Transpector® MPS

Gas Analysis System

PN 074–603–P1B

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Equipment Description: Transpector® MPS
Gas Analysis System

Applicable Directives: 2014/35/EU (LVD)
2014/30/EU (EMC)
2011/65/EU (RoHS)

Applicable Standards:

Safety: EN 61010-1:2010

Emissions: EN 61326-1:2013 (Radiated & Conducted Emissions)
Class A:
(EMC – Measurement, Control & Laboratory Equipment)

CISPR 11/EN 55011 Edition 2009-12 Emission standard for industrial, scientific, and medical (ISM) radio RF equipment

FCC 47 CFR Part 18 Class A emission requirement (USA)

ICES-001 Issue 4 ISM emission requirements (Canada)

Immunity: EN 61326-1:2013 (General EMC)
Class A: Immunity per Table 2
(EMC – Measurement, Control & Laboratory Equipment)

RoHS: Fully compliant

CE Implementation Date: April 29, 2013 (updated 03/07/2016)

Authorized Representative:

Peter Maier
Intelligent Sensor Solutions President
INFICON Inc.

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Chapter 1
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1.1 Introduction

The Transpector® MPS Gas Analysis System is a quadrupole-based mass spectrometer Residual Gas Analysis (RGA) instrument designed for use in high vacuum environments for monitoring trace contaminants and process gases. Transpector MPS runs with the Windows® operating system using either a member of the FabGuard® suite of programs or the Transpector Web UI onboard web server.

This chapter provides an overview of the Transpector MPS Gas Analysis System. Topics include: the purpose of Transpector MPS, its specifications, a list of supplied items, installation instructions and customer support contact information.

Software information can be found either in the FabGuard Explorer operating manual (PN 074-528) or in the FabGuard help files (for all other FabGuard programs). Instructions for use of the Transpector Web UI are provided in Chapter 5.

1.2 Using This Manual

Please read this Operating Manual before operating Transpector MPS.

1.2.1 Note and Hint Paragraphs

NOTE: This is a note paragraph. Notes provide additional information about the current topic.

HINT: This is a hint paragraph. Hints provide insight into product usage.

1.2.2 Warning and Caution Paragraphs

The following Caution and Warning paragraphs are used to alert the reader of actions which may cause either damage to the instrument or bodily injury.

CAUTION

This is an example of a Caution paragraph. It cautions against actions which may cause an instrument malfunction or the loss of data.

WARNING

This is an example of a General Warning paragraph. It warns against actions which may cause bodily injury.

WARNING - Risk Of Electric Shock

This is an example of a Electrical Warning paragraph. It warns of the presence of electrical voltages which may cause bodily injury.

1.3 How To Contact Customer Support

Worldwide customer support information is available under **Contact >> Support Worldwide** at www.inficon.com:

◆ Sales and Customer Service

◆ Technical Support

◆ Repair Service

If you are experiencing a problem with Transpector MPS, please have the following information readily available:

◆ the Transpector MPS serial number

◆ a description of the problem

◆ an explanation of any corrective action already attempted

◆ the exact wording of any error messages

1.3.1 Returning Your Transpector MPS to INFICON

Do not return any component of Transpector MPS to INFICON before speaking with a Customer Support Representative and obtaining a Return Material Authorization (RMA) number. Transpector MPS will not be serviced without an RMA number.

Prior to being given an RMA number, a Declaration Of Contamination (DOC) form may need to be completed if the sensor has been exposed to process materials. DOC forms must be approved by INFICON before an RMA number is issued. INFICON may require that the sensor be sent to a designated decontamination facility, not to the factory.

1.4 Quick Start

Read this operating manual in full prior to operating Transpector MPS. Then, follow the steps below to quickly start using Transpector MPS.

1 Ensure that all supplied items have been received. See Chapter 12, Supplied Items.

2 Install the hardware. See section 1.16, Hardware Installation, on page 1-9.

3 Install the communication cable. See section 1.16.3, Installing Ethernet Communications, on page 1-15.

4 Install the software. Refer to the FabGuard Explorer Operating Manual for information on installing the software.

NOTE: Transpector MPS requires FabGuard Version 8.4.2 or higher for operation.

1.5 Purpose of the Transpector MPS Gas Analysis System

Transpector MPS Gas Analysis System identifies and performs a quantitative analysis of residual gas species present inside a vacuum system. The sensor, a quadrupole mass spectrometer, analyzes gases by:

* ionizing some of the gas molecules

* separating the ions by their mass-to-charge ratio

* measuring the quantity of ions at each mass

The ions exit the quadrupole at their specific mass-to-charge ratio and generate a signal at the detector which allows for qualitative identification of the gas species in the vacuum chamber. The magnitudes of these signals are proportional to the quantity of the respective gases present inside of the vacuum system.

Transpector MPS is an important aid for detecting leaks and contaminants in high-vacuum systems. Transpector MPS can also indicate the abundance of process specific gases present within a vacuum or other vessel, and be used to investigate a process at a molecular level or to monitor process conditions.

1.6 General Description of the Transpector MPS Gas Analysis System

The Transpector MPS Gas Analysis System is comprised of three parts:

1 Sensor

The sensor functions only in a high-vacuum environment with pressures below 5×10^{-4} Torr (6.7×10^{-4} mbar) [6.7×10^{-2} Pascals].

The sensor itself is comprised of three components:

- the ion source (ionizer)
- the quadrupole mass filter
- the ion detector

The sensor is mounted on an electrical feedthrough flange, which is bolted to the vacuum space where the gas analysis measurements are made.

2 Electronics Module

The electronics module controls the sensor and communicates to the operating computer. The electronics module and sensor are sold in sets.
The electronics module attaches to and is supported by the sensor.

3 Software

The software controls the electronics module and displays the data from the sensor.

1.7 Specifications for the Transpector MPS Gas Analysis System

See Chapter 11 for the the Transpector MPS Gas Analysis System specifications.

1.8 Supplied Items

See Chapter 12 for items that are packaged with a Transpector MPS Gas Analysis System.

1.9 Physical Requirements

The following sections show the physical dimensions, weight, mounting requirements, ventilation requirements, and the perimeter required for maintenance access for Transpector MPS.

1.9.1 Physical Dimensions

Figure 1-1 shows the overall physical dimensions for Transpector MPS.

Figure 1-1 Physical dimensions

Transpector MPS	(A)	(B)	(C)
MPS100F, MPS200F	143 mm (5.63 in.)	50 mm (1.98 in.)	365.7 mm (14.40 in.)
MPS100M, MPS200M	199 mm (7.83 in.)	50 mm (1.98 in.)	421.6 mm (16.60 in.)
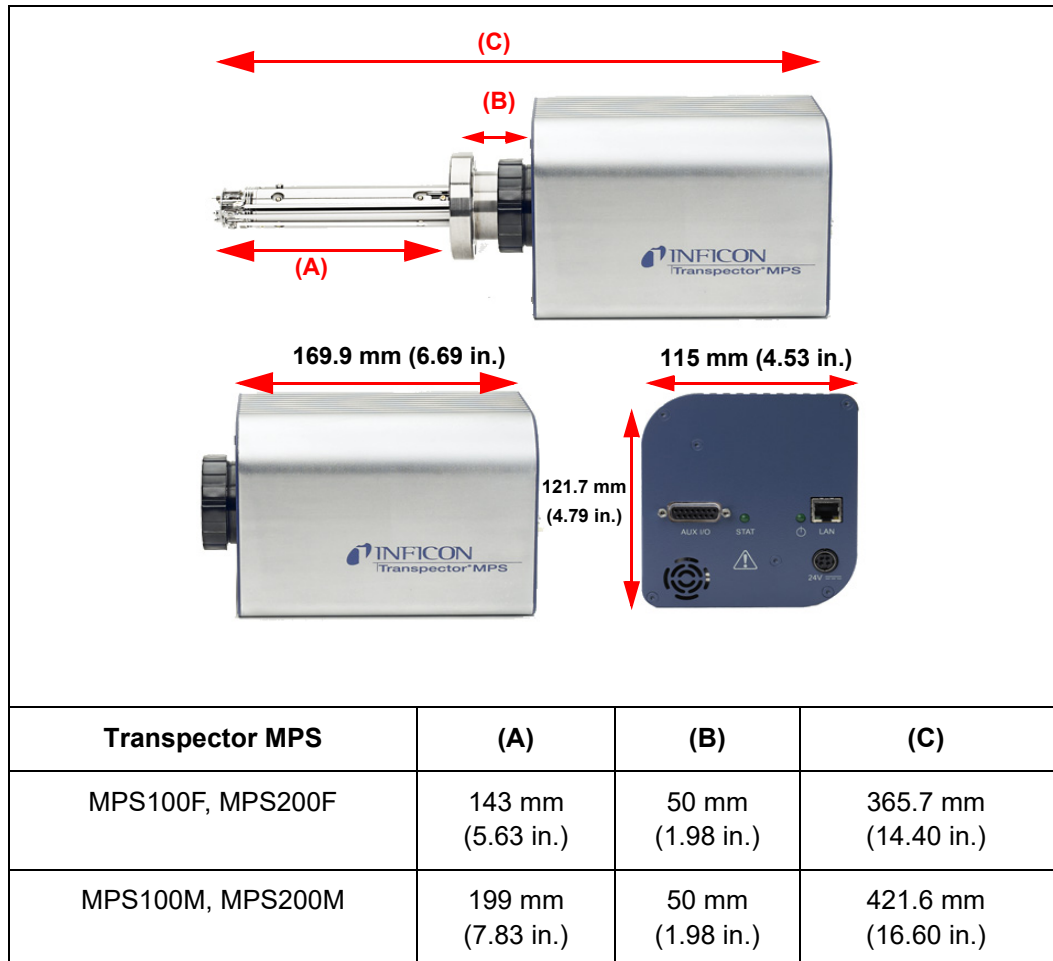
1.9.2 Weight

The Transpector MPS electronics module weighs 1.53 kg (3 lb. 6 oz.). The Transpector MPS systems complete weight depends on which sensors are used.

1.9.3 Mounting Requirements

The sensor is mounted to a high-vacuum chamber with a 69.9 (2.75 in.) DN40 ConFlat® flange with an extension tube with an OD of 41.2 mm (1.62 in.) and a 38.1 mm (1.5 in.) ID.

The electronics module attaches to and is supported by the sensor.

Transpector MPS can be mounted in any position.

1.9.4 Ventilation Requirements

At least 25.4 (1 in.) of open space around the Transpector MPS electronics module must be maintained for proper ventilation.

1.9.5 Maintenance Access

Easy access to Transpector MPS should be maintained for installation and maintenance activities.

1.10 Electrical Power Requirements

Transpector MPS must be connected to a source of power as specified in the following sections.

1.10.1 Required Supply Voltage

20 to 30 V (dc), 24 V (dc) typical

1.10.2 Current Rating

1.25 A maximum

1.10.3 Electrical Connection

Latching, 4-pin DIN connector, internally isolated from system ground. See Figure 1-2.

Figure 1-2 Transpector MPS connections
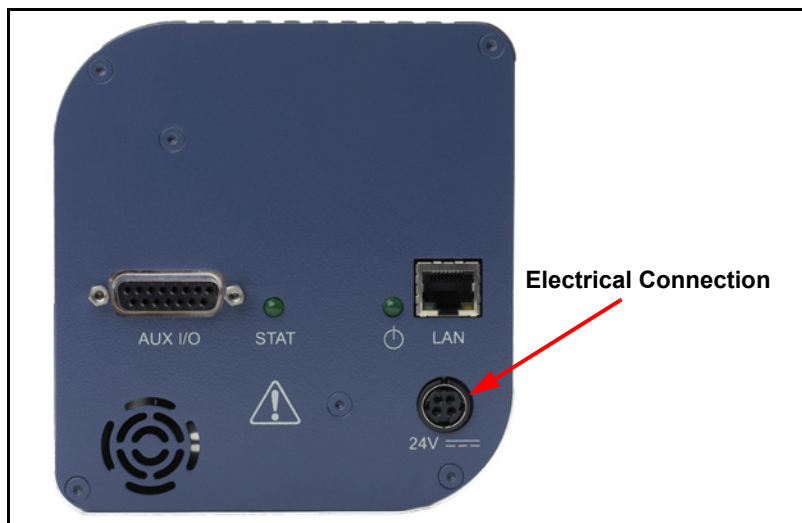
1.11 Overvoltage Category

Overvoltage Category II (per EN61010-1)

1.12 Required Vacuum

<5 x 10^{-4} Torr (6.7 x 10^{-4} mbar) [6.7x 10^{-2} Pascals]

1.13 Environmental Requirements

The following paragraphs explain the use, altitude range, humidity, pollution degree, and operating temperature for Transpector MPS.

1.13.1 Use

Transpector MPS is designed for indoor use only.

1.13.2 Altitude Range

Transpector MPS can be used up to a maximum altitude range of 2000 m (6561 ft.).

1.13.3 Pollution Degree

Pollution Degree 2 (per EN61010-1)

1.13.4 Operating Temperature

Transpector MPS is designed to operate within a temperature range of 5°C (41°F) to 50°C (122°F).

1.13.5 Humidity

Transpector MPS is designed to operate in an environment with up to 98% relative humidity.

1.14 Computer System Requirements

Refer to the FabGuard Explorer Operating Manual (PN 074-528) for computer system requirements.

1.15 Software Installation

Refer to the FabGuard Explorer Operating Manual (PN 074-528) for information on installing the software and setting up the protocols necessary to ensure proper software operation.

1.16 Hardware Installation

Three pieces of hardware must be installed in the following order:

1 Install the sensor as explained in section 1.16.1 on page 1-9.

2 Install the electronics module as instructed in section 1.16.2 on page 1-14.

3 Install the communications cables from the computer to the electronics module as explained in section 1.16.3 on page 1-15.

If the optional extension tube heater was purchased with the Transpector MPS, see section 1.18, Installing the Heater Jacket (optional), on page 1-18 for installation instructions.

1.16.1 Sensor Installation

⚠️ **CAUTION**

Do not touch any surface on the vacuum side of the sensor with bare fingers. If it is necessary to touch any of these parts, always wear clean linen, nylon, powder free latex or vinyl laboratory gloves.

Before installing the sensor on your system, check for any signs of loose or broken parts.

Do not attempt to clean the sensor in any kind of solvent. Cleaning the sensor requires its disassembly. If the sensor is contaminated and needs cleaning, contact INFICON.

1.16.1.1 ConFlat Flanges

The sensor is installed on a vacuum system with a 2.75 in. DN40 ConFlat flange. ConFlat flanges, and similar compatible types made by other manufacturers, are used for attaching devices to ports on high vacuum systems. If there are no concerns with the installation of this type of flange, proceed to section 1.16.1.2, Attaching the Sensor to the Vacuum Chamber, on page 1-11.

NOTE: If your system does not have a port with a compatible mating flange, an adapter will be necessary.

To install these flanges without leaks, follow proper operating procedures. These flanges are sealed with a metal gasket and can be heated for bakeout to temperatures of up to 300°C. For bakeout temperatures when a sensor is installed, see Table 1-1 on page 1-13.

1.16.1.1.1 Assembling ConFlat Flanges

To assemble a pair of ConFlat flanges:

1 Wipe the sealing areas of the flanges with a laboratory towel using a clean solvent, such as water free alcohol. These areas must be clean and free of particulate matter.

⚠️ **CAUTION**

Do not touch the gasket and flange faces with your fingers during the installation process.

2 Install the copper gasket between the two flanges. See Figure 1-3. Always use a new gasket. *Do not attempt to use gaskets more than once.*

Figure 1-3 Gasket and flange assembly
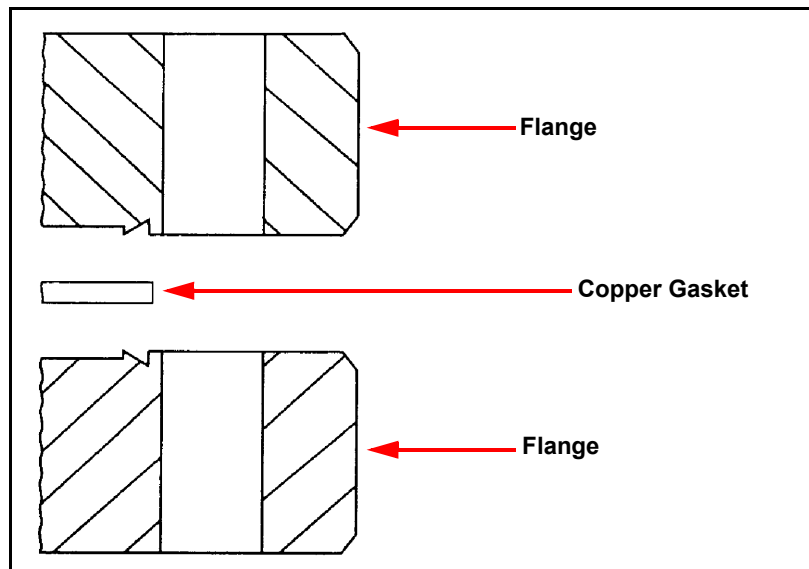
3 Bring the two flanges together making sure that the gasket fits in the recess in both flanges. Flange faces should be parallel. If the gasket is properly seated, it should not be possible to slide the two flanges laterally with respect to each other.

4 Install supplied silver-coated stainless steel bolts in the bolt holes of the flanges and finger-tighten only.

NOTE: If the factory-supplied silver-coated stainless steel hardware is not used and the flanges are going to be baked, coat the bolt threads with an anti-seize compound (FelPro® C 100 or equivalent).

⚠️ **CAUTION**

Do not get any of the anti-seize compound on the gaskets or the vacuum parts of the flange.

5 After the bolts have been finger-tightened and the flange faces are parallel, tighten the bolts gradually and evenly in a star pattern until the flange faces are brought into even contact with each other.

1.16.1.2 Attaching the Sensor to the Vacuum Chamber

The sensor may be mounted in any position when attaching it to the vacuum vessel or chamber.

⚠️ **CAUTION**

Avoid mounting the sensor near any magnetic fields greater than two gauss.

It is important that the connection between the sensor and the vacuum chamber does not interfere with gas exchange to ensure that the gas composition accurately reflects that existing in the vacuum chamber.

If materials are evaporated or coatings are deposited in the vacuum chamber, you must protect the sensor against the deposition of these materials on its surfaces by installing a baffle or deflector.

In systems which are baked, include the sensor in the bakeout zone or provide it with separate heaters.

Dimensions of the quadrupole sensors are shown in Figure 1-4.

Figure 1-4 Sensor dimensions

249.1 mm
(9.81 in.)

193 mm
(7.83 in.)

MPS100M, MPS200M

193.3 mm
(7.61 in.)

143 mm
(5.63 in.)

MPS100F, MPS200F
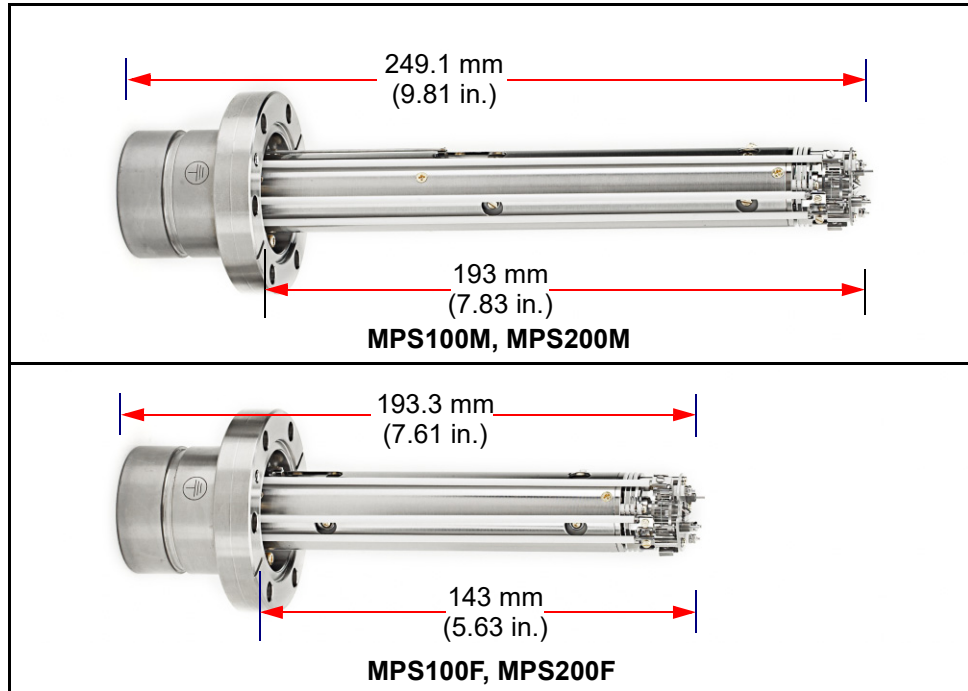
The sensor is shipped inside an extension tube with 38.1 mm (1.5 in.) ID. This tube is provided to attach the sensor to your vacuum chamber. The part number for the 203.2 mm (8 in.) long extension tube kit is 961-206-G2.

⚠ **CAUTION**

The silver-plated bolts used for mounting the sensor to the vacuum system must be oriented such that the bolt heads are on the same side of the sensor as the electronics box. Otherwise, there may be interference between the black INFICON Transpector mounting nut and the sensor mounting hardware.

⚠ CAUTION

Maximum bakeout temperature for sensors is shown in Table 1-1.

Table 1-1   Sensor maximum bakeout temperature

Sensor	Maximum Operating Temperature	Maximum Bakeout Temperature Electronics Removed
MPS100F/200F	200°C	300°C
MPS100M/200M	150°C	300°C

⚠ CAUTION

The Transpector MPS electronics module must be removed prior to bakeout at temperatures greater than 200°C (FC).

Do not turn on the electron multiplier at sensor temperatures above 150°C. Turning on the EM at elevated temperature could result in permanent damage to the detector.

⚠ WARNING

During or immediately after bakeout, the heating jacket and metal surfaces in the vicinity of the heating jacket may be extremely hot. These surfaces may exceed 100°C at the maximum ambient operating temperature (50°C), which will cause burns if touched directly without using the proper personal protection equipment.

1.16.2 Electronics Module Installation

The Transpector MPS electronics module should be mounted in an area where the ambient temperature does not exceed 50°C and there is free air circulation around the electronics module. Best performance will be achieved if the electronics module is not located close to major heat sources where it is subjected to wide temperature variations. For Electronics module dimensions, see section Figure 1-5 on page 1-14

After the sensor has been installed on the vacuum system, the Transpector MPS electronics module must be mounted on the sensor:

1 The Transpector MPS sensor mounting connector assembly includes a mounting nut and an O-ring. When the mounting nut is tightened, the O-ring compresses making a tight fit on the sensor housing. For proper installation, place the nut over the end of the sensor and roll the O-ring back to the groove on the sensor.

2 Note the recessed area on the sensor feedthrough and the ground tab on Transpector MPS electronics module. Match the recessed area of the feedthrough to the ground tab and carefully slide the Transpector MPS electronics module onto the sensor. Make sure the Transpector MPS electronics module slides on fully.

3 Hand tighten the mounting nut on the Transpector MPS sensor.

4 Continue with section 1.16.3 and install the communications cable.

Figure 1-5 Electronics module dimensions

121.67 mm
(4.79 in.)

60.32 mm
(2.375 in.)

57.48 mm
(2.263 in.)

114.96 mm
(4.526 in.)
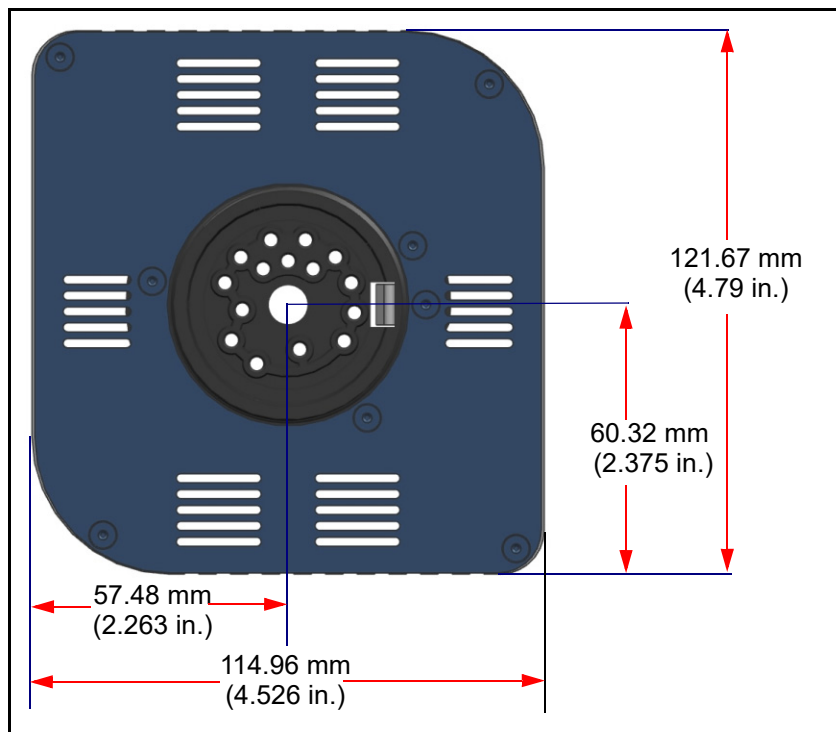
1.16.3 Installing Ethernet Communications

Communication cables are required to connect Transpector MPS to the computer. Ethernet communication is the default communication method for Transpector MPS. Ethernet communication uses standard RJ45, Cat5e Ethernet cables. To use Ethernet communications, attach the supplied Cat5e Ethernet cable to the LAN port on the back of the Transpector MPS electronics module. See Figure 1-6.

For networking information, see Chapter 2, Connecting Transpector MPS.

Figure 1-6 Ethernet port

Ethernet Port
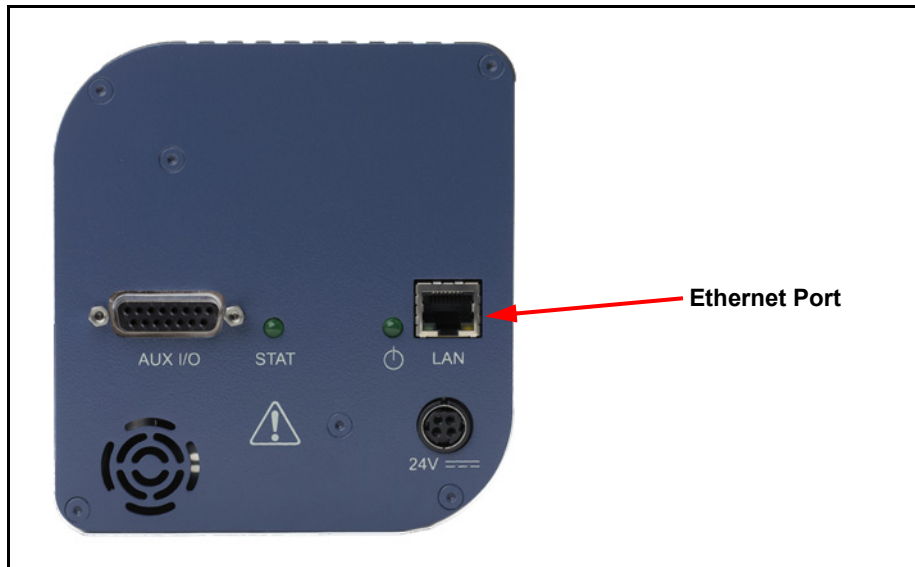
1.16.4 Connecting the 24 V(dc) Power Supply

1 Connect the +24 V(dc) power supply cable to the **24V** connector on the Transpector MPS electronics module by sliding back the latch, installing the cable, and then releasing the latch.

   NOTE: The latch locks the connector to the electronics module, and must be slid back to detach the cable from the Transpector MPS electronics module.

2 Plug the AC line cord into the mating IEC320 connector on the power supply module.

   NOTE: The AC Line Input for the +24 V(dc) Power Supply must be rated: 90-260 V(ac), 40 W maximum, 47-63 Hz.

3 Plug the AC line cord into an appropriate AC outlet.

4 Verify that the green power LED on the Transpector MPS back panel is illuminated. If the green indicatoris not illuminated, check the power connections.

1.17 Input/Output (I/O)

This section describes the output and input for Transpector MPS.

The Transpector MPS electronics module supports the following I/O functions through the AUX I/O connector located on the back panel. See Figure 1-7.

1.17.1 Two Digital Inputs

Logic Inputs 1 and 2 are by default set to remotely control emission status. Connecting Pin 14 (Logic Input 1) to Pin 15 (Ground) will turn on the emission. Connecting Pin 13 (Logic Input 2) to Pin 15 will turn off the emission. See Table 1-2.

Table 1-2 Digital inputs

Emission ON	PIN 14
Emission OFF	PIN 13
GND	PIN 15

⚠️ **CAUTION**

Controlling emission through the digital inputs bypasses all software or hardware interlocks. When using digital inputs for controlling Transpector MPS emission, develop an interlock that will not allow the emission to turn on if the pressure is too high for operation of Transpector MPS.

1.17.2 One Status Relay Output

One status relay output is active (closed) when the emission is on. See Table 1-3.

Table 1-3 Status relay output

EMISSION ON	Relay closed. PIN 2 and PIN 1connected
EMISSION OFF	Relay open
CONTACT RATING	24 V (dc) at 0.5 A
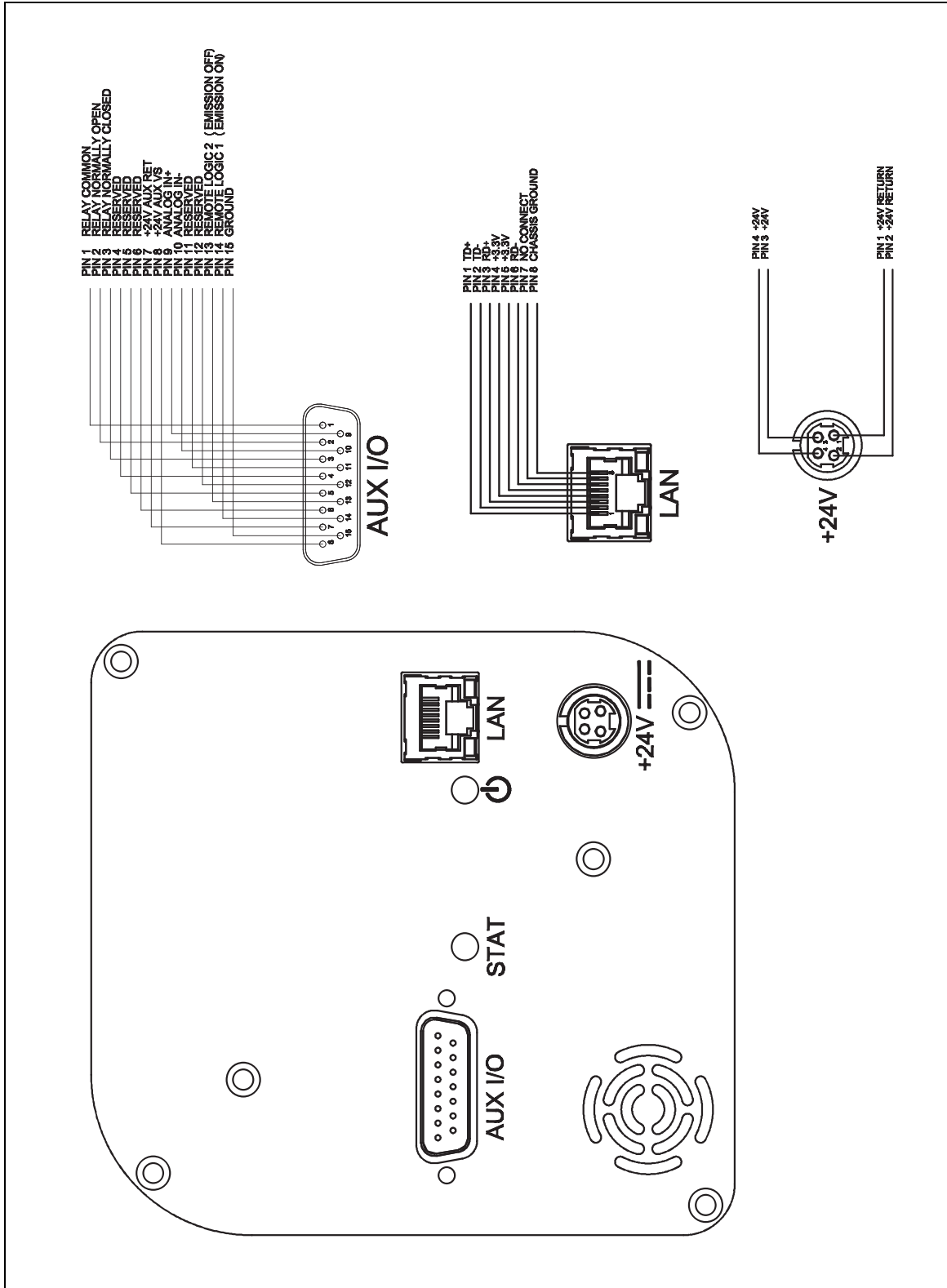
Figure 1-7 Pinout connectors

1.17.3 One Analog Input

One analog input is differential and can handle inputs between 0 to +10 volts and common mode voltages of 100 volts. See Table 1-4.

Table 1-4 Analog inputs

ANALOG INPUT 1	(+)	PIN 9
ANALOG INPUT 1	(-)	PIN 10

NOTE: The analog input is supported through FabGuard software.

1.18 Installing the Heater Jacket (optional)

The Transpector MPS Heater Jacket Mount Kit (961-433-G1) provided with Heating Jacket Kit (961-029) is intended to inhibit the movement of the Manifold Heater. This kit is only for system installations without calibration standards that are mounted in a vertical orientation. (See Figure 1-8.)

NOTE: For all other heater installations, discard this kit.

1 Install the Manifold Heater over the tube extension and align the snaps with the tapped hole in the sensor flange.

2 Align the Internal Heater Bracket so the large hole fits over the snap on the heating jacket and capture the bracket in the Manifold Heater by securing the snaps.

3 Using a 7 mm combination wrench, attach the Internal Heater Bracket to the tapped hole in the sensor flange using the hex head fastener provided in the kit.

4 Attach the manifold heater power connector to the mating connector on the 600-1487 power cable and 068-0433 (120V) or 068-0434 (230V) provided in the 961-029 heating jacket kit.

Figure 1-8 Heater jacket installation
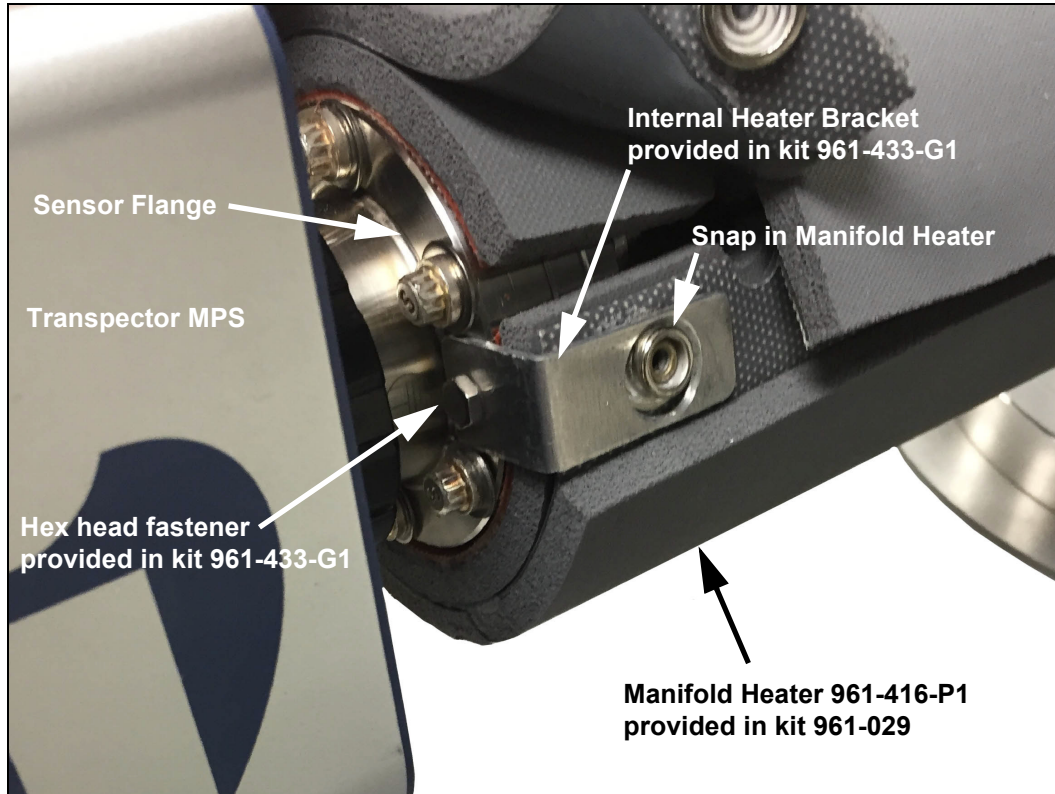
Chapter 2
Connecting Transpector MPS

2.1 Introduction

Transpector MPS uses Ethernet as its default communications method.

Transpector MPS has an IP address and a MAC address.

IP addresses are used as a means of identifying individual devices on a network. IP addresses are unique on a network but not universally, that is, meaning that only one device on a network can have a specific IP address but two devices on separate networks can have the same IP address.

MAC addresses are another identifier that are unique for each device. MAC addresses are never duplicated. FabGuard uses IP addresses to locate and identify sensors on a network.

2.2 General Networking Information

This section will discuss some of the general networking variables that can affect the connection of Transpector MPS.

2.2.1 IP Addresses

IP addresses can be set either manually or automatically:

 ◆ Static (manual) IP addresses are set by the user and are manually changeable by the user

 ◆ Dynamic (automatic) IP addresses are automatically set by a Host

INFICON recommends using Static IP addresses for Transpector MPS but allows for Dynamic IP addresses set through DHCP (Dynamic Host Communication Protocol).

NOTE: When using Static IP addresses, a block of addresses should be reserved for Static use and prohibited from being assigned by the DHCP server (Host). This will avoid duplicate IP address conflicts from occurring.

⚠️ **CAUTION**

Since FabGuard uses the IP address to identify each connected Transpector MPS, the IP address must not change during operation of Transpector MPS.

Using DHCP, the host may generate a new IP address every time Transpector MPS is taken offline and then returns online.

DHCP may also change the IP address automatically if there is an IP address conflict on the network.

If the Transpector MPS IP address is randomly changed during data acquisition, FabGuard will not automatically reconnect to the Transpector MPS sensor because it does not know the newly assigned IP address. This will lead to loss of communication and loss of data.

Static IP addresses do not change unless the IP address is manually changed. Static IP addresses help protect Transpector MPS from losing communication and data.

Transpector MPS uses IPv4 IP addresses. IPv4 IP addresses consist of 32 bits that are traditionally displayed in dot-decimal notation which consists of four decimal numbers each ranging from 0 to 255 separated by dots. An example of an IP address in dot-decimal notation would be 192.168.1.100. Each part represents an octet. Normally, the IP address consists of a Network Prefix and a Host Protocol.

2.2.2 Subnetworking

A subnetwork (or subnet) is a logically visible subdivision of an IP (Internet Protocol) network. Splitting an IP network into multiple subnets is referred to as subnetting. Subnetting sets the region of the IP address that will be used as a Network Prefix for all IP addresses inside of a subnet. This is accomplished through a subnet mask. Different types of subnet masks and their implications to IP addresses are shown in Table 2-1.

Table 2-1 Subnetting

	Example 1	**Example 2**	**Example 3**
IP address	192.168.1.104	192.168.1.105	192.168.1.150
Subnet mask	255.255.255.0	255.255.0.0	255.255.255.192
Network prefix	192.168.1.0	192.168.0.0	192.168.1.128
Host Protocol	0.0.0.104	0.0.1.105	0.0.0.22

As seen in Table 2-1, the subnet masks determine which octets of the IP address are used as the network prefix.

In order for two network devices to communicate, they must be on the same subnet. This means that they must not only be connected to the same internet network, but must also have the same network prefix. If two devices have two different network prefixes, this means that the two devices are on different subnets.

2.3 Transpector MPS IP Address

By default, Transpector MPS ships with an IP address of 192.168.1.100 with a subnet mask of 255.255.0.0.

NOTE: When connecting Transpector MPS to an existing local network, there must be a static IP address for each Transpector MPS being installed. Contact your network administrator for IP address assignments.

2.3.1 Changing Transpector MPS IP Address

There are two different methods of changing the Transpector MPS IP address.

The first method utilizes the onboard Transpector Web UI to change the IP address. Instructions for changing the IP address via Transpector Web UI can be found in section 5.5.2.4 on page 5-22.

Alternatively, the IP address can be changed through a standalone.exe as discussed next in section 2.3.1.1.

2.3.1.1 *Using the INFICON Mass Spectrometer Search Utility to Change the IP Address*

The alternative method of changing the Transpector MPS IP address employs the INFICON Mass Spectrometer Search Utility (IMSSU), a standalone executable found on the software installation disk and the RGA Manuals CD that ships with each Transpector MPS. To use the IMSSU, locate and double-click **INFICONMassSpecSearch.exe**. The program does not need to be installed to work. Upon double-clicking, the IMSSU will display as shown in Figure 2-1.

Figure 2-1 INFICON Mass Spectrometer Search Utility
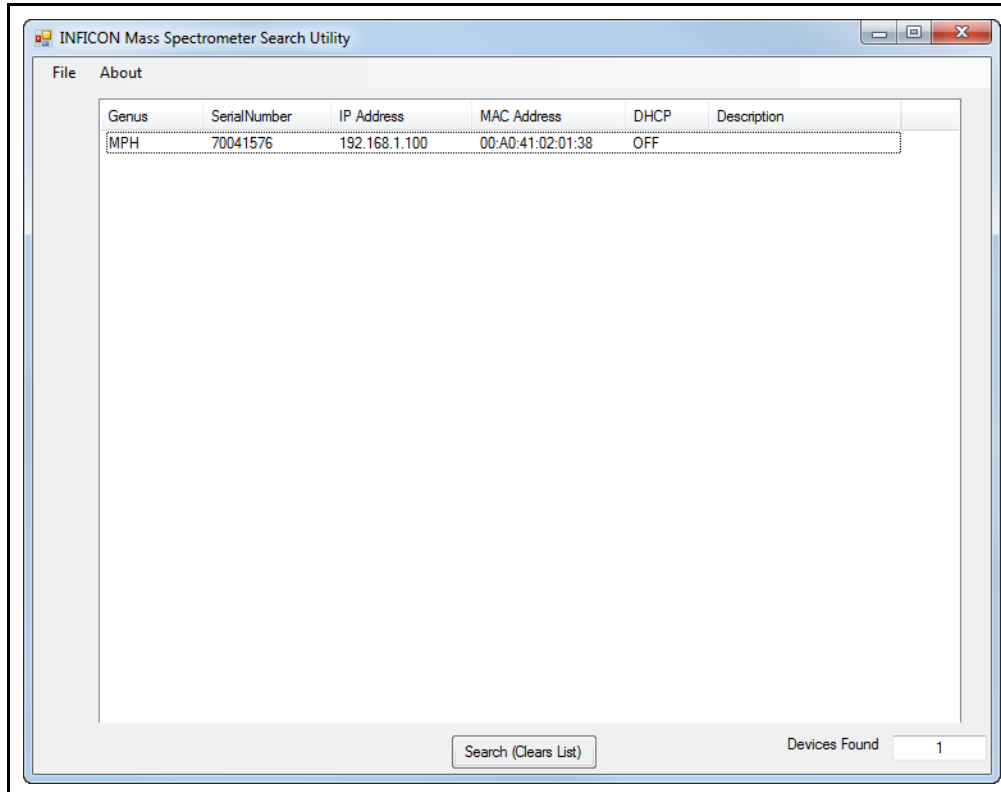
When the IMSSU first opens, nothing will be displayed. The IMSSU acts detects all Transpector MPS installed on the network regardless of IP address. The IMSSU will start automatically, or it can be manually started by clicking **Search (Clears List)**. The IMSSU will then display the:

◆ Genus (which will display MPS for Transpector MPS sensors)

◆ Transpector MPS Serial Number

◆ Current IP address of Transpector MPS

◆ MAC address of Transpector MPS

◆ DHCP status of Transpector MPS (On or Off)

◆ Description (which is user editable)

2.3.1.1.1 IMSSU Capabilities

The IMSSU has multiple built-in functions. All of these functions are available by right-clicking on the sensor inside of the IMSSU. The right-click menu can be seen in Figure 2-2, and the different functions are described in the following sections.

Figure 2-2 IMSSU right-click menu
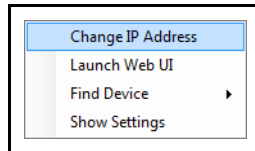
Changing Transpector MPS IP Address

To change the IP address, right-click on the sensor and select **Change IP Address**. The **TCP/IP Properties** window will display, see Figure 2-3.

Figure 2-3 IMSSU TCP/IP Properties window
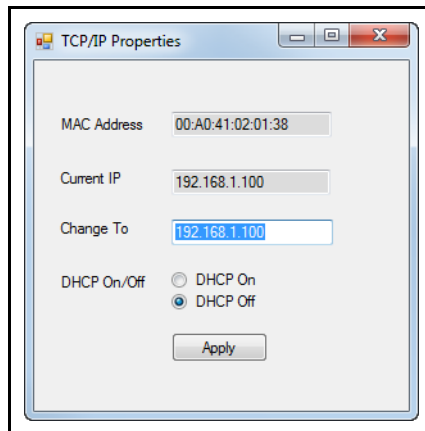
The **TCP/IP Properties** window will display:

◆ Transpector MPS MAC Address

◆ the current Transpector MPS IP address

◆ a **Change To** text box, to enter the new Transpector MPS IP address

◆ a selection of either **DHCP On** or **DHCP Off**

To change the IP address, type in the new IP address in the **Change To** box and click **Apply**. Transpector MPS will automatically reboot and will come back online with the new IP address.

Alternatively, the IP address can be automatically assigned to Transpector MPS by selecting **DHCP On** (*this is not recommended*).

Launching Transpector Web UI

Transpector Web UI can be launched from inside of the IMSSU. More information about Transpector Web UI can be found in Chapter 5, Using Transpector Web UI.

Find Device

Find Device On will flash the power LED so that the device can be located. The LED will flash for up to 60 seconds and then return to the fully On state.

Find Device Off will stop the flashing if executed within 60 seconds of turning the **Find Device** On.

Show Settings

Click **Show Settings** to open a display on the right-side of the IMSSU that will display multiple settings of Transpector MPS. This is an excellent tool for troubleshooting. The following settings are displayed:

- Serial Number
- Gateway
- IP Address
- DHCP Status
- MAC Address
- Description
- Subnet Mask
- Name
- Description
- Structure Version
- Name
- Box Type
- Port
- Firmware Version
- TCP/IP Source

2.3.1.2 *Changing the Computer IP Address*

An alternative to changing the Transpector MPS IP address is to change the host computer's IP address to allow for communication between the host computer and Transpector MPS. To change the computer's IP address, follow these instructions:

2.3.1.2.1 *Windows 7 Instructions*

NOTE: Changing the IP address of the host computer requires administrator rights. An administrator account is necessary to change the IP address.

1 Click **Start** to display the **Start** menu, then click **Control Panel**. **Start** is located on the taskbar on the Windows 7 desktop. See Figure 2-4.

Figure 2-4 Start menu
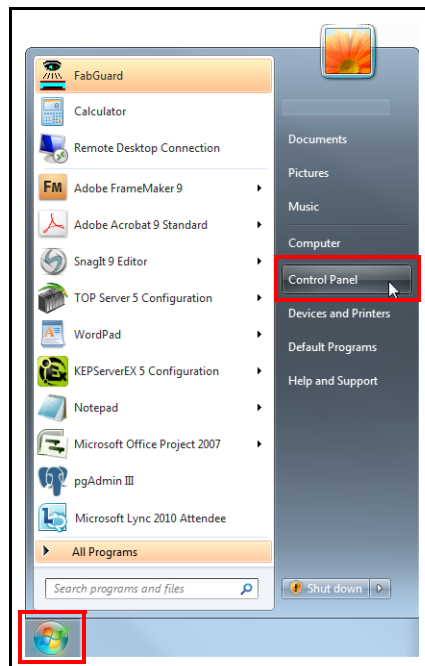
2 In the **Network and Internet** group. click **View network status and tasks**. See Figure 2-5.

Figure 2-5 View network status and tasks
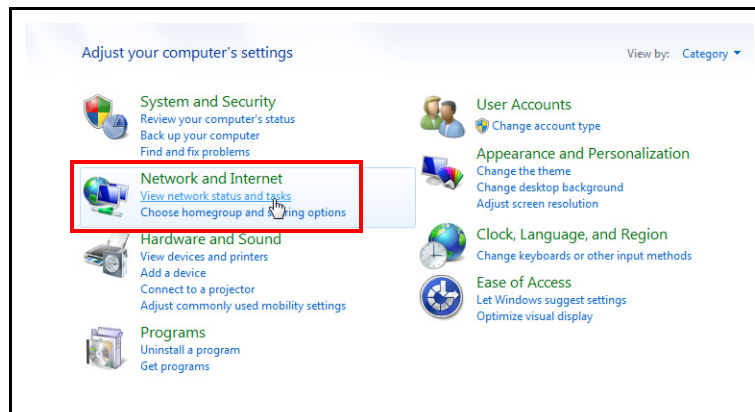
3 On the network status and tasks window, click **Change adapter settings**.

Figure 2-6 Change adapter settings
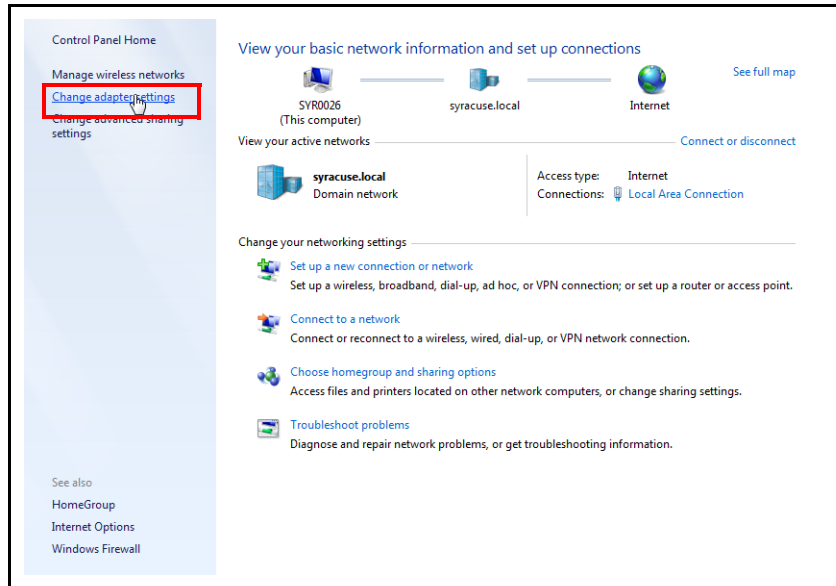
4 If the host computer is connected to Transpector MPS through the Ethernet port of the computer, right-click **Local Area Connection** and select **Properties**. See Figure 2-7.

Figure 2-7 Changing adapter settings
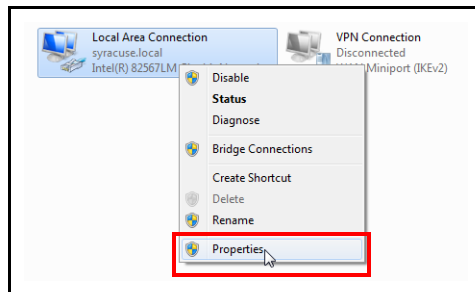
5 Select **Internet Protocol Version 4 (TCP/IPv4)**, then click **Properties**. See Figure 2-8.

Figure 2-8 TCP/IPv4
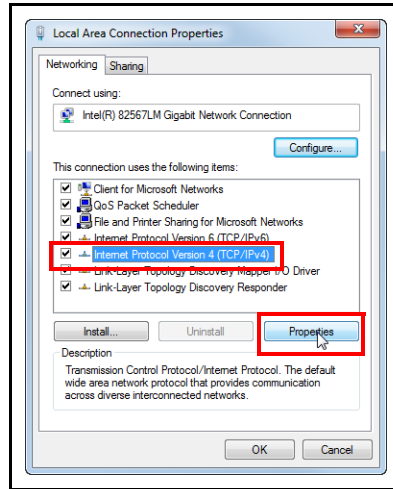
6 In the TCP/IPv4 properties menu, select **Use the following IP address**. See Figure 2-9.

Figure 2-9 Use the following IP address
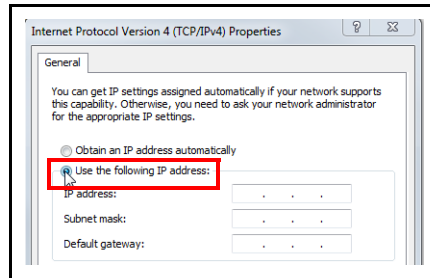
7 In **IP address:** type **192.168.1.XXX**. The last octet can be any number as long as it is unique to the network. See Figure 2-10.

8 In **Subnet mask:** type **255.255.0.0**.

9 Click **OK**.

Figure 2-10 Changing the computer IP address
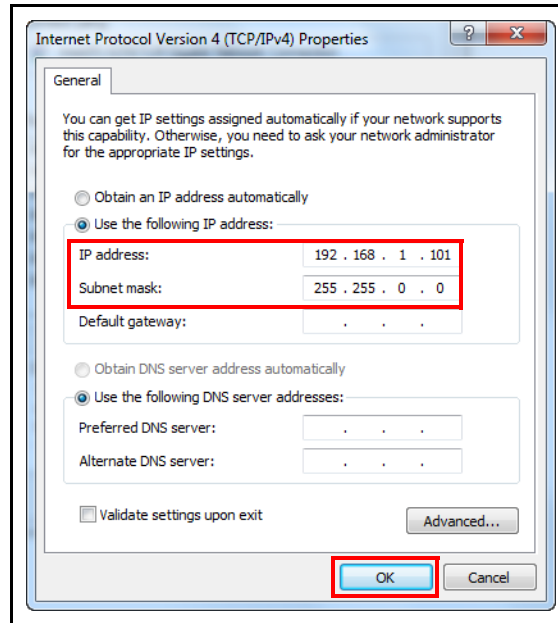
10 The IP address will now be set to the manual IP address chosen in step 7. Exit all of the menus and then connect to Transpector MPS.

11 To change the IP address back to its default settings, follow steps 1 through 6 and return the IPv4 properties to their original settings.

2.3.1.2.2 Windows XP Instructions

1 Click **Start** to display the **Start** menu, then click **Control Panel**. **Start** is located on the taskbar on the Windows XP desktop. See Figure 2-11.

Figure 2-11 XP Start Menu
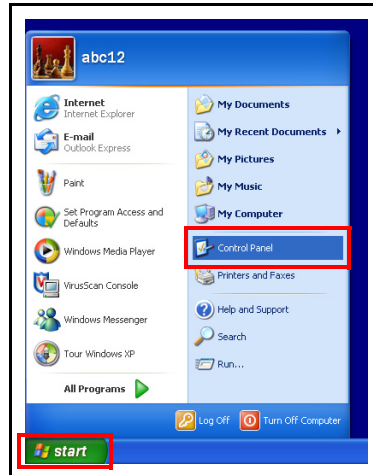
2 On the **Control Panel**, click **Network and Internet Connections**. See Figure 2-12.

Figure 2-12 XP Control Panel
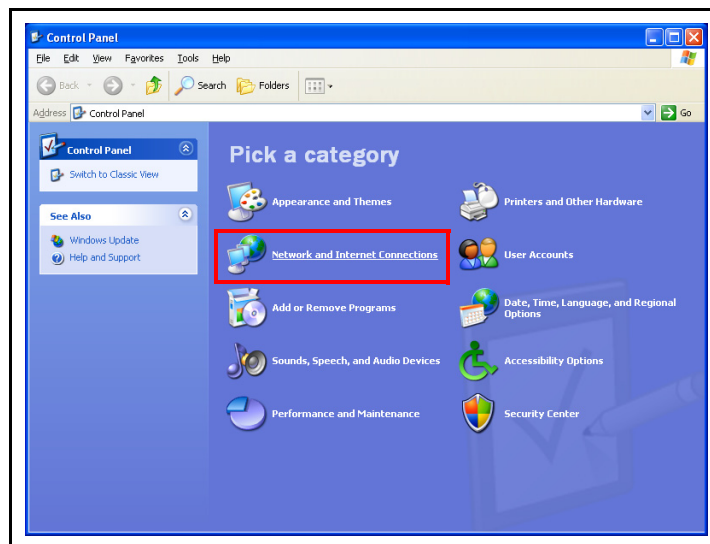
3 In the **Network and Internet Connections** window, click **Network Connections**. See Figure 2-13.

Figure 2-13 Network and Internet Connections
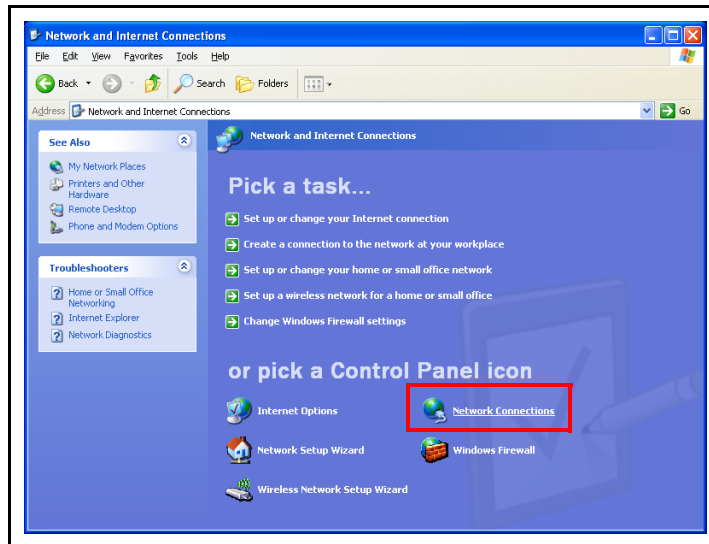
4 Double-click the **Local Area Connection** icon. See Figure 2-14.

> **NOTE:** The icon may have a number after it if more than one connection has been installed. Make sure to choose the correct **Local Area Connection**.

Figure 2-14 Network Connections
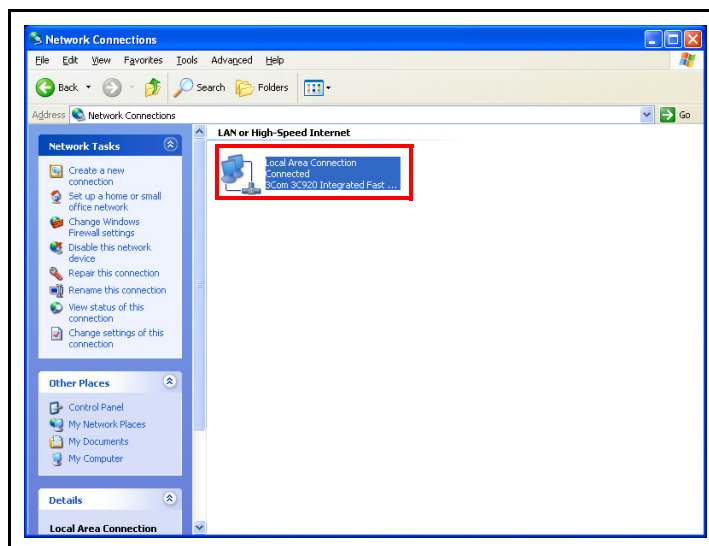
5 Click **Properties**. See Figure 2-15.

Figure 2-15 Local Area Connection Status
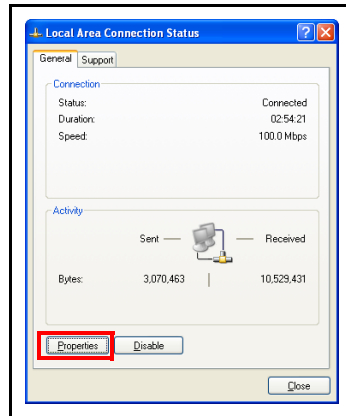
6 Select **Internet Protocol (TCP/IP)**, then click **Properties**. See Figure 2-16.

Figure 2-16 Local Area Connection Properties
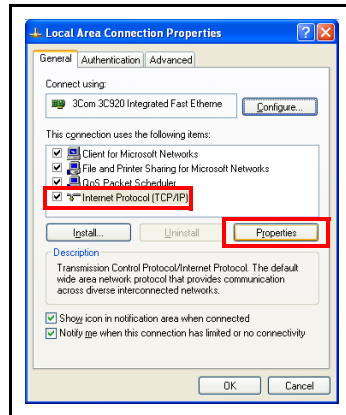
7 Select **Use the Following IP Address** and enter in the desired IP address. Then click **OK**. The IP address will update. See Figure 2-17.

Figure 2-17 TCP/IP Properties
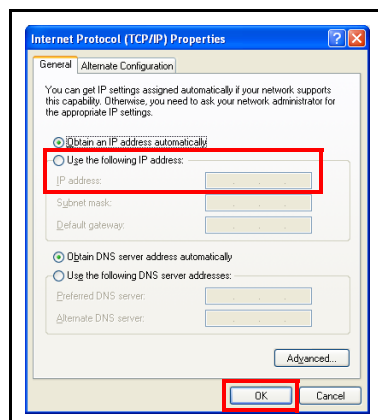
2.4 Connecting Transpector MPS

Before connecting Transpector MPS, decide:

1 Is Transpector MPS going to be set up on:

- ◆ a private network (installed directly on to either a computer or a router that is not hooked up to the internet), or

- ◆ an internal network where multiple computers are connected with access to the internet?

2 Is more than one Transpector MPS sensor being installed at the same time?

2.4.1 Connecting a Single Transpector MPS

2.4.1.1 Single Transpector MPS Direct Connection Installation

When installing a single Transpector MPS on a private network or directly connected to a computer, changing the IP address of Transpector MPS is only necessary if the computer being used to connect to Transpector MPS has a different network prefix than Transpector MPS.

The network prefix of Transpector MPS is **192.168.x.x**. The IP address of the host computer used to control Transpector MPS must have a subnet mask of **255.255.0.0** and a network prefix of **192.168.x.x**.

If this is not the case, change the computer IP address to match the network prefix of Transpector MPS. For example, giving the computer an IP address of **192.168.1.101** will allow Transpector MPS to communicate directly with the computer. Refer to section 2.3.1.2, Changing the Computer IP Address, on page 2-7.

2.4.1.2 Installing a Single Transpector MPS on an Existing Local Network

When installing a single Transpector MPS on an existing local network, the default IP address of Transpector MPS may not be compatible with the network.

Transpector MPS can have either a Static IP address (*recommended*) or a Dynamic IP address set by DHCP (*not recommended*).

Contact your network administrator for information regarding valid IP addresses and have them assign an IP address for Transpector MPS. See section 2.3.1, Changing Transpector MPS IP Address, on page 2-3.

2.4.2 Installing Multiple Transpector MPS Sensors

Since each Transpector MPS is shipped with the same default IP address, the IP address of each Transpector MPS must be changed one at a time so that each sensor has a unique IP address. See section 2.3.1, Changing Transpector MPS IP Address, on page 2-3.

⚠️ **CAUTION**

Do not connect multiple Transpector MPS to a network at the same time without first changing the IP addresses. Since the IP addresses are not unique, connecting multiple units at the same time will cause IP address conflicts on the network.

2.4.2.1 Installing Multiple Transpector MPS Directly to a Host Computer

If multiple Transpector MPS sensors are to be connected to a single host computer and not to an existing local area network, a private local network must be created. Transpector MPS will have to be installed on either a router or Ethernet switch. The router or switch is then connected to the host computer through the LAN port of the router/switch.

2.4.2.2 Installing Multiple Transpector MPS on an Existing Local Network

If multiple Transpector MPS sensors are to be connected to an existing local network, use an Ethernet switch instead of a router.

NOTE: Routers can cause conflicts with local networks because the router will attempt to set IP addresses for all network connected devices.

Since Transpector MPS sensors will be network connected devices, each sensor must have an IP address assigned to it by a network administrator. After changing each IP address manually, connect all of the sensors to the Ethernet switch and connect the switch to the local network.

Chapter 3
How The Instrument Works

3.1 Introduction

This section explains how Transpector MPS produces measurements. For a discussion of how to interpret these measurements, see Chapter 4, Applications Guide.

3.2 Overview

The Transpector MPS Gas Analysis System is a quadrupole based Residual Gas Analyzer which analyzes the presence and relative abundance of gases in a mixture. The Transpector MPS Gas Analysis System consists of three parts:

- ◆ a sensor, which functions only in a high-vacuum environment

- ◆ an electronics module, which operates the sensor

- ◆ software, which resides on an external computer and controls the electronics module

NOTE: A *high-vacuum environment* correlates to pressures below
     6.7×10^{-2} Pascals, or approximately 5×10^{-4} Torr [approx. 6.7×10^{-4} mbar].

By attaching the sensor to a small vacuum system with a suitable controlled leak or other gas-inlet device, the Transpector MPS Gas Analysis System can measure gases or volatile materials at pressures higher than those at which the sensor itself can operate.

The Transpector MPS sensor analyzes gases by:

- ◆ ionizing some of the gas molecules (in the ion source)

- ◆ separating the ions by their mass-to-charge ratio (m/z) (in the quadrupole mass filter)

- ◆ measuring the quantity of ions at each mass (in the detector)

The masses and their fragmentation patterns, unique for each substance, can be used to identify the gas molecules from which the ions were created. The magnitudes of these signals are used to determine the relative abundance of the respective gases.

The sensor consists of three main parts: (See Figure 3-1.)

◆ ion source (ionizer)

◆ quadrupole mass filter

◆ ion detector

These parts are mounted on an electrical feedthrough flange, bolted to the vacuum space where the gas analysis measurements are made.

Figure 3-1 Transpector MPS sensor

Ion Source   Quadrupole   Detector
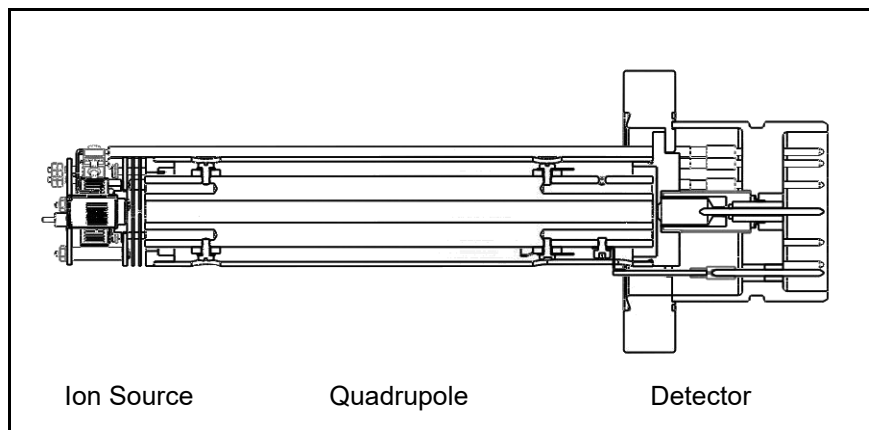
The sensor works only in a high-vacuum environment because the ions, once created, must not collide with neutral gas species or the walls of the ion source. Otherwise, they cannot be detected. At low pressure, the total flight path of the ions is long enough to pass through the quadrupole without collisions.

3.3 The Ion Source

The ion source of Transpector MPS is optimized for detecting residual gases in a vacuum system. The sensor has an open construction that facilitates the flow of gas species into the ionization region. Figure 3-2 on page 3-3 shows the open ion source in more detail.

Inside the ion source, a "large" current is put through a filament. This current heats the filament and causes it to emit electrons, which collide with the gas species forming ions. Once a gas specie is ionized, electric fields can be used to manipulate it.

The ions formed in the ion source result from the loss of electrons and thus are positive in charge.

Figure 3-2 Sensor's ion source

Electron Repeller

Filament (Cathode)

Anode (with Cage)

Focus Lens

Source Exit Lens
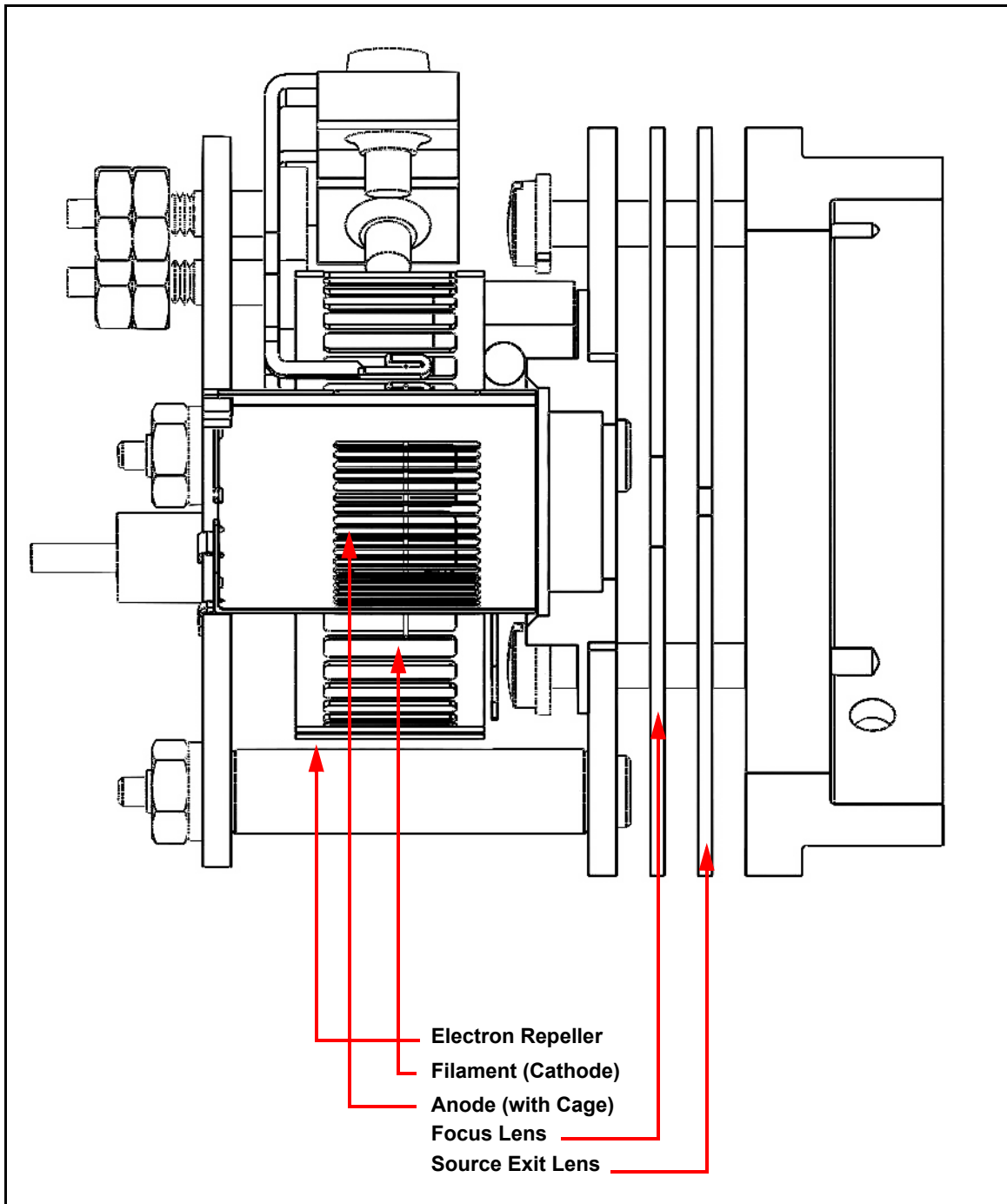
The Transpector MPS filament is Dual Yttria-coated Iridium. See section 3.3.1.

Emission current refers to the stream of electrons emitted by the filament. The filament is heated with a DC current from the emission regulator circuit, with the resulting temperature of the filament used as the means of controlling the emission current.

Centered inside the curved filament is the ion cage, which is mounted to the anode plate. The cage has an open mesh structure to facilitate the flow of gas molecules into the ionizing region. The potential (voltage) on the anode is positive with respect to the electron repeller (also an open mesh structure); the potential on the filament lies somewhere between these other two electrodes. The potential difference between the filament and the anode determines the kinetic energy (usually called the electron energy) of the emitted electrons. The electron energy in turn determines how gas molecules will ionize when struck by the electrons.

The ions formed within the cage on the anode are pulled away by the potential on the focus lens and formed into a beam. (The focus lens is sometimes called an extractor, since it extracts the ions from the region in which they are created.) The focus lens also serves to focus the ion beam into the hole in the source exit lens. To attract positive ions, the focus lens is biased negatively with respect to the anode.

The potential on the source exit lens is negative with respect to the anode, and (for the particular design illustrated here) the focus lens as well. Part of the ion beam passes through the hole in the exit lens and is injected into the mass filter.

The remaining portion of the beam strikes the exit lens and is neutralized, resulting in a current flow. The magnitude of this current is related to the pressure in the ion source, and can therefore be used as a measure of the total pressure. When this current exceeds a preset level, the voltages operating the sensor are turned off to protect the sensor from damage due to an over-pressure condition.

NOTE: This protection feature works only after the filament has been operating for a short period of time. Therefore, the filament will not be protected from excessive pressure if the sensor is turned on too early in a pump-down cycle.

3.3.1 Transpector MPS Filament

Dual Yttria-coated Iridium is the only available filament for Transpector MPS.

Yttria-coated iridium filaments have a coating of yttrium oxide over an iridium core. Yttria is a rare-earth element that, in its oxide form, is fully oxidized. This means that the surface of the yttria-coated iridium filament is inert with respect to oxygen damage. For applications which will include exposure to oxygen, choosing the yttria-coated iridium filament is appropriate.

Yttria-coated iridium filaments do not withstand exposure to halogens. Upon exposure to halogens, the yttria coating will form yttria-oxyhalides which will chip off of the filament and cause direct exposure of the iridium core, shortening the lifetime of the filament.

3.4 The Quadrupole Mass Filter

The ions produced in the ion source are injected into the mass filter, which rejects all ions except those of a specific mass-to-charge ratio. Most ions contain only one unit of charge. In Transpector MPS, the mass filter is a quadrupole type, to which a combination of RF and DC potentials is applied. The RF frequency and amplitude determine the mass/charge ratio, and the RF/DC ratio determines the filter sensitivity. (See Figure 3-3.)

Figure 3-3 Sensor's quadrupole mass filter
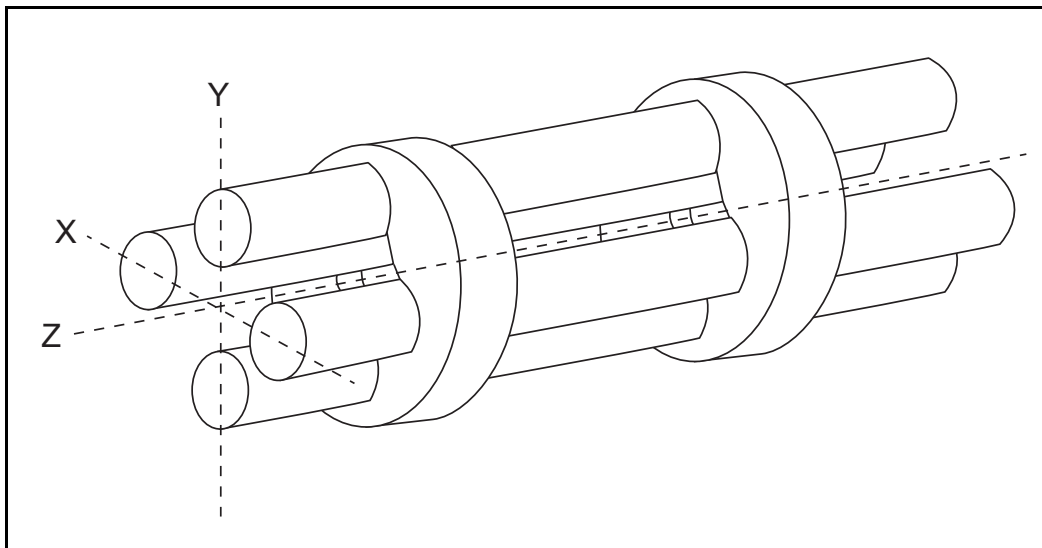
The mass filter's four rods are alternately charged to direct ions of specific masses down through the center, deflecting all larger and smaller masses (hence the term mass filter).

The mass filter consists of four parallel rods, or poles, in a square array. The rods, and the insulators in which they are mounted, form an extremely precise mechanical assembly. The distance between the center of the square array and the closest rod surface is known as the quadrupole radius, with the symbol r_0. If the ratio of the round rod radius to r_0 is made equal to 1.148, the resulting electric field generates the maximum quadrupole field.

Opposite rods are electrically connected together. The ions are directed down the central axis of the assembly in a direction nominally parallel to the length of the rods. There the ions are separated by their mass-to-charge ratios by the lateral forces resulting from the potentials applied to the poles.

The applied potentials consist of an RF component and a DC component. The RF potential on one set of rods is out of phase by 180° with respect to the RF potential on the other set of rods, but of the same amplitude. For one pair of rods, the "X" pair, the DC potential is positive. For the other, the "Y" pair, the DC potential is of

the same magnitude but negative. The DC and RF potentials are referenced to a center voltage (sometimes called the pole zero). The following equations summarize the potentials applied to the rods:

$$X \ = \ V\cos(2\pi ft) + U + PZ \qquad\qquad [1]$$

$$Y \ = \ -V\cos(2\pi ft + \pi) - U + PZ \qquad\qquad [2]$$

where V is the RF amplitude, f is the RF frequency, t is time, U is the DC potential, and PZ is the pole zero.

The RF component removes the low-mass ions from the beam. Ions of sufficiently low mass have their motions remain in phase with that of the applied RF. These ions will gain energy from the field and oscillate with increasingly large amplitudes. Eventually, as they travel along the length of the rods, they will strike one of the rods and be neutralized. On the other hand, high-mass ions are focused by the RF component to an area close to the quadrupole's long axis, the "Z" axis.

The DC component is superimposed on the RF to remove high-mass ions from the beam. The DC field deflects the high-mass ions toward the negative poles, opposing the focusing effects of the RF field. Eventually, these high-mass ions strike the negative rods and are neutralized. By a suitable choice of DC-to-RF ratio, the mass filter can be made to discriminate against both high and low-mass ions to the desired degree.

The kinetic energy directed along the Z axis of the mass filter (usually called the ion energy) is primarily dependent on the difference between the potential at which the ions were formed (approximately the anode voltage), and the pole zero. The ion energy is usually only slightly modified by the electric field (the fringing field) between the source exit aperture and the quadrupole. Imbalances in the amplitude of the two phases of RF applied to the rod pairs, and of the DC voltages also applied, result in a further modification of the ion energy.

The mass of the ions passed by the filter is determined by the RF amplitude, the RF frequency, and the quadrupole radius, as shown by the following equation:

$$V \ = \ 14.438 M f^2 r_0^2 \qquad\qquad [3]$$

where V is the peak-to-peak RF amplitude in Volts, M the mass of the ion in atomic mass units (AMU) per electron charge, f the RF frequency in megahertz, and r_0 the quadrupole radius in centimeters.

For example, a 200 AMU singly charged ion would pass through a quadrupole with nominal 1/4 in. diameter rods (an r_0 of 0.277 cm), operating at 1.78 MHz, at a peak-to-peak RF amplitude of approximately 700 Volts.

The mass of ions transmitted (M) is directly proportional to the RF amplitude (provided f is constant). As the RF amplitude is increased, progressively higher mass ions will be made to oscillate in phase with the RF field and thus gain sufficient energy to strike the poles. Of course, the DC voltage must also be increased to maintain the high-mass rejection properties of the filter. A mass spectrum can therefore, be obtained by sweeping the RF amplitude, along with the DC voltage.

The next Section (Scanning Characteristics) discusses the variation in the efficiency of transmission of ions through the filter with mass. Following that, section 3.4.2, The Zero Blast, on page 3-9 discusses the behavior of the filter at very low masses where the applied voltages approach zero.

3.4.1 Scanning Characteristics

As described above, the quadrupole acts as a mass filter for a mixed beam of ions, rejecting those of both high and low mass, while passing those of an intermediate mass. The selectivity of the mass filter is expressed in terms of resolution, R, which is numerically given by the ratio of the center mass, M, to the width, ΔM (both in AMU), of the pass band. Since the number of the ions passed by the filter falls off gradually as the edge of the pass band is approached, the width is defined at the point where the ion current falls to some specified fraction (usually 1/2 or 1/10) of the maximum value. The width of the pass band is determined by the DC-to-RF ratio.

While the quadrupole drive circuits can be designed so that R varies in any desired manner with M, it is usually most convenient to keep ΔM constant at a value, which ensures adequate separation of masses that are 1 AMU apart. This mode of scanning is called Constant ΔM. As a result, R is proportional to M, and therefore, the efficiency with which ions of mass M are transmitted through the quadrupole decreases with M. Thus, the sensitivity of the sensor decreases as M increases.

3.4.2 The Zero Blast

When the mass filter is tuned to very low masses, the RF and DC voltages applied to the rods approach zero. The quadrupole then ceases to act as a filter, and a large current of unseparated ions is detected. This current is called the zero blast. See Figure 3-4 on page 3-9.

The zero blast, present in all quadrupole-based sensors, can interfere with the observation of masses 1 and 2 when significant quantities of higher-mass ions are present. In some instruments, the magnitude of the zero blast is concealed by preventing the voltages from reaching zero. With Transpector MPS, the zero blast only produces parts-per-million interference to masses 1 and 2.

Figure 3-4 Zero blast
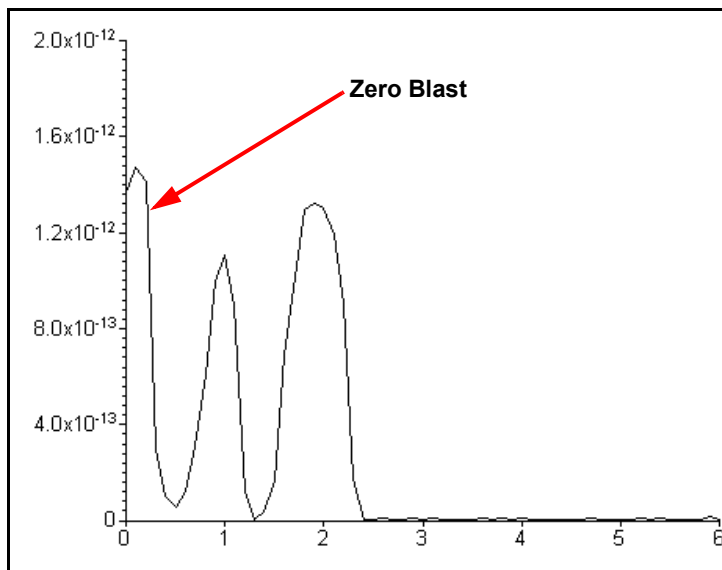
3.5 The Ion Detector

The ion detector region of the sensor consists of the quadrupole exit lens and the detector itself. Often, the quadrupole exit aperture is biased negatively with respect to the anode, focusing ions that have been transmitted through the quadrupole into the detector element. The detector can be a simple Faraday Cup (FC), an Electron Multiplier (EM), or a combination of both.

3.5.1 The Faraday Cup Detector

The Faraday Cup detector is typically a metal plate or a cup-shaped electrode, on which the ion beam impinges. Ions strike the detector and are neutralized, thus drawing a current from the circuitry connected to the electrode. Usually, the current flow that results is exactly equal to the incident ion current. In Transpector MPS instruments, the Faraday Cup is at ground potential.

The sensitivity for Transpector MPS instruments equipped with a simple Faraday Cup detector is typically 3×10^{-4} amps per Torr. The detected currents can be as small as 1×10^{-15} amps for ultra-high vacuum levels. See Figure 3-5.

Figure 3-5 Faraday Cup detector
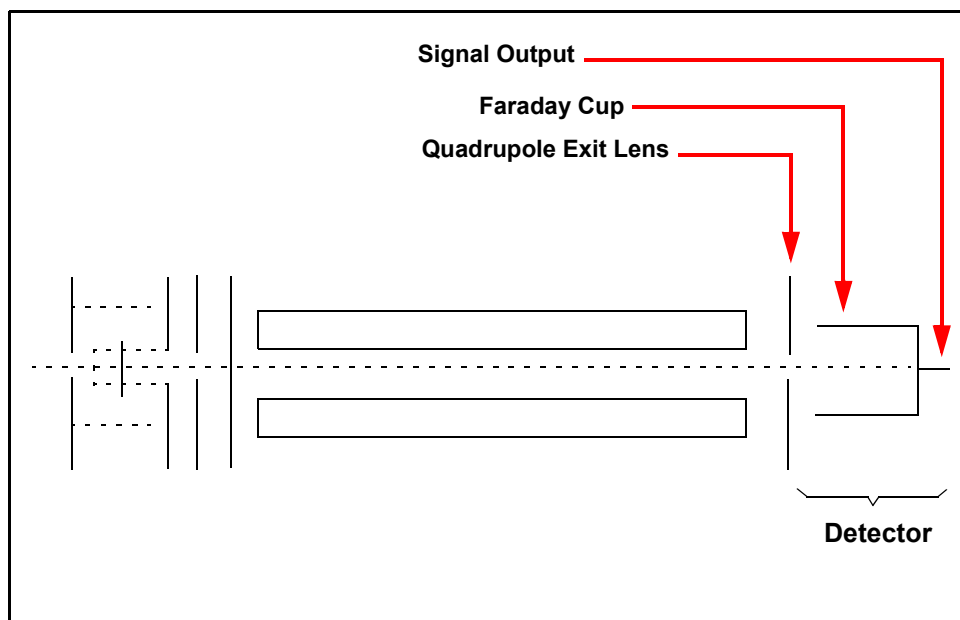
3.5.2 The Electron Multiplier (EM) Detector

The Electron Multiplier (EM) acts as an in situ preamplifier for improved sensitivity. Although there are several different types of EM, their operating principals are the same. Incoming ions are accelerated into the input of the EM by a high negative voltage (usually -1.0 kV or more). When an ion strikes the surface of the EM, one or more secondary electrons are emitted. These electrons are accelerated to a second surface which is at a more positive potential, where additional electrons are generated.

This process repeats itself until a pulse of electrons emerges from the output of the EM and is collected on a Faraday Cup. The result is that as many as a million electrons or more can be produced by each incident ion. The current from a Faraday detector is positive (for positive ions). An EM detector current is negative.

The ratio of the electron output current to the incident ion current is known as the EM gain. The gain primarily depends on the EM type, the voltage applied to the EM input, the voltage applied across the EM, the condition of the EM, and, to a lesser extent, the mass and chemical nature of the incident ion. In general, the EM gain decreases as the ion mass increases.

The advantage of the EM detector sensor is its high sensitivity (at least 500 amps/Torr), thus making it possible to measure partial pressures as low as 1.5×10^{-14} Torr for Transpector MPS sensors. A typical Faraday Cup sensor would have a sensitivity of only 3×10^{-4} amps/Torr, resulting in a minimum detectable partial pressure of 2.6×10^{-12} Torr.

3.5.3 The Continuous Dynode Electron Multiplier/Faraday Cup Detector

The Continuous Dynode Electron Multiplier/Faraday Cup (CDEM/FC), used for the EM containing MPS models, offers the advantages of both the FC and EM detectors combined in one unit.

Figure 3-6 A CEM/FC Detector
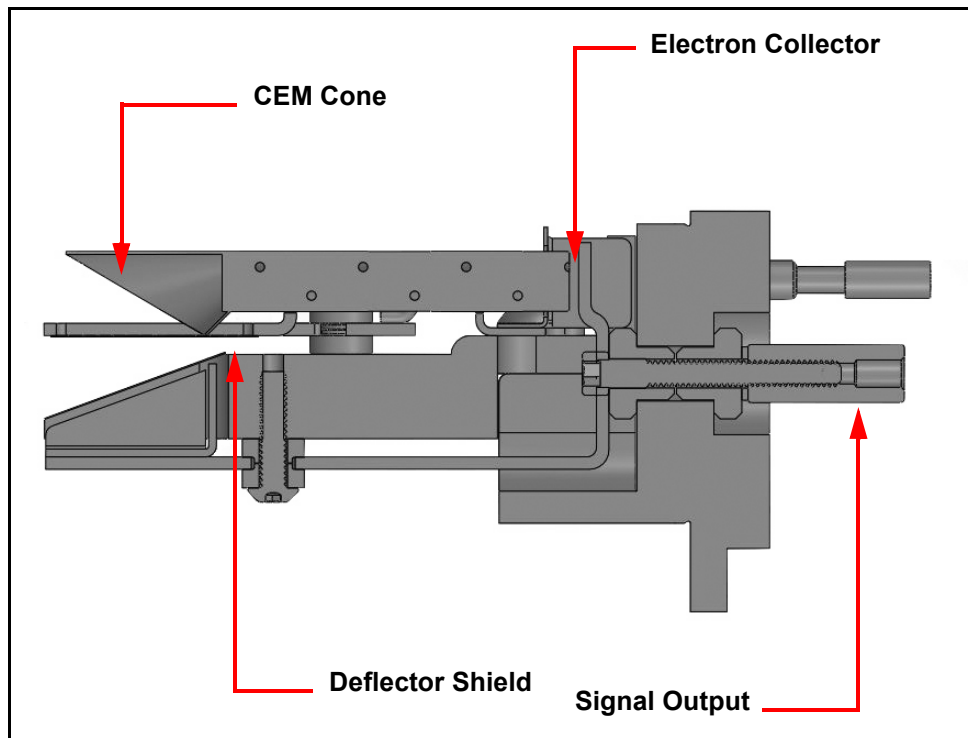
In CDEM/FC detectors, the EM cone amplifies the electron pulse, significantly increasing the analyzer's sensitivity.

The Transpector MPS CDEM/FC detector uses a continuous dynode element made of a special type of glass, rather than discrete dynode EMs, which are made from a copper-beryllium alloy. The principal advantage of the CDEM is that its performance does not degrade when exposed to air. In order to prolong its useful life, a copper-beryllium dynode multiplier must be stored under vacuum; exposure to air for more than a brief period can result in a significant decrease in the maximum available gain.

The CDEM has some disadvantages. The maximum operating temperature for the CDEM is 150°C. (It can still be baked out at 300°C, provided that the high voltage is off.) Also, the CDEM is slightly slower to recover after exposure to excessive input or output currents, and it may take a bit longer to stabilize its gain after the high voltage is changed.

The CDEM is operated at high voltages between -0.6 and -2.0 kV. A new CDEM will typically have a gain of between 10 and 1,000 at -0.8 kV. The gain at -3.0 kV typically exceeds 1×10^6. Transpector MPS default EM voltage is -0.8 kV.

⚠️ **CAUTION**

> **Do not operate the CDEM at temperatures above 150°C. Permanent damage may result. Also, avoid output currents in excess of 1 x 10^{-6} amps; either decrease the high voltage or, if possible, decrease the pressure.**

Use the minimum CDEM voltage required to obtain the necessary peak amplitudes and/or signal-to-noise ratio. Operating at higher voltages than necessary will result in premature aging of the Electron Multiplier, requiring early replacement. As the CDEM ages, the voltage needed to get a specific EM gain will increase.

Since EM performance depends on the condition of its interior surfaces, prevent hydrocarbon or other contamination as follows:

◆ Ensure diffusion-pumped vacuum systems are properly trapped to reduce oil back-streaming.

◆ Ensure turbomolecular pumped systems are interlocked to eliminate mechanical pump oil back-streaming through a nonspinning turbo pump.

Electron Multiplier gain reduction from these kinds of problems can range from 50% to more than 90%. The initial gain of the EM is generally high enough to accommodate some degradation and yet still be usable. With repeated instances of contamination, the multiplier will eventually require replacement.

NOTE: In addition to hydrocarbon contamination, multipliers can be adversely affected by exposure to highly reactive chemicals. Avoid any substance that will either cause the deposition of a surface film on the EM or etch its surface. Avoid high levels of reactive fluorides, such as tungsten hexafluoride, hydrogen fluoride, and nitrogen trifluoride.

Chapter 4
Applications Guide

4.1 How to Interpret the Result

This chapter discusses how to interpret Transpector MPS measurements:

◆ Section 4.1.1, Qualitative Interpretation of Mass Spectra, on page 4-1, explains how to determine which substances are present in the gas sample being analyzed.

◆ Section 4.1.2, Quantitative Interpretation of Mass Spectra (Calculating Partial Pressures), on page 4-8, shows how to estimate how much of each substance is present.

◆ Section 4.1.3, Additional Information for Interpreting Mass Spectra, on page 4-14, provides additional information that may help you interpret mass spectra.

FabGuard software includes routines which serve as aids in the interpretation of spectra and the calculation of partial pressures and relative concentrations.

For a discussion of how Transpector MPS produces measurements, refer to Chapter 3, How The Instrument Works.

4.1.1 Qualitative Interpretation of Mass Spectra

The basic graphical output of a Transpector MPS is the mass spectrum. A mass spectrum is a plot of ion intensity as a function of ion mass-to-charge ratio. Each chemical substance has a characteristic mass spectrum. Different instruments will give slightly different spectra for the same substance. The particular characteristics of the ionizer, mass filter, and detector, not to mention the manner in which the sample is introduced into the mass spectrometer, all influence the spectrum that is produced.

Rarely will a mass spectrum be obtained for a pure substance. Most of the time (especially for residual gas analyzers), the spectrum obtained will be a composite of the individual substances which together comprise the actual sample present. See Figure 4-1.

Figure 4-1 Example mass spectrum

The bottom graph is a trend analysis showing the most important masses versus time. The top graph shows the data taken during the scan and shows the air spectra over a six decade y-axis. The prominent peaks for air are mass 28 from Nitrogen, mass 32 from Oxygen, mass 40 from Argon and mass 18 from water vapor.
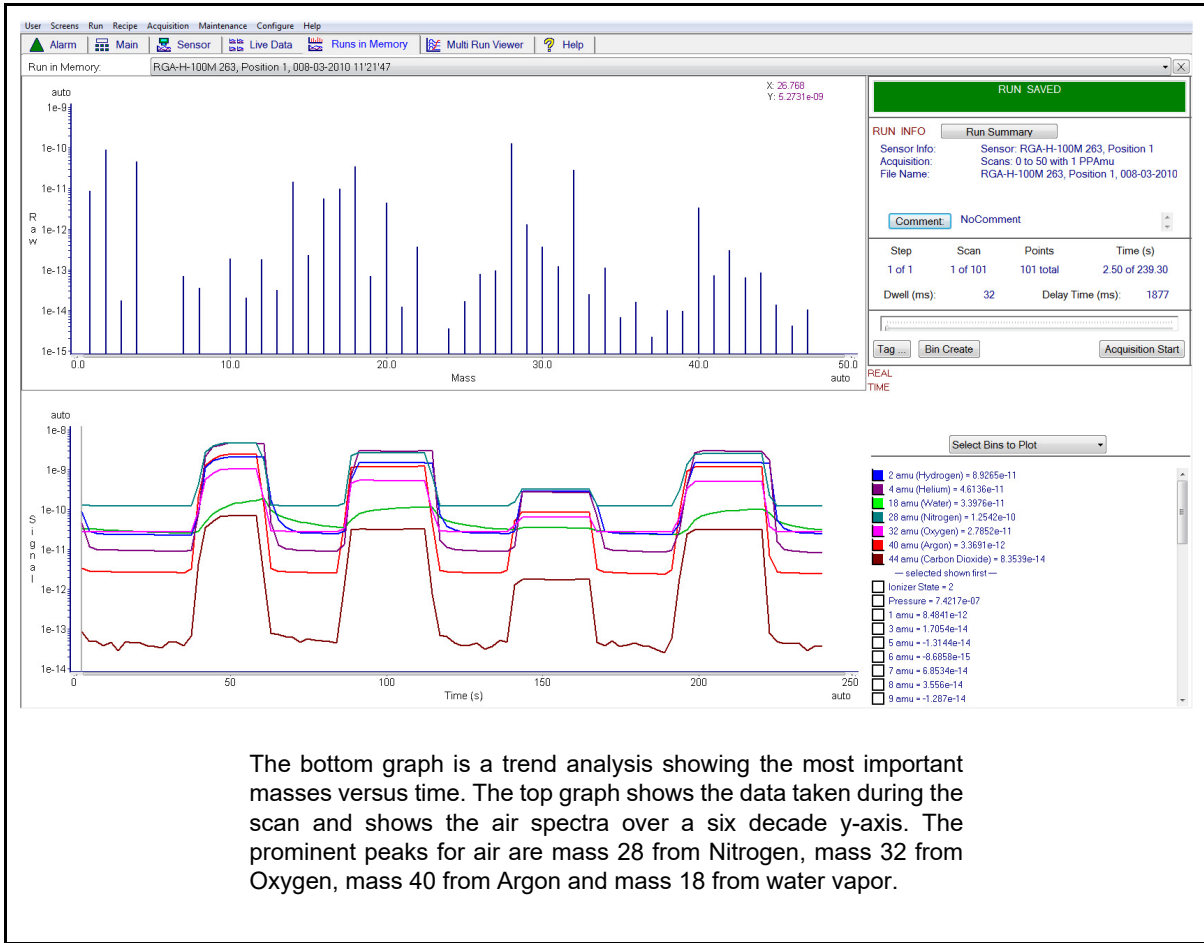
4.1.1.1 Ionization Process

When a sufficiently energetic electron strikes a gas molecule, there are many processes that can occur, just some of which are summarized in Table 4-1.

Table 4-1 Electron impact ionization processes

$XYZ^+ + e^- \rightarrow$

$XYZ^+ + 2e^-$	(1)
$XYZ^{2+} + 3e^-$	(2)
$XY + Z^+ + 2e^-$	(3)
$XY^+ + Z + 2e^-$	(4)
$X^+ + YZ + 2e^-$	(5)
$X + YZ^+ + 2e^-$	(6)
$XZ + Y^+ + 2e^-$	(7)
$XZ^+ + Y + 2e^-$	(8)
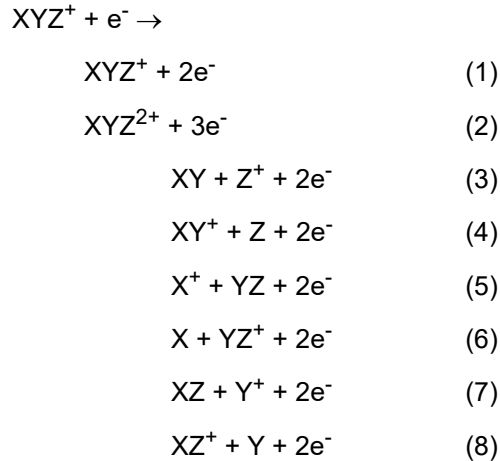
In all cases, the reactants are a high energy electron, e⁻, and a gas molecule, XYZ. The products of the first reaction are the molecule with a single electron removed (the so-called parent ion) and two low energy electrons. In the second reaction, two electrons are removed from the gas molecule, resulting in a doubly charged ion. Triply (or even more highly) charged ions are also possible, provided the incident electron has enough energy.

Reactions 3 through 8 are all examples where the original molecule is broken into fragments, at least one of which is positively charged (negative ions can also be produced in this manner). Only the positive ion fragments are observed; the neutral (i.e., uncharged) fragments are not detected. The mass spectrum obtained when the parent molecule breaks apart under electron impact is commonly referred to as the fragmentation pattern (or, sometimes, the cracking pattern). For example, a fragmentation pattern for Nitrogen shows $^{14}N^+$ (14 AMU), $^{14}N_2^+$ (28 AMU), and $^{14}N^{15}N^+$ (29 AMU).

In general, peaks from multiply charged species will be less intense than those for the corresponding singly charged ion. For example, the doubly charged peak for argon is typically less than one fifth as intense as the singly charged peak (it should be noted that this intensity ratio is sensitive to the incident electron energy).

There are some situations when it is difficult to determine whether the ion is singly or multiply charged. When a molecule is composed of two atoms of the same element, Transpector MPS has difficulty distinguishing between the singly charged one-atom fragment ion and the doubly charged two-atom molecular ion; which will both have the same mass-to-charge ratio. Refer to Figure 4-1; the peak at 28 AMU is the parent ion, N_2^+. It is not discernible from this spectrum if the peak at 14 AMU is from N^+ or N_2^{2+}. It has been demonstrated, by other means, that the 14 AMU peak in the nitrogen spectrum is from the singly charged fragment ion.

Most ions (with the important exception of complex hydrocarbons) have masses very close to integer values. When the mass of an ion is not evenly divisible by the number of charges on it, the mass-to-charge ratio will not be an integer. This means that an ion such as Ar^{3+} will appear at 13.33 AMU, while F^{2+} will show up at 9.5 AMU.

4.1.1.2 Isotope Ratios

An additional cause of multiple peaks in the mass spectrum of a pure substance is that most (but not all) elements are composed of more than one isotope. For example, 99.63% of all nitrogen atoms in nature have a mass of 14 AMU; only 0.37% have a mass of 15 AMU. Carefully examine the nitrogen spectrum in Figure 4-1 on page 4-2. The largest peak at 28 AMU is the parent ion, N_2^+. The peak at 29 AMU is the isotope peak, $^{14}N^{15}N^+$, and is 0.74% (two times 0.37%) as high as the parent peak since there are two nitrogen atoms in the ion, each one of which has a 0.37% chance of being 15 AMU.

Some elements have many intense isotopes (e.g., xenon is 0.096% mass 124, 0.090% mass 126, 1.92% mass 128, 26.44% mass 129, 4.08% mass 130, 21.18% mass 131, 26.89% mass 132, 10.44% mass 134, and 8.87% mass 136).

Isotope ratios, like fragmentation patterns, are a very useful aid in recognizing specific materials. Under normal ionization conditions, the peak height ratios for the various isotopes of an element will be the same as the ratios of their natural abundances. That is, the probability of ionizing, for example, the mass 35 isotope of chlorine (^{35}Cl) is the same as the probability of ionizing the mass 37 isotope (^{37}Cl). Thus, the peak height ratio of mass 35 to 37 from HCl will be 3.07 to 1 (75.4% / 24.6%).

For a listing of the isotopic ratios for the lighter elements, see Table 4-2. For a complete listing of the natural abundances for the isotopes of all the elements, see the *Handbook of Chemistry and Physics* from CRC Press.

Table 4-2 Isotope ratios

Isotope Ratios		
Element	**Mass No.**	**Relative Abundance**
H	1	99.985
	2	0.015
He	3	0.00013
	4	~100.0
B	10	19.78
	11	80.22
C	12	98.892
	13	1.108
N	14	99.63
	15	0.37
O	16	99.759
	17	0.0374
	18	0.2039
F	19	100.0
Ne	20	90.92
	21	0.257
	22	8.82
Na	23	100.0
Al	27	100.0
Si	28	92.27
	29	4.68
	30	3.05
P	31	100.0
S	32	95.06
	33	0.74

Table 4-2 Isotope ratios (continued)

Isotope Ratios		
Element	**Mass No.**	**Relative Abundance**
	34	4.18
	36	0.016
Cl	35	75.4
	37	24.6
Ar	36	0.337
	38	0.063
	40	99.600

4.1.1.3 Electron Energy Effects

As previously discussed, the exact fragmentation pattern observed will depend on the energy of the bombarding electrons. Figure 4-2 graphs the number of argon ions (of different charge states) produced per incident electron per Torr of gas pressure as a function of electron energy.

Figure 4-2 Electron energy effects

From a paper by W. Bleakney, Physical Review, 36, p. 1303, published in 1930.
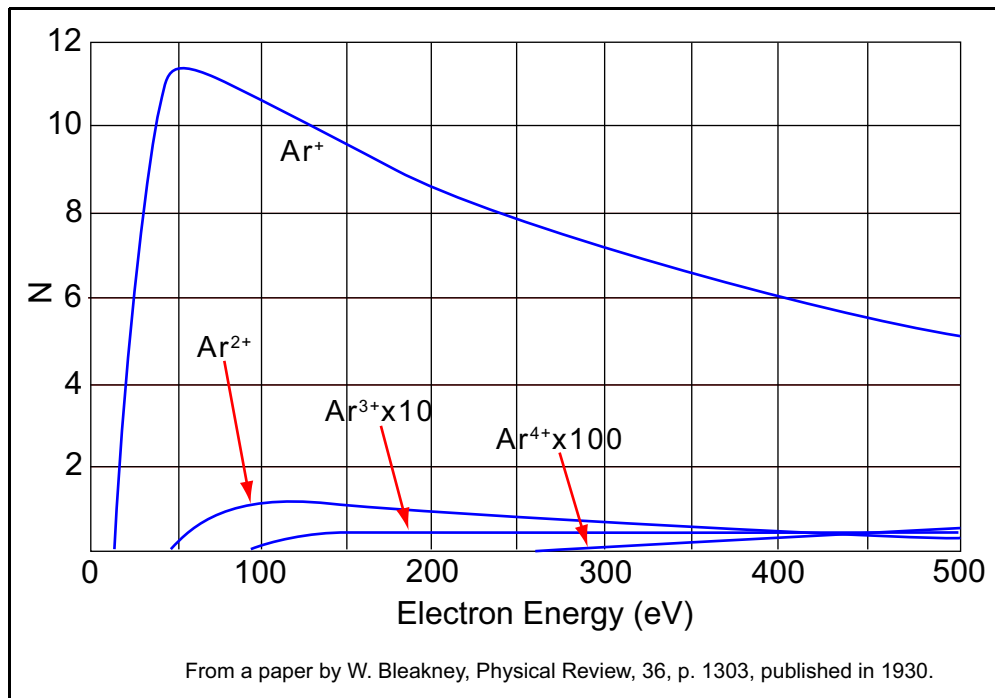
The appearance potential (i.e., the minimum electron energy required to produce a specific ion) for Ar^+ is 15.7 eV. The number of argon ions produced rises steeply with energy until a maximum is reached at about 55 eV. As the electron energy rises above this level, the rate of Ar^+ production slowly decreases.

The appearance potential for Ar^{2+} is 43.5 eV, and the ion production rate does not maximize until the electron energy exceeds 100 eV. The appearance potential for Ar^{3+} is approximately 85 eV, while the appearance potential for Ar^{4+} is over 200 eV.

4.1.1.4 A Qualitative Interpretation Guide

To use Transpector MPS to identify unknown substances, three characteristics must be recognized:

- ◆ fragmentation patterns
- ◆ multiply charged ions
- ◆ isotope ratios

Simple spectra are, in general, relatively easy to interpret and will yield useful identifications. The analysis of complicated mixtures of substances is much more difficult.

Table 4-3 is intended as a spectrum interpretation guide which may be of use when first examining an unknown spectrum. The guide lists the masses of peaks, possible ion identities for each of these masses, and common sources for each of these ions.

NOTE: This list is by no means all-inclusive.

Table 4-3 Spectrum Interpretation Guide

Spectrum Interpretation Guide		
AMU #	**Chemical Symbol**	**Sources**
1	H	water F or hydrogen F
2	H_2, D	hydrogen, deuterium (^{2}H)
3	HD, ^{3}H	hydrogen-deuterium, tritium (^{3}H)
4	He	helium
5	No known elements	
6	C	Doubly Ionized ^{12}C (Rare)
7	N	DI ^{14}N (Rare)
8	O	DI ^{16}O (Rare)
9	No known elements	
10	Ne, ^{10}B	DI ^{20}Ne (Rare), BF_3, BCl_3
11	Ne, ^{11}B	DI ^{22}Ne (Rare), $^{11}BF_3$, BCl_3
12	C	carbon, carbon monoxide F, carbon dioxide F
13	CH, ^{13}C	methane F, carbon isotope
14	N, CH_2	nitrogen, methane F or Note 1
15	CH_3	methane F or Note 1
16	O, CH_4, NH_2	oxygen or carbon monoxide F, ammonia
17	OH, NH_3	water F, ammonia F

Table 4-3 Spectrum Interpretation Guide (continued)

AMU #	Chemical Symbol	Sources
	Spectrum Interpretation Guide	
18	H_2O	water
19	F	fluorine or freon F
20	Ar^{2+}, Ne, HF	argon DI, neon, hydrofluoric acid
21		
22	^{22}Ne, CO_2	neon, DI CO_2
23		
24	C_2	See Note 1
25	C_2H	See Note 1
26	C_2H_2 CN	See Note 1, hydrogen cyanide F
27	C_2H_3, Al, HCN	See Note 1, aluminum, hydrogen cyanide
28	N_2, CO, C_2H_4, Si	nitrogen, carbon monoxide, ethylene P, silicon
29	CH_3CH_2	ethane F or ethanol F or isopropyl alcohol
30	C_2H_6, NO	ethane P, nitric oxide
31	P, CH_2OH,	oxygen, methanol F,
32	O_2, S	oxygen, sulfur, methanol P
33	HS	hydrogen sulfide F
34	H_2S, ^{34}S, O_2	hydrogen sulfide P, sulfur isotope, oxygen isotope
35	Cl	chlorine isotope, See Note 2
36	HCl, ^{36}Ar, C_3	hydrochloric acid, argon isotope, hydrocarbons
37	^{37}Cl, C_3H	chlorine isotope, See Note 2, hydrocarbons
38	^{37}HCl, C_3H_2	hydrochloric acid or See Note 2, hydrocarbons
39	C_3H_3	See Note 3, hydrocarbons
40	Ar, C_3H_4	argon, See Note 1, hydrocarbons
41	C_3H_5	See Note 1, hydrocarbons
42	C_3H_6	See Note 1, hydrocarbons
43	C_3H_7, CH_3CO	Note 1, acetone F or methyl ethyl ketone F
44	CO_2, C_3H_8	carbon dioxide, See Note 3
45	CH_3CH_2O	ethanol F or isopropyl alcohol F

Table 4-3 Spectrum Interpretation Guide (continued)

Spectrum Interpretation Guide		
AMU #	**Chemical Symbol**	**Sources**
46	CH_3CH_2OH	ethanol P
47	$C^{35}Cl$	See Note 2
48	$HC^{35}Cl$, SO	See Note 2, sulfur dioxide F
49	$C^{37}Cl$	See Note 2
50	$C^{37}Cl$, CF_2, C_4H_2	See Note 2, freon F, Note 3
NOTES: (1) Fragments of several hydrocarbons, such as mechanical pump oil, diffusion pump oil, vacuum grease, cutting oil, and organic solvents. (2) Fragments of several chlorinated hydrocarbons, such as carbon tetrachloride, tichloroethylene, and many freons. (3) Fragments from both straight chain hydrocarbons and benzene ring hydrocarbons. (4) F = Fragment ion; P = Parent ion; DI = Doubly ionized		

4.1.2 Quantitative Interpretation of Mass Spectra (Calculating Partial Pressures)

Partial pressure is defined as the pressure of a designated component in a gas mixture. By Dalton's Law, the sum of all the partial pressures is the total pressure. Transpector MPS is designed so that the height of a peak in a mass spectrum is proportional to the number of ions giving rise to that peak. Also by design, the number of ions is more or less proportional to the partial pressure of the substance giving rise to that peak (over some specified operating pressure range). Therefore, the height of a peak is proportional to the partial pressure of the substance giving rise to that peak.

The following equation shows the relationship between the partial pressure of substance determined by measuring the ion current at mass b:

$$PP_a \; = \; K_{ab} \times I_{ab} \qquad\qquad [1]$$

The partial pressure of substance a is symbolized by $\mathbf{PP_a}$, while $\mathbf{K_{ab}}$ is the proportionality constant for the peak at mass b from substance a, and I_{ab} is the ion current at mass b from substance a.

The proportionality constant, K_{ab}, depends on the nature of the substance being detected and on the characteristics of Transpector MPS. The substance-dependent part is called the material factor, M_{ab}. The instrument-dependent part is called the analyzer factor, A_b, and depends primarily on the ion mass, b. Therefore, the original equation [1] can therefore, be rewritten as follows:

$$PP_a \; = \; (M_{ab} \times A_b) \times I_{ab} \qquad\qquad [2]$$

The material factor, M_{ab}, depends on the fragmentation pattern for the particular substance, the fragmentation pattern for a reference gas (usually nitrogen), and the ease with which the substance can be ionized relative to the same reference gas. The relationship involved is shown in equation [3]:

$$M_{ab} = \frac{1}{FF_{ab} \times XF_a} \tag{3}$$

The term FF_{ab} is the fragmentation factor for substance a at mass b. It is equal to the fraction of the total current of all ions from substance a which have a mass b. Finally, XF_a is the ionization probability of substance a, relative to nitrogen (i.e., XF_N =1). That is, it is the ratio of total ion current (for all masses) from substance a to the total ion current from nitrogen, both measured at the same true partial pressure. Both fragmentation factors and ionization probabilities depend strongly on the energy of the ionizing electrons. If the correct values of these factors are not known for the exact conditions of the particular analyzer being used, they can be approximated using published values for other conditions with, generally, only a small loss in accuracy.

Fragmentation factors can be calculated from fragmentation patterns given in the general references cited in Chapter 8. Other valuable references include the Index of Mass Spectral Data from ASTM, EPA/NIH Mass Spectral Data Base by Heller and Milne, and an extensive library of spectra available from the National Institute of Standards and Technology (formerly the National Bureau of Standards).

Table 4-4 lists the fragmentation factors (FF) for the major peaks for selected substances.

NOTE: Actual fragmentation factors vary significantly depending especially on the ionizer, electron energy, and mass filter turning. For best accuracy, measure fragmentation factors with the same instrument used for the analysis, under the same tuning conditions

Table 4-4 Typical fragmentation factors for the major peaks of some common substances

Mass	FF	Mass	FF	Mass	FF
Acetone $(CH_3)_2CO$		Helium He		Oxygen O_2	
43	.63	4	1.00	32	.95
58	.23			16	.05
42	.04	Hydrogen H_2			
27	.03	2	1.00	Toulene $C_2H_5CH_3$	
				91	.46
Argon Ar				92	.34
40	.83	Krypton Kr		60	.07
20	.17	84	.45	65	.05
		86	.13		
Benzene C_6H_6		82	.10	Trichlorethylene C_2HCl_3	
78	.53	83	.10	95	.22
51	.11			130	.22
52	.11	Methane CH_4		132	.21
50	.10	16	.46	97	.14
		15	.40	60	.13
Carbon Dioxide CO_2		14	.07		
44	.70	13	.04	Water H_2O	
28	.11			18	.75
16	.06	Methanol CH_3OH		17	.19
12	.01	31	.43	1	.05
		32	.23	16	.02
Carbon Monoxide CO		29	.18		
28	.91	28	.03	Xenon Xe	
12	.05			132	.26
16	.03	Neon Ne		129	.26
		20	.90	131	.22
Ethanol C_2H_5OH		22	.10	134	.11
31	.49			136	.09
45	.21	Nitrogen N_2			
27	.09	28	1.00		
29	.07	14	.12		
		29	.01		

Ionization probability factors can be approximated by substituting the relative ion gauge sensitivities for various gases. Table 4-5 gives relative ion gauge sensitivities for some common gases.

NOTE: Table 4-5 lists relative ionization gauge sensitivities for selected molecules. The data was compiled from *Empirical Observations on the Sensitivity of Hot Cathode Ionization Type Vacuum Gauges* by R. L. Summers (NASA Technical Note NASA TN D5285, published in 1969). Similar, although more limited, lists of ionization sensitivities can be found in the books by O'Hanlon (Chapter 8, Section 1.1) and Drinkwine and Lichtman (Table I, page 5).

HINT: Actual ionization probabilities vary significantly depending on the ionizer and the electron energy. For best accuracy, measure the relative ionization probability using a hot cathode ionization gauge (calibrated for nitrogen) to monitor a known pressure of the substance of interest. The ratio of the gauge reading to the known true pressure is the relative ionization probability. To determine the true pressure, use a gauge which is gas species independent (for example, a capacitance manometer) or a gauge with a known sensitivity factor (for example, a spinning rotor gauge).

Table 4-5 Ionization Probabilities for some Common Substances

Substance	Formula	Relative Ionization Gauge Sensitivity	substance	Formula	Relative Ionization Gauge Sensitivity
acetone	$(CH_3)_2CO$	3.6	hydrogen chloride	HCl	1.6
air		1.0	hydrogen fluoride	HF	1.4
ammonia	NH_3	1.3	hydrogen iodide	HI	3.1
argon	Ar	1.2	hydrogen sulfide	H_2S	2.2
benzene	C_6H_6	5.9	krypton	Kr	1.7
benzoic acid	C_6H_5COOH	5.5	lithium	Li	1.9
bromine	Br_2	3.8	methane	CH_4	1.6
butane	C_4H_{10}	4.9	methanol	CH_3OH	1.8
carbon dioxide	CO_2	1.4	neon	Ne	0.23
carbon disulfide	CS_2	4.8	nitrogen	N_2	1.0
carbon monoxide	CO	1.05	nitric oxide	NO	1.2
carbon tetrachloride	CCl_4	6.0	nitrous oxide	N_2O	1.7
chlorobenzene	C_6H_5Cl	7.0	oxygen	O_2	1.0
chloroethane	C_2H_5Cl	4.0	n-pentane	C_5H_{12}	6.0
chloroform	$CHCl_3$	4.8	phenol	C_6H_5OH	6.2
chloromethane	CH_3Cl	3.1	phosphine	PH_3	2.6

Table 4-5 Ionization Probabilities for some Common Substances (continued)

Substance	Formula	Relative Ionization Gauge Sensitivity	substance	Formula	Relative Ionization Gauge Sensitivity
cyclohexane	C_6H_{12}	6.4	propane	C_3H_8	3.7
deuterium	D_2	0.35	silver perchlorate	$AgClO_4$	3.6
dichlorodifluormethane	CCl_2F_2	2.7	stannic iodide	SnI_4	6.7
dichloromethane	CH_2Cl_2	7.8	sulfur dioxide	SO_2	2.1
dintrobenzene	$C_6H_4(NO_2)_2$	7.8	sulfur hexafluoride	SF_6	2.3
ethane	C_2H_6	2.6	toluene	$C_6H_5CH_3$	6.8
ethanol	C_2H_5OH	3.6	trinitrobenzene	$C_6H_3(NO_2)_3$	9.0
ethylene oxide	$(CH_2)_2O$	2.5	water	H_2O	1.0
helium	He	0.14	xenon	Xe	3.0
hexane	C_6H_{14}	6.6	xylene	$C_6H_4(CH_3)_2$	7.8
hydrogen	H_2	0.44			

The analyzer factor, A_b, depends on the transmission and detection characteristics of the analyzer, the Electron Multiplier gain (if the analyzer is so equipped), and the basic sensitivity, as indicated in equation [4]:

$$A_a = \frac{1}{TF_b \times DF_{ab} \times G \times S}$$

[4]

Here, TF_b is the transmission factor of the mass filter at mass b. The transmission factor is the fraction of ions at mass b which pass through the mass filter, relative to nitrogen ions at mass 28. Nominally, the transmission factor is equal to 28 divided by the mass of the ion, b.

The detection factor, DF_{ab}, is equal to 1 for a Faraday Cup detector. For an Electron Multiplier, the detection factor is a function of the mass of the ion and its chemical nature, and is measured relative to that of a reference gas, typically nitrogen. In general, as the mass ion increases, the Electron Multiplier detection factor decreases.

The gain of the Electron Multiplier, G, measured at mass 28 for nitrogen, is the Electron Multiplier output current divided by the Faraday mode output current, under otherwise identical conditions. The multiplier gain is a strong function of the high voltage applied.

The sensitivity of the instrument, S, is the ratio of Faraday mode ion current for a given pressure of pure nitrogen measured at mass 28, and is typically expressed in amps/Torr.

The overall relation between partial pressure and ion current, given in equation [5], is quite general. The constants for this equation can be obtained from various tables, but for the best accuracy, they should be measured for each instrument.

$$PP_a = \left\{ \frac{FF_{N28}}{FF_{ab} \times XF_{ab} \times TF_b \times DF_{ab} \times G \times S} \right\} \times I_{ab} \qquad [5]$$

A brief discussion of each of the terms follows:

PP_a . . . . partial pressure of substance a (usually in Torr)

FF_{ab} . . . . fragmentation factor, or fraction of total ion current from substance a having mass b (dimensionless; see Table 4-4 on page 4-10)

FF_{N28} . . . . fragmentation factor for N_{2+} ions at 28 AMU from nitrogen (dimensionless; typically around 0.9)

XF_a . . . . ionization probability of substance a relative to nitrogen; approximately the same as the relative ion gauge sensitivity as shown in (dimensionless)

TF_b . . . . transmission factor, the fraction of total ions at mass b which pass through the mass filter, relative to ions with a mass of 28 AMU; nominally, $T_{FM} = 28 / M$ (dimensionless)

DF_{ab} . . . . detection factor for mass b ions from substance a, relative to nitrogen at 28 AMU; assumed to be 1.00 for Faraday detectors, but varies for Electron Multiplier detectors (dimensionless)

G . . . . Electron Multiplier gain for nitrogen ions at 28 AMU (dimensionless; set equal to 1 for a Faraday Cup detector)

S . . . . sensitivity of instrument to nitrogen, the ion current at 28 AMU per unit of nitrogen partial pressure (usually in amps/Torr)

I_{ab} . . . . ion current of mass peak b resulting from substance a (in amps; assumes that there are no other substances present which contribute significantly to the total current at mass peak b)

4.1.3 Additional Information for Interpreting Mass Spectra

4.1.3.1 Ion Source Characteristics

It is important to recognize that Transpector MPS (especially the ion source) and the vacuum system configuration can both have an effect on the relative concentrations of the gases detected. In order to minimize these effects, have the right type of ionizer, the right type of filament, and the right configuration of the vacuum system. This is particularly true when a differential pumping arrangement is used because the pressure of the gas to be sampled is too high for the sensor to operate. J. O'Hanlon's book, *A User's Guide to Vacuum Technology*, has a brief discussion (in Chapter 8, Section 2) of some of these concerns.

When using Transpector MPS as a residual gas analyzer, the sensor should be installed such that the conductance between the ion source and the vacuum region to be analyzed is maximized. If possible, install the sensor without any intervening valves or vacuum hardware. If the sensor is equipped with a residual gas analyzer ion source, there are four classes of interactions between the sensor and the immediate vacuum environment which can have a significant effect on the detected gas composition.

First, the analyzer itself is a source of gas molecules because of outgassing from its surfaces. Usually, the outgassing levels can be reduced by baking the analyzer in vacuum and by using the Degas function (wherein the ion source surfaces are bombarded by high energy electrons). When operating in the ultra-high vacuum (UHV) region, it is best to bake the sensor overnight at the maximum permissible temperature with the electronics removed and thermal insulation applied around the sensor feedthrough flange. A second overnight bakeout should be performed at the maximum sensor operating temperature. (It can take more than three hours for all parts of the sensor to reach maximum temperature during a bakeout, and more than six hours to cool back down.)

⚠️ **CAUTION**

Ensure that the Electron Multiplier is turned off if the (second) bakeout temperature exceeds the maximum EM operating temperature. Otherwise, permanent damage to the EM may result.

Second, it is possible that the opposite of outgassing can occur; that is, gas molecules can be captured by the surfaces of the sensor. This effect is called pumping. In such cases, the magnitude of the signals of the gases pumped will be lower than is properly representative of the composition of the gas in the vacuum chamber. Significant temporary pumping effects will frequently occur following degassing of the ion source.

Third, reactions involving gas molecules on surfaces of the analyzer can result in a change of composition. Gases can either be consumed by the surfaces, or produced by the surfaces. One example of gas consumption is the reaction of oxygen with a hot filament, particularly when tungsten filaments are used. The typical result is an anomalously low concentration of oxygen detected. See O'Hanlon's book (Chapter 8, Section 2) for more information on filament materials and their interactions with the gas being analyzed. An example of gases being produced from surfaces is the liberation of carbon monoxide molecules from a Yttria oxide coated iridium filament by a sputtering mechanism in the presence of significant quantities of argon. This latter mechanism makes the combination of a pressure reduction system and a Transpector MPS sensor unsuitable for measuring nitrogen contamination in argon at the low parts-per-million (PPM) level from a sputter deposition process. A special type of inlet system and ion source (often referred to as a Closed Ion Source (CIS)) should be used for this type of application.

Fourth, there are cases where at least some of the ions detected are emitted from surfaces in the ion source under electron bombardment and are not generated in the gas phase from neutral molecules. This process is known as electron stimulated desorption (ESD) or sometimes as electron induced desorption (EID). When the sensor has been exposed to fluorine containing substances (such as sulfur hexafluoride, chlorofluorocarbons, perfluorotributylamine, or perfluorokerosene) for extended periods of time, it is not uncommon for a strong F^+ peak at 19 AMU to remain even after the fluorine containing substance has been removed. When operating in the UHV region, EID/ESD of H^+, C^+, O^+, and CO^+ (and other ions) is not uncommon. The clue to diagnosing this problem is that the observed fragmentation patterns do not match known gas phase patterns. See pages five and six, and typical spectra TS-2 through 5, 16, 28, and 30 of Partial Pressure Analyzers and Analysis by Drinkwine and Lichtman for more information on EID/ESD.

Transpector MPS is also characterized by varying degrees of mass discrimination; that is, the sensitivity of the instrument is a function of mass. Ion sources show mass discrimination because various substances offer different degrees of difficulty of ionization. Generally, heavy, large molecules are ionized more readily than light, small molecules. There is also a rough correlation between the number of electrons in a molecule and its ease of ionization. Although the total ion yield (i.e., the sum of ions of all masses) is electron energy and ionizer dependent, a reasonable estimate for the number of ions produced (relative to some standard, usually nitrogen) in an Transpector MPS is the relative ionization gauge sensitivity.

4.1.3.2 Scanning Characteristics

Quadrupole mass filters can also exhibit mass discrimination characteristics depending on how the control voltages are varied during the sweep through the mass range. Most instruments are designed to operate with a constant peak width (constant ΔM) which results in a resolution which is proportional to the mass. This

characteristic provides a good degree of peak separation throughout the mass spectrum, but results in an ion transmission efficiency (i.e., the fraction of all ions of the selected mass entering the mass filter which are transmitted through it) that decreases as mass increases.

The way the mass scale is *calibrated* or *tuned* (i.e., the way the peak positions and widths are adjusted) can have a significant effect on the transmission efficiency of the mass filter across the mass spectrum. If the adjustments are not made properly, the ratios of peak heights across the mass range will not be correct.

4.1.3.3 Fragmentation Factors

The fragmentation factor is the fraction of the total ion current contributed by ions of the chosen mass. Only peaks contributing at least one percent to the total ion current are included in the list. The sum of the factors for all the peaks in a mass spectrum cannot exceed 1.00. The sum can be less than 1.00 if only some of the peaks are listed (either there are many peaks, or some of the ions produced lie outside the mass range of the particular instrument used).

The data presented earlier in Table 4-4 on page 4-10, Typical fragmentation factors for the major peaks of some common substances, is compiled from more than one source and is for illustrative purposes only. For maximum accuracy in determining partial pressures, the fragmentation factors for the substances of interest should be measured with the same instrument, and the same adjustments, as the samples to be analyzed.

Chapter 5
Using Transpector Web UI

5.1 Introduction

Transpector MPS includes Transpector Web UI, an onboard, browser-based user interface (UI) that provides remote Transpector MPS control and monitoring from network connected devices.

This chapter will discuss the purpose of, the requirements for running, and instructions for operating Transpector Web UI.

5.1.1 What is Transpector Web UI

Transpector Web UI:

- ◆ displays data in a spectrum window

- ◆ can perform leak checking when the computer that controls Transpector MPS is located away from Transpector MPS

- ◆ provides a diagnostic window that displays instrument status and errors

Transpector Web UI should be used in parallel with a program from the FabGuard® Suite.

NOTE: *Transpector Web UI does not allow for saving data*. It is a remote monitoring and diagnostic tool. For data saving, selected peaks mode or trend graphs, a full software program must be used.

5.2 System Requirements

5.2.1 Using Transpector Web UI on Computers

Transpector Web UI allows for Transpector MPS control through standard Internet browsers. Transpector Web UI is fully supported for use in:

◆ Microsoft Internet Explorer® 10

◆ Mozilla Firefox®

◆ Google Chrome™

Transpector Web UI is not supported for use in Opera™ or Apple Safari®.

The minimum computer requirements are shown in Table 5-1.

Table 5-1 Minimum computer requirements

Parameters	Transpector Web UI Requirements
Processor	Pentium 4 1.8 GHz or greater
RAM	1 GB or greater
Resolution	1024 x 768 16 Bit color or greater
Operating System*	Windows 8, Windows 7, Windows Vista, Windows XP**
Communications	Requires Ethernet Port or Wi-Fi†
* Transpector Web UI itself does not have operating system requirements. The requirements for the operating system are dependant on the browser being used.	
**Windows XP does not support Internet Explorer 9. Firefox or Chrome are recommended for use with Windows XP.	
† To use Wi-Fi, Transpector MPS must be connected to a Wi-Fi equipped router.	

5.2.2 Using Transpector Web UI on Mobile Devices

Transpector Web UI is optimized for 10.1 in. tablet devices such as the Samsung Galaxy Tab, and 9.7 in. devices such as the Apple iPad.

Because Transpector Web UI is browser based, OEM Android/Apple browsers will not work with the Transpector Web UI. A third party browser must be installed.

Transpector Web UI has not been optimized for use on Smart Phones such as Android Devices and iPhones. Check http://www.inficon.com for updates.

5.3 Connecting to Transpector Web UI

To connect to Transpector Web UI, *the device that is being used for operating Transpector Web UI must be connected to the same network as Transpector MPS.*

If the device is not connected to the same network as Transpector MPS, Transpector Web UI will not work. In this situation, connecting to a computer that is on the same network via Remote Desktop is necessary. Transpector Web UI will then run on the Remote Desktop computer.

5.3.1 Connecting to Transpector Web UI with default Factory IP address

The default web address for Transpector MPS is **192.168.1.100**. To connect to Transpector Web UI, type **192.168.1.100** into the browser address field, then press **Enter**. See Figure 5-1.

Figure 5-1 Navigating to Transpector Web UI
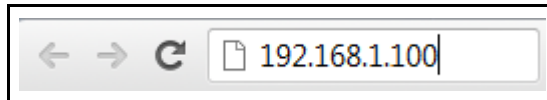
NOTE: The device running the browser must also be configured with an address on this network (e.g., **192.168.1.101**).

The browser will connect to Transpector MPS. If Transpector MPS is powered on and connected to the same network as the device, the Transpector Web UI **STATUS** webpage will display. See Figure 5-2.

Figure 5-2 STATUS webpage
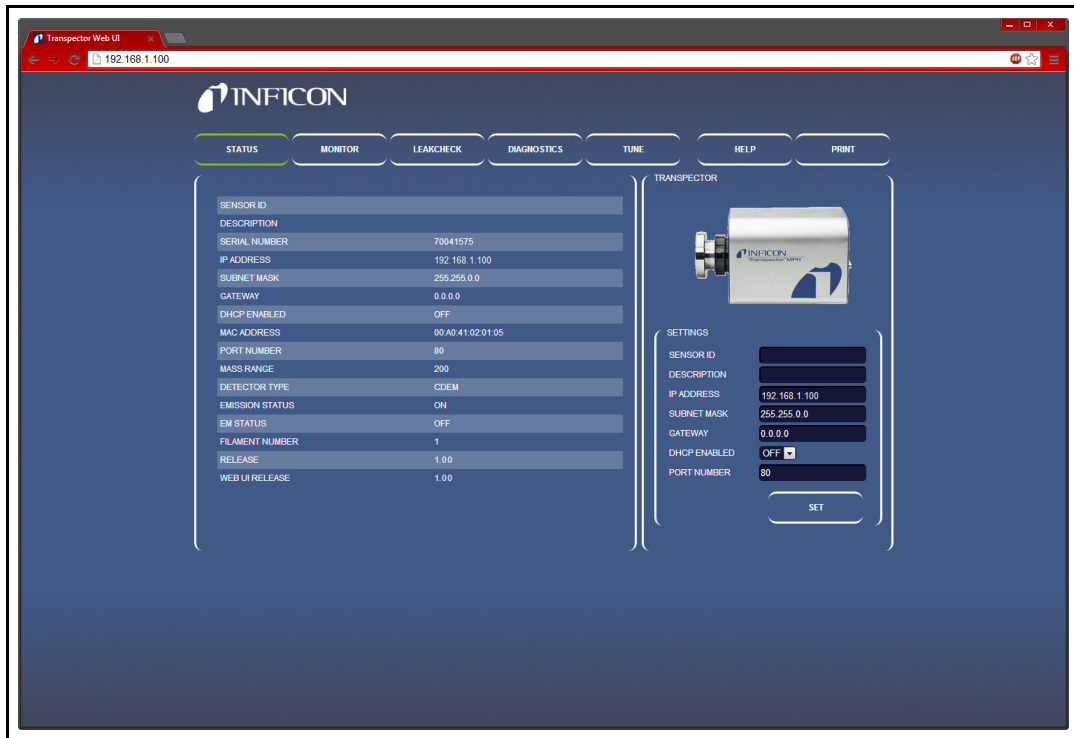
If the Transpector Web UI **STATUS** webpage does not display, refresh the browser.

If Transpector Web UI **STATUS** webpage still does not display, verify that the IP address was not changed from the factory default IP address. If the IP address has been changed, follow the instructions in section 5.3.2.

If the IP address was not changed from the factory default, make sure there are no other devices connected to Transpector Web UI.

5.3.2 Connecting to Transpector Web UI with a User-Defined IP Address

If the IP address has been changed from the default factory IP address, the new user-defined IP address must be entered into the browser. If the IP address was changed and the new address has been lost, contact INFICON.

5.4 Navigating Transpector Web UI

Transpector Web UI functionality is split between several different windows. To navigate from window to window, click on the button of the desired window. The buttons are displayed in Figure 5-3.

Figure 5-3 Transpector Web UI window selection buttons

The first window displayed by Transpector Web UI is **STATUS**. In the following sections, the different windows are identified and described.
For information on using the different windows, continue to section 5.5, Using Transpector Web UI, on page 5-10.

5.4.1 STATUS

The **STATUS** window, see Figure 5-4, provides information regarding several parameters.

*Figure 5-4 **STATUS** window*

SENSOR ID . . . . A user-definable ID for the sensor

DESCRIPTION . . . . A user-definable description for the sensor, useful for identifying different sensors

SERIAL NUMBER . . . . The factory serial number of the connected Transpector MPS, each Transpector MPS has a unique serial number

IP ADDRESS . . . . The IP address of the connected Transpector MPS

SUBNET MASK . . . . The subnet of the connected Transpector MPS

GATEWAY . . . . The gateway of the connected Transpector MPS

DHCP ENABLED . . . . Describes whether DHCP is turned ON or OFF

MAC ADDRESS . . . . The MAC address of the connected Transpector MPS

PORT NUMBER . . . . The port that the connected Transpector MPS is using

MASS RANGE . . . . The mass range of the connected Transpector MPS (100 or 200 AMU)

DETECTOR TYPE . . . . The detector type of the connected Transpector MPS (either FC or CDEM)

EMISSION STATUS . . . . The status of the emission of the Transpector MPS sensor (either ON of OFF)

EM STATUS . . . . The status of the Electron Multiplier (if equipped) of the Transpector MPS sensor (either ON or OFF)

FILAMENT NUMBER . . . . The filament currently in use by the Transpector MPS sensor (either 1 or 2)

RELEASE . . . . The firmware version number

WEB UI RELEASE . . . . Transpector Web UI version number

The **STATUS** window allows for changing **IP address**, **Port Number**, **Sensor ID** and **Description**. For more information, see section 5.5.2.4, Changing the Transpector MPS IP Address and Port Number, on page 5-22 and section 5.5.2.5, Changing the Sensor ID and Description, on page 5-24.

5.4.2 MONITOR

The **MONITOR** window, see Figure 5-5, is the data acquisition window of Transpector Web UI. For instructions on using the **MONITOR** window, see section 5.5.2.1, Data Acquisition, on page 5-10.
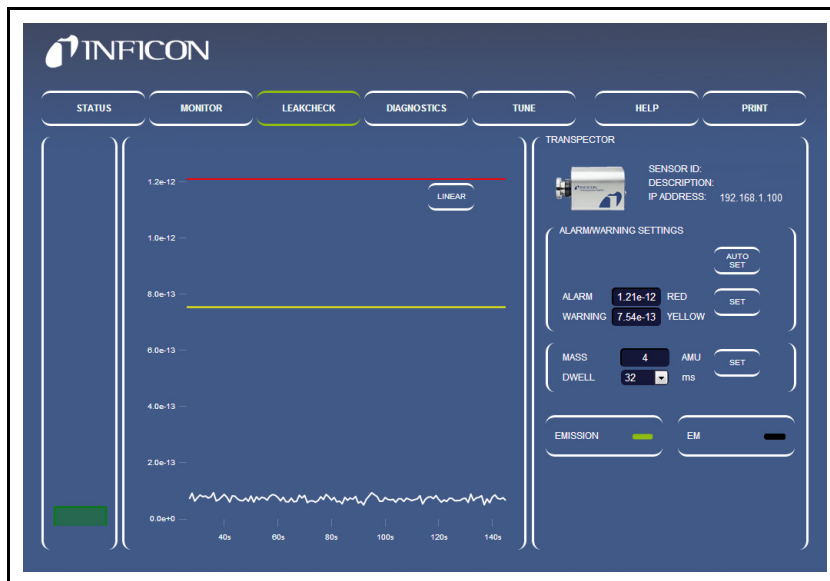
Figure 5-5 MONITOR window
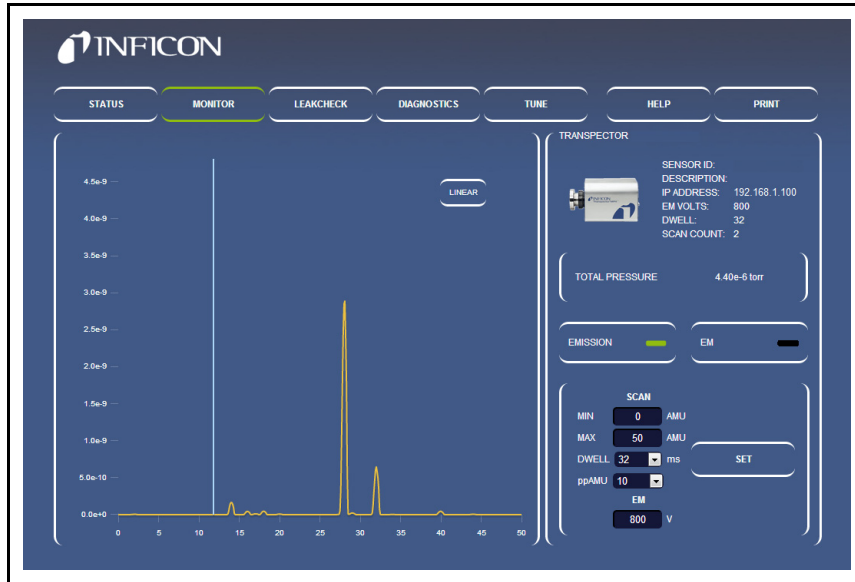
5.4.3 LEAKCHECK

The **LEAKCHECK** window, see Figure 5-6, is used for leak checking with Transpector MPS. For instructions on how to use the **LEAKCHECK** window, see section 5.5.2.2, Leak Checking, on page 5-13.

Figure 5-6 LEAKCHECK window

5.4.4 DIAGNOSTICS

The **DIAGNOSTICS** window, see Figure 5-7, includes **System Status** and other diagnostic tools useful when contacting INFICON for assistance.

Figure 5-7 DIAGNOSTICS window

5.4.5 TUNE

The **TUNE** window, see Figure 5-8, is password locked. It allows for tuning Transpector MPS. For tuning instructions, see section 5.5.2.3, Tune Mode, on page 5-16.

*Figure 5-8 **TUNE** window*
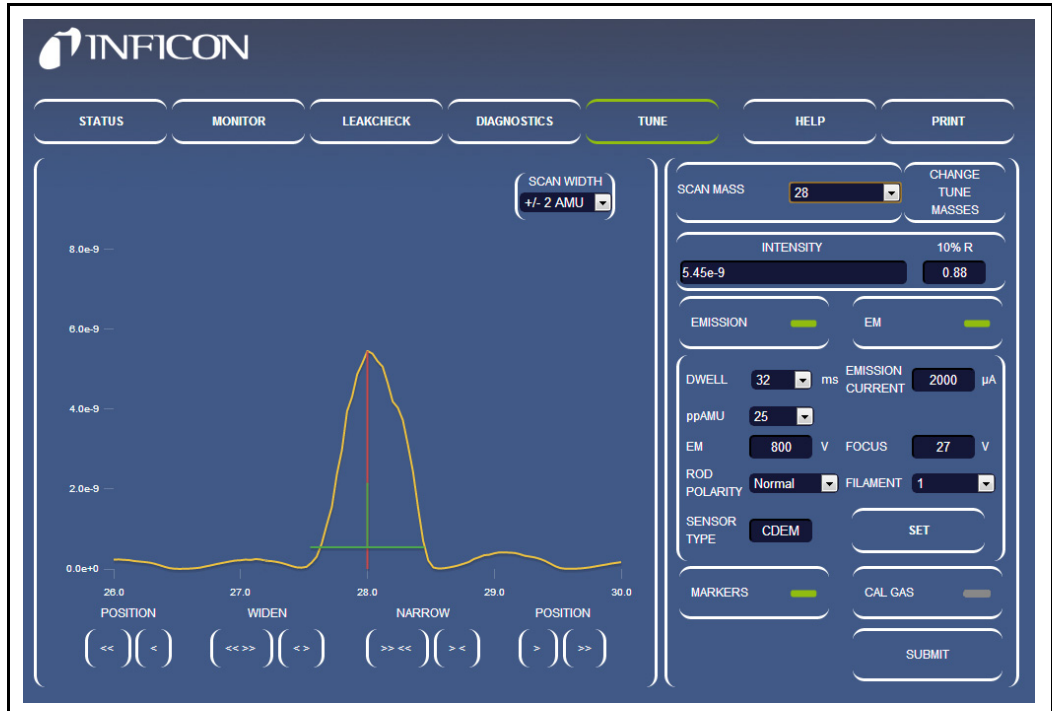
5.4.6 HELP

Click **HELP** to display the Transpector Web UI Operating Manual in a separate browser tab.

5.4.7 PRINT

Click **PRINT** to display a printing dialog box that allows for printing the displayed window.

5.5 Using Transpector Web UI

This section provides instruction for common Transpector MPS applications.

5.5.1 Transpector Web UI and FabGuard Explorer

> ⚠️ **CAUTION**
>
> **FabGuard and Transpector Web UI cannot access the same sensor at the same time.**

FabGuard Explorer is the primary software package for the Transpector MPS sensor, but there are instances when using Transpector Web UI is appropriate. FabGuard Explorer will give control of the Transpector MPS sensor to the Web UI if the RGA is idle.

5.5.2 Standalone Transpector Web UI Operation

This section provides instruction for using Transpector Web UI as a standalone software program.

5.5.2.1 Data Acquisition

The **MONITOR** window is used for data acquisition.

NOTE: *Transpector Web UI does not allow for saving data or displaying the data in a Trend graph.* Transpector Web UI is designed for data monitoring and simple vacuum diagnostics.

When the **MONITOR** window is first opened, Transpector MPS will begin collecting data using default parameters shown in Table 5-2.

Table 5-2 Default Monitor Parameters

| Parameter	Value
Min (AMU)	0
Max (AMU)	50
Dwell	32 ms
ppAMU	10

5.5.2.1.1 Editable Parameters

Transpector MPS has editable scan parameters that affect how data is acquired. The editable parameters are:

Emission On/Off . . . . Turns the filament in the Transpector MPS ion source on or off. Emission must be ON to collect data.

EM On/Off . . . . Turns the EM detector (if equipped) on or off. Turning on the EM will improve the signal-to-noise ratio of Transpector MPS and allow for smaller level signals to be seen above the noise. Emission must be ON to enable the EM to be turned on.

Min . . . . The starting point of the scan in AMU. For all models, this can be as low as 0.

Max . . . . The ending point of the scan in AMU. The maximum point is defined by the model: 100 AMU Transpector MPS can scan up to 100 AMU and 200 up to 200 AMU.

Dwell . . . . The amount of time that Transpector MPS averages data for each collected point. Longer dwell times will decrease noise and increase scan time while shorter dwell times will be noisier and decrease scan time.

ppAMU . . . . This is the number of points that Transpector MPS collects for each AMU. 1 ppAMU will generate a bar chart with a data point at each integer AMU value. >1 ppAMU will generate an analog scan showing peak shapes.

Linear/Logarithmic . . . . Displays the data either in a linear or logarithmic scale. Since Transpector MPS has such a large Dynamic Range, log scale is often helpful for seeing low level contaminants.

5.5.2.1.2 How To Change Scan Parameters

On the right side of the **MONITOR** window is a group for controlling **EMISSION** and **EM**. See Figure 5-9. In this group are editable boxes that change the scan parameters described in section 5.5.2.1.1.

Figure 5-9 Where to change scan parameters
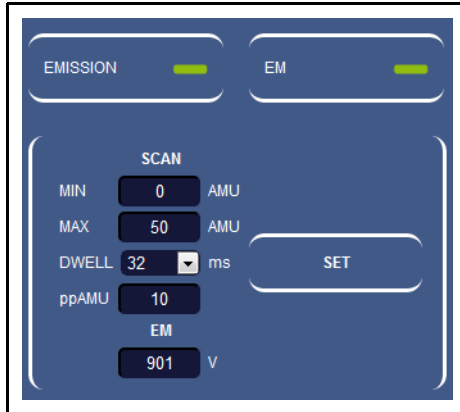
To turn On/Off Emission, click **EMISSION**. There is an indicator on the right side of the **EMISSION** button. This indicator changes color based on emission state. There are three colors, as shown in Figure 5-10.

Figure 5-10 Emission status
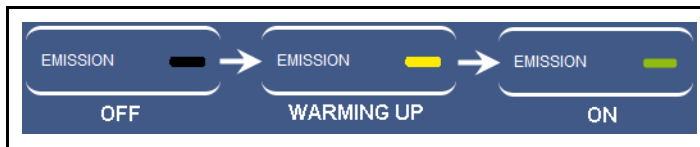
The Electron Multiplier is controlled the same way as the emission. To turn the Electron Multiplier on or off, click **EM**. There are only two different EM states: **OFF** (**Black**) and **ON** (**Green**). See Figure 5-11.

Figure 5-11 Electron multiplier status
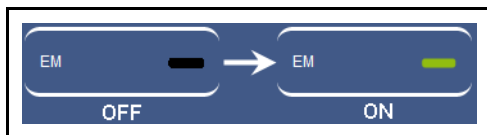
Emission and EM are the only settings that, when altered, have an immediate impact on data collection.

The other scan parameters can be changed, but will not affect the data collection until **SET** is clicked. Click **SET** to restart data acquisition using the changed parameters.

To change Min/Max AMU values, highlight the current value in the appropriate box and type in the Min or Max AMU value that is desired. Click **SET** to start collecting data in the new mass range.

Dwell and **ppAMU** are changed by a drop-down list which includes all allowable values. Once either parameter is changed, click **SET** to start collecting data with the new parameters.

EM Voltage displays the voltage of the Electron Multiplier.

5.5.2.2 Leak Checking

Transpector MPS is commonly used as a leak check tool by:

◆ determining leaks while detecting helium that is sprayed by an operator and then monitoring the change in helium concentration

◆ indicating the presence of a leak by showing increased levels of nitrogen, oxygen and carbon dioxide.

Click **LEAKCHECK** to display the **LEAKCHECK** window. Upon entering the **LEAKCHECK** window, Transpector MPS will start collecting data using the default parameters as shown in Table 5-3.

The Transpector Web UI **LEAKCHECK** window utilizes Transpector MPS signal levels to generate alarm statuses. When the **LEAKCHECK** window is first entered, Transpector Web UI auto-generates alarm levels based on the current Mass signal.

Table 5-3 Leak check default parameters

| Parameter	Default Value
Mass	4 (Helium)
Dwell	32 ms
Emission	Uses Current Transpector MPS status
EM (if equipped)	Uses Current Transpector MPS status

NOTE: Emission must be turned on to perform a leak check.

5.5.2.2.1 Leak Check Components

Figure 5-12 points out the different components of the **LEAKCHECK** window. This section will discuss the different leak check functions.

Figure 5-12 LEAKCHECK window
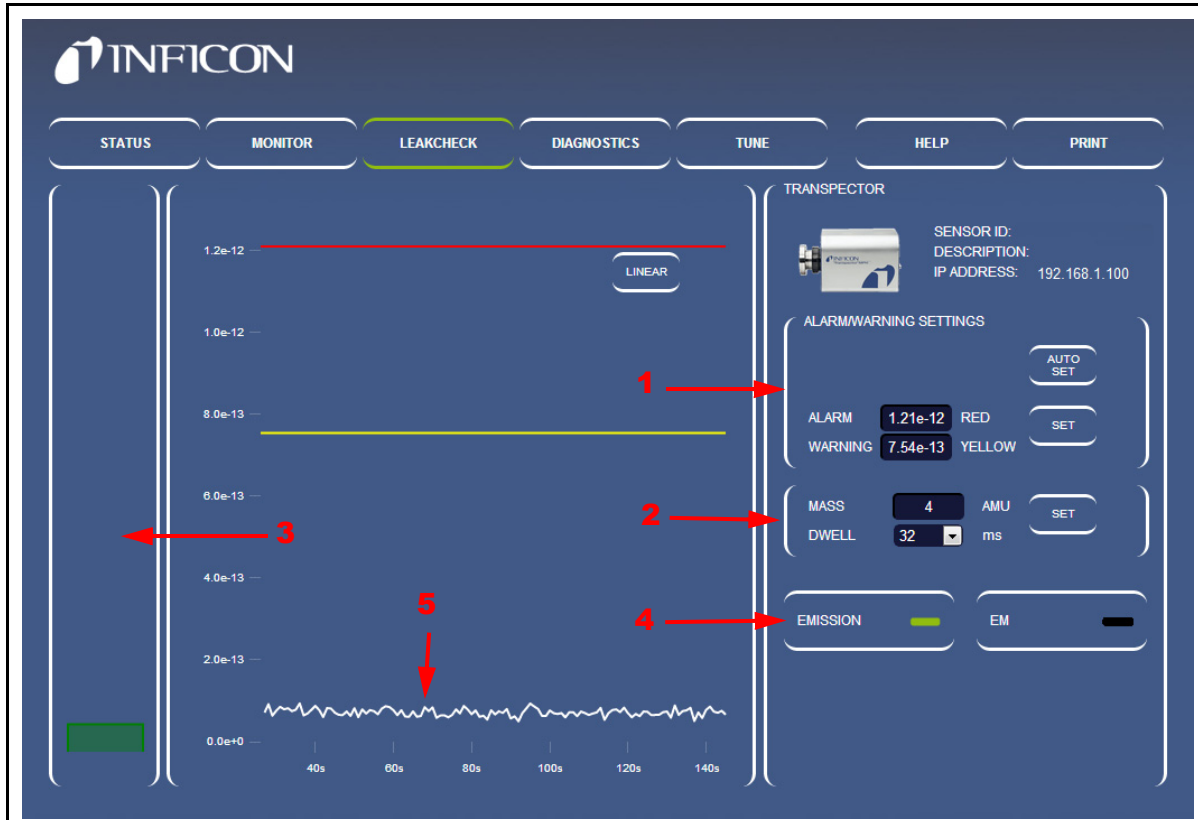
1 **ALARM/WARNING SETTINGS**—The **ALARM/WARNING SETTINGS** group is used to manually or automatically change the alarm levels for leak checking. Clicking **AUTO SET** causes Transpector Web UI to automatically generate alarm levels based on recent data acquired. To manually set alarm levels, highlight the alarm level of interest, type the desired alarm level, then click **SET**.

2 **Transpector MPS Scan Parameters**—Transpector MPS can use any mass for leak detection. To change the mass, highlight the mass shown in the **MASS** box, type the new desired mass, then click **SET**.

The **DWELL** time that is used for the mass that is being analyzed can be changed. **DWELL** behaves the same way as in data acquisition, see section 5.5.2.1.1, Editable Parameters, on page 5-11. The **DWELL** time does not change until the **SET** is clicked.

NOTE: ALARM/WARNING SETTINGS and Transpector MPS Scan Parameters each have a **SET** button next to the changeable parameters.

The **SET** buttons are not interchangeable.

- ◆ To change alarm and warning settings, click **SET** next to the **ALARM** and **WARNING** group.

- ◆ To change scan parameters, click **SET** next to the **MASS** and **DWELL** group.

3 **Thermometer Bar**—The Thermometer bar shows the real-time level of the signal. The bar will raise and lower based on the signal in amps of the specified mass. If the signal exceeds warning or alarm levels, the color of the bar will change. See Figure 5-13.

Figure 5-13 Thermometer bar levels
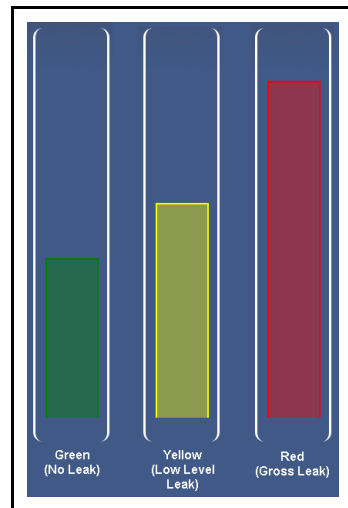
4 **EMISSION and EM Control**—These work the same as **EMISSION** and **EM** in the **MONITOR** window (section 5.5.2.1.1, Editable Parameters, on page 5-11). Click **EMISSION** or **EM** to turn on or off the emission or EM.

5 **Mass Trend Graph**—The mass trend graph will display how the signal (in amps) for the specified mass changes with time. There are two lines (one yellow and one red) on the trend graph. These lines represent warning and alarm levels. When the signal increases above the alarm level lines, there is the presence of a leak.

5.5.2.2.2 Using the Leak Check Mode

To leak check with Transpector MPS using Transpector Web UI:

1   Click **LEAKCHECK** to display the **LEAKCHECK** window.

2   Determine the gas that will be used for leak checking.

3   Enter the **MASS** of the leak check gas.

> **HINT:** Typically the leak check gas is Helium, whose mass is 4 AMU.

4   Select the desired **DWELL** time. A longer dwell will decrease the random noise of the signal.

5   Click **SET**.

> **NOTE:** If audio alarms are desired, make sure that the PC is at an appropriate level and Google Chrome is used as the browser.

6   If the signal starts exceeding the alarm levels while not spraying the leak check gas, click **AUTO SET** to automatically reset the alarm levels to reduce the signal below the current alarm. **AUTO SET** implies that the signals generated by Transpector MPS are normal and displays green for alarm status.

7   Spray leak check gas around the area of interest and monitor for changes in the **Mass Trend Graph**.

8   Continue spraying the leak check gas until the **Thermometer Bar** indicates an alarm status with a change in color.

> **NOTE:** An audible alarm will be heard if Google Chrome is the browser and sound is on.

9   When finished with leak checking, leave the **LEAKCHECK** window.

5.5.2.3 Tune Mode

Transpector Web UI allows for mass-scale tuning of Transpector MPS. Since tuning can alter the quality of data recorded by Transpector MPS, the **TUNE** window is password locked. To enter the **TUNE** window, click **TUNE** and type the password: **Admin**.

⚠️ **CAUTION**

Tuning of Transpector MPS should only be done by qualified operators. Changes to the tune file can affect the ability to accurately collect data.

Do not enter the Tune Mode without being well versed in how to tune Transpector MPS.

5.5.2.3.1 Tune Mode Components

Figure 5-14 points out the different components of the **TUNE** window. This section will outline the different components and discuss their functionality.

Figure 5-14 Tune Mode components
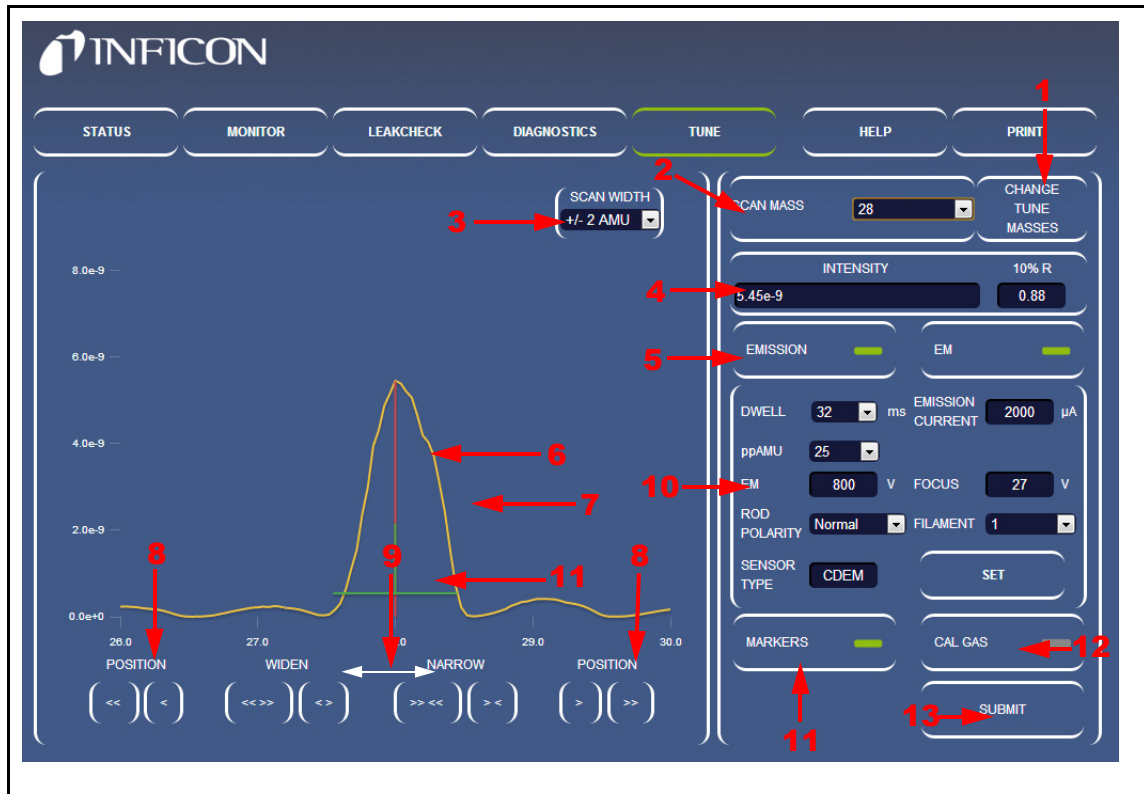
1. **CHANGE TUNE MASSES**—Click **CHANGE TUNE MASSES** to change the masses used for Transpector MPS tuning. The **Tune Table Editor** will display, which allows for editing the tune masses. See Figure 5-15.

Figure 5-15 Tune table
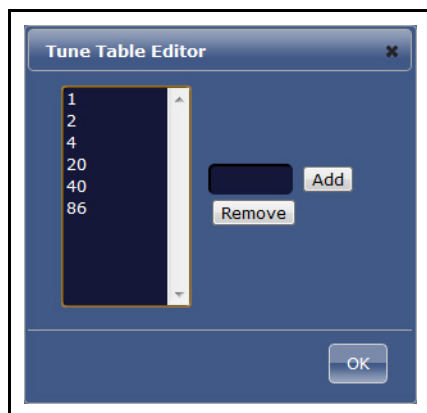
2. **SCAN MASS**—The **SCAN MASS** drop-down is used to select the mass to be tuned.

3 **SCAN WIDTH**—The **SCAN WIDTH** drop-down sets the width to scan around the Scan Mass. This is useful for finding a mass that is far from its expected mass position.

4 **INTENSITY and 10% R**—Lists the intensity in Amps of the peak being tuned. The **10% R** box displays the width of the peak at 10% peak height.

5 **EMISSION/EM controls**—Turns on and off the emission and electron multiplier.

6 **MASS TARGET**—A red line is displayed at the peak of interest.
For example, when mass 2 is scanned, the mass target will be displayed at mass 2.

7 **Transpector MPS spectrum data**—This line displays the Transpector MPS data for the scan width selected.

8 **POSITION buttons**—The **POSITION** buttons change the location of the peak. There are two different buttons on each side. The single button (**<** or **>**) will finely move the peak. The double button (**<<** or **>>**) moves the peak the equivalent of ten clicks of the single button.

> **NOTE:** The **POSITION** buttons move the peak in the direction of the arrows (i.e., the **<<** button will move the peak left).

9 **WIDTH buttons**—The **WIDTH** buttons increase or decrease the width of the peak to achieve target 10% R. The single button (**<** or **>**) will finely change the peak width. The double button (**<<** or **>>**) is a change equivalent to ten clicks of the single button.

> **NOTE:** The **WIDTH** buttons are not directional. For example, both **<<** and **>>** increase the width equally around the mass.

10 **Transpector MPS scan parameters**—These scan parameters affect the Transpector MPS scan. Click **SET** to send the parameters to Transpector MPS.

DWELL . . . . The amount of time that Transpector MPS averages data for each collected point. Longer dwell times will decrease noise and increase scan time. Shorter dwell times will be noisier and decrease scan time.

ppAMU . . . . The number of points that Transpector MPS collects for each AMU. 1 ppAMU will generate a bar chart with a data point at each integer AMU value. >1 ppAMU will generate an analog scan showing peak shapes.

EM Voltage . . . . The voltage of the EM (if equipped). The minimum voltage for the EM is 600 V. The maximum voltage for the EM is 2000 V. The default voltage for the EM is 800 V. Changing this value will impact the gain of the Electron Multiplier. This is useful only when trying to resolve a peak from the noise floor. *EM voltage should be changed only by experienced operators.*

ROD POLARITY . . . . Defines the polarity of the Quadrupole rods. In the factory, Rod Polarity is determined for each individual Transpector MPS to produce optimum tune quality. *Do not alter this setting unless directed by INFICON.*

SENSOR TYPE . . . . Defines whether the sensor is equipped with an EM/FC combination or an FC only detector. *Do not alter this setting unless directed by INFICON.*

EMISSION CURRENT . . . . The Emission Current affects the current at the filament in the ion source. This has been optimized in the factory for each individual Transpector MPS to produce optimum tune quality. *Do not alter this setting unless directed by INFICON.*

FOCUS Voltage . . . . Changes the voltage of the focus plates which generate an ion beam from the ion source. This has been optimized in the factory for each individual Transpector MPS to produce optimum tune quality. *Do not alter this setting unless directed by INFICON.*

FILAMENT NUMBER. . . . . Transpector MPS has dual filaments. This allows for switching from one filament to the other.

11 **MARKERS button and displayed marker—MARKERS** turns on and off the markers. The marker consists of two components: a vertical one that represents the highest intensity of the displayed peak and a horizontal one that indicates 0.9 AMU width at 10% peak height.

12 **CAL GAS button—CAL GAS** is not available for Transporter MPS (Only used in Transpector MPH systems with HPR option).

13 **SUBMIT button—SUBMIT** submits the changes made to Transpector MPS tune into the Transpector MPS Non-Volatile RAM (NVRAM) in the Transpector MPS electronics box. **SUBMIT** must be clicked to save the changes made on the Tune window.

5.5.2.3.2 Default Tune Mode Parameters

When first entering the **TUNE** window, Transpector Web UI is set with the default parameters displayed in Table 5-4.

Table 5-4 Default Tune Mode parameters

Parameter	Value
Dwell	32 ms
ppAMU	25
Electron Energy	70 eV
Scan Mass	1 AMU
Scan Width	±2 AMU

5.5.2.3.3 Tuning Transpector MPS

During normal operation, the tune should not deviate much from the original factory tune. This tuning guide will only discuss fine tuning of the sensor. If the tune has been altered significantly, contact INFICON.

In general, tuning Transpector MPS involves mass alignment (ensuring that the peak is aligned with the proper AMU) and width adjustment.

Tuning RGAs is not something that should be done by novice users. For general tuning instructions, see section 6.6.1 on page 6-15. These tips and instructions should be reviewed prior to doing any tuning regardless of the interface. Instructions for tuning Transpector MPS using the Transpector Web UI interface are as follows:

1 Click **CHANGE TUNE MASSES**. A tune table will display, see Figure 5-15.

- ◆ To remove masses from the tune table, click the mass to remove, then click **REMOVE**.

⚠️ **CAUTION**

> **Do not remove masses 1, 2 or 4. Removing the low tune masses can significantly alter the higher-mass tuning.**

- ◆ To add masses to the tune table, type the mass into the box next to **ADD**, then click **ADD**. The default Tune masses are displayed in Table 5-5.

Using the tune table, select the masses that will be tuned.

Table 5-5 Factory tune settings

100 AMU		200 AMU	
Mass	10% R	Mass	10% R
1	0.5 ±0.10	1	0.5 ±0.10
2	0.9 ±0.05	2	0.9 ±0.05
4	0.9 ±0.05	4	0.9 ±0.05
28	0.9 ±0.05	28	0.9 ±0.05
86	0.9 ±0.05	86	0.9 ±0.05
		134	0.9 ±0.05

2 Ensure that the emission has been on and the RGA has been scanning for 30 minutes prior to tuning. Transpector MPS can be tuned either with the EM on or off.

3 Select the mass to tune using the **TUNE MASSES** drop-down.

◆ The default tune mass is mass 1, but *mass 1 should not be tuned unless instructed by INFICON.*

◆ Transpector Web UI is capable of tuning one mass at a time.

◆ Ensure that a gas is present that represents the selected mass.

4 Transpector MPS will begin scanning based on the tune mass selected, the tune width selected (±2 AMU is default and satisfactory for fine tuning) and the Transpector MPS **PARAMETERS**.

5 Click **MARKERS** to display the markers. This will generate a marker that shows the highest intensity point of the peak and the width at 10% Peak Height.

6 Use **POSITION** to align the **MASS TARGET** to the vertical **MARKER**. When done properly, the target and marker will overlap.

7 Use **WIDTH** to change the 10% R that is displayed in the **10% R** box. An ideal 10% R is 0.90 ±0.05.

8 While adjusting the width of the peak, the peak position can change a bit. Repeat steps 6 and 7 until the peak position is accurate and the 10% R is 0.90 ±0.05.

9 Repeat Steps 3-8 for each Tune Mass. Then repeat Steps 3-8 for each tune mass again to make sure that tuning of higher masses have not shifted lower masses.

10 Once Transpector MPS is tuned, click **SUBMIT** to store the new tune file into Transpector MPS.

5.5.2.4 Changing the Transpector MPS IP Address and Port Number

The Transpector MPS IP address and Port Number are set on the **STATUS** window.

NOTE: If you change the IP address of Transpector MPS, Transpector Web UI will no longer be accessible by the default IP address. You will need to reenter Transpector Web UI by entering the new IP address into the address box of the browser after the Transpector MPS has been turned off then on. You may also have to change the IP address of your device (e.g., PC) depending on the newly changed Transpector MPS IP address.

5.5.2.4.1 Manually Changing the IP address

To manually change the IP address of Transpector MPS:

1 Click **STATUS** to display the **STATUS** window.

2 In the **SETTINGS** group, delete the current **IP ADDRESS**. See Figure 5-16.

3 Type the new **IP ADDRESS**.

4 Click **SET**.

5 A notification is displayed, see Figure 5-17. Click **OK**.

6 Transpector MPS will reboot automatically and will use the new **IP ADDRESS**.
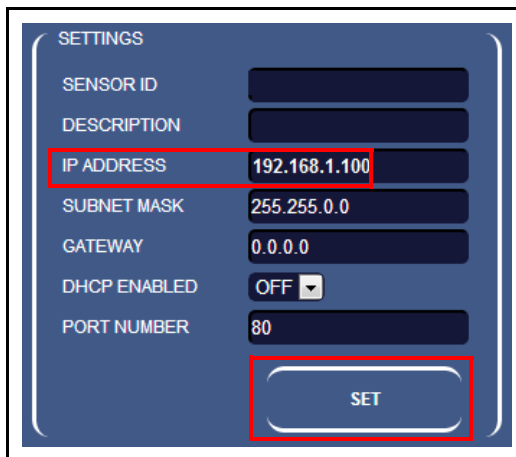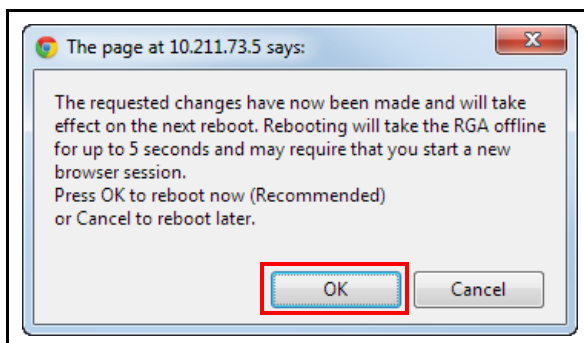
Figure 5-16 IP address

Figure 5-17 Rebooting Transpector MPS

5.5.2.4.2 Using DHCP to Allow the Network to Assign an IP address

By default, **DHCP ENABLED** is set to **OFF**. To turn DHCP on (refer to Figure 5-16):

1 Select **ON** from the **DHCP ENABLED** drop-down.

2 Click **SET**.

3 Power off and then power up Transpector MPS.

4 Upon power up, the Transpector Web UI browser session will be connected to the original IP address and will therefore not work.

5 In order to reconnect to Transpector Web UI, the INFICON Mass Spectrometer Search Utility must be run to find the new Transpector MPS IP address. The IMSSU will locate Transpector MPS and display the new IP address. Refer to section 2.3.1.1, Using the INFICON Mass Spectrometer Search Utility to Change the IP Address, on page 2-4.

6 To return to Transpector Web UI, the new IP address must be entered in the address bar of the browser.

> ⚠️ **CAUTION**
>
> **If you do not have the IMSSU installed on your computer, you will not be able to determine the new IP address of Transpector MPS.**

5.5.2.4.3 Changing the Port Number of Transpector MPS

Transpector MPS is set with a default port number of 80. If this port is blocked by the network that Transpector MPS is installed on, the port number must be changed. To change the port number:

1 Connect a computer with an open port 80 to Transpector MPS.

2 Open Transpector Web UI.

3 Enter the **STATUS** window.

4 Delete the port number in the **PORT NUMBER** box and type the new port number.

5 Click **SET**.

6 Reboot Transpector MPS. After reboot, Transpector MPS will communicate via the new port number and can be connected to the network.

5.5.2.4.4 Changing the Subnet Mask of Transpector MPS

Transpector MPS is set with a default subnet mask of 255.255.0.0. The subnet mask of Transpector MPS must match the subnet mask of the computer network that it is installed on. To change the subnet mask:

1 Connect Transpector MPS to a computer with a subnet mask of 255.255.0.0.

2 Open Transpector Web UI.

3 Enter the **STATUS** window.

4 Delete the subnet mask in the **SUBNET MASK** box and type the new subnet mask.

5 Click **SET**.

6 Reboot Transpector MPS. After a reboot, Transpector MPS will use the proper subnet mask for the network to which it is connected.

5.5.2.4.5 Changing the Gateway of Transpector MPS

Transpector MPS is set with a default gateway of 0.0.0.0. If the network on which Transpector MPS is connected requires a gateway:

1 Connect Transpector MPS to a computer with a gateway of 0.0.0.0.

2 Enter Transpector Web UI.

3 Enter the **STATUS** window.

4 Delete the gateway in the **GATEWAY** box and type the new gateway.

5 Click **SET**.

6 Reboot Transpector MPS. After a reboot, Transpector MPS will use the proper gateway for the network to which it is connected.

5.5.2.5 Changing the Sensor ID and Description

Sensor ID and **Description** are changeable on the **STATUS** window.

1 Click **STATUS** to display the **STATUS** window.

2 To change either the **Sensor ID** or the **Description**, delete the current ID or Description and type the new ID or Description.

3 Click **SET**.

5.6 *Transpector Web UI Best Known Methods*

This section discusses a few tips that will help with using Transpector Web UI.

5.6.1 *When to Use Transpector Web UI*

Transpector Web UI does not save data. Thus, it is not a quantitative tool. The following is a list of suggested applications for Transpector Web UI.

5.6.1.1 *Vacuum Diagnostics*

A common application for Transpector Web UI is to run general vacuum diagnostics. This is useful when a vacuum system is having difficulty pumping down or has an unknown contaminant. Some knowledge of reading RGA spectra is necessary for this application.

To perform vacuum diagnostics, enter the **MONITOR** window of Transpector Web UI. After choosing the settings that are appropriate for the application, Transpector MPS will scan through the indicated mass range. A quick qualitative analysis can then be performed to determine what is present inside of the system. For deeper analysis, use FabGuard software.

5.6.1.2 *Leak Checking*

Transpector Web UI is useful as a leak checking tool. Upon first entering the **MONITOR** window, peaks at 28 (Nitrogen), 32 (Oxygen), and 44 (Carbon Dioxide) indicate the presence of a leak. If the leak is not an air leak, different masses can be monitored.

After determining the presence of a leak, leak checking can be performed by the **LEAK CHECK** window. While spraying Helium around the vacuum system, Transpector Web UI will indicate the presence of Helium, indicating the location of the leak.

5.6.1.3 *Remote Monitoring*

Transpector Web UI allows for access to Transpector MPS from a remote, network-connected computer without the limitations of a Remote Desktop Connection.

If FabGuard is idle, Transpector Web UI can remotely collect data and verify the status of the vacuum system.

5.6.2 Generating Shortcuts for Quick Access

Since Transpector Web UI is browser based, shortcuts can be generated that will open a browser and direct it to the attached webpage address. In this manner, remembering the IP address for one (or multiple) Transpector MPS sensors is not necessary. Creating shortcuts also allows for differentiating between different Transpector MPS when more than one is present on the network.

1 Open Transpector Web UI.

2 Highlight the webpage address in the browser, right-click, then click **Copy**. See Figure 5-18.
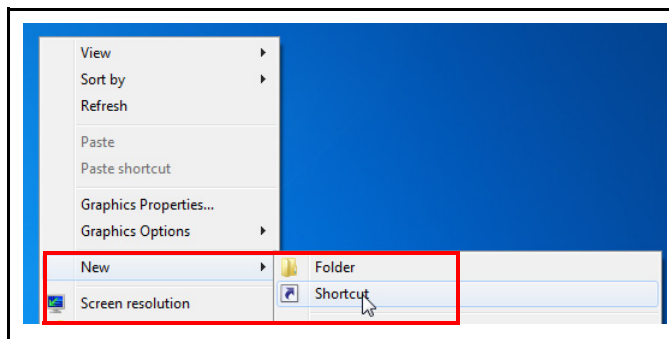
> **NOTE:** You can create more than one shortcut per sensor. For instance, you could create a shortcut to the **MONITOR** window, and a different shortcut to the **LEAK CHECK** window.
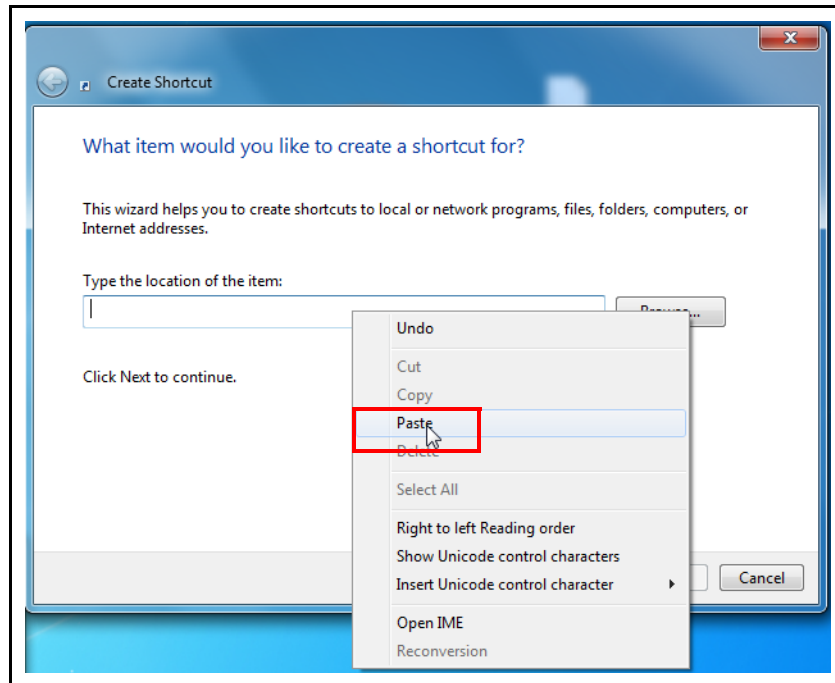
Figure 5-18 Copy web address
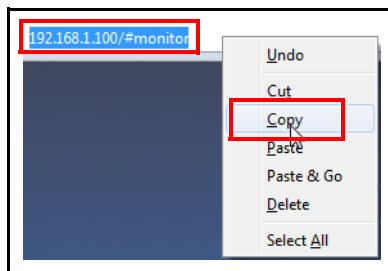
3 Right-click on the Desktop and select **Create New >> Shortcut**. See Figure 5-19.
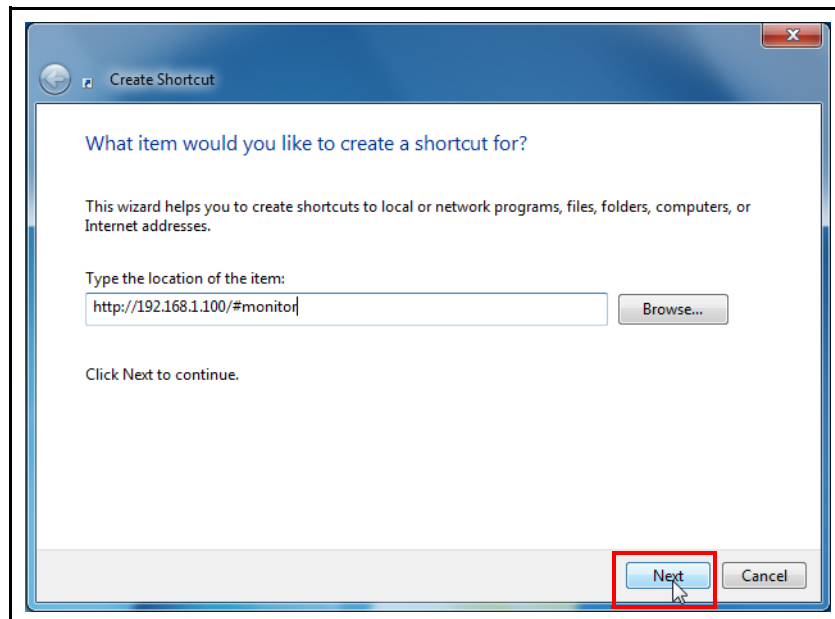
Figure 5-19 Create new shortcut

4 In the **Create Shortcut** window, paste the webpage address of Transpector Web UI. See Figure 5-20.
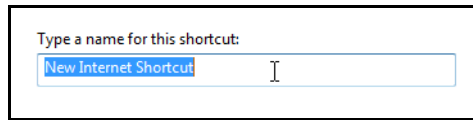
Figure 5-20 Paste webpage address
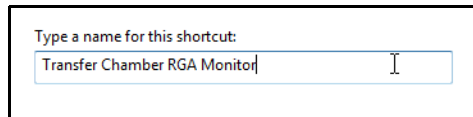

5 Click **NEXT**. See Figure 5-21.

Figure 5-21 Next

6 Enter a name for the shortcut. This is where a **Sensor ID** is useful for naming the shortcut. See Figure 5-22 and Figure 5-23.

Figure 5-22 Entering a name for the shortcut

Figure 5-23 Differentiating name

7 The shortcut will now be generated on the desktop with the name given to it in step 5. See Figure 5-24.

Figure 5-24 Shortcut icon
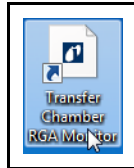
⚠️ **CAUTION**

If you change the IP address of Transpector MPS, the shortcuts will no longer work.

5.6.3 Creating Bookmarks

In addition to creating shortcuts on the computer Desktop, bookmarks can also be generated inside of the internet browser. To set a bookmark, click **CTRL + d** when at the intended webpage address. The bookmark can then be named to differentiate different functions and sensors.

5.6.4 Using Wi-Fi

INFICON offers an optional 4-port Push-Button Wi-Fi router (PN 961-417-P1) as an accessory for Transpector MPS. This router provides the capability to turn the Wi-Fi on/off with the push of a button on the router. The router also allows for controlling the diameter of the router range. This allows for either only turning the Wi-Fi signal on when needed or controlling the range of the Wi-Fi signal to limit access to the exterior of the tool.

5.6.4.1 Why Use Wi-Fi

Transpector MPS connected to a Wi-Fi router allows access to Transpector Web UI from any Wi-Fi device (laptops, tablets, etc.). Leak checking using the handheld Wi-Fi device to monitor for leaks is a much easier task.

5.7 Troubleshooting

The main problems that will occur with operating Transpector Web UI involve communications problems. If Transpector Web UI cannot be opened, check the following:

1   Is anyone else using Transpector Web UI?

Transpector Web UI will block any incoming requests when it is actively being used.

2   Is the web address (IP address of Transpector MPS) correct?

If the IP address was recently changed, make sure that the browser is directed to the correct address.

3   Does Transpector MPS have 24 V power supplied to it?

If yes, try resetting the power.

4   Is the Ethernet cable connected to Transpector MPS and the network?

5   Try clearing the web browser cache. For instructions, visit the help files of the browser being used.

6   If these steps do not solve the problem, connect Transpector MPS directly to the computer (bypassing the router/network) and try connecting.

If Transpector Web UI starts working, it is likely that Transpector MPS has a conflict with its IP address (another device on the network has the same IP address) or the port that Transpector MPS is using is being blocked by the network/router. See section 5.5.2.4, Changing the Transpector MPS IP Address and Port Number, on page 5-22.

If Transpector MPS is still not working, contact INFICON.

Chapter 6
Maintenance

6.1 Introduction

The Transpector MPS sensor is subject to aging in normal use and some of its components will eventually require repair or replacement.

The Transpector MPS electronics module does not normally require repair or maintenance.

⚠️ **WARNING - Risk Of Electric Shock**

Opening the Transpector MPS Electronic Module should only be done by qualified service personnel. There are no user-serviceable parts inside the Electronic Module.

INFICON provides complete maintenance service for both sensors and Electronic Modules. Refer to section 1.3, How To Contact Customer Support, on page 1-3.

6.2 Safety Considerations

If Transpector MPS is used in a manner not specified by INFICON, protection provided by the equipment may be impaired.

6.2.1 Toxic Material

The Transpector MPS sensor does not contain any toxic material. However, if the Transpector MPS sensor is used in an application wherein toxic material is used or generated, residue of the toxic material will likely be present on the surface of the Transpector MPS sensor. Appropriate safety precautions must be taken when handling contaminated sensors in order to assure safety of maintenance personnel.

To return your sensor to INFICON for repair, refer to section 1.3.1, Returning Your Transpector MPS to INFICON, on page 1-3.

The Transpector MPS electronics module is RoHS compliant.

6.2.2 Radiation

Transpector MPS Gas Analysis systems are not known to produce harmful radiation.

6.2.3 Electrical Voltages

Transpector MPS does not present electrical hazards when enclosed and grounded according to the specifications given in the installation instructions.

> ⚡ **WARNING - Risk Of Electric Shock**
>
> **If the Transpector MPS electronics module is operated while open, hazardous electrical voltages may be present. Such operation should not be attempted except by qualified service personnel.**

6.3 General Instructions For All Repair Procedures

> ⚠️ **CAUTION**
>
> **Perform all service procedures in a clean, well illuminated area.**
>
> **Wear clean, nylon, lint free lab gloves or finger cots.**
>
> **Do not touch the vacuum side of the sensor with unprotected fingers.**
>
> **Use clean tools for sensor disassembly (and assembly).**

6.4 Maintenance Procedures

This section will detail the sensor's required routine maintenance.

6.4.1 Bakeout of Quadrupole

If the symptoms in section 7.2, Symptom-Cause-Remedy Chart, on page 7-1, suggest that the sensor is contaminated, try first to restore normal performance by baking the sensor under a high vacuum of at least 1×10^{-5} Torr (1.333×10^{-5} mbar) [1.333×10^{-3} Pa] for several hours or preferably overnight. Table 6-1 represents the maximum bakeout temperatures.

If baking the sensor doesn't increase the sensor performance, it may be necessary to perform the tasks described in section 6.5.3, Filament Kit Replacement, on page 6-6 and also in section 6.5.4, Ion Source Removal, on page 6-9.

If the procedures explained above do not solve the problem, contact INFICON. Refer to section 1.3, How To Contact Customer Support, on page 1-3.

Table 6-1 Maximum bakeout temperatures

		While Operating	With Electronics Removed
Faraday Cup Sensors		200°C	300°C
Electron Multiplier Faraday Cup Combination	EM Mode FC Mode	150°C 200°C	300°C 300°C

⚠️ **CAUTION**

When heating the sensor above 200°C, the electronics module and the signal contact must be removed from the sensor.

6.4.2 Spare Heating Jacket Part Numbers

INFICON offers several heating jackets to help in baking a sensor. These heating jackets operate at a maximum temperature of 150°C.

Heating jacket part numbers are shown in Table 10-1 on page 10-1.

6.5 Repair Procedures

The sensor repair procedures are discussed in the following sections.

6.5.1 Tools Required for Filament Kit Replacement, Ion Source Replacement and EM Replacement

6.5.1.1 Tools for Replacing the Filament Kit

- ◆ 3 mm Nut Driver
- ◆ 1/16 in. Flat Blade Screwdriver

6.5.1.2 Tools for Replacing the Ion Source

- ◆ 1/16 in. Flat Blade Screwdriver
- ◆ #2 Phillips Head Screwdriver
- ◆ Precision Pliers

6.5.1.3 Tools for Replacing the Electron Multiplier

- ◆ 1/16 in. Flat Blade Screwdriver
- ◆ Phillips Head Screwdriver
- ◆ 1.5 mm x 50 mm Hex Driver
- ◆ 2.0 mm x 75 mm Hex Driver
- ◆ Precision Pliers
- ◆ Non-Metallic Tweezers

6.5.2 *How to Determine if a Filament Kit Replacement is Required*

Follow these steps to determine if a filament replacement is required. Remember that Transpector MPS has dual filaments, so if one filament is blown, but the second filament is intact, Transpector MPS can still be used with the second filament.

NOTE: Performance of the second filament may be impacted by previous use of Transpector MPS.

1 Measure the resistance of each filament. This can be accomplished while the sensor is under vacuum by measuring the resistance between pins **3** and **10 for filament 1 and pins 4 and 10 for filament 2** (see Figure 6-1). A failed filament will measure open while an intact filament will measure 0.8 Ω.
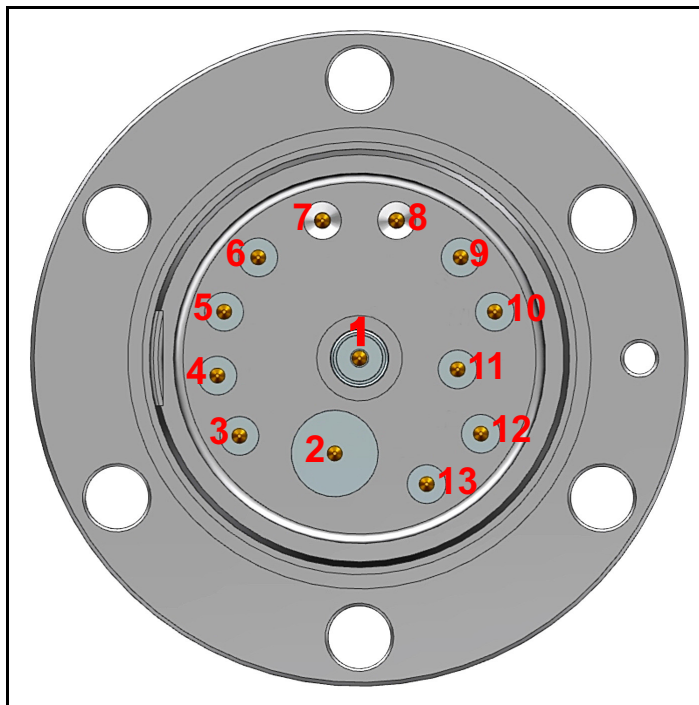
Figure 6-1 Sensor pinout

Table 6-2 Pin assignment

Pin	Assignment	Pin	Assignment
1	PP	8	GND
2	EM HV	9	RF+
3	Filament 1	10	Filament Common
4	Filament 2	11	Reserved
5	Anode	12	Focus
6	RF-	13	TP
7	GND		

NOTE: Although the following measurements may measure below 30 MΩ with the filament assembly and ceramic shield in place, they must be above 30 MΩ when measured with the filament assembly and ceramic shield removed.

2 Measure the resistance of each of the pins with respect to ground (pin **7 and 8**). These measurements must be above 30 MΩ.

3 Measure the resistance of each of the pins with respect to each other. All of these measurements must be above 30 MΩ, with the exception of the measurements between each filament pin and the filament common pin if the filaments have not failed.

6.5.3 Filament Kit Replacement

A filament replacement kit can be purchased from INFICON. This kit contains a new filament assembly mounted on a shipping fixture and a small Allen wrench. Perform the following steps to replace the filament.

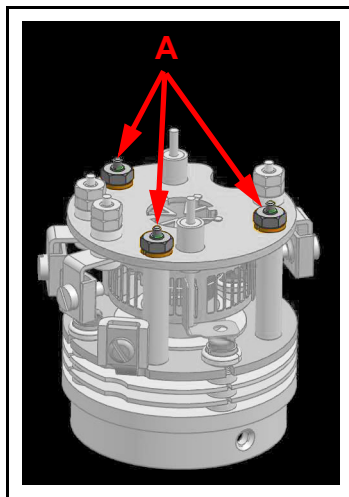**NOTE:** Refer to section 6.5.1.1, Tools for Replacing the Filament Kit, on page 6-4, before continuing.

> ⚠️ **CAUTION**
>
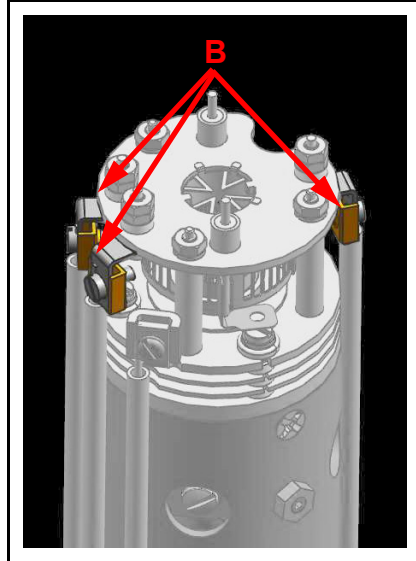> **Neither the filament assembly or the ion source can be cleaned. When dirty, they must be replaced.**

1 Using the 3 mm nut driver, remove the three nuts and lock washers (A) from the standoffs. See Figure 6-2.
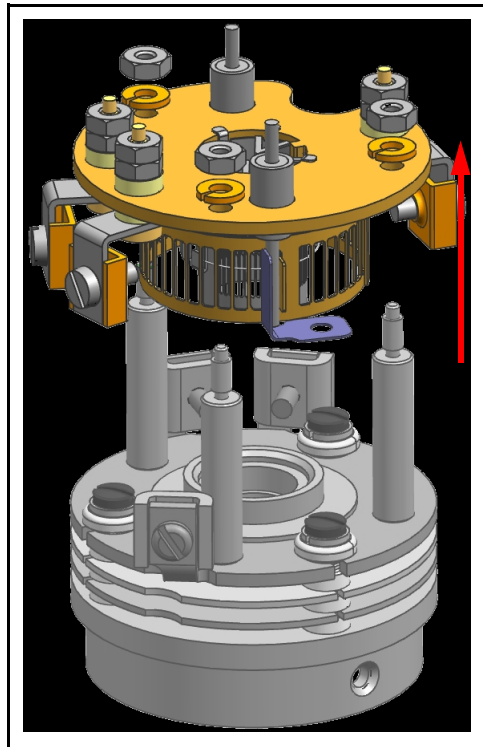
Figure 6-2 Removing the nuts

2 While holding the clamps with the pliers, use the flat blade screwdriver to loosen the clamps holding the filament leads (B). Gently pull the leads away from the filament assembly. See Figure 6-3.

Figure 6-3 Remove the leads

3 Carefully pull the filament assembly from the ion source. See Figure 6-4.

Figure 6-4 Remove the filament assembly

**4** Carefully remove the new filament assembly from its packaging and place it on the ion source standoffs.

> ⚠️ **CAUTION**
>
> **The new filament assembly must be carefully placed onto the ion source. Excessive horizontal movement will cause the damage to the anode.**

5 Replace the three washers and locknuts and ensure that the anode (C) aligns with the mating bore (D). See Figure 6-5.

Figure 6-5 Align anode to mating bore
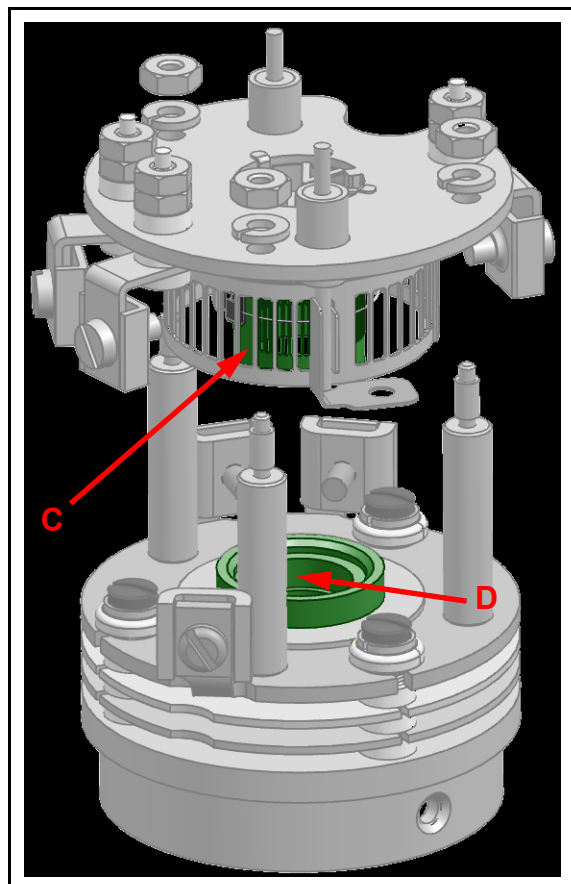
6 Tighten the washers (A).

7 Insert the filament leads back into the clamps and tighten.

8 Using an ohmmeter, check that the filament is not shorted to ground and that the filament shows a resistance of approximately 0.8 Ω at the feedthrough.

6.5.4 Ion Source Removal

The following steps should be performed to remove the ion source:

NOTE: See section 6.5.1.2, Tools for Replacing the Ion Source, on page 6-4 before continuing.

1 While holding the clamps with the pliers, use the flat blade screwdriver to loosen the clamps holding the filament leads (A) and ion source leads (B - one is hidden in the figure). There are a total of six leads that need to be loosened. See Figure 6-6.
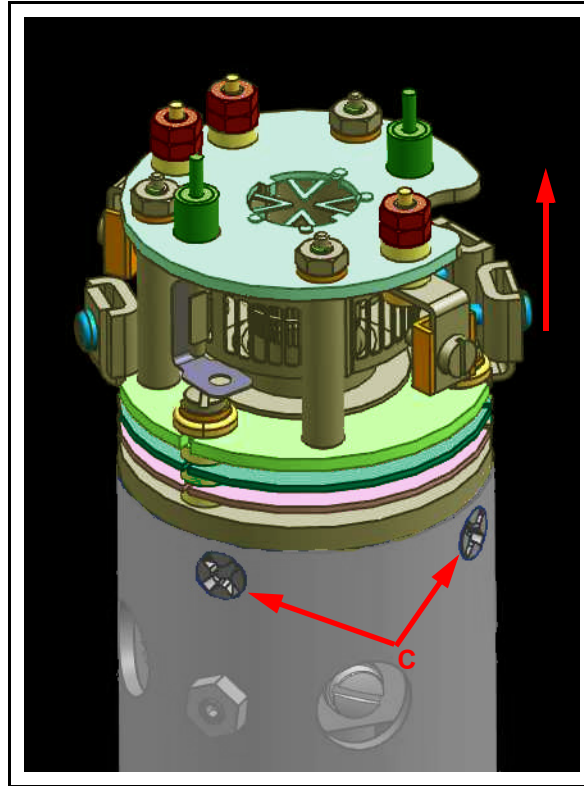
Figure 6-6 Detach leads
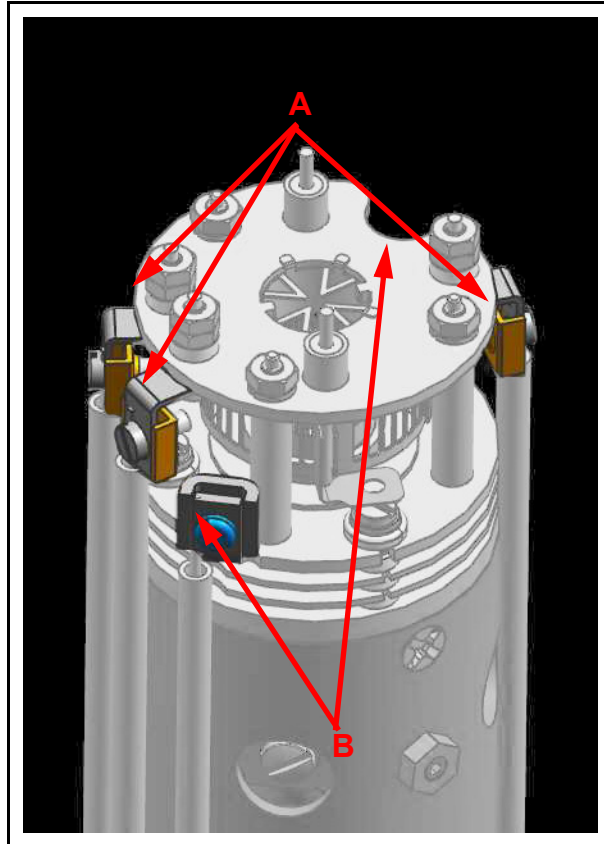
2 Pull the electrical leads away from the sensor.

NOTE: Be careful not to bend the leads.

3 Using the Phillips head screwdriver, remove the gold screws (C - one is hidden in the figure) that hold the ion source onto the quadrupole. There are three screws in total. See Figure 6-7.

Figure 6-7 Remove screws holding ion source

4 Remove the ion source by lifting it off the quadrupole assembly.

5 A new ion source assembly can now be installed by reversing the above steps.

6 Using an ohmmeter, check:

◆ that both filaments are not shorted to ground or to any of the lenses

◆ that the filament leads show a filament resistance of approximately 0.8 Ω at the feedthrough between each filament pin and the filament common pin, refer to Figure 6-1 on page 6-5 for pin out locations

6.5.5 Electron Multiplier Replacement

The following steps should be performed to remove the ion source:

NOTE: See section 6.5.1.3, Tools for Replacing the Electron Multiplier, on page 6-4 before continuing.

1   While holding the clamps with the pliers, use the flat blade screwdriver to loosen the clamps holding the filament leads (A) and ion source leads (B - one is hidden in the figure). There are a total of six leads that need to be loosened. Using the 1.5 mm x 50 mm hex driver, unscrew the screws (C) holding the two RF leads. Make sure to remove the lock washers as well. See Figure 6-8.

Figure 6-8 Detach leads
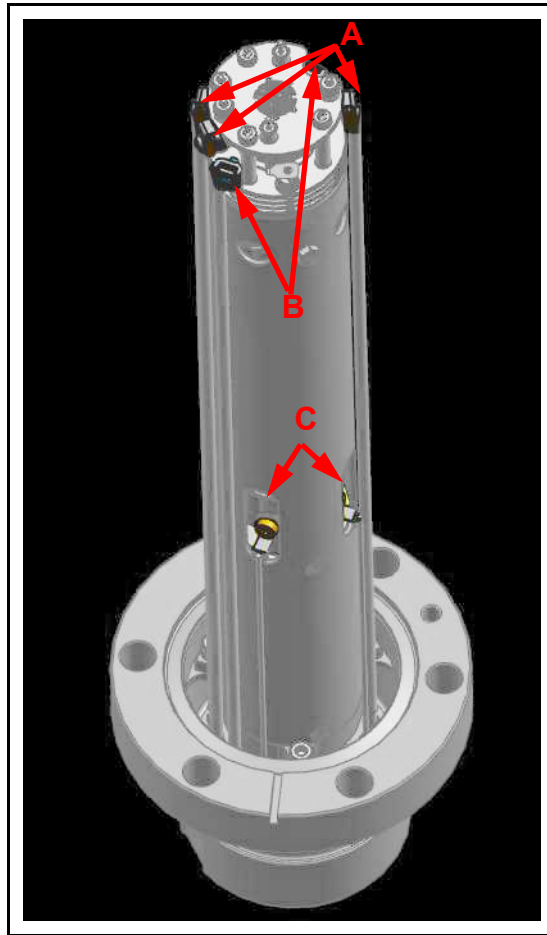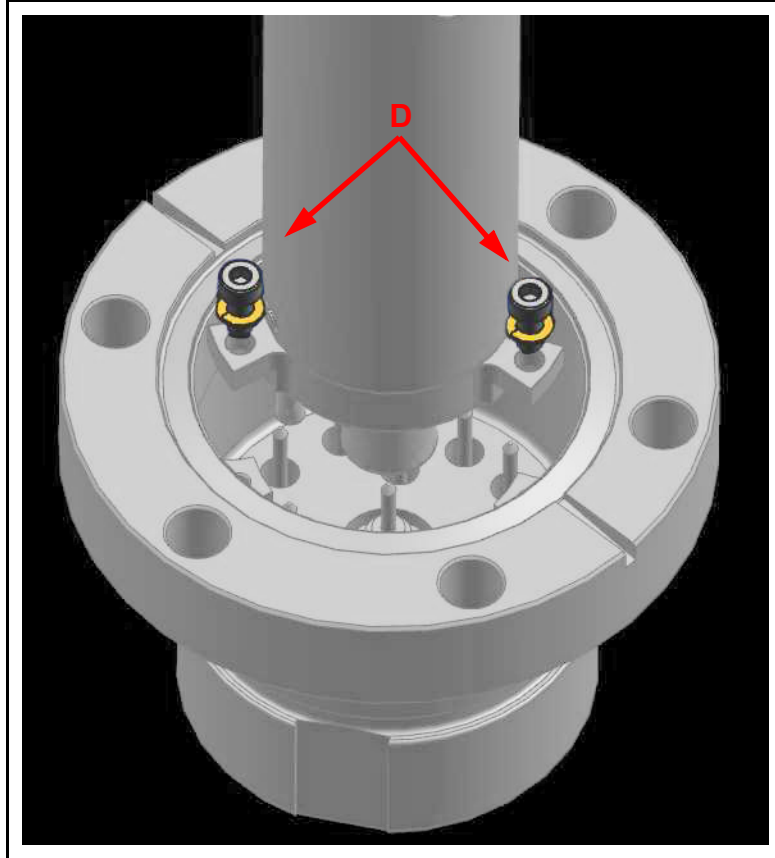

2   Gently pull the electrical leads away from the sensor.

NOTE: Be careful not to bend the leads when detaching.

3 Using the 2.0 mm x 75 mm hex driver, unscrew the three screws (D - one is hidden in the figure) holding the sensor assembly to the feedthrough. Gently remove the sensor assembly from the feedthrough. See Figure 6-9.

Figure 6-9 Removing the sensor assembly

4 Using the Phillips head screwdriver, remove the three gold screws (E - one is hidden in the figure) holding the EM assembly inside of the sensor assembly. See Figure 6-10.

Figure 6-10 Removing the screws holding the EM
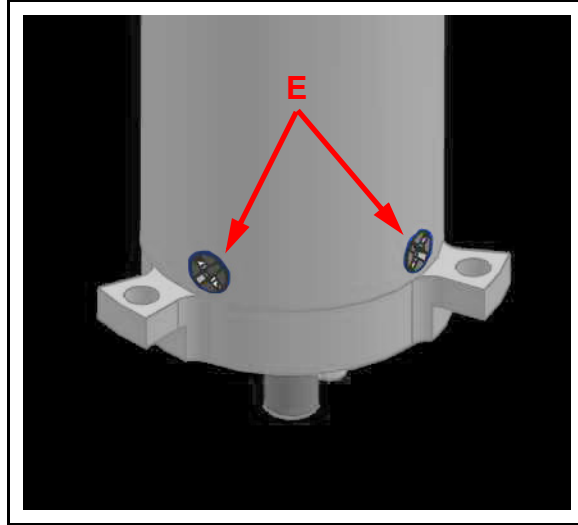
5 Gripping the bottom of the EM assembly, gently remove the EM from the sensor assembly. See Figure 6-11.

Figure 6-11 EM Detector
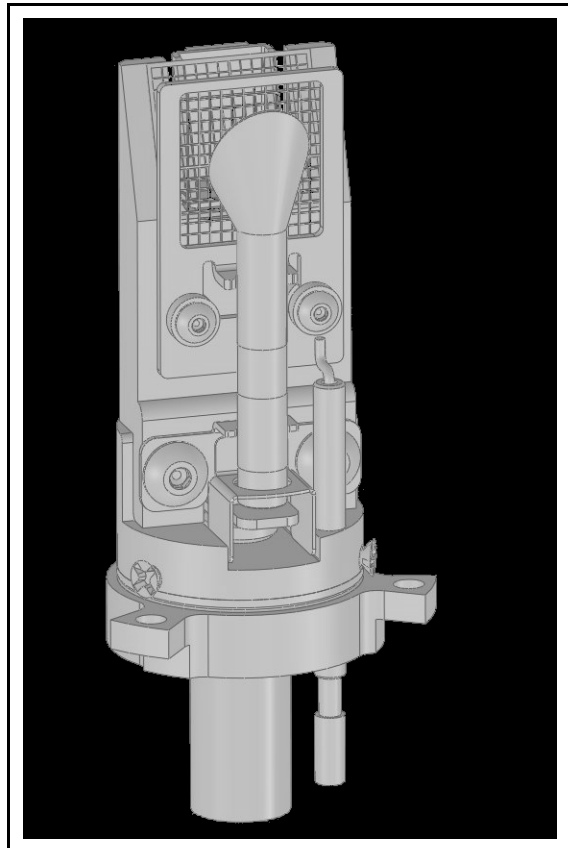
6 Remove the ceramic shield on the bottom of the old detector assembly. See Figure 6-12

Figure 6-12 Removing Ceramic Shield
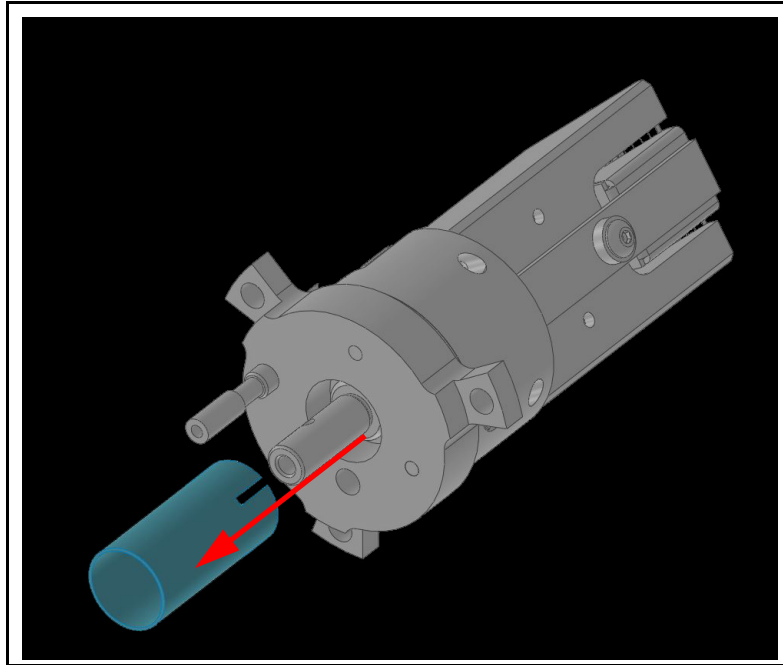
7 Install the ceramic shield removed in step 6 onto the new Electron Multiplier assembly.

8 Install the new Electron Multiplier assembly into the sensor can.

9 When installing the sensor back into the feedthrough, ensure that the two pins on the bottom of the detector align with the two pins shown in Figure 6-13.

Figure 6-13 Pin location
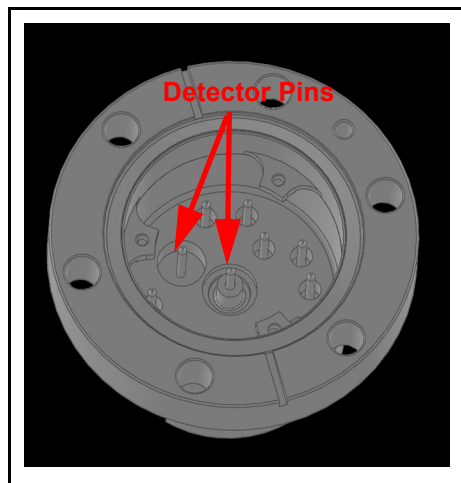
10 Reverse steps 1-4 to reassemble the Transpector MPS sensor.

6.6 Calibration

6.6.1 Mass Alignment

Transpector MPS is tuned such that it generates a known RF/DC ratio that allows one mass to exit the quadrupole at a time. When tuning the mass scale of Transpector MPS, the RF/DC ratio is fine tuned to each tune mass.

6.6.1.1 Factory Tuning

In the factory, Transpector MPS is tuned to different masses depending on the mass range of Transpector MPS. The factory tune masses and width standards are displayed in Table 6-3.

Table 6-3 Factory tune settings

100 AMU		200 AMU	
Mass	**10% R**	**Mass**	**10% R**
1	0.5 ±0.10	1	0.5 ±0.10
2	0.9 ±0.05	2	0.9 ±0.05
4	0.9 ±0.05	4	0.9 ±0.05
28	0.9 ±0.05	28	0.9 ±0.05
86	0.9 ±0.05	86	0.9 ±0.05
		134	0.9 ±0.05

The gases that are used for factory tuning of these masses are:

◆ Hydrogen (mass 1 and 2)

◆ Helium (mass 4)

◆ Nitrogen (mass 28)

◆ Krypton (mass 86)

◆ Xenon (mass 134)

6.6.1.2 Selecting Tune Masses

The most important portion of mass scale tuning is determining which masses are to be tuned.

There are three different methods of tuning:

- To tune using a user-supplied test mixture, continue to .

- To tune using process gases, continue to .

- To tune with background gases, continue to .

6.6.1.2.1 Selecting Masses for Tuning with a User-Supplied Test Mix

In some applications, it can be useful to have a test mix manufactured by a gas supplier. The ideal mix would include the factory tune masses for the mass range of Transpector MPS to be tuned. The factory tune masses can be found in .

6.6.1.2.2 Selecting Masses for Tuning with Process Gases

In general, Transpector MPS tuning requires access to a low mass, a mid mass and a high mass.

Do not tune mass 1 or 2 if Hydrogen is not present in the process, but *do not delete them from the tune table*.

Preferably, mass 4 should be tuned especially if Transpector MPS is used for leak checking. One way of doing this would be to create a leak and spray in helium. This will satisfy the low mass.

For a mid mass, try to use Nitrogen or another mass in that area (water, oxygen, etc.)

Tuning higher masses can be more difficult.

- If the process does not contain gases with masses over 40 AMU, tune with argon

- If the process does contain gases with higher masses:

  - Tune one between the mid mass and 100 AMU for 100 AMU sensors

  - Tune one mass between 100 and 200 AMU for 200 AMU sensors

6.6.1.2.3 Tuning with Background Gases

Mass 4 must be calibrated for proper leak detection. If Transpector MPS is used as a leak detector, make sure that Helium is available for tuning. If Transpector MPS is only used for leak checking, mass 4 is the only mass to tune. To tune mass 4, find a way to introduce Helium into the vacuum chamber.

The following procedure may be used if test mix or helium is not available:

1 Default all tune parameters.

2 Delete all masses except 1, 2, and 4.

3 Add mass 28 (or 40) and tune.

4 Delete mass 4.

5 Tune highest mass available in your system, in some cases this may be mass 40 or 44.

Chapter 7
Diagnosing Problems

7.1 Introduction

If you are experiencing trouble with Transpector MPS, first look at Table 7-1 and see if the problem is listed there. If not, contact INFICON (refer to section 1.3, How To Contact Customer Support, on page 1-3).

7.2 Symptom-Cause-Remedy Chart

Make sure that the insulation on all cables is intact and there is no damage on the insulating material before using Table 7-1.

Table 7-1 Symptom—Cause—Remedy Chart

SYMPTOM	CAUSE	REMEDY
Power LED does not turn on	+24 V external power supply	Check input AC line voltage to external power supply.
		Check +24 V input, verify input between 20 - 30 V.
		Replace power supply.
	Electronics failure	Return to INFICON for repair.
No communication to HOST computer	Sensor IP address not compatible with network	Refer to Chapter 2, Connecting Transpector MPS.
	Transpector Communications port (port 80) is not open on the host computer	Either open port 80 on the host computer or change the communications port of Transpector MPS.
	Cable connections	Make sure cables are connected to proper connectors.
	Host computer Ethernet card malfunctioning	Replace Ethernet Card on host computer.

Table 7-1 Symptom—Cause—Remedy Chart (continued)

SYMPTOM	CAUSE	REMEDY
EMISSION error (Cold Start, Warm Start)	Defective sensor filament open, shorted	Check sensor with OHM meter.
		Replace sensor or filament.
	Electronics failure	Return to INFICON for repair.
	Insufficient vacuum	Verify pressure is less than 5E-4 Torr.
	Sensor operating voltages incorrect	Verify correct settings Contact INFICON for assistance.
	Transpector MPS electronics box not fully engaged on sensor	Make sure that the Transpector MPS electronics module is pushed all the way on sensor.
ANODE error	Defective sensor, anode shorted	Check sensor with OHM meter for shorts. See sensor pin-out diagram.
		Fix or replace sensor.
	Electronics failure	Return to INFICON for repair.
RF error	Defective sensor, RF leads open RF/DC card fault	Fix or replace sensor.
	Electronics failure	Return to INFICON for repair.
Electron Multiplier error	Defective sensor, EM shorted	Check sensor with Ohm meter. See sensor pin-out diagram.
		Fix or replace sensor.
	EM just replaced	Verify that EM is plugged into the HV pin properly.
	Electronics failure	Return to INFICON for repair.

Table 7-1 Symptom—Cause—Remedy Chart (continued)

SYMPTOM	CAUSE	REMEDY
Temperature error	Transpector MPS internal ambient temp >70°C	Verify unit is installed properly, ambient temp <50°C.
		Verify that there are no heat sources in local proximity.
		Verify that internal fan is running.
	Electronics failure	Return to INFICON for repair.
Overpressure	Total Pressure Plate current exceeded trip threshold	Reduce pressure.
	Total Pressure plate is contaminated	Replace ion source.
Electrometer Error	Excessive current (>2E-6 Amps)	Reduce pressure.
		Reduce EM voltage.
	Electronics failure	Return to INFICON for repair.
Mass Filter Error	Bad Tune file	Retune RGA.
	Contaminated Quadrupole	Return to INFICON for repair.
Ion Source Error	Incorrect Ion Source settings	Load original configuration file.
	Ion Source contaminated	Replace Ion Source.
Detector Error	EM Voltage set too high	Reduce EM voltage.
	Detector not working correctly	Replace EM detector.
DSP Communications Error	Incorrect DSP response detected	Reset Electronics box.
		Return Electronics box to INFICON for repair.
DEC Communications Error	Incorrect DEC response detected	Reset Electronics box.
		Return Electronics box to INFICON for repair.

Table 7-1 Symptom—Cause—Remedy Chart (continued)

SYMPTOM	CAUSE	REMEDY
Peakfind Error	No Peak at target mass	Upload original configuration file.
		Return Electronics box to INFICON for repair.
Filament Potential Error	Insufficient vacuum	Verify pressure is less than 5E-4 Torr.
	Filament broken	Verify integrity of filament.
	Filament shorted	Verify that filament is not shorted to ground.
Filament Current Error	Insufficient vacuum	Verify pressure is less than 5E-4 Torr.
	Filament broken	Verify integrity of filament.
	Filament shorted	Verify that filament is not shorted to ground.
Focus Error	Unable to start or maintain Focus voltage	Reset Electronics box.
		Return Electronics box to INFICON for repair.
No spectra	Emission is OFF	Turn Emission ON.
	EM is ON, when operating	Turn EM OFF.
	Contaminated sensor	Degas, or service sensor.
		Replace sensor.
	Electronics failure	Return to INFICON for repair.
	Pressure too low for FC	Use EM detector.
	EM voltage too low	Increase voltage.
	Transpector MPS electronics box not fully engaged on sensor	Push Transpector MPS electronics module completely onto sensor.
	Mass calibration	Adjust Mass calibration.

Table 7-1 Symptom—Cause—Remedy Chart (continued)

SYMPTOM	CAUSE	REMEDY
Poor sensitivity	Sensor contaminated	Degas sensor.
		Bake-out sensor.
		Service sensor.
	System pressure too low	Increase sample pressure, if possible.
	Mass calibration (resolution)	Adjust Mass Calibration, increase peak width.
	Sensor Operating parameters set wrong	Check settings of: electron energy, ion energy, focus emission current.
	Improper calibration	Ensure that the total pressure gauge used for sensitivity calibration was properly calibrated.
	Electronics failure	Return to INFICON for repair.
	EM has low gain	Bake-out sensor.
		Replace sensor.
Poor peak shape	Sensor contaminated	Degas sensor.
		Bake-out sensor.
		Service sensor.
	System pressure too high	Verify pressure less than 5E-4 Torr for Transpector MPS.
	Mass calibration required	Perform Mass calibration.
	Electronics failure	Return to INFICON for repair.

Table 7-1 Symptom—Cause—Remedy Chart (continued)

SYMPTOM	CAUSE	REMEDY
High noise level	System grounding	Verify that vacuum system is grounded.
	Electronics failure	Return to INFICON for repair.
	Transpector MPS electronics box not mounted properly on sensor	Push Transpector MPS electronics box all the way on to the sensor.
	EM defective	Replace EM assembly or sensor.
	Scan speed too fast for gain setting	Increase dwell time.

7.3 Communication Problems

To correct communication problems, check the following:

- ◆ Is the Ethernet cable connected to Transpector MPS and the host computer (either directly or through a router/switch)?

- ◆ Does the Transpector MPS IP address have the same network prefix as the host computer?

- ◆ Is Port 80 open on the host computer?

- ◆ Is there an IP address conflict between Transpector MPS and another network device?

- ◆ See Chapter 2, Connecting Transpector MPS for more information on communications problems.

Chapter 8
Bibliography

For further information on partial pressure analyzers, see *Partial Pressure Analyzers and Analysis*, M. J. Drinkwine and D. Lichtman, American Vacuum Society Monograph Series, or *A User's Guide to Vacuum Technology*, J. F. O'Hanlon, John Wiley and Sons (1989). The latter book also contains a wealth of information on related topics including gas flow, pressure gauges, pumps, materials, and the design of vacuum systems.

Chapter 9
Glossary

Anode

The anode is the structure in the ion source in which ions are created by electron impact. It can be formed from a mesh, such as in the open ion source, or from a solid tube, such as in the closed ion source. Its electrical potential is positive with respect to the filament, focus lens, total pressure plate, pole zero, exit aperture and Faraday cup.

Appearance Potential

The minimum electron energy required to produce, by electron bombardment, a given ion in its lowest energy state.

Atomic Mass Unit (AMU)

An atomic mass unit is a unit of measurement for the mass of a molecule or ion. It is based on the definition that the mass of an atom of the carbon-12 isotope is exactly 12.

Background

The background is the residual atmosphere in a vacuum apparatus when no gases are being deliberately introduced.

Bakeout

A bakeout is the process of heating a vacuum chamber above the ambient temperature in order to accelerate the desorption of species such as water vapor and hydrocarbons which are adsorbed onto the inner surfaces of the vacuum chamber.

Center Voltage

The center voltage is the DC potential to which the quadrupole rod RF and differential DC potentials are referenced.

Closed Ion Source (CIS)

The closed ion source is an ion source in which the pressure in the ionization region is higher than in the rest of the analyzer sensor. This is usually accomplished by fabricating the anode from a solid walled tube instead of an open mesh. This type of source is usually employed to measure trace contaminant levels in a process gas.

Conductance

The conductance of a gas flow channel is the ratio of the gas quantity flowing through the channel to the pressure drop across that channel.

Cracking Pattern

See **Fragmentation Pattern**.

Detection Factor

The detection factor is the ratio of the detected signal for a given ion current from a certain substance to the detected signal for the same ion current of nitrogen ions as measured at mass 28. For Faraday cup detectors, the detection factor is usually 1. For electron multiplier detectors, this factor depends on the mass and chemical nature of the ion.

Detector

The detector is that part of the mass spectrometer sensor which converts a beam of ions into an electrical signal.

Doubly Charged Ion

For positive ions, a doubly charged ion is a parent or fragment ion where two electrons have been removed.

Electron Energy

The electron energy is the kinetic energy of the ionizing electrons in an electron bombardment ion source and is typically measured in units of electron volts (eV). The electron energy is approximately equal to the difference between the bias voltage on the filament and the anode potential, times the electron charge.

Electron Multiplier

An electron multiplier is a *in situ* amplifier which is used to increase the sensitivity of a mass spectrometer. When a high voltage is applied to an electron multiplier, positive ions are accelerated into the multiplier, causing the release of a large number of electrons per incident ion at the output.

Emission Current

The emission current is the current of electrons leaving the surface of a heated filament.

Exit Aperture (Quadrupole)

The exit aperture is a focus lens at the ion exit (detector) end of a quadrupole mass spectrometer. This lens is often biased by a potential that is negative with respect to the quadrupole center voltage such that ions are extracted from the exit end of the quadrupole and focused into the detector.

Extractor

See **Focus Lens**.

Faraday Cup

The Faraday Cup is a detector for ions and/or electrons consisting of a cup shaped, conductive electrode.

Filament

The filament is a fine wire or ribbon, which, when heated by means of electrical current, emits electrons. The filament typically made of iridium with a thorium or yttrium oxide coating.

Focus Lens

The focus lens is a conductive aperture located next to, and usually biased negatively with respect to, the anode. Its purpose is to draw the ions out of the anode, form them into a beam, and focus them into the next lens element.

Fragment Ion

A fragment ion is an ion with fewer atoms than the parent gas molecule from which the ion is produced. The mass of the fragment ion is always less than that of the parent ion.

Fragmentation Factor

The fragmentation factor is the fraction of the total ions produced from a specified substance which have a given mass. The sum of the fragmentation factors for all of the ions produced from a specified substance is equal to one.

Fragmentation Pattern

The fragmentation pattern is the pattern of ion masses and intensities produced by electron bombardment of a specified gas species as transmitted by the mass filter, detected and recorded.

Gain (Electron Multiplier)

The gain of an electron multiplier is the ratio of incident ion current to electron current output. The gain of the multiplier is a strong function of the bias potential applied across it.

Ion

An ion is a molecule or atom which has either lost or added one or more electrons. Those molecules which have lost electrons are positive ions. Those molecules which have added electrons are negative ions.

Ion Current

An ion current is the rate of flow of electrical charge associated with the flow of ions.

Ion Energy

The ion energy is the kinetic energy associated with a beam of ions. It is equal to the potential difference across which the ion beam is accelerated (or decelerated) times the charge on the ion, and is typically measured in electron volts (eV). Specifically, in a quadrupole mass spectrometer, it is the kinetic energy, along the axis, of the ions as they pass through the mass filter. The ion energy is approximately equal to the anode potential minus the quadrupole center voltage time the ionic charge.

Ion Source

The ion source is that part of a mass spectrometer in which neutral gas molecules or atoms are ionized by electron bombardment.

Ionization Probability

The ionization probability for a chemical substance is the ratio of the total ion current (at all masses) produced from a given partial pressure of that substance, to the total ion current produced from nitrogen at the same partial pressure.

Isotope

The atom is composed of nucleus protons and neutrons surrounded by an electron cloud. The chemical properties of an element are determined by the number and arrangement of electrons (with -1 charge) in an atom. The number of electrons in a neutral atom in turn depends on the number of protons (with +1 charge) within the nucleus of that atom. Atomic nuclei also contain neutrons which, being uncharged, do not affect the chemistry of an element. Protons and neutrons have approximately the same mass, which is approximately 1,800 times the mass of an electron. All atoms of a given element have the same number of protons but not necessarily the same number of neutrons. Atoms of the same element which have a different number of neutrons are called isotopes. See also **Natural Abundance**.

Linearity

Linearity is the mathematical relationship between an ion current and the total or partial pressure giving rise to that current. A mass spectrometer is said to have good linearity when the ion current is proportional to the pressure over a specified pressure range within a specified tolerance. Typically (but not always), the ion current will be linear with pressure at the low end of an instrument's pressure range. At some pressure near the high pressure end of an instrument's range, the ion current will be less than proportional to the pressure.

Mass to Charge Ratio

The mass to charge ratio is ratio of the mass of an ion to its charge, usually expressed in atomic mass units per unit electron charge.

Mass Filter

The mass filter is that part of the mass spectrometer which separates a beam of ions by their mass to charge ratios.

Mass Spectrometer

A mass spectrometer is an instrument which ionizes a gas sample, separates the resulting beam of ions by mass to charge ratio, and detects the filtered ions as an electrical signal.

Mass Spectrum

A mass spectrum is a record of ion current as a function of mass to charge ratio obtained with a mass spectrometer. The spectrum can be presented as a graph with mass to charge ratio on the X-axis and ion current on the Y-axis, or as a tabular listing of ion currents and the associated mass to charge ratios.

Material Factor

The material factor for a chemical substance is that part of the proportionality constant between the partial pressure of that substance and the resulting mass filtered ion current which depends on the chemical nature of that substance but not the particular instrument used for that measurement. The material factor is a function of the ionization probability and fragmentation factor for the specified substance.

Mean-Free-Path

The mean-free-path is the average distance an ion, electron, atom, or molecule can travel before colliding with an ambient gas molecule. The mean free path is inversely proportional to the pressure.

Molecular Flow

Molecular flow is that motion of gas molecules wherein the collisional mean free path is greater than the critical dimension of a flow constraining element such as an orifice of tube diameter. The gas flow characteristics are dominated by collisions between the gas molecules and the appropriate surfaces of the vacuum system.

Natural Abundance

The natural abundance of an isotope is the average percentage of all atoms of a given element which have the same number of neutrons. For example, 99.985% of all naturally occurring hydrogen atoms have no neutrons, giving an atomic mass of approximately 1, while 0.015% have one neutron, giving an atomic mass of approximately 2. There is a third isotope of hydrogen which contains two neutrons, giving an atomic mass of 3, but this isotope is unstable with such a short radioactive half life that it is not normally naturally occurring in any significant quantity on earth.

There are occasions when an observed isotopic abundance will not reflect the natural abundance. For instance, in semiconductor processing tools know as ion implanters, it is not unusual for the BF_3 boron dopant source to be isotopically enriched to 99%+ of the boron-11 isotope (instead of the naturally occurring 80.22%).

Open Ion Source (OIS)

An open ion source is an ion source constructed with an open grid structure with high conductance between the ionization region and the vacuum region surrounding it. Residual gas analyzers are typically equipped with this type of ion source.

Outgassing

Outgassing is the evolution of gas which was dissolved in or adsorbed on solid surfaces inside a vacuum chamber.

Parent Ion

A parent ion is an ion made by removing a single electron from the original, or parent, gas molecule, and therefore has the same mass.

Partial Pressure

The partial pressure is the pressure of a specific chemical component of a gas mixture. The sum of all the partial pressures is the total pressure.

Pole Zero

See **Center Voltage**.

Quadrupole

A quadrupole is a mass filter consisting of four parallel electrodes or poles (hence quadrupole) arranged in a square array. Opposite poles are connected together electrically such that an electric field of hyperbolic geometry is produced. The potentials applied to these poles are a superposition of variable DC and RF voltages, generally of fixed RF frequency.

Repeller (Electron)

The electron repeller is an electrode located on the opposite side of the filament than the anode. The repeller is usually biased at the same potential as the negative side of the filament, or a more negative potential.

Residual Gas Analyzer

A residual gas analyzer is an instrument which is used to determine the quantities and chemical nature of gases present in a vacuum system. The instrument is typically a mass spectrometer equipped with an open ion source.

Resolution

Resolution is the ability of a mass filter to select between nearby masses. It is typically measured as the mass of the peak divided by the width of a given mass peak at 10% or 50% of the peak maximum intensity.

Secondary Electron

A secondary electron is an electron emitted from a surface when that surface is struck by a sufficiently energetic ion, electron, neutral molecule or photon.

Sensitivity

The sensitivity of a mass spectrometer is the ratio of ion current at a specified mass from a specified gas to the partial pressure of that gas, suitably corrected for background. The specified gas is typically nitrogen, measured at 28 AMU, although argon at 40 AMU is sometimes used instead, depending on the instrument.

Total Pressure

The total pressure is the force per unit area exerted by a gas on the walls of its container. It is equal to the sum of all the partial pressures of the different chemical species which comprise that gas.

Total Pressure Plate

The total pressure plate, or collector, is an electrode in the ion source on which at least a part of the ion beam impinges. The current striking this plate is a function of the total pressure in the ion source.

Transition Flow

Transition flow is that motion of gas molecules wherein the collisional mean free path is approximately the same as the critical dimension of a flow constraining element such as an orifice of tube diameter.

Transmission Factor

The transmission factor is the ratio of ion current detected at the exit end of the mass filter (set to transmit a given mass) to the current of ions of the same mass entering the filter from the ion source. Typically, the transmission factor for nitrogen ions at 28 AMU is set equal to 1. The transmission factor at other masses is given relative to that for nitrogen.

Viscous Flow

Viscous flow is that motion of gas molecules wherein the collisional mean free path is less than the critical dimension of a flow constraining element such as an orifice of tube diameter. The gas flow characteristics are dominated by collisions between gas molecules.

Zero Blast

Zero blast is the ion current which is not mass filtered and is detected when the mass spectrometer is scanning near mass zero.

Chapter 10
Transpector MPS Accessories and Spare Parts

10.1 Introduction

Transpector MPS has several accessories and spare parts for purchase. This section lists these parts and provides their INFICON part numbers.

10.2 MPS Accessories

Table 10-1   Transpector MPS accessories

Part Number	Description
600-1428-P1	Power Supply Extension Cable 15 ft. (4.5 m)
600-1429-P1	Power Supply Extension Cable 30 ft. (9 m)
961-417-G1	4-Port Ethernet Router w/ Push Button Wi-Fi
961-418-G1	8-Port Ethernet Switch
961-702-G1	Sensor Hardware Kit
914-024-G1	Angle Valve Kit, Manual (includes heater)
914-026-G1	Angle Valve Kit, Air Operated, 24 V(dc) (Includes Heater)
914-410-P1	Spare Angle Valve, Manual
914-220-G1	Spare Angle Valve, Electropneumatic
961-029-G1	Transpector MPS Heater Kit 120 V(ac)
961-029-G2	Transpector MPS Heater Kit 230 V(ac)
961-433-G1	Transpector MPS Heater Jacket Mount Kit

10.3 Transpector MPS Spare Parts
10.3.1 Preventative Maintenance Parts

Table 10-2   Transpector MPS preventative maintenance parts

Part Number	Description
961-700-G1	Filament kit - Dual Yttria-Coated Iridium Filaments
961-701-G1	Ion source kit - Dual Yttria-Coated Iridium Filaments
961-707-G1	Electron Multiplier Kit

10.3.2 Replacement Spare Parts

Table 10-3 Transpector MPS replacement spare parts

Part Number	Description
961-022-G1	Spare O-ring and Nut Kit (for connection between box and sensor)
961-206-G2	Transpector MPS EM/FC Extension Tube Kit (Including nuts/bolts)
600-1190-P8	Communications Cable Ethernet 7 m
600-1190-P15	Communications Cable Ethernet 15 m
961-021-G1	Power Supply Kit: 80-250 V(ac), 4 ft. (1.2 m) US Plug
961-021-G2	Power Supply Kit: 80-250 V(ac), 4 ft. (1.2 m) US Plug, 15 ft. Extension
961-021-G3	Power Supply Kit: 80-250 V(ac) 4 ft. (1.2 m) US Plug, 30 ft. Extension
961-021-G4	Power Supply Kit: 80-250 V(ac) 4 ft. (1.2 m) European Plug
961-021-G5	Power Supply Kit: 80-250 V(ac) 4 ft. (1.2 m) Euro 15 ft. Extension
961-021-G6	Power Supply Kit: 80-250 V(ac) 4 ft. (1.2 m) Euro 30 ft. Extension
961-416-P1	Spare Transpector MPS Heating Jacket (requires heater power cable)
914-407-P1	Spare Valve Heating Jacket (requires heater power cable)
600-1487-P1 068-0433	Heater Power Cable, 120 V(ac) AC Power Cord,120 V(ac)
600-1487-P2 068-0434	Heater Power Cable, 230 V(ac) AC Power Cord, 230 V(ac)

10.3.3 Spare Transpector MPS Electronics Boxes

Table 10-4 Spare Transpector MPS electronics boxes

Part Number	Description
MP-S10S	Transpector MPS 100 AMU FC or EM/FC (MPS100F, MPS100M) w/ Ethernet
MP-S20S	Transpector MPS 200 AMU FC or EM/FC (MPS200F, MPS200M) w/ Ethernet

10.3.4 Spare Transpector MPS Sensors

Table 10-5 Spare Transpector MPS sensors

Part Number	Description
961-S1FAS	Transpector MPS 100 AMU FC (MPS100F) Y_2O_3/Ir Filaments
961-S1MAS	Transpector MPS 100 AMU EM/FC (MPS100M) Y_2O_3/Ir Filaments
961-S2FAS	Transpector MPS 200 AMU FC (MPS200F) Y_2O_3/Ir Filaments
961-S2MAS	Transpector MPS 200 AMU EM/FC (MPS200M) Y_2O_3/Ir Filaments

Chapter 11
Specifications

11.1 Introduction

The following sections detail the specifications for the Transpector MPS Gas Analysis System. As a result of INFICON continuing product improvement and quality assurance programs, these specifications are subject to change without notice or obligation.

NOTE: All specifications are measured after a 30 minute warm-up period at constant STP unless specified.

11.2 Sensor Length (Vacuum Side)

MPS100F	MPS100M	MPS200F	MPS200M
5.63 in.	7.82 in.	5.63 in.	7.82 in.
(143 mm)	(193 mm)	(143 mm)	(193 mm)

11.3 Mass Range

MPS100F	MPS100M	MPS200F	MPS200M
1 to 100 AMU		1 to 200 AMU	

11.4 Detector Type

MPS100F	MPS100M	MPS200F	MPS200M
Faraday Cup	Continuous Dynode Electron Multiplier / Faraday Cup	Faraday Cup	Continuous Dynode Electron Multiplier / Faraday Cup

11.5 Resolution

Peak Width (AMU) at 10% of peak height			
MPS100F	MPS100M	MPS200F	MPS200M
0.9 AMU			

11.6 Temperature Coefficient

During an eight hour period, after thirty minutes of warm up			
MPS100F	**MPS100M**	**MPS200F**	**MPS200M**
For FC Only—Less than 1% of peak height per °C			

11.7 Sensitivity

Amps/Torr [mbar] (Pa)				
	MPS100F	**MPS100M**	**MPS200F**	**MPS200M**
FC	3x10-4 [2.3x10-4] (2.3x10-6)			

11.8 Minimum Detectable Partial Pressure

Torr [mbar] (Pa)				
	MPS100F	**MPS100M**	**MPS200F**	**MPS200M**
FC	$2.6x10^{-12}$ $[3.5x10^{-12}]$ $(3.5x10^{-10})$	N/A	$2.6x10^{-12}$ $[3.5x10^{-12}]$ $(5.5x10^{-10})$	N/A
EM	N/A	$1.5x10^{-14}$ $[2x10^{-14}]$ $(2x10^{-12})$	N/A	$1.5x10^{-14}$ $[2x10^{-14}]$ $(2x10^{-12})$

11.9 Zero Blast Interference at Mass 2

ppm			
MPS100F	**MPS100M**	**MPS200F**	**MPS200M**
<100 ppm			

11.10 Maximum Operating Pressure

Torr [mbar] (Pa)			
MPS100F	**MPS100M**	**MPS200F**	**MPS200M**
5×10^{-4} $[6.7\times10^{-4}]$ (6.7×10^{-2})			

11.11 Maximum Sensor Operating Temperature

Degrees C				
	MPS100F	**MPS100M**	**MPS200F**	**MPS200M**
FC	200°C	200°C	200°C	200°C
EM	N/A	150°C	N/A	150°C

11.12 Maximum Bakeout Temperature

Degrees C — with electronics removed			
MPS100F	**MPS100M**	**MPS200F**	**MPS200M**
300°C			

11.13 Operating Temperature

MPS100F	**MPS100M**	**MPS200F**	**MPS200M**
5 to 50°C ambient			

11.14 Power Input

MPS100F	**MPS100M**	**MPS200F**	**MPS200M**
20-30 V(dc), 24 V(dc) Typical, Latching, 4-pin Din connector, internally isolated from system ground			

11.15 Ethernet Communication Interface

MPS100F	MPS100M	MPS200F	MPS200M
Standard: Cat5e Ethernet Cable Connection			

11.16 Relay Outputs

MPS100F	MPS100M	MPS200F	MPS200M
1 relay, 24 V at 0.5 amps			

11.17 Inputs

MPS100F	MPS100M	MPS200F	MPS200M
1 Analog Input, 2 Digital Inputs			

11.18 LED Indicators (Green)

H100F	H100M	H200F	H200M
1 for power status, 1 for emission status			

Chapter 12
Supplied Items

12.1 Introduction

You will receive the following:

12.1.1 Ship Kit

Table 12-1 Ship kit

Part Number	Description
961-020-G1	Ship Kit
includes:	
600-1198-P8	7 m Ethernet Cable
961-702-G1	Mounting Hardware
961-022-G1	O-ring and Mounting Nut
961-370-P1	O-ring Removal Tool
051-032	D Connector
051-1082	Cable Clamp for D connector
074-5007-G1	Gas Analysis Manuals CD

12.1.2 Electronics Module

Table 12-2 Electronics module

(one of the following)	
Part Number	**Description**
MP-S10P	Transpector MPS 100 AMU FC and EM/FC Electronics Box
MP-S20P	Transpector MPS 200 AMU FC and EM/FC Electronics Box

12.1.3 Power Supply

Table 12-3 Power supply

Part Number	**Description**
961-021-G1	Power Supply Kit - 85-250 V(ac) 1.2 m (4 ft.) US Plug
961-021-G2	Power Supply Kit - 85-250 V(ac) 1.2 m (4 ft.) US Plug with 4.5 m (15 ft.) Extension
961-021-G3	Power Supply Kit - 85-250 V(ac) 1.2 m (4 ft.) US Plug with 9 m (30 ft.) Extension
961-021-G4	Power Supply Kit - 85-250 V(ac) 1.2 m (4 ft.) European Plug
961-021-G5	Power Supply Kit - 85-250 V(ac) 1.2 m (4 ft.) Euro Plug with 4.5 m (15 ft.) Extension
961-021-G6	Power Supply Kit - 85-250 V(ac) 1.2 m (4 ft.) Euro Plug w/ 9 m (30 ft.) Extension

12.1.4 Sensor

Table 12-4 Sensor

(one of the following):	
Part Number	**Description**
961-S1FAP	Transpector MPS100F Y_2O_3/Ir Filaments
961-S1MAP	Transpector MPS100M Y_2O_3/Ir Filaments
961-S2FAP	Transpector MPS200F Y_2O_3/Ir Filaments
961-S2MAP	Transpector MPS200M Y_2O_3/Ir Filaments

12.1.5 Extension Kit

Table 12-5 Extension kit

(one of the following)	
Part Number	**Description**
961-206-G2	Transpector MPS Sensor Extension Kit

12.1.6 Software

Software packages are optional and available for Windows only.

Table 12-6 Software

(one of the following) (optional)	
Part Number	**Description**
921-039-G1	FabGuard Explorer Single Sensor Version - CD
921-039-G2	FabGuard Explorer Multi Sensor Version - CD

12.1.7 Heating Jacket System (Optional)

Table 12-7 Heating jacket system (optional)

(one of the following) (optional)	
961-029-G1	Transpector MPS Heater Kit - 120 V (ac)
961-029-G2	Transpector MPS Heater Kit - 230 V (ac)

12.1.8 Angle Valve (Optional)

Table 12-8 Angle valve (optional)

(optional)	
914-024-G1	Angle Valve Kit, Manual (includes Heater)

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