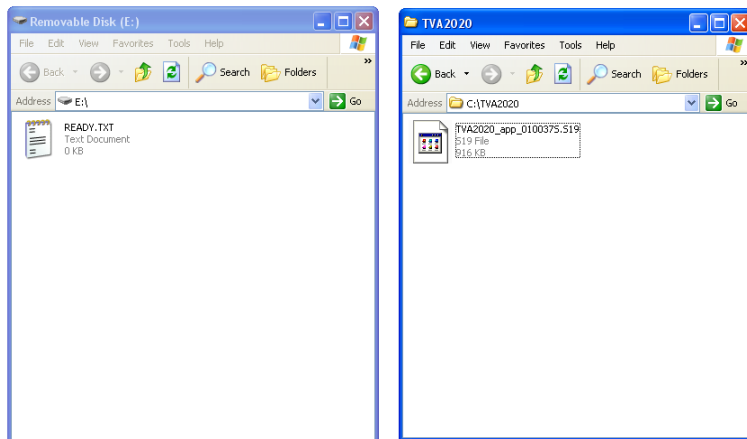
6. Follow the steps listed on the display.

```
FW UPDATE STEPS  
1. Connect USB  
2. Copy File  
3. Wait Reboot
```

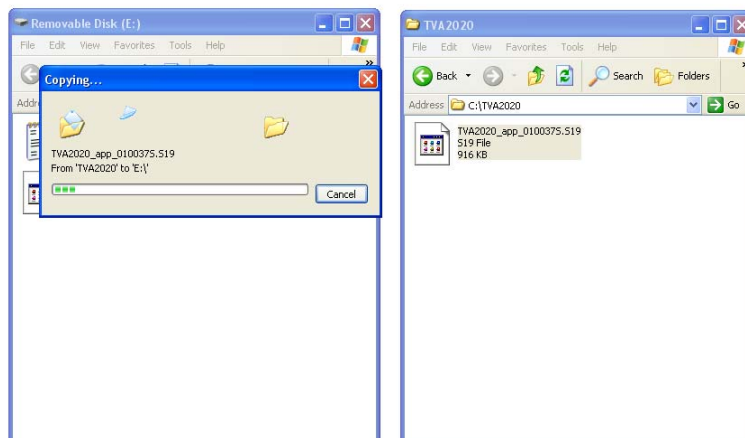
7. After connecting the USB cable the following window will open. Depending on your computer configuration, you may need to cancel one or two other message windows before this window appears.



8. Drag and Drop or Copy and Paste the new firmware file into this 'Removable Disk' window.



9. The copying window should appear while the file transfers.



10. After transfer, the 'Removable Disk' window will close and the instrument will automatically reboot to the main menu.
11. If the instrument does not reboot to the main menu, perform the following:
- a. With the USB cable still connected to the computer, disconnect and reconnect at the instrument. This will turn the instrument off.
 - b. Press the power key to turn the instrument on.
 - c. The instrument will display two black lines; however the bootloader is still active.
 - d. Return to step 7 in this section and continue from there.
 - e. If the problem persists after several attempts, contact the Thermo Fisher Scientific Service Department.
12. Confirm that the calibrations (gas and flow) are still valid. If needed, they can be transferred back into the instrument using the Memory/USB Mode functions.

Chapter 4

Calibration

This chapter describes procedures for performing a calibration on the TVA2020. For details, see the following:

- “Calibration Scenarios” on page 4-1
- “Calibration Configuration” on page 4-3
- “Detector Counts” on page 4-9
- “Defining the Response Factor” on page 4-10
- “Flow Calibration” on page 4-18

Calibration Scenarios

The use of multipoint calibration and multiple response factors/curves with the TVA2020 must be fully understood before employing these features. To help explain these TVA2020 capabilities, three scenarios follow:

Scenario 1

To maximize standard accuracy, it is highly recommended that you calibrate with methane for the flame ionization detector and isobutylene for the photoionization detector. Almost all published response factors for FIDs and PIDs are based upon methane and isobutylene, respectively. By employing a multipoint calibration for these compounds, you will improve the accuracy of each detector over the entire dynamic range. Response factors/curves can then be employed for correcting the detector’s response to different compounds. However, once a multipoint calibration has been employed, any response curve must characterize only the relative response at each concentration, excluding curvature of the calibrated compound. Thus, use of both multipoint calibration and response curves at the same time is difficult, and is not recommended.

Scenario 2

If, for example, you want to measure several different compounds over wide concentration ranges, it is best to use a single-point calibration and then enter response curves for each specific compound (up to 9 response factors/curves can be entered into the analyzer).

Scenario 3

If, instead, you want to measure in direct readings (response factor = 1) for one specific compound with maximum accuracy over a wide range of concentrations, perform a multipoint calibration with the specific compound. Up to 9 span points (plus zero) can be entered for each detector. The use of a response curve is thus unnecessary as the detector is already reading the direct ppm for that specific compound.



CAUTION If you use multipoint calibration or a gas other than methane or isobutylene and then apply response factors/curves (that have been generated with reference to a single point methane/isobutylene calibration), the resulting measurements will probably be incorrect. ▲

To provide the specified accuracy, the instrument must be calibrated at the beginning of each workday.

- From the Main Menu, choose 2 = Setup > **1 = Calib.**

When you reach the CALIBRATION menu, you will see the following selections:

```
CALIB MENU
1=Zero    2=Span
3=Backgnd 4=RF
5=Flow    6=Cfg
```

The steps involved in calibrating the TVA2020 are as follows:

1. Configure the calibration variables (6=Cfg):
 - Number or span points (1-9)
 - Span concentration
 - Background correction (None, PID, FID, Both)
 - Response factor calculation mode (Multiplication factor or Curve)
 - Accept mode (Manual or Auto)
 - Save mode (Manual or Auto)
2. Zero the instrument using either a zero gas or clean ambient air (1=Zero).

3. Calibrate the reference point(s) using known span gases. The TVA2020 can be configured for as many as nine different span gas values (2=Span).
4. Optional: Set instrument response factors if necessary (4=RF).
5. Optional: Take background reading (3=Backgnd).
6. Optional: Calibrate the flow sensor (5=Flow).

Note Prior to performing calibration, the instrument must be on and warmed up for approximately 30 minutes. The pump must be ON, the PID lamp must be ON, and the FID must be ignited throughout the warm-up period. ▲

Calibration Configuration

Before you calibrate the TVA2020 for the first time, you may want to customize certain calibration settings. Once you have configured these settings, you don't need to set them again every time you calibrate unless you want to change one.

In order to set your calibration options from the CALIBRATION menu, from the CALIB MENU display, choose menu selection #6 (Cfg). This will produce the following CAL CONFIG MENUS which can be scrolled through by using the Up and Down arrows:

```
CAL CONFIG MENU
1=Number span pt
2=Span concs
Up/Dn=More
```

```
CAL CONFIG MENU
1=Backgnd corrct
2=RF calc mode
Up/Dn=More
```

```
CAL CONFIG MENU
1=Accept Mode
2=Save mode
Up/Dn=More
```

Number Span Pt

The Number Span Pt screen is used to determine the number of span points that will be used to calibrate your TVA2020. Choosing this selection will produce the following screen:

FID	PID/FID
FID: 3 Span Gas Points Enter=New Value	PID: 5 FID: 3 Span Pts: 1=Both 2=PID 3=FID

From this screen, you may choose which detector you wish to set the number of span points for. Choosing one of these selections produces the following screens:

FID	PID/FID (Both option)
Number span pts: FID: 3 Select: 1 to 9	Number Span Pts: P&F: 5 & 3 Select: 1 to 9

From these screens, press the number of span points that you wish to use. Both detectors can have up to 9 span points each, and they do not necessarily need to have the same number of span points. When Both option is chosen, a single value will be applied to both PID and FID.

Defining the Span Gas Concentration(s)

The span gas concentration is the known concentration of the gas standards used to calibrate your TVA2020. Methane in air is the recommended calibration standard for the FID, and Isobutylene in air is the recommended calibration standard for the PID. Other gases may be used if desired.

Note If your instrument is equipped with dual detectors, you may choose to calibrate the FID separately or PID/FID together. ▲

Note If your instrument is configured for multiple span points, be sure to set the concentration for ALL span points. ▲

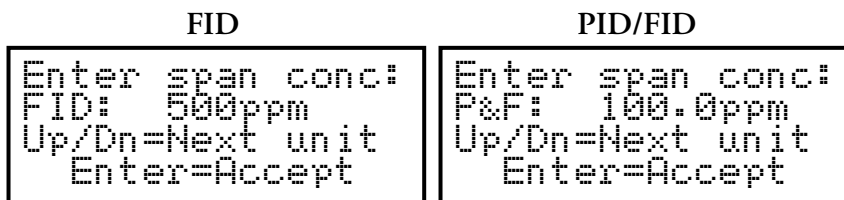
1. From the CAL CONFIG MENU (Page 1) display, press 2=Span concs. The upper display (or two displays if the unit is a dual detector version) will display the concentration value of your span gas (expressed as ppm or %) as of the last calibration:

FID	PID/FID
<pre style="font-family: monospace; margin: 0;">FID: 500ppm Span Gas Concent Enter=New conc</pre>	<pre style="font-family: monospace; margin: 0;">PID: 100ppm FID: 500ppm Span Conc:1=Both 2=FID 3=FID</pre>

If the TVA2020 is configured for multiple calibration points, the span gas concentration values for Point #3 will be displayed. The Up and Down arrow keys can be used to scroll through the span gas concentration values for other points:

FID	PID/FID
<pre style="font-family: monospace; margin: 0;">FID: 500ppm Span Pt3 (Up/Dn) Enter=New conc</pre>	<pre style="font-family: monospace; margin: 0;">PID: 100ppm FID: 500ppm Span Pt3 (Up/dn) 1=Both 2Pid 3Fid</pre>

2. To change a span gas concentration value, choose the detector(s) of interest if using a dual detector analyzer, or press ENTER if using a single detector analyzer. The following display will appear:



Use the up and down arrow keys to select the measurement units (ppm or %) and the decimal point position. There are 3 selections to choose from:

Table 4–1. Gas Concentration Units

Range	Display	Units
3	DD.DD	%
2	DDDDDD	ppm
1	DDDD.D	ppm

The range of the instrument is determined by your selection of measurement units and decimal point placement. In the run mode, the instrument will auto range upward only to select the optimum range for displaying measurement information. For example, if you entered a value in Range 1 and the measured value changes to a high value, the instrument will automatically switch to range 2. If it increases further, it will switch to Range 3.

After you have selected the measurement units and decimal point placement, use the keypad to enter the concentration value. Press ENTER to accept this value and store it in the TVA’s memory.

3. If your TVA2020 is a dual detector analyzer, you may repeat the procedure for the second detector. If your TVA2020 is configured for more than one span point, you may use the Up/Dn arrow keys to select the next span point and repeat the procedure.
4. When the last gas concentration value has been entered, you can return to the CALIBRATION menu, by pressing the EXIT key.

Background Correct

This selection allows you to choose whether or not to apply background correction to the detector readings displayed and logged in memory. If you choose to apply background correction, the last background reading stored in memory will be subtracted from the measured reading. This corrected

reading will be the value displayed and the value logged. Choosing this selection from the CAL CONFIG MENU produces the following display:

FID	PID/FID
<pre>Backgnd correct: ON 1=ON 2=None</pre>	<pre>Backgnd correct: FID 1=Both 2=None 3=FID 4=FID</pre>

The second line of the display shows what option is currently selected. You can change this option by choosing any one of the menu selections in dual detector instruments. You may choose to apply correction to FID, PID or both detectors.

Defining the Background Correction

From the CALIB MENU display, press 3=Backgnd.

FID	PID/FID
<pre>FID: 0.0ppm Background conc 1=Update 2=Zero</pre>	<pre>PID: 0.0ppm FID: 0.0ppm Background conc 1=Update 2=Zero</pre>

Press 1=Update to read live values of ambient air.

FID	PID/FID
<pre>Please wait... Sampling backgnd Enter=Accept</pre>	<pre>Please wait... Sampling backgnd Enter=Accept</pre>

FID	PID/FID
<pre>FID: 0.3ppm Sampling backgnd Enter=Accept</pre>	<pre>PID: 0.2ppm FID: 0.3ppm Sampling backgnd Enter=Accept</pre>

Press ENTER.

FID	PID/FID
FID: 0.3ppm -ACCEPTED-	PID: 0.2ppm FID: 0.3ppm -ACCEPTED-

Note A default background value of 0 is stored in memory until a background reading is taken. ▲

Note The background correction is reset to zero when the unit is powered up and when the user exits the USB Mode screen. ▲

RF Calc Mode

This selection allows you to choose how response factor correction will be applied to the reading. Choosing this selection from the CAL CONFIG MENU produces the following display:

```
RF calc Mode:  
Factor  
1=Factor 2=Curve
```

The second line of the display shows what option is currently selected. If “Factor” is chosen, the TVA2020 will use a single constant response factor which is multiplied by the reading. If “Curve” is chosen, the TVA2020 will use a two constant equation. For more information, refer to the section of the manual on “Response Factors.”

Cal Accept Mode

This selection allows you to choose whether or not calibrations will be automatically accepted. Choosing this selection from the CAL CONFIG MENU produces the following display:

```
Cal accept mode:
  Manual
1=Manual  2=Auto
```

The second line of the display shows what option is currently selected. If “Manual” is chosen, the instrument will display the detector count during calibration and prompt the user to decide when to accept the calibration value. If “Auto” is chosen, the instrument will automatically determine the value to be stored and when to do it.

Cal Save Mode

This selection allows you to choose whether or not the TVA2020 will automatically save an accepted calibration. Choosing this selection from the CAL CONFIG MENU produces the following display:

```
Cal save mode:
  Manual
1=Manual  2=Auto
```

The second line of the display shows what option is currently selected. If “Manual” is chosen, after a calibration value has been accepted the instrument will prompt the user to decide whether to save the calibration value or repeat the calibration (1 = Yes or 2 = Again?). If “Auto” is chosen, the instrument will automatically store the accepted calibration value without prompting the user.

Detector Counts

Detector counts are the raw, unscaled detector output values associated with a gas measurement performed by the FID or the PID. Before a detector reading is displayed or recorded, the detector signal is converted from analog to digital. The result is a raw number, or A/D counts.

When a detector is calibrated, the detector counts for the zero gas and each of the span gases are saved in memory. These detector counts are then used as reference points for calculating the concentration values to be displayed or stored.

When calibrating the TVA2020 in the “Manual” accept mode, the counts from the last calibration (Zero or Span) are displayed before the calibration process is initiated. Once the calibration process is initiated, the live detector counts are then displayed. You can refer to these counts as an

indication of when the reading has stabilized, or as a means of tracking the repeatability of your calibrations.

You can also use these counts as an indication of the success of a calibration. The “zero” counts are the counts expected when a zero gas is applied to the detector. The span counts are the counts expected when a span gas of known concentration is applied to the detector. Finally, the detector sensitivity can be calculated by subtracting the zero counts from the span counts and dividing by the span gas concentration. Use the following general observations as a guideline:

Table 4–2. Detector Counts

Detector	Zero Counts	Detector Sensitivity
FID	<6000	160-260 counts/ppm Methane
PID (10.6 eV lamp)	1000-2000	10-35 counts/ppm Isobutylene

Example: A TVA2020 FID is calibrated with zero air and a 100 ppm Methane in air span gas. The counts observed for the zero are 2895 and the counts observed for the span are 27395. The span sensitivity is thus 245 counts/ppm [(27395-2750)/100 ppm]. Since both of these values (2895 zero counts and 245 detector sensitivity) are within the acceptable range, the calibration is a good calibration. Examples of a bad calibration include unusually high zero counts, or unusually low detector sensitivity. These problems can often be attributed to poor calibration gases, contaminated sampling accessories, a faulty detector capsule, or failure to follow the proper calibration procedure. For more information, consult the “[Troubleshooting](#)” chapter in this manual or contact Thermo Fisher Scientific for assistance.

Defining the Response Factor

Although the FID and PID are calibrated with span gases of known concentration (usually Methane and Isobutylene, respectively), both detectors respond to many different compounds with differing levels of sensitivity. In order to adjust the analyzer reading from “ppm of Methane” or “ppm of Isobutylene” to ppm of the compound of interest, a correction factor must be applied to the reading. This correction factor is also known as a Response Factor. You can choose from up to nine (9) user-defined response factors, or use the default response factor of 1.00. Each response factor can be assigned a 9-character alphanumeric name.

The TVA2020 uses one of two different response factor formats: a Multiplier or a Curve.

Response Factor Multiplier

A response factor multiplier is defined as follows:

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

Example: If 100 ppm of a compound produces an FID response of 50 ppm on an analyzer calibrated with Methane, then the FID response factor would be 2.00 (100/50).

When using a response factor multiplier to correct a TVA2020 reading, the analyzer multiplies the reading by the response factor and displays the corrected reading. As in the example give above, if a 50 ppm reading is obtained by the TVA2020, the analyzer would automatically multiply 50 times 2.00 to get the actual concentration of 100 ppm.

Response Curve

Response factors can change as concentration changes. The response factor for a compound determined at 500 ppm may not be the same as the response factor determined at 10,000 ppm. By using a response curve, you can characterize a compounds response over a broader range of concentrations. If the actual concentration is plotted as Y vs. X (measured concentration), the resulting curve can be represented by the rational equation

$$Y = \frac{AX}{\left(1 + \frac{BX}{10000\text{ppm}}\right)}$$

When using the RF Calc Mode “curve”, the terms A and B are entered into the TVA2020. A represents the response factor multiplier at very low concentrations and B represents a change to the response for every percent concentration increase.

The curve can only be defined by collecting response data at several different concentrations and using a xy math spreadsheet to calculate the “best-fit” polynomial expression.

Note Once the response curve has been fit, the calibration gas concentrations and number of span points should not be changed without readjusting the curve fit. ▲

Calibration

Defining the Response Factor

To define and/or choose a response factor, choose 4=RF from the CALIB MENU. The following display will appear:

```
RF0: Default
  Up/Dn=Next RF
  Enter=Accept
```

The top line shows the currently active response factor. If no response factor is applied, the currently active response factor will be the factory DEFAULT (1.00 for FID methane and 1.00 for PID isobutylene). The name and value of the default response factor cannot be changed. You can scroll through the other response factors by using the Up and Down arrow keys. The other response factor names will show as you scroll through them:

```
RF3: PROPANE
  Up/Dn=Next RF
  1=Change
  Enter=Accept
```

If you would like to activate a different response factor, press ENTER=Accept. The TVA2020 will show an ACCEPTED message. If you would like to modify the response factor name or numbers, press 1=Change:

FID

```
RF3: PROPANE
FID: 1.50
1=Name 2=Numbers
```

PID/FID

```
RF3: PROPANE
PID: 1.50
FID: 1.50
1=Name 2=Numbers
```

If you would like to change the name assigned to the response factor, press 1=Name. If you would like to change the response factor value, press 2=Numbers. If you choose 1=Name, the following display will appear:


```

Enter name:
RF3: Hexa_____

Press char key
    
```

Use the alphanumeric keypad to enter a compound name for the response factor. Press enter when you are finished.

If you choose 2=Numbers, the following display will appear:

FID	PID/FID
<pre> Enter RF3: FID: 01.50 Enter=Accept </pre>	<pre> Enter RF3: P&F: 01.50 Enter=Accept </pre>

Use the keypad to enter a new response factor and press ENTER to store it in instrument memory.

Note The TVA2020 will not accept a response factor of 00.00. ▲

Note If a response curve is used, the TVA2020 will prompt you to enter two numbers. ▲

FID	PID/FID
<pre> RF3: PROPANE FID: 1.25 1.50 1=Name 2=Numbers </pre>	<pre> RF3: PROPANE PID: 1.25 1.50 FID: 1.25 1.50 1=Name 2=Numbers </pre>

Press 2=Numbers

Calibration

Defining the Response Factor

FID	PID/FID
Enter RF3 fact1: FID:01.25 Enter=Accept	Enter RF3 fact1: P&F:01.25 Enter=Accept

Press ENTER.

FID	PID/FID
Enter RF3 fact2: FID: 1.25 +01.50 Up/Dn=+/- Enter=Accept	Enter RF3 fact2: P&F: 1.25 +01.50 Up/Dn=+/- Enter=Accept

Zero Reference Point Calibration

Use the following procedure to zero the instrument.

1. From the CALIB MENU display, press 1=Zero.

Note The following sequence shows the procedure when the TVA2020 is configured with both Cal Accept mode and Cal Save mode = Auto. If either mode is Manual, an extra confirmation is required at the appropriate step. ▲

Note If your instrument is a dual detector type (PID and FID), you can zero the PID and FID separately, both together, or one in zero gas and one in clean ambient air. To do so, follow the same procedure. However, it is suggested that you zero both detectors together. ▲

If you press 1=Zero, the display will show:

FID	PID/FID
<pre style="font-family: monospace; margin: 0;">FID: 3500 Zero Calib Value Enter=New Calib</pre>	<pre style="font-family: monospace; margin: 0;">PID: 1350 FID: 3500 Zero Cal: 1=Both 2=PID 3=FID</pre>

2. To perform the actual ZERO procedure:

- FID-only: Press ENTER
- PID/FID: Press 1, 2, or 3

FID	PID/FID
<pre style="font-family: monospace; margin: 0;">Apply zero gas at sample inlet Enter=Start</pre>	<pre style="font-family: monospace; margin: 0;">Apply zero gas at sample inlet Enter=Start</pre>

3. Apply the zero gas to the probe at ambient pressure (using a clean and labeled gas sampling bag) and then press ENTER.

FID	PID/FID
<pre style="font-family: monospace; margin: 0;">FID: 3500 Wait for zero... Exit=Cancel</pre>	<pre style="font-family: monospace; margin: 0;">PID: 1350 FID: 3500 Wait for zero... Exit=Cancel</pre>

The instrument analyzes the zero sample.

FID	PID/FID
FID: 3500	PID: 1350
	FID: 3500
-ACCEPTED-	-ACCEPTED-

The ACCEPTED message appears for a short time and is then replaced by the normal CALIBRATION menu.

When the ACCEPTED message disappears and the CALIB MENU appears, the ZERO reference value is stored. This value is stored in non-volatile memory until the next calibration is performed. The date and time of this calibration are stored and can be accessed through the INFO menu.

Note For optimum accuracy, re-zero the FID every time the hydrogen supply is turned on. ▲

Span Reference Point(s)

To set the span reference point, execute the procedure described below. Note that the procedure is the same as that for setting the zero reference except that a span gas is used instead of a zero gas. The procedure is:

1. From the CALIB MENU display, press 2=Span.

Note The following sequence shows the procedure when the TVA2020 is configured with both Cal mode and Cal Save mode = Auto. If either mode is Manual, an extra confirmation is required at the appropriate step. ▲

Note If your instrument is a dual detector type (PID and FID), you can set the span reference for the PID and FID separately, both together, or one in one type of calibration gas and one in another type of gas. To do so, follow the same procedure. ▲

Note The FID and PID span concentrations must be the same for both span reference point selections, otherwise an error screen will be displayed. ▲

Note If multiple span points are used, repeat the following procedure for each and every span point. ▲

When you press 2=Span, the display will show:

FID	PID/FID
<pre style="font-family: monospace; margin: 0;">FID: 44750 Span Pt1 (Up/Dn) Enter=New calib</pre>	<pre style="font-family: monospace; margin: 0;">PID: 4000 FID: 44750 Span Pt1 (Up/Dn) 1=Both 2Pid 3Fid</pre>

If more than one reference span gas concentration has been configured, pressing the Up/Dn keys will allow you to scroll through all defined reference gas concentration points.

2. To perform the actual SPAN calibration (for example at 100 ppm isobutylene):
 - FID-only: Press ENTER
 - PID/FID: Press 1, 2, or 3

FID	PID/FID
<pre style="font-family: monospace; margin: 0;">Apply span gas1 100.0ppm Enter=Start</pre>	<pre style="font-family: monospace; margin: 0;">Apply span gas1 100.0ppm Enter=Start</pre>

3. Apply the appropriate span gas to the probe at ambient pressure (using a clean and labeled gas sampling bag) and then press ENTER.

FID	PID/FID
<pre style="font-family: monospace; margin: 0;">FID: 44750 Wait for span... Exit=Cancel</pre>	<pre style="font-family: monospace; margin: 0;">PID: 4000 FID: 44750 Wait for span... Exit=Cancel</pre>

The instrument analyzes the span sample.

When only one reference span gas concentration is used, the ACCEPTED message appears for a short time and is then replaced by the normal CALIBRATION menu.

FID	PID/FID
FID: 44750 -ACCEPTED-	PID: 4000 FID: 44750 -ACCEPTED-

When the ACCEPTED message disappears and the CALIBRATION menu appears, the SPAN reference value is stored. This value is stored in non-volatile memory until the next calibration is performed. The date and time of this calibration are stored and can be accessed through the INFO menu.

4. If more than one reference span gas concentration has been defined, the span calibration display returns. Move to the next concentration point (Up/Dn keys) and repeat steps 2-3 above until each reference gas concentration point has been calibrated.

Flow Calibration

Use the following procedure to perform a flow calibration.

1. Confirm that the instrument passes the [Leak Check](#) on page 7-16 prior to performing this calibration. A new water trap filter and a new or clean sintered metal filter should be installed prior to performing this calibration.
2. From the SETUP MENU, choose 1=Calib > **5=Flow**.
3. Establish the 1 ±.01 LPM flow at the probe inlet.
 - a. Typical values are 50-60% power with 28K-30K counts.
4. Press **Enter=Accept** to save the Flow 1 values.
5. Attach one of the red flow restrictors between the probe inlet and the flow meter.
6. Press “**2**” for the second flow calibration point.
7. Adjust the pump power with the up and down arrows for a reading of 1 ±.01 LPM at the probe inlet.

- a. Typical values are 65-75% power with 29K-31K counts
8. Press **Enter=Accept** to save the Flow 2 values.
9. Attach a second red flow restrictor, in line with the first, between the probe inlet and flow meter.
10. Press “**3**” for the third flow calibration point.
11. Adjust the pump power with the up and down arrows for a reading of $1 \pm .01$ LPM at the probe inlet.
 - a. Typical values are 85-95% power with 31K-33K counts.
12. Press **Enter=Accept** to save the Flow 3 values.
13. Press **4= calc coef** to calculate the flow calibration values.

Note The flow calibration values are stored in a file called FACTORY.TXT. This file can be saved to a computer and reloaded to the instrument if the flow calibration were to become corrupted. See the section on flash file transfers. ▲

Chapter 5

Preventive Maintenance

This chapter describes the periodic maintenance procedures that should be performed on the instrument to ensure proper operation. Since usage and environmental conditions vary greatly, the components should be inspected frequently until an appropriate maintenance schedule is determined. Thermo Fisher Scientific suggests that you return the entire instrument to the factory or an authorized service center once a year for cleaning, testing, and calibration.

This chapter includes the following maintenance information and replacement procedures:

- “Safety Precautions” on page 5-2
- “Replacement Parts” on page 5-2
- “Battery and Battery Charger” on page 5-2
- “Hydrogen Gas Tank” on page 5-4
- “Cleaning the PID Lamp” on page 7-9
- “Cleaning an FID Cartridge” on page 5-7
- “Cleaning the FID Detector Cap” on page 5-9
- “Cleaning the FID Detector Cavities” on page 5-10
- “Replacing Water Trap Probe Filter and O-Rings” on page 5-11
- “Cleaning or Replacing a Sintered Metal Filter Cup” on page 5-13
- “Replacing the Charcoal Filter” on page 5-14

Safety Precautions

Read the safety precautions before beginning any procedures in this chapter.



WARNING Never change an electrical component in an area classified as hazardous due to presence of flammable gases or vapors. ▲



WARNING Parts replacement and maintenance should not be performed in areas classified as hazardous due to presence of flammable gases or vapors. Use only Thermo Fisher Scientific replacement parts. (Extended Service Plans are available; contact Thermo Authorized Service for further information.) ▲

Replacement Parts

See the “[Servicing](#)” chapter for a list of replacement parts.

Battery and Battery Charger

You may charge the battery in or out of the instrument or replace it with a charged battery. For information on replacing the battery, see “[Replacing the Battery](#)” on page 7-6.



WARNING Do not replace battery in an area classified as hazardous due to presence of flammable gases or vapors. ▲



WARNING Do not operate battery charger in an area classified as hazardous due to presence of flammable gases or vapors. ▲



WARNING Charger and USB connections are not allowed in an area classified as hazardous due to presence of flammable gases or vapors. ▲

Battery Warnings and Precautions

Various safety features have been included in the design of the lithium-ion battery packs. However, misusing or mishandling the battery packs can lead to fluid leakage, heat generation, fire or an explosion.



WARNING Misusing or mishandling the battery packs can lead to fluid leakage, heat generation, fire or an explosion. ▲

To prevent these situations from occurring and to ensure safe use of the battery packs, observe the following precautions:

- Do not use or store the battery packs in environments with high temperatures, such as in strong, direct sunlight, in vehicles during hot weather, or directly in front of a heater (80 °C or higher).
- Do not immerse the battery packs in water. Do not allow them to get wet.
- Do not break open or damage the battery packs or the casing of the lithium-ion batteries. Do not pierce the battery packs with a nail or other sharp object. Do not strike it with a hammer or step on it.
- Do not put the battery packs into a microwave oven or pressurized container.
- Do not strike, drop, or throw the battery packs.
- Do not assemble or modify the battery packs or the lithium-ion batteries located inside the battery packs.
- Do not install the battery packs into the TVA2020 if the battery packs leak electrolyte, change color, change shape, or become deformed in any other way. If leaked electrolyte comes in contact with your eyes, flush your eyes immediately. Wash them thoroughly with clean water and consult physician. If skin or clothing comes in contact with leaked electrolyte, wash the area immediately with clean water.
- Do not charge the TVA2020 unit in an environment below 0 °C or above 40 °C).
- Do not charge the TVA2020 unit near fire or in an extremely hot environment.
- Always properly dispose of the TVA2020 battery packs (recycling is preferable, contact Thermo Fisher Scientific for further information). Do not dispose of the battery packs in fire or heat.



Equipment Damage Do not operate the TVA2020 if its case is damaged or otherwise compromised. ▲

The lithium-ion battery, supplied with the unit, lasts for a minimum of ten hours of continuous use at 20 °C. Extreme heat or cold and/or use of the backlight, however, will shorten that time.

A battery charger with cable is shipped with the instrument. You do not have to remove the battery for charging. Simply plug the output of the charger into the mating connector marked with the battery symbol in the instrument. The cable and connectors are keyed. Orient the cable so that

the flat side is facing up. Then, insert the charger plug into the appropriate wall outlet.

The charger has three LEDs. The left most LED indicates power status. When green, the charger is ready to charge a battery. Orange or Red indicates a problem with the charger and should not be used.

Once the instrument is connected to the charger the center LED will light. The light will initially turn orange for 5 to 10 seconds while measuring the temperature of the battery. If the battery temperature is within the charging limits then the light will turn green. If the light turns red the battery may be too hot or too cold and will not charge until the proper temperature is reached. If you are sure the temperature is correct then either the battery or charger is defective.

After the center LED turns green the charger tests the battery to determine the correct charge state. The right most LED will illuminate as defined below to indicate the charge state.

- Orange – Constant current charge state
- Orange/Green alternating – Constant voltage (90% full charge)
- Steady Green – Fully charged
- Red – Indicates the charger or battery is defective and should not be used.

Normal charge time for a fully discharged battery is approximately eight hours, or approximately one hour of charge for every hour of use.

The battery can be charged while the instrument is ON and running. It takes approximately 14 hours to fully charge a battery with the instrument running.

Do not leave the battery on charge for extended periods (greater than 96 hours). If you wish to remove the battery from the TVA2020 for charging or swapping with a spare battery, turn the instrument off.

Safety Test Criteria

The lithium-ion battery packs are designed to meet all U.S. Department of Transportation (DOT) criteria, per: UN Manual of Tests and Criteria Part III sub-section 38.3, T1, T2, T3, T4, T5, T7. This is currently pending.

Hydrogen Gas Tank

FID instruments are supplied with an 85cc hydrogen gas tank. This tank, which may be pressurized to 2200 psi maximum at 25°C, will provide ten hours operation when fully charged. The tank has an integrally mounted high pressure gauge that can be easily read when the tank is in or out of the instrument. Install the tank in the instrument by inserting it into the receptacle on the top and tightening (left hand threads, tighten counter-

clockwise) until the rubber tank boot is flush with the instrument sidepack and a slight resistance is felt. **Do not overtighten.**



WARNING A safe refill operation means there are no hydrogen leaks. Before any valves are opened, use a wrench to firmly tighten connections to the hydrogen supply tanks and the tank fill adapter. If escaping hydrogen is heard during the filling operation, close all valves and correct the leak before proceeding. Leak test with soapy water or equivalent. ▲



CAUTION Do not fill hydrogen tank to a pressure greater than 15.2 MPa (2200 psig). ▲

Note Use prepurified ZERO grade hydrogen (certified total hydrocarbons as methane <0.5 ppm recommended). ▲

Note The hydrogen filling assembly contains a flow-limiting safety device. Approximately two minutes are required to fill the tank. ▲

Precautions in Handling and Storage

The major hazard associated with the handling of hydrogen is flammability. The following specific rules apply when handling hydrogen:

- Never use cylinders of hydrogen in areas where flames, excessive heat, or sparks may occur.
- Use only explosion-proof equipment and spark-proof tools in areas where hydrogen is handled.
- Ground all equipment and lines used with hydrogen.
- Never use a flame to detect hydrogen leaks — use soapy water.
- Do not store reserve stocks of hydrogen with cylinders containing oxygen or other highly oxidizing or combustible materials.
- Store hydrogen tanks in a well ventilated area.
- Follow all regulatory safety and labeling precautions when shipping hydrogen in the TVA2020.

Note A bleeder assembly is provided in the tool kit to allow the hydrogen tank to be emptied for common carrier shipment. To use the bleeder, manually screw the bleeder onto the tank valve and allow the hydrogen to vent. This process will take about two minutes to complete. ▲



CAUTION Observe all hydrogen handling procedures listed below. ▲

Note When transporting the instrument, remove the hydrogen tank and place it in its normal location in the carrying case. ▲

Fuel Refilling Procedure

Use the following procedure to refill the hydrogen tank.

Note All hydrogen fittings are left hand thread — **do not overtighten.** ▲

1. Turn supply tank valve OFF.
2. Attach tank fill adapter to supply tank with valve OFF and with manifold valve on OFF position.
3. Attach TVA2020 hydrogen tank to tank fill adapter. (Note left hand thread — **do not overtighten.**)
4. Open supply tank valve. Move fill adapter valve to FILL position.
5. Wait for TVA2020 tank to fill. This may take 2 to 3 minutes because of flow restrictors in the tank and fill adapter.
6. Close fill adapter valve.
7. Remove TVA2020 tank.
8. Close supply tank valve.
9. Remove tank fill adapter.

Always remove the tank from the instrument before storing in the instrument carrying case.

Cleaning an FID Cartridge

Use the following procedure to remove and clean the FID cartridge frequently (Figure 5–1). Replace when needed.

1. Remove the hydrogen tank. Turn the instrument off.
2. Using the special spanner wrench provided with the instrument tool kit, unscrew the black cap holding the FID cartridge in place.

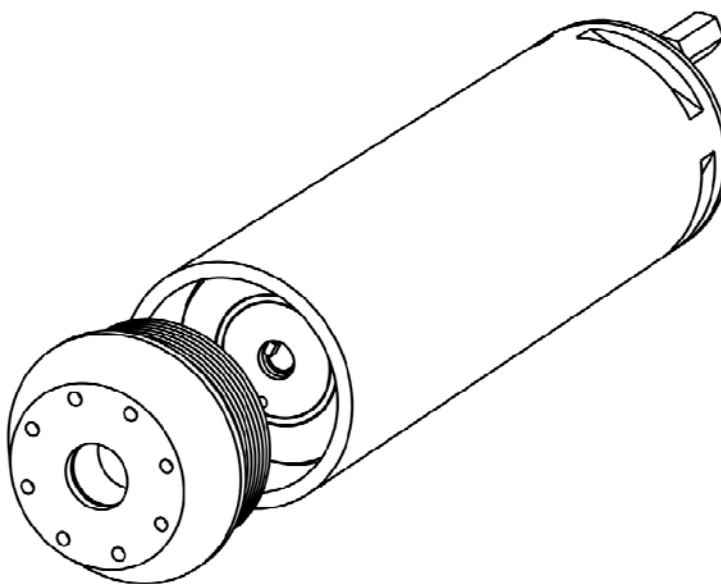


Figure 5–1. Replacing the FID Cartridge

3. Screw the special extractor tool provided with the accessory kit into the off-center hole in the cartridge (Figure 5–2).
4. Remove the cartridge by pulling on the extractor. Unscrew the extractor from the cartridge. Clean or replace the cartridge.
5. To insert a new cartridge, reverse the procedure.

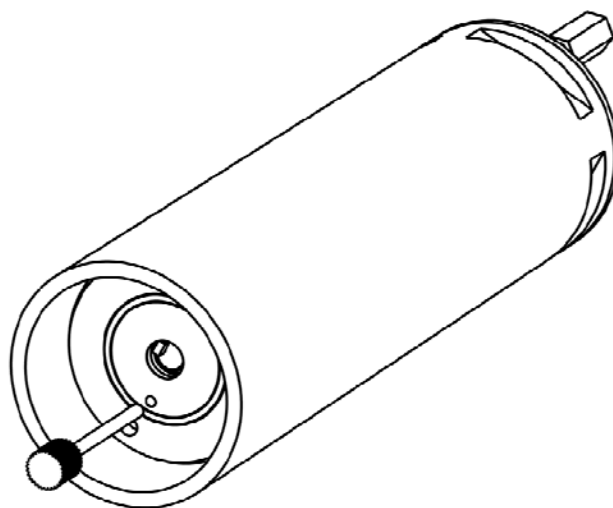


Figure 5–2. Removing the FID Cartridge

To clean an FID cartridge, you will need a cotton swab and some isopropyl alcohol. Dip the swab into the isopropyl alcohol and insert it into the center of the cartridge. Swab the surface until clean and discard the swab. Take care not to touch the igniter coil, which is located close to the end of the capsule opposite the threaded hole used to remove capsule. Then dry the cartridge in an oven at 45 °C to 55 °C for one hour. When dry, reinsert the cartridge into the instrument, reversing the removal procedure. **Do not overtighten cap.**



CAUTION Do not allow any contact with the igniter coil during cleaning. ▲

Cleaning the FID Detector Cap

Use the following procedure to clean the FID detector end cap (Figure 5–3).

1. Remove the hydrogen tank from the top of the instrument and turn off the power.
2. Using the special spanner wrench provided with the tool kit, unscrew and remove the FID detector cap.
3. Clean the cap using the isopropyl alcohol followed with a de-ionized or distilled water rinse. Blow out carefully with compressed dry air.
4. Replace the cap.

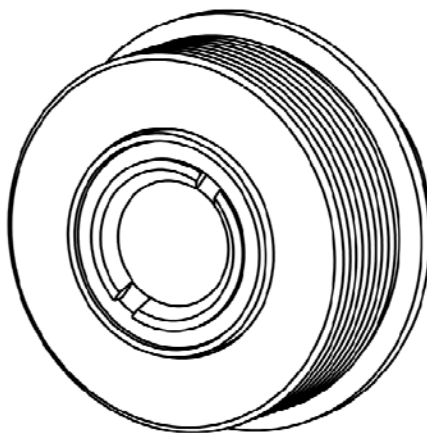


Figure 5–3. Cleaning the FID Detector Cap

Cleaning the FID Detector Cavities

Use the following procedure to clean the FID detector cavity.

1. Remove the hydrogen tank from the top of the instrument. Turn the instrument off.
2. Using the special spanner wrench provided with the tool kit, unscrew the cap holding the detector cap.
3. Using the special extractor tool provided with the tool kit, screw the extractor into the cartridge.
4. Remove the cartridge by pulling on the extractor. Unscrew the extractor from the cartridge.
5. Carefully clean the inside of the detector cavity using a cotton swab and isopropyl alcohol. Be sure to clean the high voltage contacts along the side of the cavity. Be especially careful around the detector signal collector probe at the rear of the cavity (and the thermocouple probe in the FID).
6. Dry the inside of the cavity using a low heat gun.
7. Insert the cartridges into their respective cavities by reversing the procedure. Note that the cartridges must be rotated to properly locate the key tabs.

Replacing Water Trap Probe Filter and O-Rings

Use the following procedure to replace the water trap probe filter (Figure 5-4).

1. Unscrew the bottom housing from the top housing.
2. Remove filter.
3. Place new filter into cavity of top housing.
4. Filter can be inserted in either direction into top housing.
5. Screw bottom housing into top housing.

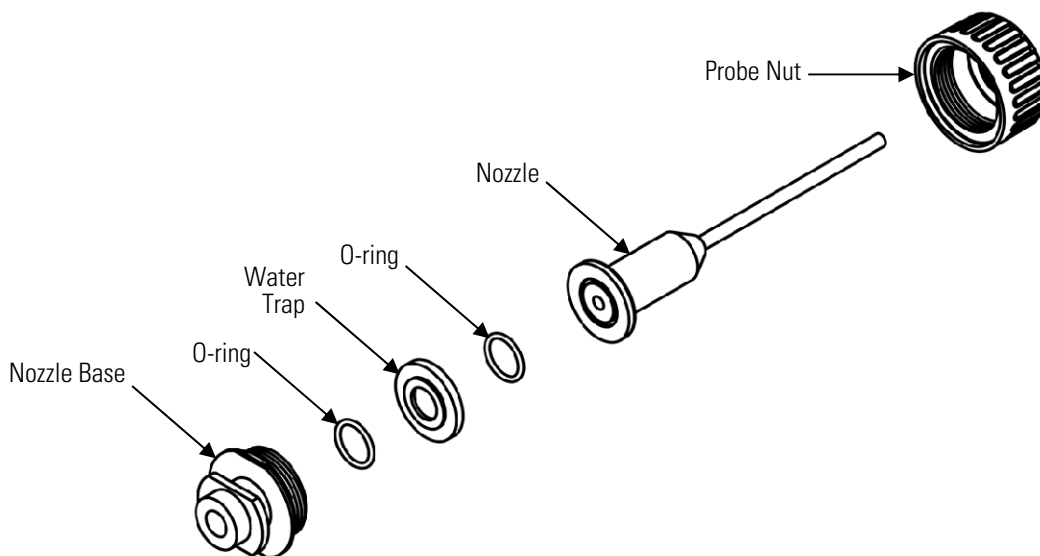


Figure 5-4. Water Trap Probe Assembly – Filter and O-Ring Replacing

Replacing the O-Rings

Use the following procedure to replace the o-rings (Figure 5–5).

1. Unscrew the bottom housing from the top housing.
2. Remove filter.
3. Remove o-ring from either top housing groove or bottom housing groove or both as necessary.
4. Place new o-ring in groove of housing. Make sure o-ring is seated properly in groove.
5. Repeat for other housing if necessary.
6. Place filter into top housing.
7. Screw bottom housing into top housing.

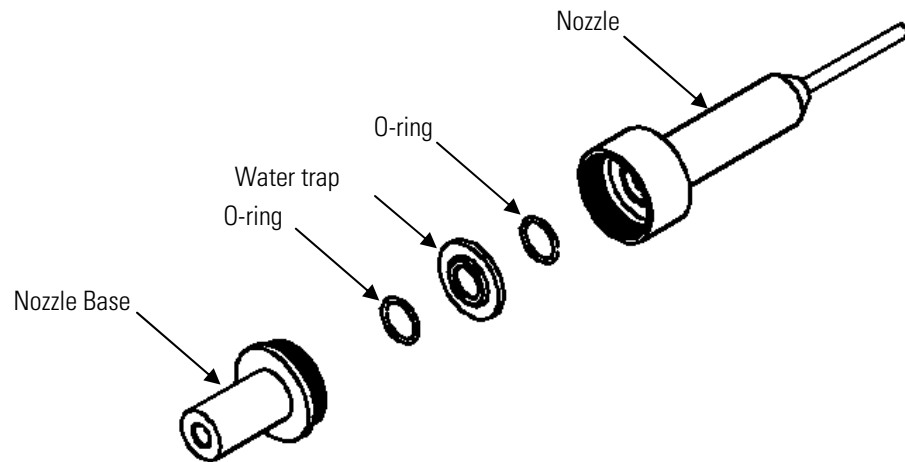


Figure 5–5. Water Trap Probe Assembly – Filter and O-Ring Replacing

Cleaning or Replacing a Sintered Metal Filter Cup

The filter cup is located behind the sample line quick connect at the sidepack assembly. To remove, unscrew the quick connect to expose the filter (Figure 5–6). Pull the filter cup from behind the fitting and replace and clean as noted below.

You may clean the filter by immersing it in isopropyl alcohol or equivalent solvent and/or swabbing the surface with a Q-tip or cotton swab. After thoroughly cleaning the surface of the filter, place the filter in an oven and dry it at 40 °C to 55 °C for one hour. You can then re-insert the filter into the sampling assembly and screw in the cap.

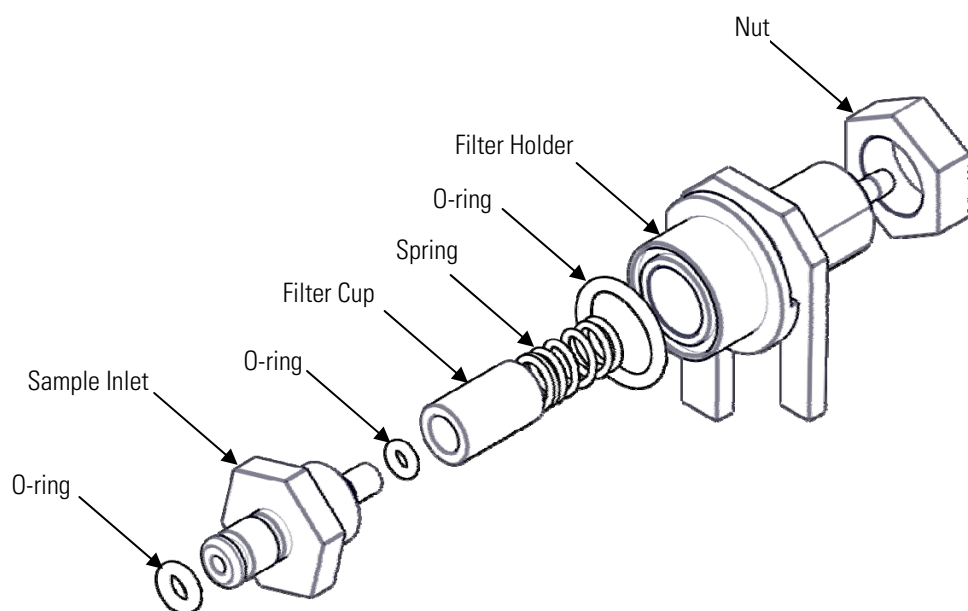


Figure 5–6. Sintered Metal Filter – Cleaning or Replacing

Replacing the Charcoal Filter

Use the following procedure to replace the optional charcoal filter.

1. Remove the sampling assembly from the probe by loosening the probe nut and pulling the sampling assembly free from the probe.
2. Unscrew the cap from the sampling assembly. This will expose the end of the charcoal filter cartridge (Figure 5–7).
3. Tip the cartridge up and empty the charcoal from the cartridge.
4. Clean the inside of the cartridge with a cotton swab dipped in isopropyl alcohol.
5. Dry the cartridge thoroughly.
6. Re-fill the cartridge with new “dust-free” charcoal of the type specified for the filter.
7. Apply PTFE tape to the male threads of the charcoal cartridge and screw on the cap.
8. Re-insert the sampling assembly into the probe and tighten the probe nut.

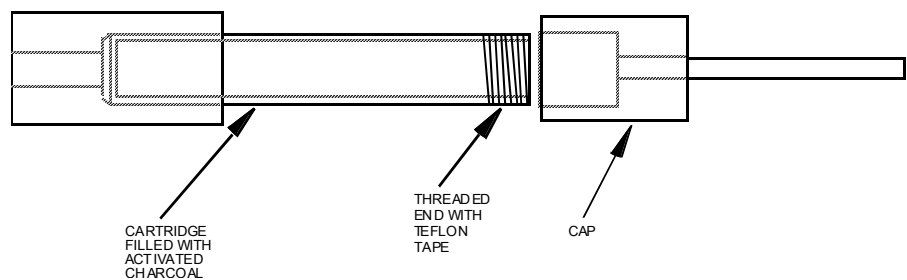


Figure 5–7. Activated Charcoal Filter Adapter

Chapter 6

Troubleshooting

This chapter provides the following troubleshooting and service support information:

- [“Troubleshooting Guide”](#) on page 6-2
- [“Warning Messages”](#) on page 6-6
- [“Service Locations”](#) on page 6-7

Troubleshooting Guide

Table 6–1 provides general troubleshooting information and indicates the checks that you should perform if you experience an instrument problem.

Table 6–1. Troubleshooting

Problem	Possible Reason	Solution/Action
Unit will not turn on	Battery charge low	Charge battery.
	Bad battery connection	Ensure proper battery connection.
	Bad battery	Replace battery.
	Blown fuse or faulty keypad	Call Thermo Fisher Scientific Service Department.
Pump won't turn on	Defective pump	Call Thermo Fisher Scientific Service Department.
	Faulty keypad	Call Thermo Fisher Scientific Service Department.
Low pump flow	Clogged sample intake	Clean/replace filter cups.
		Clean/replace sample line.
	Pump fault	Clean/replace flame arrestor.
		Service pump.
	Call Thermo Fisher Scientific Service Department.	
Keypad will not respond	Faulty keypad	Call Thermo Fisher Scientific Service Department.
Probe display blank or probe buttons will not respond	Faulty probe/display assembly	Replace probe/display assembly.
		Call Thermo Fisher Scientific Service Department.
FID won't ignite	Insufficient sample flow	Turn pump on.
		Clean/replace filter cups.
		Clean/replace flame arrestor.
	Insufficient hydrogen supply (<500 psi)	Service pump.
		Check hydrogen gauge on supply tank. Refill tank if necessary.
Hydrogen leak	Check low pressure hydrogen output gauge. If <8 psi, call Thermo Fisher Scientific Service Department.	

Problem	Possible Reason	Solution/Action
	Broken ignitor	Inspect ignitor coil on FID capsule for breakage. If broken, replace capsule.
	Dirty ignitor contacts	Inspect/clean ignitor contacts (not ignitor coils).
	Battery charge low	Charge battery pack.
FID noisy	Water/contamination in the detector chamber	Clean/replace FID capsule and flame detector.
	Erratic pump flow	Clean/replace cups. Clean/replace flame arrestor. Service pump.
	Bad calibration	Ensure proper calibration.
Unable to calibrate FID	FID flame out	Ignite FID.
	Span concentration not properly set	Input correct span gas concentration at CAL menu.
	Cal gases contaminated	Use clean cal gases and sampling equipment.
	Sample line/filter cups contaminated	Clean/replace sample line. Clean/replace filter cups. Service pump.
	FID capsule contaminated or faulty	Clean/replace FID capsule.
	Contaminated hydrogen tank	Replace hydrogen tank.
Excessive hydrogen consumption (<8 hours of run time for 2200 psi hydrogen)	Insufficient hydrogen pressure	Refill tank.
	Leaking hydrogen tank	Replace tank.
	Internal hydrogen leak	Call Thermo Fisher Scientific Service Department.
Flameout problems	Sample hydrogen content too high	Use dilutor kit to achieve concentration within the dynamic range.
	Insufficient oxygen in the sample (<14%)	Use dilutor kit to dilute sample with air contaminating sufficient oxygen.

Problem	Possible Reason	Solution/Action
		Use PID for measurements.
	FID capsule contamination	Clean/replace FID capsule.
	Insufficient sample flow (min 800 ml/min)	Clean/replace filter cups.
		Clean/replace flame arrestor.
		Service pump.
Moisture at FID flame arrestor.	Insufficient sample flow (min 800 ml/min)	Clean/replace filter cups.
		Clean/replace flame arrestor.
		Service pump.
	Insufficient warmup time	Allow 15-20 minutes warmup.
PID lamp not operating	Bad PID lamp	Replace PID capsule.
PID noisy	Bad PID lamp	Replace PID capsule.
	Dirty PID window	Clean PID window.
	Erratic pump flow	Clean/replace FID capsule.
		Clean/replace filter cups.
		Service pump.
	Bad calibration	Ensure proper calibration.
Unable to calibrate PID	Pump not on	Turn pump on.
	PID lamp not on	Turn PID lamp on.
	Span concentration not properly set	Input correct span gas concentration at CAL menu.
	Cal gas contaminated	Use clean cal gases and sampling equipment.
	Sample line/filter cups contaminated	Clean/replace sample line.
		Clean/replace filter cups.
	PID window dirty or capsule contaminated or faulty	Clean PID window.
		Replace PID capsule.
	Internal detector fault or contamination	Call Thermo Fisher Scientific Service Department.
Slow response time	Insufficient sample flow	Clean/replace filter cups.
		Clean/replace flame arrestor.
		Clean/replace sample line.

Problem	Possible Reason	Solution/Action
		Service pump.
	Sampling non-volatile compounds	Call Thermo Fisher Scientific Service Department.
High background readings	High ambient concentration	N/A.
	Zero drift/improper calibration	Ensure proper zero/span calibration.
	Sample line contamination	Clean/replace sample line.
		Clean/replace filter cups.
	Detector capsule contamination	Clean/replace FID capsule.
		Clean PID window.
		Replace PID capsule.

Warning Messages

The following is a list of error and warning messages for the TVA2020.

Table 6–2. Warning Messages

Message	Description
Battery Power is low.	This display occurs whenever the battery has reached a low level (approximately 6.5 V). It indicates that approximately 15 minutes of operating time remain. Press EXIT to return to the operating display. The lower right corner of all displays now show ± (blinking). If you continue to operate after the warning is displayed, the unit will eventually shut off automatically. To restart after an auto shut down, you must first recharge or replace the battery. Note that collected data is not lost
Logger memory is already full.	Log memory is full. You cannot continue to log any entries until you have transferred the log memory to a PC or have cleared log memory. The instrument will, however, continue to operate.
FID Flameout! Ignite again.	This display appears whenever the FID flame is extinguished. Press EXIT to clear, then CONTROL key and 2 to ignite. This warning is active only in RUN and CALIBRATE modes. In the RUN mode, once the alarm is acknowledged, a flashing F appears on the sidepack display and the probe display flashes.
Low Flow detected.	This message will follow the FID Flameout message if a low flow condition was measured prior to the flameout.
High Concentration detected.	This message will follow the FID Flameout message if the instrument sees a spike in the concentration prior to a flameout condition.
Log rate too slow for PC STEL calc.	This message appears whenever you enter a log rate value greater than 90 seconds. The data sampling rate is too low for valid STEL calculations in the PC. Press EXIT to bypass the warning.
Log rate invalid!	This message appears whenever you enter a log rate of zero. To correct the problem, enter a log rate other than zero.
Entry is invalid!	This message appears whenever you enter a value equal to zero (except for alarm levels). To correct the problem, enter numbers other than zero.
Bad Calibration parameters!	This warning display appears during calibration if the current zero calibration value equals or exceeds the span calibration value. To correct the problem, perform a re-zero, a re-span, or both.
Hardware Failure.	This message appears as a result of a self-test failure. Return the instrument to the factory for service.

Message	Description
FID not operating.	Displays when the instrument detects a problem with the FID module. Most common cause is the FID is not plugged into the main board.
Measurement range exceeded.	This message appears if the PID reading exceeds 2,000 ppm or the FID reading exceeds 30,000 ppm.

Service Locations

Service is available from exclusive distributors worldwide. Contact one of the phone numbers below for product support and technical information or visit us on the web at www.thermoscientific.com/aqi.

1-866-282-0430 Toll Free

1-508-520-0430 International

Chapter 7

Servicing

This chapter includes the following parts information and component replacement procedures.

Thermo Fisher Scientific suggests that you return the entire instrument to the factory or an authorized service center once a year for cleaning, testing, and calibration.

From time to time, you must remove and renew several components of the TVA2020 analyzer. Some components may be replaced as normal maintenance functions performed by operating personnel. Other components, however, should be replaced only by personnel thoroughly trained and familiar with the analyzer instrument and its applications.

This chapter includes the following parts information and component replacement procedures:

- [“Replacement Parts List”](#) on page 7-2
- [“Replacing the Battery”](#) on page 7-6
- [“Hydrogen Gas Tank”](#) on page 7-6
- [“Cleaning the PID Lamp”](#) on page 7-9
- [“Replacing the FID End Cap”](#) on page 7-14
- [“Flow Tests”](#) on page 7-14
- [“Leak Check”](#) on page 7-16
- [“Flow Check”](#) on page 7-17
- [“Flow Calibration”](#) on page 7-17
- [“Servicing the Pump”](#) on page 7-19
- [“Replacing the Sample Line in Enhanced Probe”](#) on page 7-23
- [“Replacing Sample Line in Sample Probe”](#) on page 7-25
- [“Replacing the Connector Access Door”](#) on page 7-26
- [“Replacing the Internal Battery Charger Connector Cable”](#) on page 7-28
- [“Replacing the Internal Probe Connector Cable”](#) on page 7-28

Replacement Parts List

Table 7–1 lists the replacement parts for the TVA2020 major subassemblies. Refer to Figure 7–1 to identify the component location.

Table 7–1. TVA2020 Replacement Parts

Part Number	Description
56-011811	Battery Pack
114012-00	Hydrogen Tank
CR012WJ	Hydrogen Refill Assembly
111256-00	PID Capsule
114971-00	PID Maintenance Kit
111177-00	FID Capsule
111420-00	FID End Cap (FM)
620090	Filter Cups / 5 pk
56-011950	Enhanced Probe (complete assembly)
510033-1	Split Ferrule – Probe (for enhanced probe)
CR012EG	Probe Buttons (for enhanced probe)
CR015AC	Water Trap Probe (for enhanced probe)
CR012EK	Probe Nut (for enhanced probe)
55-011879	Sample Probe (complete assembly)
34-011877-0001	Straight Tip
34-011877-0002	Angled Tip
34-011878	Probe Nut
CR015DK	Water Trap Filter / pk 10 (both probes)
112387-00	Sample Line Tubing 80" (both probes)
112415-00	Sample Line Fitting (both Probes)
CR012YH	Sample Inlet Connection
B0164KB	Sample Side Tubing (12" section of TPE lined Tygon tubing)
111246-00	Pump Assembly
113305-00	O-Ring Kit
113306-00	Hardware Kit
113413-00	Pump Rebuild Kit
111401-00	Battery Charger
112461-00	Sidepack Display
111409-00	Sidepack Probe Connection

Part Number	Description
111328-00	Sidepack Charger Connection
34-011690-0060	Rubber Connector Door
34-011690-0030	Internal Frame (goes over battery and H2 cylinder)
111782-00	Strap Rods
112694-00	Tool Kit (parts indicated by an asterisk [*] below)
CR012PT	Spanner Wrench (*part of tool kit)
112697-00	Capsule Extraction Tool (*part of tool kit)
112696-00	Flow Restrictors (*part of tool kit)
CR012TA	Hydrogen Bleeder (*part of tool kit)
105639-00	USB Cable
114295-00	USB Barrier Device
112693-00	Charger Cable
N0249XS	Charger Line Cord (120V)
8926	Charger Line Cord (220V)
107315-00	Charger Line Cord (230V – China)
112451-00	Carrying Case
CR012DY	Carrying Strap



WARNING Power down the instrument before performing any service procedures. ▲



WARNING Parts replacement and maintenance should not be performed in areas classified as hazardous due to presence of flammable gases or vapors. Use only Thermo Fisher Scientific replacement parts. (Extended Service Plans are available; contact Thermo Fisher Scientific Department for further information.) ▲



WARNING Never change an electrical component in an area classified as hazardous due to presence of flammable gases or vapors. ▲

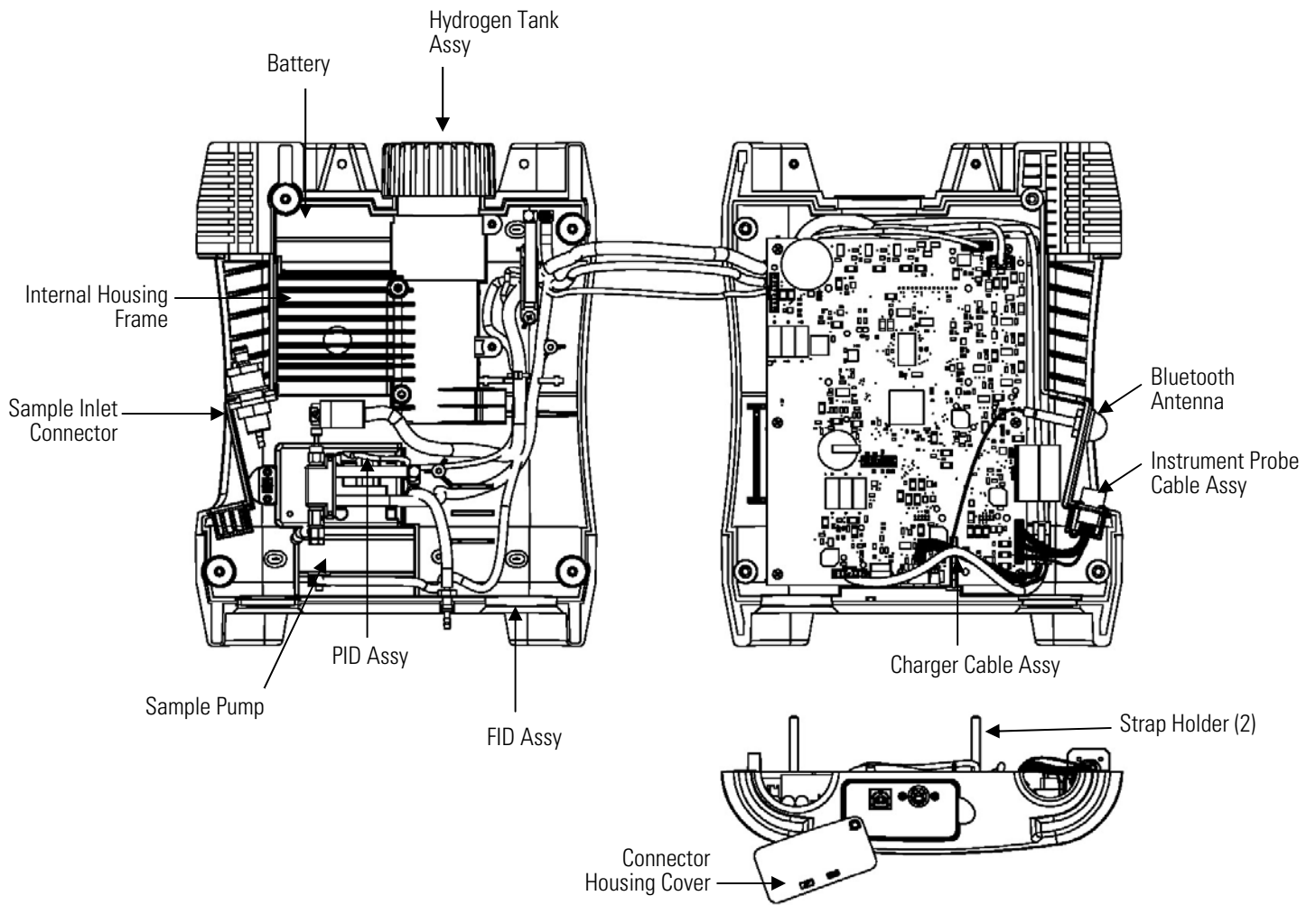


Figure 7-1. TVA200 Component Layout

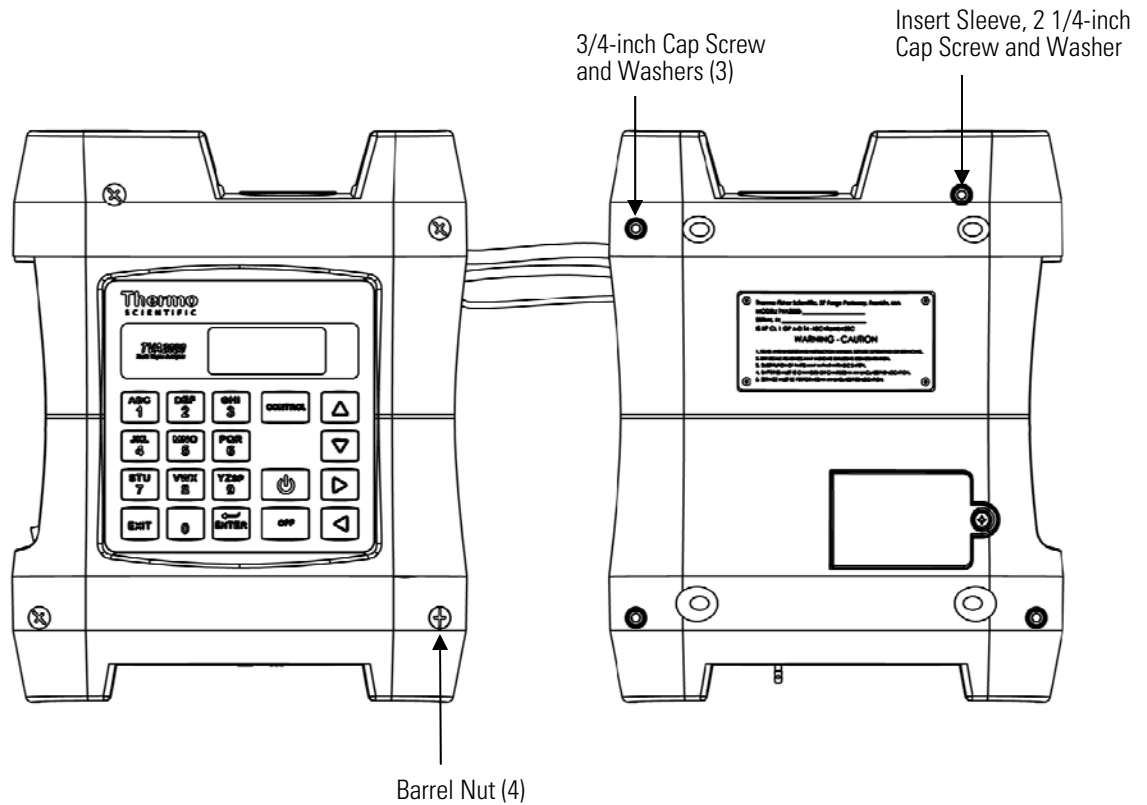


Figure 7-2. Hardware

Opening the Instrument

Use the following procedure to gain access to the internal components.

1. Stand the instrument on end. While holding the barrel nut loosen the socket head screws.
2. Remove the four 10-24 screws to be reused later. Note that one of the screws is much larger than the other three.
3. Position the instrument resting on its back with the keypad facing up.
4. Grasp the instrument cover near the probe connections and carefully open the cover to the right.

Replacing the Battery

Use the following procedure to replace the battery.



WARNING Do not replace battery in an area classified as hazardous due to presence of flammable gases or vapors. ▲



WARNING Do not operate battery charger in an area classified as hazardous due to presence of flammable gases or vapors. ▲



WARNING Remove the hydrogen tank from the instrument before servicing. ▲

1. Identify the four self-tapping screws securing the internal frame to the bottom enclosure.
2. Remove the four screws. Save for reuse.
3. Unscrew the two captive screws securing the d-sub connector to the battery.
4. Remove and replace the battery. Reverse the above procedure for reassembly.

Hydrogen Gas Tank

FID instruments are supplied with an 85 cc hydrogen gas tank. This tank, which may be pressurized to 2200 psi maximum at 25°C, will provide 10 hours operation when fully charged. The tank has an integrally mounted high pressure gauge that can be easily read when the tank is in or out of the instrument. Install the tank in the instrument by inserting it into the receptacle on the top and tightening (left hand threads tighten counterclockwise) until the rubber tank boot is flush with the instrument sidepack and a slight resistance is felt. **Do not overtighten.**

Precautions in Handling and Storage

The major hazard associated with the handling of hydrogen is flammability. The following specific rules apply when handling hydrogen:

- Never use cylinders of hydrogen in areas where flames, excessive heat, or sparks may occur.
- Use only explosion-proof equipment and spark-proof tools in areas where hydrogen is handled.
- Ground all equipment and lines used with hydrogen.
- Never use a flame to detect hydrogen leaks — use soapy water.
- Do not store reserve stocks of hydrogen with cylinders containing oxygen or other highly oxidizing or combustible materials.
- Store hydrogen tanks in a well ventilated area.
- Follow all regulatory safety and labeling precautions when shipping hydrogen in the TVA2020.

Note A bleeder assembly is provided in the tool kit to allow the hydrogen tank to be emptied for common carrier shipment. To use the bleeder, manually screw the bleeder onto the tank valve and allow the hydrogen to vent. This process will take about two minutes to complete. ▲



CAUTION Observe all hydrogen handling procedures listed above. ▲

When transporting the instrument, remove the hydrogen tank and place it in its normal location in the carrying case.

Fuel Refilling Procedure



Use the following procedure to fill the tank.

WARNING A safe refill operation means there are no hydrogen leaks. Before any valves are opened, use a wrench to firmly tighten connections to the hydrogen supply tanks and the tank fill adapter. If escaping hydrogen is heard during the filling operation, close all valves and correct the leak before proceeding. Leak test with soapy water or equivalent. ▲



CAUTION Do not fill hydrogen tank to a pressure greater than 15.2 MPa (2200 psig). ▲

Note Use prepurified ZERO grade hydrogen (certified total hydrocarbons as methane <0.5 ppm recommended). ▲

Note The hydrogen filling assembly contains a flow-limiting safety device. Approximately two minutes are required to fill the tank. ▲

Note All hydrogen fittings are left hand thread — **do not overtighten.** ▲

1. Turn supply tank valve OFF.
2. Attach tank fill adapter to supply tank with valve OFF and with manifold valve on OFF position.
3. Attach TVA2020 hydrogen tank to tank fill adapter. (Note left hand thread — **do not overtighten.**)
4. Open supply tank valve. Move fill adapter valve to FILL position.
5. Wait for TVA2020 tank to fill. This may take 2 to 3 minutes because of flow restrictors in the tank and fill adapter.
6. Close fill adapter valve.
7. Remove TVA2020 tank.
8. Close supply tank valve.
9. Remove tank fill adapter.

Always remove the tank from the instrument before storing in the instrument carrying case.

Cleaning the PID Lamp

Use the following procedure to remove and clean the PID lamp. Replace when needed.



WARNING Power down the instrument before performing any service procedures. ▲



WARNING To prevent a potential explosion, do not operate the instrument with the PID compartment open or FID detector cap removed. ▲



WARNING All maintenance procedures must be performed on a clean surface using clean tools. Avoid touching the lamp's window as well as the metalized portion of the cell assembly with your bare fingers. Fingerprints left on these parts may adversely affect the sensors operation. Latex gloves are preferred, but if they are not used, your hands must be clean and free of oils, lotions, etc. It is acceptable to hold the lamp by its glass body or by the edges of the window. ▲

1. Turn the instrument OFF and remove the sensor from the instrument (Figure 7-3).

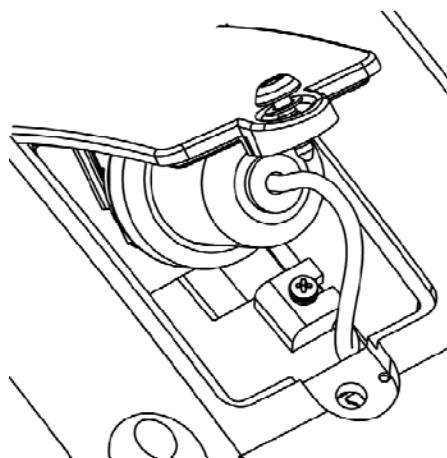


Figure 7-3. Removing the PID Sensor

2. Remove the filter cap by applying slight upward pressure with the tip of a screwdriver or X-Acto blade just below the hole in the cap and between the cap and housing; it will pop off (Figure 7-4).



Figure 7-4. Removing the Filter Cap

3. With fine-tipped tweezers, remove both filter media and set aside (Figure 7-5).



Figure 7-5. Removing the Filter Media

4. Using the X-Acto blade, remove the spacer and set aside (Figure 7-6).



Figure 7-6. Removing the Spacer

5. With fine tipped tweezers, carefully remove the cell assembly by prying under the cell's edge where connector pins are located (Figure 7-7).



Figure 7-7. Removing the Cell Assembly

6. With fine tipped tweezers, grasp the lamp by placing the tips in the housing notch and gently pull it out. Be careful not to scratch the lamp lens or chip edges (Figure 7-8).



Figure 7-8. Removing the PID Lamp

7. Grab the lamp by the cylindrical glass body and clean the window by rubbing it against the polishing pad. Use a circular motion and try to keep the window surface flat relative to the pad. Five seconds of rubbing will be enough in most cases. Another indication of cleaning completeness is that you have used about 1/6-inch of the pads surface during the procedure (Figure 7-9).

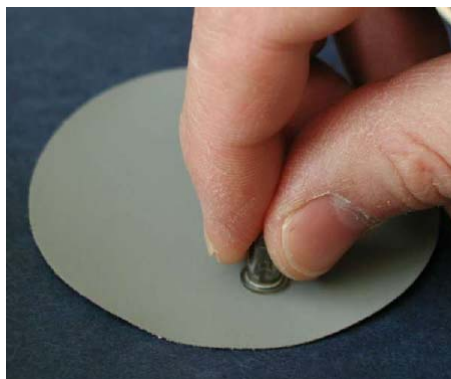


Figure 7-9. Cleaning the PID Lamp

Servicing

Cleaning the PID Lamp

8. To reassembly, install the lamp into the sensor, making sure that the lamps metalized pads are aligned with the corresponding excitation springs inside the lamp cavity (Figure 7–10).



Figure 7–10. Installing the Lamp into the Sensor

9. With the end of the clean tweezers, or the clean blade of a screwdriver, press down firmly. Be careful not to scratch the surface of the lamp (Figure 7–11).



Figure 7–11. Pressing Down the PID Lamp

10. Using fine-tipped tweezers, install the cell assembly. Align the pins with the corresponding sockets on the sensor and push down on the end with the pins. Make sure the cell assembly is flush with the lamp window (Figure 7–12).



Figure 7–12. Installing the Cell Assembly

11. Place the spacer around the cell assembly (Figure 7-13).



Figure 7-13. Placing the Spacer

12. Place the filter media over the cell assembly centered on top of the sensor. Make sure the filters are installed in the correct order. Filter media #2 first, then filter media #1 on top, with the shiny side up (Figure 7-14).



Figure 7-14. Placing the Filter Media

13. Align the cap key with the notch on the housing. Starting at the side opposite the notch, press down until the filter cap snaps on to the housing. If the cap key is incorrectly aligned, there will be a noticeable bulge on the side of the cap (Figure 7-15).



Figure 7-15. Aligning the Cap Key

Replacing the FID End Cap

The flame arrestor, located in the center of the FID end cap, is a critical safety feature to prevent flame propagation into a potentially hazardous area. It has been precision fit into the end cap and must be replaced as an assembly.

1. Remove the hydrogen tank from the top of the instrument and turn off the power.
2. Using the special spanner wrench provided with the tool kit, unscrew and remove the FID detector cap.
3. Replace the end cap as a full assembly.

Flow Tests

Most flow problems can be traced to a loose connection or dirty filters. Based on that premise this section is organized from the least to the most invasive repair procedures. Reference the Sample Flow Troubleshooting Flowchart (Figure 7-16) to diagnose flow problems. Start with the Leak Check procedure with the probe connected to the instrument. The leak and flow check procedures can be performed on the sub assemblies to identify the source of the problem.

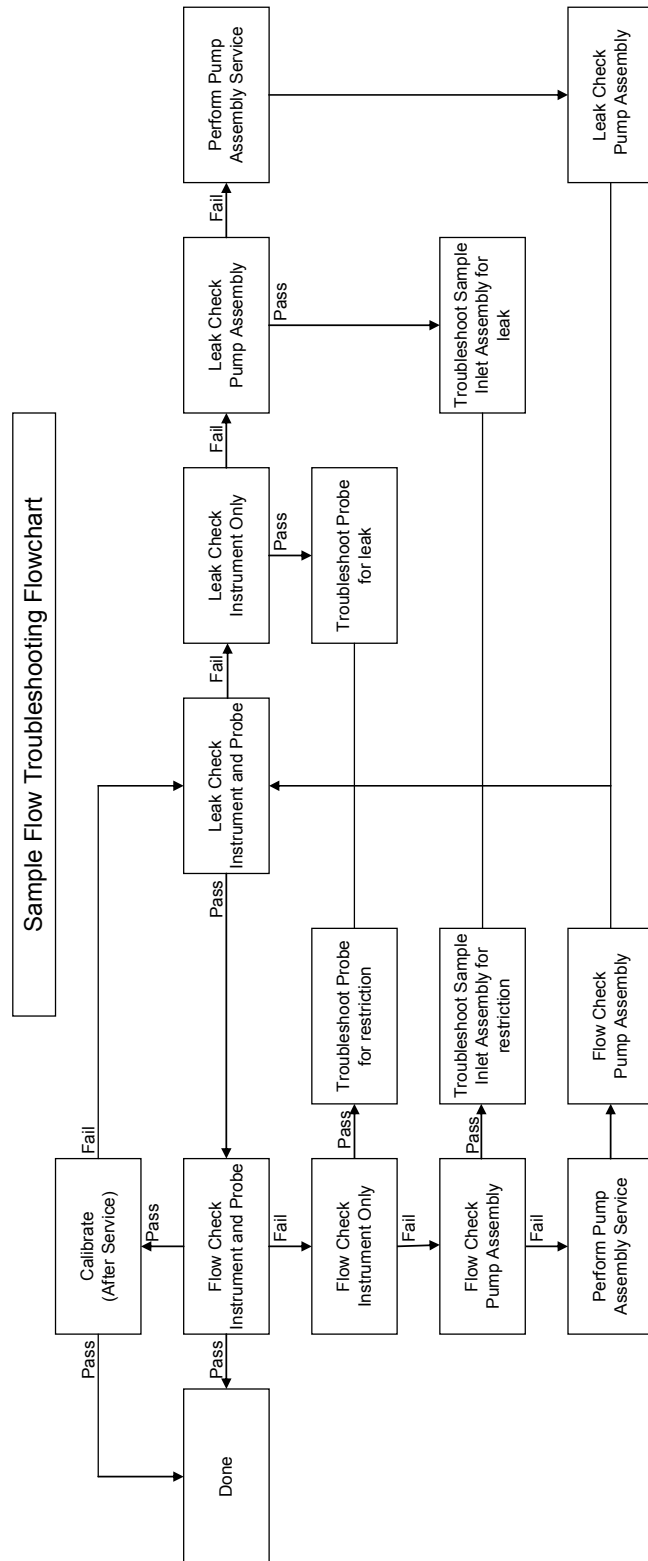


Figure 7-16. Sample Flow Troubleshooting Flowchart

Leak Check

Use the following procedure to verify no leaks.

1. Attach a flow meter capable of reading at least 2 LPM to the probe inlet.
2. From the SETUP MENU, choose 1=Calib > **5=Flow**.
3. Press “**1**” for the first flow calibration point.
4. Adjust the pump power with the up and down arrows for a reading of 1 LPM at the probe inlet.
5. From the CONTROL MENU, press **1=Pump Off**.
6. Record the counts associated with the pump off.
7. From the CONTROL MENU, press **1=Pump On**.
8. Plug the inlet of the probe. The counts should drop to within ± 200 of the “Pump Off” recorded value.

Flow Check

Use the following procedure to check flow.

1. Attach a flow meter capable of reading a least 2 LPM to the probe inlet.
2. Place the instrument in the RUN mode. From the MAIN MENU, press **1=Run**.

Note The dynamic flow control is only active in the Run, Span or Zero modes. ▲

3. The flow should read between 1.050 LPM and 0.950 LPM.
4. Attach one of the red flow restrictors between the flow meter and the probe inlet. The flow should drop to 0.80 to 0.85 LPM and slowly climb to 1.05 to 0.950 LPM within 1-2 minutes.
5. Attach a second flow restrictor in line with the first between the flow meter and the probe inlet. The flow should drop to 0.80 to 0.85 LPM and slowly climb to 1.05 to 0.950 LPM within 1-2 minutes.

Note If the pump has been serviced the actual flows may be different than above. In this case a flow calibration should be performed. ▲

Flow Calibration

Use the following procedure to perform a flow calibration.

1. Confirm that the instrument passes the [Leak Check](#) on page 7-16 prior to performing this calibration. A new water trap filter and a new or clean sintered metal filter should be installed prior to performing this calibration.
2. From the SETUP MENU, choose 1=Calib > **5=Flow**.
3. Establish the 1 ±.01 LPM flow at the probe inlet.
 - a. Typical values are 50-60% power with 28K-30K counts.
4. Press **Enter=Accept** to save the Flow 1 values.

5. Attach one of the red flow restrictors between the probe inlet and the flow meter.
6. Press “**2**” for the second flow calibration point.
7. Adjust the pump power with the up and down arrows for a reading of $1 \pm .01$ LPM at the probe inlet.
 - a. Typical values are 65-75% power with 1K-3K higher counts
8. Press **Enter=Accept** to save the Flow 2 values
9. Attach a second red flow restrictor, in line with the first, between the probe inlet and flow meter.
10. Press “**3**” for the third flow calibration point.
11. Adjust the pump power with the up and down arrows for a reading of $1 \pm .01$ LPM at the probe inlet.
 - a. Typical values are 85-95% power with 1K-3K higher counts.
12. Press **Enter=Accept** to save the Flow 3 values.
13. Press **4= calc coef** to calculate the flow calibration values.

Note The flow calibration values are stored in a file called FACTORY.TXT. This file can be saved to a computer and reloaded to the instrument if the flow calibration were to become corrupted. See the section on flash file transfers. ▲

Servicing the Pump

Servicing the pump involves removing the pump assembly, accessing the orifice, and replacing the pump.

Removing the Pump Assembly

Use the following procedure to remove the pump assembly.

1. Disconnect the 8 pin connector from the pump board (Figure 7-17).
2. Using the correct wrenches, remove the hex elbow attached to the valve assembly (Figure 7-17).
3. Remove the Tygon tubing from the barb fitting on the sample inlet assembly (Figure 7-17).

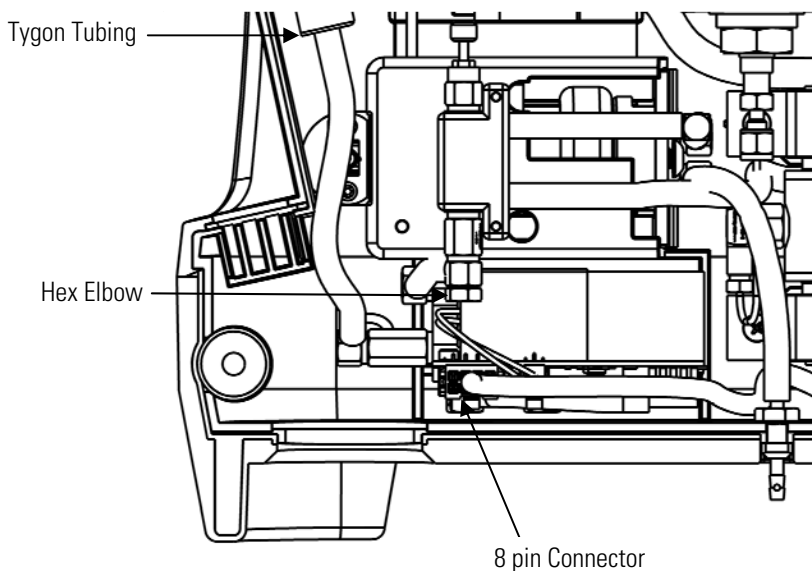


Figure 7-17. Removing the Pump

4. Lift the pump up and out of the instrument.
5. Disconnect the pump motor from the pump board.

6. Gently remove the tubing from the pressure transducer (both ports) (Figure 7–18).
7. Loosen the screw on the backside of the board (Figure 7–18).
8. Grasp the pump housing with one hand and the orifice block with the other.
9. Pull the pump/board assembly away from the orifice block assembly.

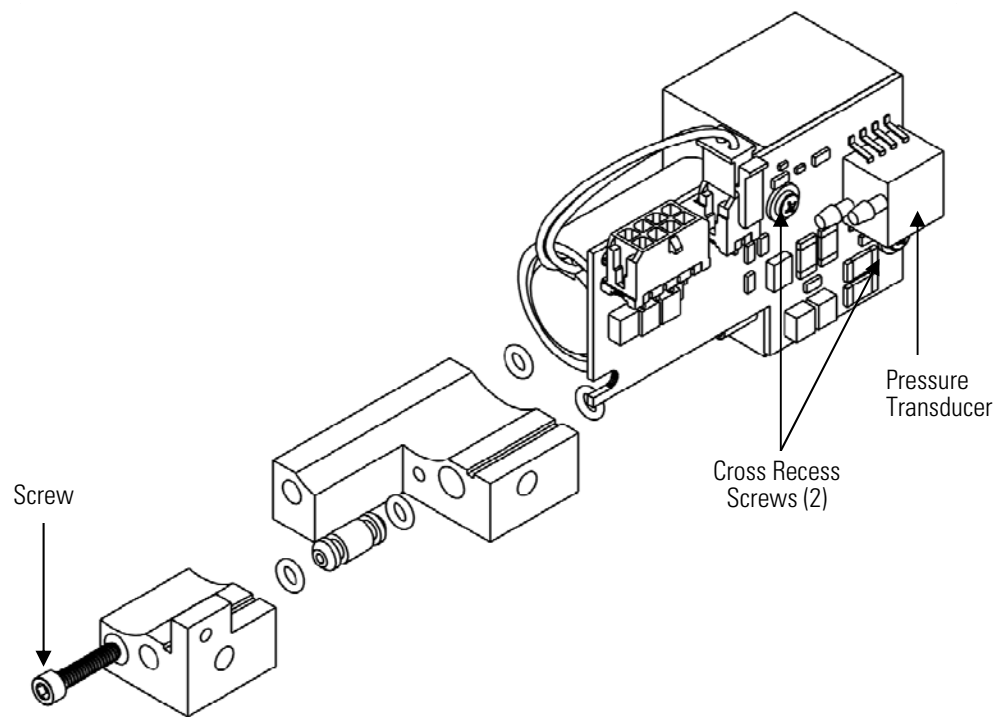


Figure 7–18. Replacing the Pump

Accessing the Orifice

Use the following procedure to access the orifice.

1. Remove the hex head screw.
2. Pull the orifice block apart.
3. Remove the orifice for cleaning.

4. Apply a very small amount of non-hydrocarbon based grease to the o-rings to facilitate reassembly.
5. Reinstall the orifice into the L-shaped block first.
6. Reverse the procedure to reassemble the pump assembly.

Note Be sure to push the pump firmly into the orifice block while tightening the cross recess screw. If the gap is too large the pump will not fit correctly in the bottom housing recess. ▲

Replacing the Pump

Use the following procedure to replace/service the pump.

1. Remove the two cross recess screws holding the board to the pump (Figure 7–18).
2. The pump can be further disassembled to replace the diaphragm and valves.
3. Reverse the above procedures to reassemble the pump assembly.

Replacing the Pump Valve

Use the following procedure to replace the pump valve.

1. Disconnect the pump from electrical power. Make a sketch of the position of any tubes and fittings for ease of re-assembly later.
2. Remove the five screws (010) with a Phillips head screw driver and remove the headplate (020). Check that all parts are free from dirt and clean as necessary. **Do not** scratch the parts.
3. Remove the old valveplate (030) from the Compressor housing (040).
4. Repeat steps 2 and 3 for opposite pump head.
5. Place the new valveplate (030) in the contour on the compressor housing (040). **Do not** use tools!

6. Install headplate (020) on to compressor housing (040)
7. Install the five new screws using a Phillips head screw driver.
8. Repeat steps 5-7 for opposite head.

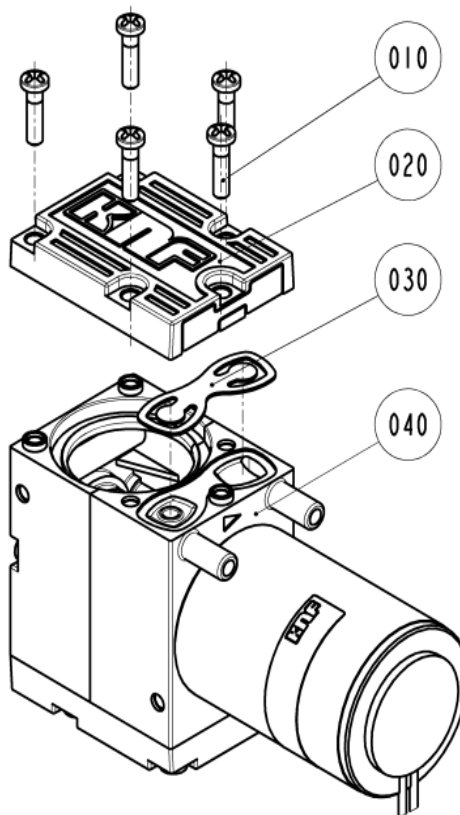


Figure 7–19. Exploded View of Pump Head

Replacing the Sample Line in Enhanced Probe

Use the following procedure to replace the sample line (Figure 7–20).

1. Loosen the probe nut and remove the sampling assembly by pulling it free from the probe assembly.
2. Insert a thin rod through the hole in the side of the probe fitting adapter. You will use this rod to pull the adapter and tubing from the probe assembly.
3. Remove the tubing from the quick-connect fitting by carefully cutting the tubing.
4. At the base of the probe handle, gently push the tubing into the probe. At the same time, use the rod to pull the probe fitting adapter and tubing forward from the probe assembly. When the adapter fitting is fully exposed, cut the tubing from the fitting and pull the remainder of the tubing back through the probe assembly until it is completely out of the probe.
5. Cut a new piece of tubing about three inches longer than the old tubing.
6. Insert new tubing through the bottom protective covering (where you connect to the analyzer), and slowly feed the tubing through toward readout handle.
7. Once the tubing exits the top protective covering, insert the new tubing into the probe handle and carefully push it through to the other end. When the tubing is in position, cut the end square and push it over the barbed adapter fitting.
8. Grasp the tubing below the probe assembly handle and pull it back through the probe assembly until the adapter fitting is properly seated in the probe assembly.
9. Cut the other end of the tubing to the proper length and insert it into the end of the quick-connect fitting. (Allow 5/8-inch of tubing inside the fitting.)

Servicing

Replacing the Sample Line in Enhanced Probe

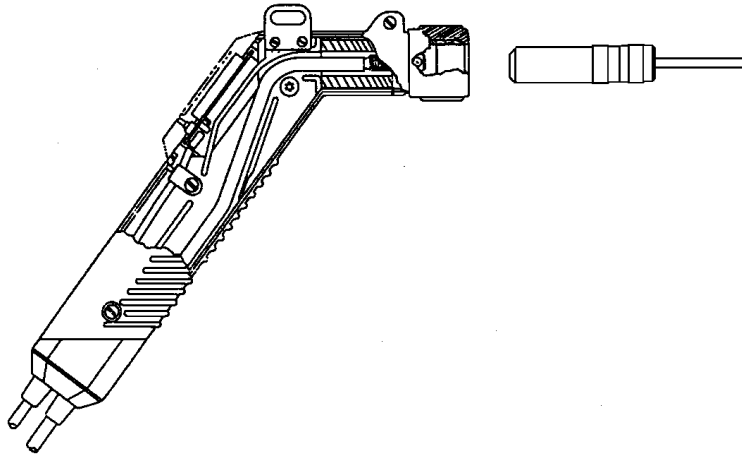


Figure 7–20. Replacing Sample Line in Enhanced Probe

Replacing Sample Line in Sample Probe

Use the following procedure to replace the sample line in sample probe (Figure 7–21).

1. Remove the three screws holding the two halves together.
2. Separate the halves to access the tubing.
3. Remove the water trap assembly.
4. Carefully cut the tubing lengthwise to free it from the barbs. Do not cut too deeply or the barbs could be damaged.
5. Attach the new tubing and return the water trap to either handle half. Make sure the tubing is routed correctly in the grooves.
6. Reinstall the three screws.

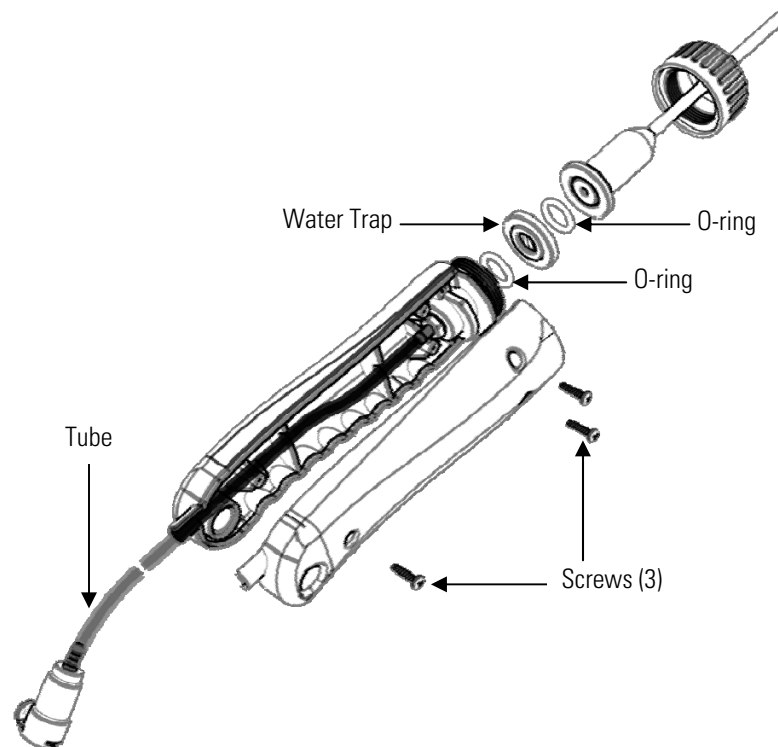


Figure 7–21. Replacing the Sample Line in Simple Probe

Replacing the Connector Access Door

Use the following procedure to replace the connector access door (Figure 7-22).

1. Cut off the retaining tail from the door if needed.
2. Tilt the case top half up so that the cut off piece slips into the gap between the board and the case.
3. Take the new door and press the retaining tail into the hole. Use a small blade screwdriver to work the tail into the hole.

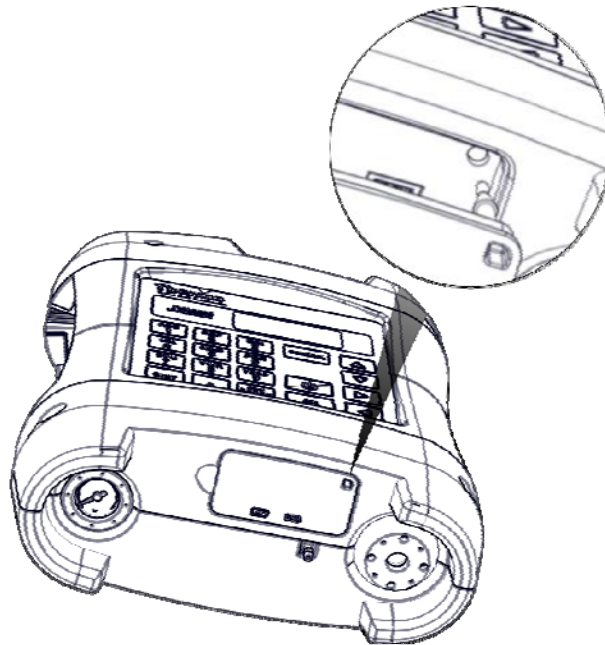


Figure 7-22. Replacing the Connector Access Door

Replacing the Internal Battery Charger Connector Cable

Use the following procedure to replace the internal battery charger connector cable (Figure 7–23).

1. Locate the battery charger connection.
2. Disconnect the charger cable from the main power cable.
3. Remove the two screws holding the connector in the housing.
4. Re-use the screws to mount the new connector cable.
5. Reconnect the main power cable to the new charger cable.

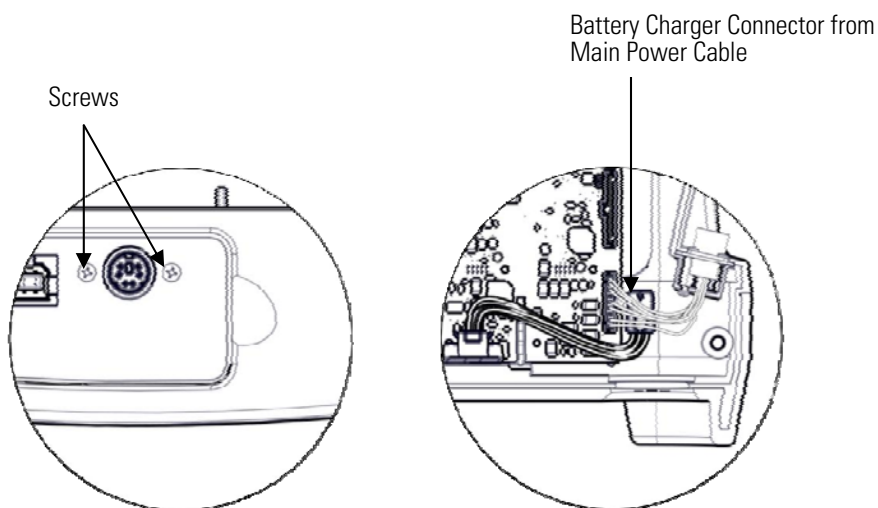


Figure 7–23. Replacing the Internal Battery Charger Connector Cable

Replacing the Internal Probe Connector Cable

Use the following procedure to replace the internal probe connector cable (Figure 7–24).

1. Locate the probe connector connection.
2. Disconnect the probe cable from the main board.
3. Loosen the cross recess screw holding the connector assembly in the housing.
4. Install the new probe connector cable assembly and secure in the housing.
5. Reconnect the cable to the main board.

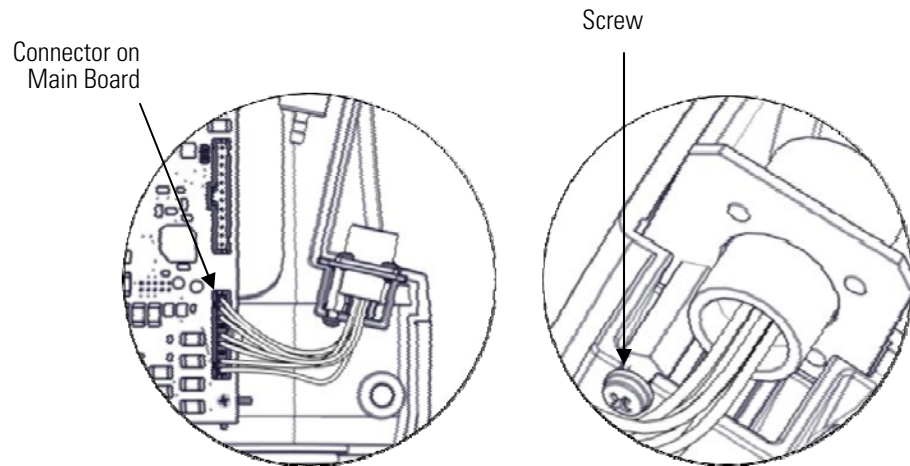


Figure 7–24. Replacing the Internal Probe Connector Cable

Chapter 8

Optional Accessories

The TVA2020 is available with the following options:

- “Sample Probe Option” on page 8-1
- “Enhanced Probe Option” on page 8-2
- “Telescoping Extension Option” on page 8-11
- “Activated Charcoal Filter Adapter” on page 8-12
- “Bluetooth Communications” on page 8-13
- “GPS” on page 8-16

For information on additional accessories, such as calibration kits, enhanced probes, or dilutor kits, please contact Thermo Fisher Scientific.

Sample Probe Option

The sample probe option is a hand-held device that enables you to take vapor samples at precise locations. It connects to the instrument by means of an umbilical. The umbilical has a quick-disconnect fastener. The probe comes with both a straight tip and a bent tip. The probe ends can be quickly changed depending on user preference.



Figure 8–1. Sample Probe Option

Enhanced Probe Option

This probe/display option is used to perform menu-driven operational/datalogging functions from the handheld unit and reduces the need to access the sidepack keypad.

There are three buttons on the Enhanced Probe which allow you to interact with the TVA2020:

- MENU – Used to cause the menu to appear on the bottom of the probe display and to step through the available selections
- SELECT – Used to choose the currently highlighted menu selection; e.g., “LOG”.
- Light Bulb Icon – Used to turn the display backlight on and off

The probe accepts a single display control message. The message is tested for validity, and if valid, the display is updated. The probe displays the contents of the last valid message received since power on.

The display provides two display modes. Both display modes display the current concentration for one detector:

1. Bar graph value > 0: Display bar graph
2. Bar graph value = 0: Displays 6 line x 20 character text

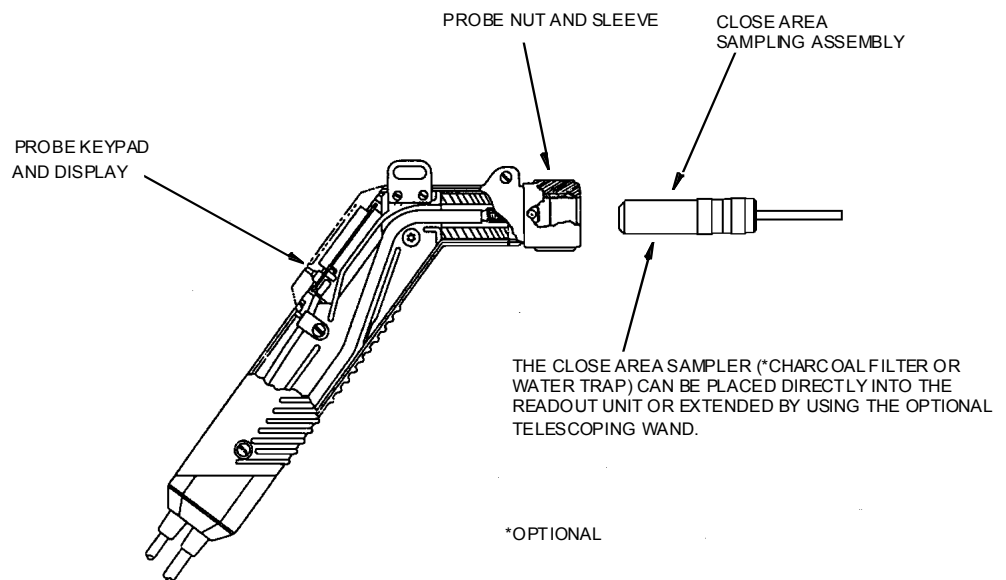


Figure 8–2. Enhanced Probe Option

Enhanced Probe Display

The enhanced probe also has an LCD screen which displays the basic measurement information. The enhanced probe display is larger (8 line x 20 character display) and is capable of providing several menu-driven functions. These Menu selections allow the user to start a datalogging application, switch detectors, ignite the FID, and perform a background scan. In Fugitive Emissions monitoring applications, the MENU selections also allow the user to step through a tag route, search for a selected tag, start a logging event, log repair data, etc. The display, which may be backlit under low light conditions, is active only in the Run mode. In all other modes, the display is OFF.

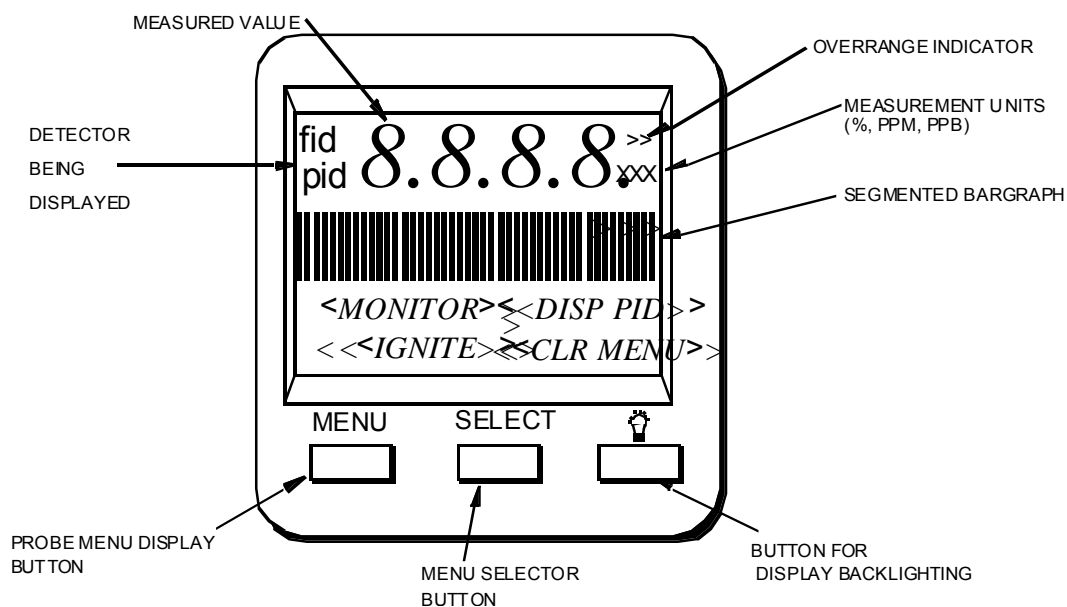



Figure 8–3. Enhanced Probe Option Display

Enhanced Probe Keys

The enhanced probe has three keys, labeled MENU, SELECT, and a lamp Symbol. MENU and SELECT are multi-functional.

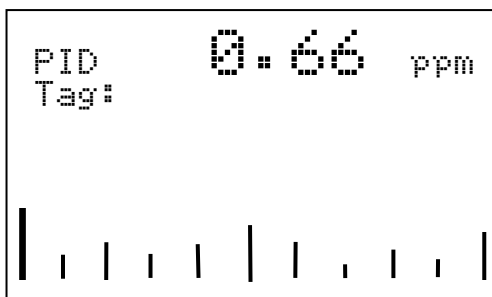
Table 8–1. Enhanced Probe Keys and Functions

Key	Function
MENU	Press and release this key to show the probe display menu or to move to the next menu option. Press and hold this key (approx. 2 seconds) to toggle the info screen on/off.
SELECT	Press and release this key to select the highlighted menu option.
Lamp Symbol 	Press this key to turn the backlight for the probe on or off. As it draws additional power from the battery and thus shortens instrument run time, use it only during low light conditions.

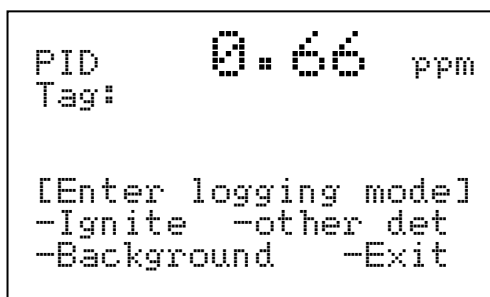
The Enhanced Probe and the RUN Mode

Use the following procedure to use the enhanced probe in Run mode.

1. From the MAIN MENU, choose **1=Run**.
2. The enhanced probe display will display the detector reading (FID or PID) at the top and an analog bargraph on the bottom.



3. Press the MENU key on the Enhanced probe display to show the Opening menu:



The highlighted menu item is the item surrounded by brackets. Pressing the MENU key will cause the brackets to move from menu item to menu item. When you reach the menu item you wish to choose, press SELECT. The Opening menu items are as follows:

Table 8–2. Enhanced Probe Menu

Menu Item	Function
Enter logging mode	Enters FE, VOC, or Auto logging mode, allowing you to enter tags, toggle through route files, log data, etc. If no logging is selected in the SETUP menu, then this selection does not appear.
Ignite	Ignites FID.
Other det	Toggles between FID and PID reading. This selection does not appear in single detector models.
Background	Records a new background reading.
Exit	Clears the menu and returns to the bar graph display.

Auto Logging with the Enhanced Probe

Use the following procedure to use the enhanced probe in auto logging mode.

1. In the RUN mode, from the Opening menu, press the **select** key to “Enter logging mode.”
2. Use the sidepack to enter a tag, or simply select “Accept” to enter a blank tag.
3. Choose “Start log sampling” to begin Auto logging.
4. The Enhanced probe will display the countdown and continue to log until EXIT is selected at the probe or the sidepack keypad.

```
PID      0.66 ppm
Tag:

      0.59ppm  PID
      2.50ppm  FID
Sampling: 3s [Exit]
```

5. Once EXIT is selected, you may enter another tag and begin logging again or exit from the RUN mode.

VOC Logging with the Enhanced Probe

Use the following procedure to use the enhanced probe in VOC logging mode.

1. In the RUN mode, from the Opening menu, press the **select** key to “Enter logging mode.”
2. Use the sidepack to enter a tag, or simply select “Accept” to enter a blank tag.
3. Choose “Start log sampling” to begin Auto logging.
4. The Enhanced probe will display the count down for the interval selected in the SETUP menu and freeze on the reading to be saved (Maximum, Average, or Last Reading).

```
PID      0.66 ppm
Tag:

      0.59ppm  PID
      2.50ppm  FID
[Sav] -Again  -Exit
```

5. You may choose to save the reading (SAV), repeat the reading for the same tag (AGAIN), or return to the previous menu (EXIT).

- Once you have saved a reading, you may enter another tag and begin logging again or exit from the RUN mode.

FE Logging with the Enhanced Probe

In FE logging, you follow a preconfigured route list consisting of component records for equipment to be monitored. You should first download a route to the TVA2020's memory before entering the RUN mode. For more information on downloading routes, see the "Memory" section in Chapter 3.

In the RUN mode, from the Opening menu, press the **select** key to "Enter logging mode."

```

PID      0.66 ppm
Tag:0033
Eqp:CMP  Size: 0.00
Leak: 600 RF:0.80
        0.66ppm LastLog
[Start log sampling]
-Nx -Pr -List -Exit
  
```

In addition to the concentration display at the top, the FE mode shows several fields which have been filled in by the downloaded route. The TVA2020 starts at the first record in the route and displays the component tag number (Tag), equipment type (Eqp), equipment size (Size), and leak definition (Leak). If a reading has already been logged into memory for this record, it will also be displayed followed by the words "LastLog."

Route Entry Response Factor

A secondary response factor correction is based on the response factor associated with the current route entry. This secondary correction adjusts the concentration reading for different component measurements in the same route.

For example, let a route contain two entries, one for propane and one for methane. Assume that propane has only half the detector response of methane. If each route location has a leak of 100 ppm, a single response factor based on methane would produce a concentration reading of 100 ppm for methane, but only 50 ppm for propane. The addition of a secondary response factor allows each entry to be corrected for detector sensitivity. Thus, if the secondary response factor is 1.0 for methane and 2.0 for propane, both route samples will read correctly as 100 ppm.

Only the linear correction mode is used for the secondary route response correction:

$$\text{Linear:} \quad \text{FinalConc} = \text{RouteRF} \times \text{BackConc}$$

The secondary RouteRF is downloaded to the instrument as part of each route entry. This factor is applied to both detectors, as it is expected that when operating in this mode, only one detector will be used. Entries inserted by the instrument default to a RouteRF of 1.0.

Navigating the Route File

Selecting “Nx” from the first logging mode screen will allow you to step to the next record in the route. Selecting “Pr” will allow you to step to the previous record in the route. Selecting “List” will show 10 records per page for faster searching through the route. You can also enter a tag via the keypad and the TVA2020 will automatically skip to that tag if it is contained within the route. If the tag is not contained within the route, a “TAG NOT FOUND” message will appear and you will be given the option to “Insert” that tag into the route or “Exit.”

Logging Data

Once you have reached the correct tag for the component you wish to monitor, you may select “Start log sampling” to begin recording data. The TVA2020 will display the reading from the selected detector and begin counting down for the time interval selected in the SETUP menu. The countdown is shown on the last line of the display:

```
PID      0.66 ppm
Tag:0019
Eqp:PMP  Size: 0.75
Leak:    50 RF:1.80
          0.66ppm PID
Sampling: 24s [Exit]
```

Once the countdown is complete, the TVA2020 display will freeze on the reading to be logged and indicate if it is a leak (i.e., if the reading of the active detector exceeds the indicated leak rate). You will be given several options:

```
PID      0.66 ppm
Tag:0019
Eqp:PMP  Size: 0.75
Leak:    50 RF:1.80
          0.66ppm NoLeak
          -Repair
[Sav]    -Again -Exit
```

If you choose “Sav”, the TVA2020 will store the reading in memory (replacing any previously logged readings for that Tag) and proceed to the next component record in the route. If you choose “Again,” the TVA-1000B will repeat the countdown and obtain a new reading. If you choose “Exit” the TVA2020 will return to the previous screen.

Repair Menus

If the reading obtained during the logging interval exceeds the leak definition, the TVA2020 will indicate that it is a leak by printing “Leaker!” If you wish, you may record what part of the component is leaking and what action was taken as a first attempt at repair. Choose “Repair” instead of “Sav” and the TVA2020 will proceed to the Repair menus:

```
PID      0.66 ppm
Leak Source: N/A
Repair Method: N/A
[Save & sampl again]
-Select leak source
-Select repair mthd
          -Exit
```

The two lines below the reading show the currently selected leak source and repair method. Choosing “Select leak source” will allow you to record what part of the component is leaking by choosing from a list of leak sources (Valve Bonnet, Compressor Seal, Downstream Flange, Valve Packing, Pump Seal, Upstream Flange). Choosing “Select repair method” will allow you to record what method was used for the first attempt at repair (Place Cap, Gun Pack Valve, Place Plug, Repack Valve, Replace Gasket, Replace, Seal Job, Steam Seal, Tighten Bonnet, Tighten Cap, Tighten Flange, Tighten Packing, Tighten Plug, Wash Seal). Choosing “Exit” will return you to the previous display.

If you choose a leak source and repair menu, be sure to select “Sav” when you return to this menu so the reading and repair information will be saved in memory before proceeding to the next component record.

Additional Component Information

Displays containing additional information about the component and the TVA2020 status are available from the handheld unit. If you press and hold the MENU key for approximately 2 seconds, the Enhanced display will present an INFO page:

```
PID      0.66 ppm
Tag:0020
Area:1515 BEN
Subarea:WEST
Leak:  10
RF:1.00
14:17:52 [Pg] -Exit
```

The INFO page overwrites the bottom four lines of the record with other fields such as Location (Loc) and Description (the two lines below the location). The Location field contains the Area and the Subarea where the component is located. The Description field displays up to 40 characters of additional information about the component. Selecting “Pg” at the bottom of the display will step you through other INFO pages containing information such as Run ID, Record number, number of points logged, number of leakers found, number of repairs performed, pump status, free memory, etc. Selecting “Exit” will return you back to the normal component record.

Telescoping Extension Option

To use an optional telescoping extension, loosen the probe nut and unplug the sampling assembly. Next, insert the telescoping wand and tighten the probe nut. Then, insert the appropriate sampling assembly into the other end of the extension unit and tighten the retaining nut.

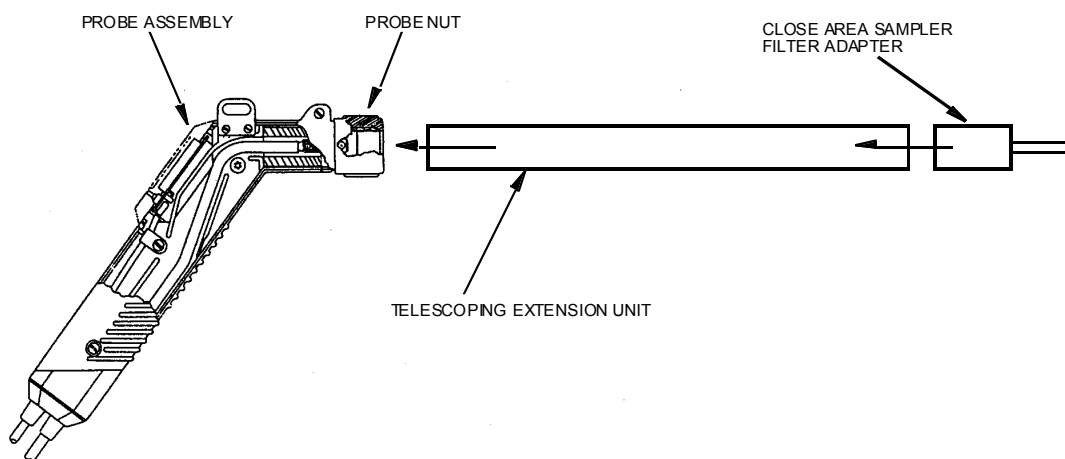


Figure 8–4. Telescoping Extension Option

Activated Charcoal Filter Adapter

The Activated Charcoal Filter Adapter is an accessory that can be installed or attached to the end of the standard probe or to the end of a telescoping extension. The filter is typically filled with activated charcoal which acts as an adsorbent and effectively filters out organic vapors other than methane or ethane.

A screw cap on the probe end may be removed for refilling the filter with activated charcoal or other filtering medium.

Applications of the filter include:

- Obtaining a clean air sample for zero baseline check and adjustment.
- Rapid screening of methane and non-methane organic vapors.
- Selective screening for natural gas surveys.

The charcoal filter adapter fits directly into the telescoping wand.

The life of the filter depends on the time in use, the types of compounds, and concentrations of the compounds being filtered. Under typical industrial air monitoring conditions, the filter will last for many days of continuous sampling. For information on replacing the charcoal filter, see [“Replacing the Charcoal Filter”](#) on page 5-14.

Bluetooth Communications

An optional Bluetooth module may be installed inside the sidepack to provide a wireless data interface via Bluetooth. Bluetooth is used for Digital Data Logging, to turn the pump on or off, or to reignite the FID.

The TVA 2020 will advertise the Bluetooth friendly name TVA2020<last six hex digits of Bluetooth address>. A PC or PDA can then connect to it using a passkey of 0000.

Bluetooth Commands

After connecting to the Bluetooth module from a computer or PDA, the Serial Port Profile (SPP) is used to issue the following commands according to [Table 8–3](#).

Table 8–3. Bluetooth Commands

Command	Result
log start	Start Digital Data Logging
log stop	Stop Digital Data Logging
detector pid	Log PID data only
detector fid	Log FID data only
detector pid_fid	Log PID and FID data
ignite	Reignite FID
pump on	Turn pump on
pump off	Turn pump off
screen	Enter screen mode. In screen mode the sidepack screen is shown, and is updated when the sidepack screen is changed, or every two seconds.
push co (control)	Send key to sidepack (screen mode only)
push do (down)	
push en (enter)	
push ex (exit)	
push le (left)	
push ri (right)	
push up	
push 1	
push 2	
push 3	
push 4	
push 5	
push 6	
push 7	

Command	Result
push 8	
push 9	
quit	Exit screen mode

Note The commands are case insensitive. ▲

All commands are terminated by <CR> or <CR><LF>.

If an invalid command is received by the TVA, it will respond with “bad cmd”. This response is terminated by <CR><LF>.

Digital Data Logging (Bluetooth)

If digital data logging is enabled, streaming concentration data is sent out via Bluetooth at the end of each measurement cycle (once per second) when the analyzer is in RUN mode. The digital data format is as follows:

Digital data log record:

```
pppppppppp sssssssss ffffffff sssssssss aaaaaaaaa ooooooooo hhhh rr nn <CR><LF>
```

where:

pppppppppp = PID concentration, floating point, right justified, leading spaces, or
" " when PID detector not selected

fffffff = FID concentration, floating point, right justified, leading spaces, or
" " when FID detector not selected

ssssssss = data status:
" ", detector not selected
"OK ", no errors or alarms
"DET_OFF ", detector not valid
"DET_FAIL ", detector failed, not "DET_OFF"
"OVERFLOW ", A/D overflow, not "DET_FAIL"
"UNDERFLOW", A/D underflow, not "OVERFLOW"
"BAD_CALIB", invalid calibration parameters
"CAL_SLOPE", calibration sensitivity out of range
"CLAMPED ", an intermediate concentration exceeded 100%
"AVG_OVFLW", during log point averaging, an overflow occurred
"HIGH_ALARM", high alarm, no STEL, not "UNDERFLOW"
"LOW_ALARM", low alarm, no high alarm or STEL, not "UNDERFLOW"
"STEL_ALARM", STEL alarm, no low or high alarm, not "UNDERFLOW"
"HIGH&STEL", high alarm and STEL, not "UNDERFLOW"
"LOW&STEL ", low alarm and STEL, no high alarm, not "UNDERFLOW"

Digital data logging is initially disabled and the logging type is set according to what detectors are installed so, e.g., if only an FID is installed the logging type will be set to FID data only logging.

GPS

An optional Global Positioning System (GPS) module may be installed inside the sidepack to add location to the logged data. The GPS module is based on the SiRF Star III chipset which provides exceptional sensitivity, even in dense refineries. The module can acquire and track up to 20 satellites simultaneously and provide down to 5 meter resolution. The following data is provided by the GPS module for inclusion with logged data and real-time digital data logging:

- Latitude (Degrees with 5 digits to the right of the decimal)
- Longitude (Degrees with 5 digits to the right of the decimal)
- Altitude (Meters)
- Resolution (Meters)
- Number of Satellites

Appendix A

Warranty

Seller warrants that the Products will operate or perform substantially in conformance with Seller's published specifications and be free from defects in material and workmanship, when subjected to normal, proper and intended usage by properly trained personnel, for the period of time set forth in the product documentation, published specifications or package inserts. If a period of time is not specified in Seller's product documentation, published specifications or package inserts, the warranty period shall be one (1) year from the date of shipment to Buyer for equipment and ninety (90) days for all other products (the "Warranty Period"). Seller agrees during the Warranty Period, to repair or replace, at Seller's option, defective Products so as to cause the same to operate in substantial conformance with said published specifications; provided that (a) Buyer shall promptly notify Seller in writing upon the discovery of any defect, which notice shall include the product model and serial number (if applicable) and details of the warranty claim; (b) after Seller's review, Seller will provide Buyer with service data and/or a Return Material Authorization ("RMA"), which may include biohazard decontamination procedures and other product-specific handling instructions; and (c) then, if applicable, Buyer may return the defective Products to Seller with all costs prepaid by Buyer. Replacement parts may be new or refurbished, at the election of Seller. All replaced parts shall become the property of Seller. Shipment to Buyer of repaired or replacement Products shall be made in accordance with the Delivery provisions of the Seller's Terms and Conditions of Sale. Consumables, including but not limited to lamps, fuses, batteries, bulbs and other such expendable items, are expressly excluded from the warranty under this warranty.

Notwithstanding the foregoing, Products supplied by Seller that are obtained by Seller from an original manufacturer or third party supplier are not warranted by Seller, but Seller agrees to assign to Buyer any warranty rights in such Product that Seller may have from the original manufacturer or third party supplier, to the extent such assignment is allowed by such original manufacturer or third party supplier.

In no event shall Seller have any obligation to make repairs, replacements or corrections required, in whole or in part, as the result of (i) normal wear and tear, (ii) accident, disaster or event of force majeure, (iii) misuse, fault or negligence of or by Buyer, (iv) use of the Products in a manner for which

they were not designed, (v) causes external to the Products such as, but not limited to, power failure or electrical power surges, (vi) improper storage and handling of the Products or (vii) use of the Products in combination with equipment or software not supplied by Seller. If Seller determines that Products for which Buyer has requested warranty services are not covered by the warranty hereunder, Buyer shall pay or reimburse Seller for all costs of investigating and responding to such request at Seller's then prevailing time and materials rates. If Seller provides repair services or replacement parts that are not covered by the warranty provided in this warranty, Buyer shall pay Seller therefor at Seller's then prevailing time and materials rates. ANY INSTALLATION, MAINTENANCE, REPAIR, SERVICE, RELOCATION OR ALTERATION TO OR OF, OR OTHER TAMPERING WITH, THE PRODUCTS PERFORMED BY ANY PERSON OR ENTITY OTHER THAN SELLER WITHOUT SELLER'S PRIOR WRITTEN APPROVAL, OR ANY USE OF REPLACEMENT PARTS NOT SUPPLIED BY SELLER, SHALL IMMEDIATELY VOID AND CANCEL ALL WARRANTIES WITH RESPECT TO THE AFFECTED PRODUCTS.

THE OBLIGATIONS CREATED BY THIS WARRANTY STATEMENT TO REPAIR OR REPLACE A DEFECTIVE PRODUCT SHALL BE THE SOLE REMEDY OF BUYER IN THE EVENT OF A DEFECTIVE PRODUCT. EXCEPT AS EXPRESSLY PROVIDED IN THIS WARRANTY STATEMENT, SELLER DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, ORAL OR WRITTEN, WITH RESPECT TO THE PRODUCTS, INCLUDING WITHOUT LIMITATION ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE PRODUCTS ARE ERROR-FREE OR WILL ACCOMPLISH ANY PARTICULAR RESULT.

Appendix B

Text Data Formats

The TVA2020 supports a USB memory device mode for communications to a computer. In this mode, the instrument will show up as a USB memory device and the files are directly accessible via this interface.

The data shown in the USB memory device mode is formatted as printable, readable ASCII text. All files are read to and written from the root directory of the file system for the memory device.

The TVA2020 generates files with both <CR> and <LF> at the end of each line. However, the TVA accepts files with <CR><LF>, just <CR>, or just <LF>.

At startup and after memory device mode is exited, an evaluation of all config/cal/factory files is performed and a warning is displayed on the sidepack if any of the files are in error. In addition, for any files with errors, a file is created with the same base name and a .ERR extension with the following format:

```
Error, line xxxx: mmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmm
```

where xxx is the line number, and mmmm... is an error description.

Route Database

The route database file is stored as ROUTE.TXT with the following format:

<u>Format</u>	<u>Comments</u>
ROUTE DATABASE<CR><LF>	Title, not processed
VER=xxxxx<CR><LF>	xxxxx=ver, right just, lead spaces
RUN ID=aaaa<CR><LF>	a=0-9, A-Z, a-z
<CR><LF>	Blank line, not processed
ROUTE FIELDS<CR><LF>	Section title, not processed
-----<CR><LF>	Section title, not processed
<route entry field 1>	See below
<route entry field 2>	
.	
.	
.	
<route entry field 15>	
<CR><LF>	Blank line, not processed
PICKLISTS<CR><LF>	Section title, not processed
-----<CR><LF>	Section title, not processed
<picklist definition 1>	See below
<picklist definition 2>	
.	
.	
.	
<picklist definition 6>	
<picklist definition LeakSource>	
<picklist definition RepairMethod>	
<CR><LF>	Blank line, not processed
DISPLAY<CR><LF>	Section title, not processed
-----<CR><LF>	Section title, not processed
<display entry 1>	See below
<display entry 2>	
.	
.	
.	
<display entry 6>	
<CR><LF>	Blank line, not processed
<route entry header line 1>	See below: not processed
<route entry header line 2>	See below: not processed
<route entry 1>	See below
<route entry 2>	
<route entry 3>	
.	
.	
.	
<route entry n>	
<CR><LF>	Blank line, not processed
END<CR><LF>	Marks end-of-text

There may be up to 15 route entry fields. The TAG field MUST be included as the first entry in the database, so the minimum number of route entry fields is one. Each route entry field consists of three columns of data: the data type, field width, and title.

The first column in the route entry field defines the type of data, as follows:

```
S String (alphanumeric)
P Pick List (alphanumeric)
N Number (numeric)
T Tag (alphanumeric)
H Hidden Database Key (alphanumeric)
L Leak Rate (numeric)
D Dead Band Rate (numeric)
R Response Factor (numeric)
C Comment (alphanumeric)
```

The String, Pick List, and Number field types may have more than one entry in the route fields. All other types may be used only once in the route fields.

An optional “X” character may be added after the data type to indicate that that entry field may not be edited, it is only shown on the TAG screen.

The second column of the route entry field defines the field width, which is used to define data storage size, display data on the probe, and during file transfers. The sum of all defined fields may not exceed 365 characters. Each field may not be larger than 60 characters, with the exception of the Tag field and Pick lists (16 characters).

The third column of the route entry field is the label for the route entry field, which is displayed as the column header in the route database file and on the probes as a field prompt. Each label may be no more than 12 characters. Each route entry field is ended with <CR><LF>.

Note that the leak source, repair method, and comment fields are not actually stored as part of the route entry. Instead these items are stored with each logged data point. They are included in this section so the user may define the pick lists and comment field size.

The next section of the file defines the PICKLISTS. There may be up to 8 pick lists included in the database definition (this includes the LeakSource and RepairMethod lists), but none are required. Each pick list may have up to 16 items consisting of no more than 16 characters each. The pick list definition consists of multiple lines of data. The first line is the pick list label as follows:

```
LABEL=llllllllllllllllll
```

Where lllllllllllll is the pick list label which is left justified and terminated by <CR><LF> at any time (does not require 16 characters). The label must match the label previously defined in the ROUTE FIELDS section of the file. Each additional line is a pick list entry. The pick list is terminated by

the start of a new pick list label, or by the blank line at the end of the PICKLISTS section.

There are two special picklists. These picklists are defined using the labels “LeakSource” and “RepairMethod”. If these picklists are present in the route database file, they are used for the Leak Source and Repair Method fields in the logged data. If they are not included in the file, default pick lists are loaded. Note that the “LeakSource” picklist has a hard-coded size of 3 characters and the “RepairMethod” picklist has a hard-coded size of 5 characters. The first entry in each of these picklists must be something equivalent to “N/A”, as these are the default settings indicating that nothing has been selected from the list.

The next section of the file is the DISPLAY section. This section defines what database fields are displayed on the Enhanced probe while monitoring. Since there are only three lines of 20 characters each available on the display during monitoring, the user may select which fields are displayed.

The first column of the display field is the label for the route entry field to be displayed. This must match a label previously defined in the ROUTE FIELDS section of the file. The second column is the line number (1-3) to display this field. The third column is the column number (1-20) to start displaying this field. The fourth column is the number of characters to display. If the number of characters to be displayed exceeds the number of characters available on the line, it will be wrapped to the next line. If the number of characters to display is less than the number of characters defined in the ROUTE FIELDS section, the first n characters of the field are displayed. If the number of characters to display is a negative number, then the last n characters of the field are displayed. An error is reported when the file is transferred if any of the display fields overlap.

The route header line is composed of route entry field titles (line 1) centered over an underline of dashes (line 2) for each field. The fields are delimited with a single space. Each column is of width defined in the route entry field section. These two lines are ignored when receiving a route database file, so formatting is not critical.

The route entry format depends on the data in the Route Fields section. Each field goes from left to right in the order they were defined in that section. Each field is delimited by a single space. Numbers may be either left or right justified. Each database entry is ended with <CR><LF>.

Downloaded route entries may be terminated any time after the tag by the <CR><LF>. Before the first entry is accepted, the instrument’s route and log memory is cleared. Partial text entries are processed as ending in trailing spaces. Partial number entries are processed as if complete. The default value for fields not included in the entry are:

<u>Field Type</u>	<u>Default</u>
String	all spaces
Number	all spaces
Tag	all spaces
Hidden	all spaces
Leak rate	0.00
Dead band	0.00
Response factor	1.00

Sample, download, beginning characters only, various lengths:

```
ROUTE DATABASE
VER= 1.00
RUN ID=0001
```

```
ROUTE FIELDS
-----
T 16 Tag
H 16 DBID
P 16 Plant
S 8 Area
SX 8 Subarea
L 5 Max
R 4 RF
S 3 EQP
P 3 EQPick
N 6 Size
S 48 Description
C 32 Comment
```

```
PICKLISTS
-----
LABEL=Plant
HOUSTON 1
HOUSTON 2
LEFT OF TRACKS
LABEL=EQPick
VLV
FLG
PMP
```

```
DISPLAY
-----
Tag 1 1 16
EQP 2 1 3
Size 2 10 6
Max 3 1 5
RF 3 12 4
```

Tag	DBID	Plant	Area	Subarea	Max	RF	EQP	EQP	Size	Description
1	1000000001	HOUSTON 1	AREA1	SUBAREA1	0	1.00	N/A		1.00	DESCRIPTION 1
2	1000000002	HOUSTON 1	AREA2	SUBAREA2	0	1.00	BON		0.50	DESCRIPTION 2
3	1000000003	HOUSTON 2	AREA3	SUBAREA3	0	1.00	CSL		1.75	DESCRIPTION 3
4	1000000004	HOUSTON 2	AREA4	SUBAREA4	0	1.00	DFL		10.00	DESCRIPTION 4
5	1000000005	LEFT OF TRACKS	AREA5	SUBAREA5	0	1.00	PKG		5.50	DESCRIPTION 5

END

Route List

This is a legacy file format for ROUTE.TXT to support older third-party applications. The route list format is as follows:

<u>Format</u>	<u>Comments</u>
ROUTE LIST<CR><LF>	Title, not processed
VER=xxxxx	xxxxx=ver, left just, trail spaces
RUN ID=aaaa<CR><LF>	a=0-9, A-Z, a-z
<CR><LF>	Blank line, not processed
<route entry header line 1>	See below: not processed
<route entry header line 2>	See below: not processed
<route entry header line 3>	See below: not processed
<route entry 1>	See below
<route entry 2>	
<route entry 3>	
.	
.	
.	
<route entry n>	
<CR><LF>	Blank line, not processed
END<CR><LF>	Marks end-of-text

The route header line is composed of text headers (lines 1 & 2) and an underline of dashes (line 3). The route header is specified below by specification of header text for lines 1 & 2 and starting position, all other characters blank.

Line 3 is a dash character '-' for all route entry characters except the delimiter (space instead).

Route header:

<u>Start</u>	<u>Header Line 1</u>	<u>Header Line 2</u>
0		TAG
17		AREA
26		SUBAREA
35	LEAK	RATE
41	RESP	FACT
46	EQP	TYP
50	EQUIP<CR><LF>	SIZE
57		DESCRIPTION<CR><LF>

The route entry format is:

<u>Byte</u>	<u>Length</u>	<u>Item</u>	<u>Format</u>
0	16	Tag	text
16	1	delimiter	space
17	8	Area	text
25	1	delimiter	space
26	8	Subarea	text
34	1	delimiter	space
35	5	Leak rate	floating point

40	1	delimiter	space
41	4	Response factor	floating point
45	1	delimiter	space
46	3	Equipment type	text
49	1	delimiter	space
50	6	Equipment size	text
56	1	delimiter	space
57	48	Description	text
105	1	<CR>	ODH
106	1	<LF>	OAH

Downloaded route entries may be terminated any time after the tag by the <CR><LF>. Before the first entry is accepted, the instrument's route and log memory is cleared. Partial text entries are processed as ending in trailing spaces. Partial number entries are processed as if complete. The default value for fields not included in the entry are:

<u>Field</u>	<u>Default</u>
Area	all spaces
Subarea	all spaces
Leak rate	0.00
Response factor	1.00
Equipment type	all spaces
Equipment size	all spaces
Description	all spaces

Sample, download, beginning characters only, various lengths:

```
ROUTE LIST
VER=1.00
RUN ID=0486
```

TAG	AREA	SUBAREA	LEAK RATE	RESP FACT	EQP TYP	EQUIP SIZE	DESCRIPTION
0123	PLANT 1	SECTION2	10.3	2.00	VLV	5.125	OUTLET
0124	PLANT 1	SECTION2	100	1.00	PMP	5.125	
0124	PLANT 1	SECTION2	100	1.00			
0125							

END

Configuration

The configuration is stored as CONFIG.TXT with the following format (options are separated by a '|'):

```
Format
CONFIGURATION<CR><LF>
VER=XX.XX<CR><LF>
<CR><LF>
MODEL=xxxxxxxxxx<CR><LF>
SERIAL NUMBER=idididididid<CR><LF>
DETECTOR=FID|PID&FID<CR><LF>
OPERATOR ID=opopopopop<CR><LF>
<CR><LF>
LOGGING<CR><LF>
-----<CR><LF>
LOG MODE=NONE|AUTO|VOC|FE|CUSTOM<CR><LF>
LOG STORAGE FORMAT=NONE|AUTO|VOC|FEVOC<CR><LF>
LOG SAMPLE TIME=nnn<CR><LF>
LOG SAMPLE TIME UNIT=SEC|MIN<CR><LF>
LOG DATA STORED=SAMPLE|AVERAGE|MAXIMUM<CR><LF>
LOG UNIT LOCK=OFF|PPM|PERCENT<CR><LF>
LOG AUTO REPEAT=OFF|ON<CR><LF>
LOG SAVE MODE=MANUAL|AUTO<CR><LF>
TAG ACTIVE=OFF|ON<CR><LF>
ROUTE ACTIVE=OFF|ON<CR><LF>
<CR><LF>
CALIBRATION<CR><LF>
-----<CR><LF>
CAL AUTO ACCEPT=OFF|ON<CR><LF>
CAL AUTO SAVE=OFF|ON<CR><LF>
CAL UNIT LOCK=OFF|PPM|PERCENT<CR><LF>
BACKGROUND CORRECTION (PID)=OFF|ON<CR><LF>
BACKGROUND CORRECTION (FID)=OFF|ON<CR><LF>
<CR><LF>
RESPONSE FACTORS<CR><LF>
-----<CR><LF>
SELECTED=n<CR><LF>
MODE=FACTOR|CURVE<CR><LF>
RFO (PID)=DEFAULT 1.00 0.00<CR><LF>
RF1 (PID)=nnnnnnnnn xx.xx +yy.yy<CR><LF>
.
.
.
RF9 (PID)=nnnnnnnnn xx.xx +yy.yy<CR><LF>
RFO (FID)=DEFAULT 1.00 0.00<CR><LF>
RF1 (FID)=nnnnnnnnn xx.xx +yy.yy<CR><LF>
.
.
.
RF9 (FID)=nnnnnnnnn xx.xx +yy.yy<CR><LF>
<CR><LF>
ALARMS<CR><LF>
-----<CR><LF>
STEL (PID)=ffffff PPM|% <CR><LF>
LOW (PID)=ffffff PPM|% <CR><LF>
HIGH (PID)=ffffff PPM|% <CR><LF>
```

```
STEL (FID)=ffffff PPM|% <CR><LF>
LOW (FID)=ffffff PPM|% <CR><LF>
HIGH (FID)=ffffff PPM|% <CR><LF>
<CR><LF>
USER OPTIONS<CR><LF>
-----<CR><LF>
PROBE=ENHANCED<CR><LF>
KEY CLICK=OFF|ON<CR><LF>
DISPLAY DELAY=SHORT|MEDIUM|LONG<CR><LF>
DIGITAL DATA LOGGING=NONE|FID|PID|PID&FID|SELDET<CR><LF>
BLUETOOTH POWER=OFF|ON<CR><LF>
GPS POWER=OFF|ON<CR><LF>
POWER (PID)=OFF|ON<CR><LF>
POWER (FID)=OFF|ON<CR><LF>
<CR><LF>
END<CR><LF>
```

Note Lines containing information on uninstalled detector (PID) are not output. ▲

Note Spaces are allowed in names and other text fields entered by the user. ▲

Note Number fields are right justified, leading spaces. ▲

Note The second detector repeats the RF names. During download the last RF name encountered is used. ▲

Note Log parameters must be correct for the specified log mode. ▲

Sample:

```
CONFIGURATION
VER= 1.00

MODEL=TVA2020
SERIAL NUMBER=123456789012
DETECTOR=PID&FID
OPERATOR ID=USERID

LOGGING
-----
LOG MODE=NONE
LOG STORAGE FORMAT=NONE
LOG SAMPLE TIME=0
LOG SAMPLE TIME UNIT=SEC
LOG DATA STORED=SAMPLE
LOG UNIT LOCK=OFF
LOG AUTO REPEAT=OFF
LOG SAVE MODE=MANUAL
```

Text Data Formats

Configuration

```
TAG ACTIVE=OFF
ROUTE ACTIVE=OFF

CALIBRATION
-----
CAL AUTO ACCEPT=OFF
CAL AUTO SAVE=OFF
CAL UNIT LOCK=OFF
BACKGROUND CORRECTION (PID)=ON
BACKGROUND CORRECTION (FID)=ON

RESPONSE FACTORS
-----
SELECTED=0
MODE=FACTOR
RF0 (PID)=DEFAULT      1.00  0.00
RF1 (PID)=-----      1.00  0.00
RF2 (PID)=-----      1.00  0.00
RF3 (PID)=-----      1.00  0.00
RF4 (PID)=-----      1.00  0.00
RF5 (PID)=-----      1.00  0.00
RF6 (PID)=-----      1.00  0.00
RF7 (PID)=-----      1.00  0.00
RF8 (PID)=-----      1.00  0.00
RF9 (PID)=-----      1.00  0.00
RF0 (FID)=DEFAULT      1.00  0.00
RF1 (FID)=-----      1.00  0.00
RF2 (FID)=-----      1.00  0.00
RF3 (FID)=-----      1.00  0.00
RF4 (FID)=-----      1.00  0.00
RF5 (FID)=-----      1.00  0.00
RF6 (FID)=-----      1.00  0.00
RF7 (FID)=-----      1.00  0.00
RF8 (FID)=-----      1.00  0.00
RF9 (FID)=-----      1.00  0.00

ALARMS
-----
STEL (PID)=  0.00 PPM
LOW  (PID)=  0.00 PPM
HIGH (PID)=  0.00 PPM
STEL (FID)=  0.00 PPM
LOW  (FID)=  0.00 PPM
HIGH (FID)=  0.00 PPM

USER OPTIONS
-----
PROBE=ENHANCED
KEY CLICK=OFF
DISPLAY DELAY=MEDIUM
PC LINK TYPE=TEXT-AUTO
DIGITAL DATA LOGGING=PID&FID
BLUETOOTH POWER=ON
GPS POWER=ON
POWER (PID)=ON
POWER (FID)=ON

END
```

Calibration

Successful download of the calibration file resets the background concentration to zero.

The calibration is stored as CAL.TXT in the following format:

Format	Comments
CALIBRATION DATA<CR><LF>	Title, not processed
VER=xx.xx	xx.xx=ver, right just, lead spaces
<CR><LF>	Blank line, not processed
<CR><LF>	Blank line, not processed
<detector calibration>	PID if available, see below
<detector calibration>	FID if available, see below
END<CR><LF>	Marks end-of-text

The detector calibration format is as follows (note: from 1 to 9 span gas points are allowed):

```
ddd CALIBRATION:<CR><LF>
<CR><LF>
CALIB      KNOWN      CALIB      MEASURED<CR><LF>
TYPE      CONC      DATE/TIME      CALIB VALUE<CR><LF>
-----
ZERO      aaaaaa uu  dd mmm yy  hh:mm:ss  bbbbbbbb COUNTS ffffffff<CR><LF>
SPAN1     aaaaaa uu  dd mmm yy  hh:mm:ss  bbbbbbbb COUNTS ffffffff<CR><LF>
.         .         .         .         .         .         .         .         .         .
.         .         .         .         .         .         .         .         .         .
.         .         .         .         .         .         .         .         .         .
SPANn     aaaaaa uu  dd mmm yy  hh:mm:ss  bbbbbbbb COUNTS ffffffff<CR><LF>
<CR><LF>
<CR><LF>
```

where:

ddd = detector type
"FID"
"PID"

aaaaaa = gas concentration, floating point, right justified,
leading spaces

uuu = concentration units:
"PPM", parts-per-million
"% ", percent

dd = day of calibration, 01-31
mmm = month of calibration, Jan-Dec
yy = year of calibration, 00-99

hh = hour of calibration, 00-23
mm = minute of calibration, 00-59
ss = second of calibration, 00-59

bbbbbbbb = detector reading for calibration gas, integer,
right justified, leading spaces

fffffff = count status:
"OK ", no errors
"DET_OFF ", detector reading invalid

Text Data Formats

Calibration

"DET_FAIL ", detector failed, not invalid
"OVERFLOW ", A/D overflow, not invalid
"UNDERFLOW", A/D underflow, not invalid or A/D overflow
"BAD_CALIB", invalid calibration parameters
"CAL_SLOPE", calibration sensitivity out of range
"CLAMPED ", an intermediate concentration exceeded 100%
"AVG_OVFLW", during log point averaging, an overflow occurred

n = span gas number, 2-9

Sample, dual detector:

CALIBRATION DATA
VER= 1.00

PID CALIBRATION:

CALIB TYPE	KNOWN CONC	CALIB DATE/TIME		MEASURED CALIB VALUE
ZERO	0 PPM	12 DEC 99	20:20:10	0 COUNTS OK
SPAN1	10.23 PPM	12 DEC 99	20:20:30	123456 COUNTS OK
SPAN2	50.23 PPM	12 DEC 99	20:20:40	1234567 COUNTS OK
SPAN3	100.23 PPM	12 DEC 99	20:20:50	12345678 COUNTS OVERFLOW

FID CALIBRATION:

CALIB TYPE	KNOWN CONC	CALIB DATE/TIME		MEASURED CALIB VALUE
ZERO	0 PPM	12 DEC 99	20:20:10	0 COUNTS OK
SPAN1	10.23 PPM	12 DEC 99	20:20:30	123456 COUNTS DET_FAIL

END

Factory The factory calibration is stored as FACTORY.TXT with the following format (options are separated by a '|'):

```

Format
FACTORY<CR><LF>
VER=XX.XX<CR><LF>
<CR><LF>
<CR><LF>
POINT 1 TIME =xxxxxxx<CR><LF>
POINT 1 FLAGS =xxxxxxx<CR><LF>
POINT 1 COUNT =xxxxxxx<CR><LF>
POINT 1 DUTY =xxxxxxx<CR><LF>
<CR><LF>
POINT 2 TIME =xxxxxxx<CR><LF>
POINT 2 FLAGS =xxxxxxx<CR><LF>
POINT 2 COUNT =xxxxxxx<CR><LF>
POINT 2 DUTY =xxxxxxx<CR><LF>
<CR><LF>
POINT 3 TIME =xxxxxxx<CR><LF>
POINT 3 FLAGS =xxxxxxx<CR><LF>
POINT 3 COUNT =xxxxxxx<CR><LF>
POINT 3 DUTY =xxxxxxx<CR><LF>
<CR><LF>
SLOPE =xxxxxxx<CR><LF>
INTERCEPT =xxxxxxx<CR><LF>
SUM OF SQUARES=xxxxxxx<CR><LF>
<CR><LF>
<CR><LF>
END<CR><LF>

```

Sample:

```

FACTORY
VER= 1.00

POINT 1 TIME =1334746787
POINT 1 FLAGS =0
POINT 1 COUNT =26601
POINT 1 DUTY =98

POINT 2 TIME =1324747069
POINT 2 FLAGS =0
POINT 2 COUNT =28642
POINT 2 DUTY =34

POINT 3 TIME =1334747227
POINT 3 FLAGS =0
POINT 3 COUNT =29690
POINT 3 DUTY =180

SLOPE =36.6918
INTERCEPT =23264

```

Text Data Formats

Factory

SUM OF SQUARES=0.934123

END

Calibration History

The calibration history data is stored as HISTORY.TXT in a read-only format. This file is generated from data stored in MRAM each time the instrument is put into USB transfer mode, thus not allowing a user to change the data in the HISTORY.TXT file. If there are fewer history records than the maximum allowed (240), the empty records are not output.

Format	Comments
CAL HISTORY<CR><LF>	Title, not processed
VER=xx.xx<CR><LF>	xxxxx=ver, right just, lead spaces
<CR><LF>	
<cal history header line 1>	See below
<cal history header line 2>	See below
<cal history header line 3>	See below
<cal history data record 1>	See below
.	
.	
.	
<cal history data record 240>	
<CR><LF>	Blank line, not processed
END<CR><LF>	Marks end-of-text

Cal history header:

DET	CALIB TYPE	KNOWN CONC	CALIB DATE/TIME	MEASURED CALIB VALUE
-----	-----	-----	-----	-----

-----<CR><LF>

Cal history data record:

ddd tttt aaaaaa uuu dd mmm yy hh:mm:ss bbbbbbb COUNTS ffffffff<CR><LF>

See calibration file description for field details, except for CALIB TYPE which is (note the * indicates that the calibration was loaded from a file instead of being performed on the instrument):

```

ttttt
"ZERO "
"SPAN1 "
"SPAN2 "
"SPAN3 "
"SPAN4 "
"SPAN5 "
"SPAN6 "
"SPAN7 "
"SPAN8 "
"SPAN9 "
"ZERO*"
"SPAN1*"
"SPAN2*"
"SPAN3*"
"SPAN4*"
"SPAN5*"
"SPAN6*"
"SPAN7*"
"SPAN8*"
"SPAN9*"

```

Sample calibration history file:

CAL HISTORY
VER= 1.00

DET	CALIB TYPE	KNOWN CONC	CALIB DATE/TIME		MEASURED CALIB VALUE
FID	ZERO	0 PPM	12 DEC 99	20:20:10	450 COUNTS OK
PID	ZERO	0 PPM	12 DEC 99	20:20:10	400 COUNTS OK
FID	SPAN1	10.23 PPM	12 DEC 99	20:20:30	123456 COUNTS OK
PID	SPAN1*	10.23 PPM	12 DEC 99	20:20:30	123456 COUNTS DET_FAIL
FID	SPAN2	50.23 PPM	12 DEC 99	20:20:40	1234567 COUNTS OK
FID	SPAN3	100.23 PPM	12 DEC 99	20:20:50	12345678 COUNTS OVERFLOW

Logged Data

The logged data is stored in binary format in MRAM, when the user enters the USB transfer mode the software generates the LOG.TXT file.

The logged data is stored as LOG.TXT in the following format:

Format	Comments
LOGGED DATA<CR><LF>	Title, not processed
VER=xx.xx	xxxxx=ver, right just, lead spaces
<logged data record 1>	See below
.	
.	
.	
<logged data record n>	
<CR><LF>	Blank line, not processed
END<CR><LF>	Marks end-of-text

The logged data record is different for each data storage type. A header is printed whenever the data storage type changes, a new auto run starts, or the configuration (excluding background) changes. The data type records are:

```
<auto logging record>
<voc logging record>
<fe logging record>
```

Auto logged header and data, single detector, GPS off:

```
<CR><LF>
AUTO DATA tttttttttttttt<CR><LF>
  DATE      TIME      ddd BACKGROUND      ddd CONCENTRATION <CR><LF>
-----
dd mmm yy  hh:mm:ss  xxxxxx uu ffffffff  xxxxxx uu ffffffff<CR><LF>
```

Auto logged header and data, dual detector, GPS off:

```
<CR><LF>
AUTO DATA tttttttttttttt<CR><LF>
  DATE      TIME      PID BACKGROUND      PID CONCENTRATION /
-----
dd mmm yy  hh:mm:ss  xxxxxx uu ffffffff  xxxxxx uu ffffffff /

                                FID BACKGROUND      FID CONCENTRATION <CR><LF>
                                -----
                                xxxxxx uu ffffffff  xxxxxx uu ffffffff<CR><LF>
```

Auto logged header and data, dual detector and GPS on:

```

<CR><LF>
AUTO DATA tttttttttttttt<CR><LF>
  DATE      TIME      PID BACKGROUND      PID CONCENTRATION  /
  -----  -----  -----  -----  /
dd mmm yy  hh:mm:ss  xxxxxx uu ffffffff  xxxxxx uu ffffffff /

                                FID BACKGROUND      FID CONCENTRATION  /
                                -----  -----  /
                                xxxxxx uu ffffffff  xxxxxx uu ffffffff /

GPS DATA                                     <CR><LF>
-----<CR><LF>
                                aaaaaaaaa ooooooooo hhhh rr nn<CR><LF>
  
```

VOC logged header and data, single detector, GPS off:

```

<CR><LF>
VOC DATA<CR><LF>
  DATE      TIME      TAG      ddd BACKGROUND      ddd CONCENTRATION  <CR><LF>
  -----  -----  -----  -----<CR><LF>
dd mmm yy  hh:mm:ss  tttttttttttttt  xxxxxx uu ffffffff  xxxxxx uu ffffffff<CR><LF>
  
```

VOC logged header and data, dual detector, GPS off:

```

<CR><LF>
VOC DATA<CR><LF>
  DATE      TIME      TAG      PID BACKGROUND      PID CONCENTRATION  /
  -----  -----  -----  -----  -----  /
dd mmm yy  hh:mm:ss  tttttttttttttt  xxxxxx uu ffffffff  xxxxxx uu ffffffff /

                                FID BACKGROUND      FID CONCENTRATION  <CR><LF>
                                -----  -----<CR><LF>
                                xxxxxx uu ffffffff  xxxxxx uu ffffffff<CR><LF>
  
```

VOC logged header and data, dual detector and GPS on:

```

<CR><LF>
VOC DATA<CR><LF>
  DATE      TIME      TAG      PID BACKGROUND      PID CONCENTRATION  /
  -----  -----  -----  -----  -----  /
dd mmm yy  hh:mm:ss  tttttttttttttt  xxxxxx uu ffffffff  xxxxxx uu ffffffff /

                                FID BACKGROUND      FID CONCENTRATION  /
                                -----  -----  /
                                xxxxxx uu ffffffff  xxxxxx uu ffffffff /

GPS DATA                                     <CR><LF>
-----<CR><LF>
                                aaaaaaaaa ooooooooo hhhh rr nn<CR><LF>
  
```

FE logged header and data, GPS off:

```
<CR><LF>
FE DATA
DATE          TIME      ihihihihih... ththththth... DET      BACKGROUND      CONCENTRATION      LEAK      LEAK      REPAIR<CR><LF>
-----      -
isisisisis... tststststs... ---
dd mmm yy    hh:mm:ss  iiiiiiiiiiiiii tttttttttttt ddd  xxxxxx uuu ffffffff xxxxxx uuu ffffffff 111111  LLL  RRRRR  cchch...<CR><LF>
cscscs...<CR><LF>
ccccc...<CR><LF>
```

FE logged header and data with comment, GPS off:

```
<CR><LF>
FE DATA
DATE          TIME      ihihihihih... ththththth... DET      BACKGROUND      CONCENTRATION      /
-----      -
isisisisis... tststststs... ---
dd mmm yy    hh:mm:ss  iiiiiiiiiiiiii tttttttttttt ddd  xxxxxx uuu ffffffff xxxxxx uuu ffffffff /

LEAK      LEAK      REPAIR<CR><LF>
SOURCE    METHOD    chchch...<CR><LF>
-----
111111  LLL      RRRRR  cccccc...<CR><LF>
```

FE logged header and data with GPS data:

```
<CR><LF>
FE DATA
DATE          TIME      ihihihihih... ththththth... DET      BACKGROUND      CONCENTRATION      /
-----      -
isisisisis... tststststs... ---
dd mmm yy    hh:mm:ss  iiiiiiiiiiiiii tttttttttttt ddd  xxxxxx uuu ffffffff xxxxxx uuu ffffffff /

LEAK      LEAK      REPAIR
SOURCE    METHOD    chchch.../
-----
111111  LLL      RRRRR  cccccc.../

GPS DATA
-----<CR><LF>
aaaaaaa oooooooo hhhh rr nn<CR><LF>
```

where:

dd = day (01-31)

mmm = month:

- “JAN”, January
- “FEB”, February
- “MAR”, March
- “APR”, April
- “MAY”, May
- “JUN”, June
- “JUL”, July
- “AUG”, August
- “SEP”, September
- “OCT”, October
- “NOV”, November
- “DEC”, December

yy = Year (00-99)

Text Data Formats

Logged Data

hh = Hours (0-23)
mm = Minutes (0-59)
ss = Seconds (0-59)

ttttttttttttttt = tag ID left justified space padded.

NOTE: The following DBID fields are only displayed if a hidden database ID is defined in the route database.

ih... = dbid header (1-16 characters, centered, space padded)
is... = dbid separator (1-16 -)
iii... = dbid (1-16 characters, user defined in route database)

th... = tag header (1-16 characters, centered, space padded)
ts... = tag separator (1-16 -)
ttt... = tag (1-16 characters, user defined in route database)

NOTE: The following comment fields are only displayed if a Comment is defined in the route database file.

ch... = comment header (0-16 characters, centered, space padded)
cs... = comment separator (0-80 -)
ccc... = comment (0-80 characters, user input during log)

xxxxxx = concentration, floating point, right justified,
leading spaces, or
"-----" when DET_OFF

uuu = concentration unit determined by the current unit_lock at the time of the upload:

"PPB"
"PPM"
"% "

ffffffff = data status:

"OK ", no errors or alarms
"DET_OFF ", detector not valid
"DET_FAIL ", detector failed, not "DET_OFF"
"BAD_CALIB", invalid calibration parameters
"OVERFLOW ", A/D overflow, not "DET_FAIL"
"UNDERFLOW", A/D underflow, not "OVERFLOW"
"CAL_SLOPE", calibration sensitivity out of range
"CLAMPED ", an intermediate concentration exceeded 100%
"AVG_OVFLW", during log point averaging, an overflow occurred
"LOW_FLOW ", low sample flow detected
"HIGH_ALARM", high alarm, no STEL, not "UNDERFLOW"
"LOW_ALARM", low alarm, no high alarm or STEL, not "UNDERFLOW"
"STEL_ALARM", STEL alarm, no low or high alarm, not "UNDERFLOW"
"HIGH&STEL", high alarm and STEL, not "UNDERFLOW"
"LOW&STEL ", low alarm and STEL, no high alarm, not "UNDERFLOW"

ddd = detector:

"PID"
"FID"

lllllll = leak indicator:

" OK ", no leak
"LEAKER!", leak

aaaaaaaa = GPS latitude, -dd.ddddd, floating point,
right justified, leading spaces
 "No Comms " = Module installed, but no communications
 "No Data " = Module installed, but no data
 "No Power " = Module installed, but power off
 "Comm Err " = Module installed, but messages not recognized

oooooooo = GPS longitude, -ddd.ddddd, floating point,
right justified, leading spaces
 " " = Module installed, but no comms or data

hhhh = GPS altitude, -999 to 9999 meters,
right justified, leading spaces
 " " = Module installed, but no comms or data

rr = GPS Resolution, 5 to 99 meters,
right justified, leading spaces
 " " = Module installed, but no comms or data

nn = Number of GPS satellites, 0 to 20,
right justified, leading spaces
 " " = Module installed, but no comms or data

Sample, auto and VOC data, low alarm=75ppm, high alarm=100ppm:

LOGGED DATA
VER=2.00

AUTO DATA		01234					
DATE	TIME	PID CONCENTRATION	PID BACKGROUND	FID CONCENTRATION	FID BACKGROUND		
----	----	-----	-----	-----	-----		
01 JAN 95	08:31:20	10.02 PPM OK	0.02 PPM OK	12.03 PPM OK	0.43 PPM OK		
01 JAN 95	08:32:20	35.02 PPM OK	0.02 PPM OK	40.23 PPM OK	0.43 PPM OK		
01 JAN 95	08:33:20	75.02 PPM LOW_ALARM	0.02 PPM OK	50.11 PPM OK	0.43 PPM OK		
01 JAN 95	08:34:20	105 PPM HIGH_ALARM	0.02 PPM OK	80.03 PPM LOW_ALARM	0.43 PPM OK		
01 JAN 95	08:35:20	110 PPM HIGH_ALARM	0.02 PPM OK	101 PPM HIGH_ALARM	0.43 PPM OK		
01 JAN 95	08:36:20	80.12 PPM LOW_ALARM	0.02 PPM OK	91.23 PPM LOW_ALARM	0.43 PPM OK		
01 JAN 95	08:37:20	60.09 PPM OK	0.02 PPM OK	74.98 PPM OK	0.43 PPM OK		
01 JAN 95	08:38:20	50.04 PPM OK	0.03 PPM OK	62.03 PPM OK	0.39 PPM OK		
01 JAN 95	08:39:20	20.03 PPM OK	0.03 PPM OK	41.23 PPM OK	0.39 PPM OK		
01 JAN 95	08:40:20	15.08 PPM OK	0.03 PPM OK	25.98 PPM OK	0.39 PPM OK		
01 JAN 95	08:41:20	9.28 PPM OK	0.03 PPM OK	17.03 PPM OK	0.39 PPM OK		

VOC DATA					
DATE	TIME	TAG	PID CONCENTRATION	PID BACKGROUND	FID CONCENTRATION
----	----	-----	-----	-----	-----
		-			
01 JAN 95	08:05:10	0500	10.50 PPM OK	0.03 PPM OK	5.30 PPM OK
01 JAN 95	08:15:25	0501	103 PPM HIGH_ALARM	0.03 PPM OK	99.30 PPM OK
01 JAN 95	08:25:37	0502	25.67 PPM OK	0.04 PPM OK	5.30 PPM OK

END

Text Data Formats

Logged Data

Sample, FE data:

LOGGED DATA

VER= 2.00

FE DATA	DATE	TIME	TAG	DET	BACKGROUND	CONCENTRATION	LEAK	REPAIR	SOURCE	METHOD	COMMENT
19 MAR 03	13:10:35	1	PID	0.00 PPM OK	0.00 PPM DET_FAIL	OK	N/A	N/A			THIS IS MY FIRST COMMENT 1234560
19 MAR 03	13:11:02	2	PID	0.00 PPM OK	0.00 PPM DET_FAIL	OK	N/A	N/A			
19 MAR 03	13:11:14	3	PID	0.00 PPM OK	0.00 PPM DET_FAIL	OK	BON	GUNP			
19 MAR 03	13:11:35	3	PID	0.00 PPM OK	0.00 PPM DET_FAIL	OK	N/A	N/A			ALL FIXED!
19 MAR 03	13:12:20	4	PID	0.00 PPM OK	0.00 PPM DET_FAIL	OK	N/A	N/A			A
19 MAR 03	13:12:38	5	PID	0.00 PPM OK	0.00 PPM DET_FAIL	OK	N/A	N/A			

END

Appendix C

Response Factors

The TVA2020 is a portable vapor analyzer for gas survey monitoring. Each unit is factory calibrated with Methane (in the case of the FID) and Isobutylene (in the case of the PID). However, both detectors respond to many different compounds with differing levels of sensitivity. In order to adjust the analyzer reading from “ppm of Methane” or “ppm of Isobutylene” to ppm of the compound of interest, a correction factor must be applied to the reading. This correction factor is also known as a “Response Factor”.

Response factors can be expressed in several different formats. When you acquire a response factor from any source, it is important that you understand the format in which the response factor is expressed so that it can be applied properly. Following are the two most common response factor formats:

1. Response Factor Multiplier

The response factor multiplier is the most commonly used and most widely recognized response factor format. This type of response factor is calculated by dividing the actual concentration of a compound introduced to the analyzer by the detector response.

$$\text{Response Factor Multiplier} = \frac{\text{Actual Concentration}}{\text{Measured Response}}$$

For example, if 100 ppm of a compound produces a 50 ppm FID reading on an analyzer calibrated with methane, then the FID response factor for that compound would be 2.00 (100 divided by 50).

When using a response factor multiplier to correct a TVA reading, simply multiply the analyzer measured response by the response factor. As in the example given above, if a 50 ppm reading is achieved, multiply 50 times 2.00 to get the actual concentration (100 ppm). Response.

Response Factor Multiplier is what the TVA2020 uses.

2. Relative Response Factor

In some cases, a response factor may be expressed as a percent or a ratio of a compound's response to that of the calibration gas. This type of response factor is calculated by dividing the detector response by the actual concentration of a compound of interest.

$$\text{Relative Response Factor} = \frac{\text{Measured Response}}{\text{Actual Concentration}}$$

(Multiply by 100 to express as a percent)

Note that the relative response is the reciprocal of the response factor multiplier. (i.e. $1/RR = RFM$). As in our example above, if 100 ppm of a compound of interest produces a response of 50 ppm, the relative response would be 50 divided by 100 (0.50 or 50 %).

When using a relative response factor to correct a TVA2020 reading, simply divide the analyzer measured response by the relative response factor expressed as a decimal. As in the example given above, if a 50 ppm reading is achieved, divide 50 by 0.50 to get the actual concentration (100 ppm).

Like any FID or PID, the TVA2020 will respond to many different compounds, producing a survey reading of all detectable compounds present. If a single compound is present, a response factor can be applied to correct for the response of that compound. If a mixture of compounds is present, the TVA2020 will respond to all components of the mixture, and will not differentiate between them. In general, response factors are not available for mixtures of compounds. However, if the composition of the mixture is known, a response factor can be calculated by adding weighted fractions of the response factors of the individual compounds. For instance, if a 75 % Benzene, 25 % Toluene mixture is to be measured, multiply the Benzene response factor by 0.75, the Toluene response factor by 0.25 and add them together to achieve the "weighted" response factor.

The data from a survey analysis may be expressed in a number of different forms:

1. Relative to the calibration gas

If the compound with which the TVA2020 was calibrated is an acceptable standard, then results may be expressed in terms of that compound. For example, an FID reading of 100 ppm could be

expressed as “100 ppm of Methane” if the calibration gas used was Methane. Please note that the TVA2020 detectors can be calibrated with gases other than the factory standards as long as the detector has adequate response to that compound.

2. Response factor corrected

If the TVA is used to measure a single known compound, a response factor from this set of response curves can be applied to correct the TVA reading for that compound. For example, if a survey of Acetone vapors yields a PID reading of 100 ppm, the response factor multiplier from the Acetone curve (1.417) could be applied to the reading to obtain the result of 141.7 ppm Acetone.

3. Relative to a standard other than the calibration gas

If a regulatory agency requires that data be referenced to a standard other than the calibration gas, the response factor for that standard can be applied to the reading. For example, suppose that a survey of total volatile organics must be measured, but the results must be reported in equivalents of benzene. The FID calibrated with methane can be used and the benzene response factor applied to correct the reading.

Response Factors

Response Factors