Operating Manual

INFICON Quantus® HP100

Gas Analysis System

INFICON

INFICON

Two Technology Place

East Syracuse, NY 13057-9714

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2 Introduction

2.1 System Overview

Quantus HP100 gas analysis system operates using the principal of optical emission spectroscopy. A gas sample or gas-flow of interest is presented to a proprietary Microplasma Sensor Cell (MSC) inside the sensor that excites the gas, causing it to produce a plasma. The light emitted by the plasma has a spectrum that provides information about the atoms and molecules present. The optical emission is detected by a spectrometer inside the sensor. The resulting spectra are analyzed by FabGuard® software on a control computer.

2.2 Safety

Quantus HP100 generates high voltages, radio-frequency signals, and light (ultra-violet, visible, and infrared). Aside from a field-replaceable MSC, Quantus HP100 has no user-serviceable parts.

⚠ **WARNING**

To prevent injury, and to prevent voiding the factory warranty, repairs to Quantus HP100 should only be performed by factory-authorized personnel.

⚠ **CAUTION**

The product is part of the end user's application. Fire protection features should be provided by the end user.

2.2.1 Definitions of Notes, Cautions and Warnings

When using this manual, please pay attention to the NOTES, CAUTIONS and WARNINGS found throughout. For the purposes of this manual, they are defined as follows:

Pertinent information that is useful in achieving maximum instrument efficiency when followed.

⚠ **CAUTION**

Failure to heed these messages could result in damage to the instrument.

> ⚠ **WARNING**
>
> Failure to heed these messages could result in personal injury.

2.2.2 Before You Begin

1. REVIEW the installation process thoroughly before beginning work.

2. CONFIRM that the sensor materials of construction and surfaces are compatible with the exposed process environment.

3. CONFIRM that the sensor is installed in an approved manner.

2.2.3 General Warnings and Cautions

> ⚠ **WARNING**
>
> NEVER operate the sensor without its protective enclosures. The sensor should only be powered when fully mounted using the KF vacuum flange interface to an appropriate system to be monitored.

> ⚠ **WARNING**
>
> NEVER install or power the sensor in a position where a user can physically access, or view directly the microplasma.

> ⚠ **WARNING**
>
> NEVER touch the microplasma source or its assembly within its containment cavity.

> ⚠ **WARNING**
>
> NEVER view directly the microplasma discharge.

> ⚠ **CAUTION**
>
> NEVER operate the sensor when the interior of the microplasma sensor cell is exposed to ambient or other sources of light, such as another process. Exposure to external light sources will interfere with system performance.

⚠ CAUTION

NEVER prevent airflow by blocking the vent holes or the cooling fan on the sensor, doing so could cause damage to the sensor and unpredictable results or loss of data could occur.

⚠ CAUTION

NEVER power the sensor with an unapproved power supply.

⚠ CAUTION

When installing the product, make sure it is properly secured in case of a seismic event.

⚠ CAUTION

Do not replace the power cord with an inadequately rated cord. The cord must be rated 10 A or higher.

2.3 Terminology

The following terms are used in describing the use of the sensor:

Sensor: A complete Quantus HP100 sensor that includes an Electronic Control Module (ECM) and Microplasma Sensor Cell (MSC).

Electronic Control Module (ECM): The ECM contains a spectrometer and electronics. This unit is powered by a 24 V (dc) 2.5 A supply.

Microplasma Sensor Cell (MSC): The MSC contains the microplasma light source. The MSC is field-replaceable.

Software: Quantus HP100 is operated by FabGuard software running on a FabGuard Controller or Windows® PC.

Controller: The computer running FabGuard software to operate. Quantus HP100 is a FabGuard Controller or Windows-based PC.

Tool or Process Tool: A process tool or other system onto which the sensor is attached. The sensor should only be used when properly installed onto an appropriate vacuum system or process tool.

2.4 How to Contact Customer Support

Worldwide support information regarding:

- Technical Support, to contact an applications engineer with questions regarding INFICON products and applications, or

- Sales and Customer Service, to contact the INFICON Sales office nearest you, or

- Repair Service, to contact the INFICON Service Center nearest you, is available at www.inficon.com.

Please have the following information readily available:

- The serial number of the instrument.

- A description of the problem.

- An explanation of any corrective action that may have already been attempted.

- The exact wording of any error messages received.

To contact Customer Support, see the Service & Support tab at www.inficon.com

2.4.1 Returning Your Instrument to INFICON

Do not return any component to INFICON without first speaking with a Customer Support Representative. You must obtain a Return Material Authorization (RMA) number from the Customer Support Representative. The RMA form is available at https://service.inficon.com

Prior to being given an RMA number, you will be required to complete a Declaration Of Contamination (DOC) form to identify what process materials your instrument has been exposed to. DOC forms must be approved by INFICON before an RMA number is issued. INFICON may require that the instrument be sent to a designated decontamination facility, not to the factory.

2.5 Purpose of the Quantus HP100 Gas Analysis System

Quantus HP100 detects changes in gas characteristics such as composition, pressure or concentration. Detecting such changes detects leaks, contaminants and process endpoints in critical process environments.

2.6 Computer System Requirements

Quantus HP100 gas analysis system utilizes INFICON FabGuard analysis software with the following computer system requirements.

	Minimum Requirement	Recommended
Processor	Intel® Pentium 4, 3 GHz	Intel Core 2 or greater
Memory	8 GB	16 GB or greater
Hard drive	80 GB	160 GB or greater
Resolution	15 in. (1024 x 768)	17 in. (1280 x 1024)

2.7 Operating System Requirements

INFICON FabGuard analysis software requires Windows 10 Operating System or higher.

Quantus HP100 requires the Java™ Runtime Engine, Version 6 or higher. Many computers already have the Java Runtime Engine installed. If necessary, the Java Runtime Engine can be downloaded from www.java.com. Note that 32-bit operating systems require the 32-bit Java Runtime Engine, while 64-bit operating systems require the 64-bit Java Runtime Engine.

2.8 Description of the Quantus HP100

2.8.1 Introduction

Quantus HP100 gas analysis system monitors changes in gas composition over the pressure range of 1 Torr - 450 Torr for argon, and 1 Torr - 120 Torr for nitrogen; operating range varies for other gas species. Quantus HP100 also monitors changes in gas consumption in many corrosive gas environments. In some cases, Quantus HP100 may function beyond these pressure ranges, however, the ability to ignite plasma may be affected by the species of gas present. Therefore, the pressure range for plasma ignition, or for sustaining the plasma, may be greater or lesser depending on the application. For application specific support, please contact INFICON.

2.8.2 Quantus HP100 Sensor Overview

Quantus HP100 is designed for applications that generally operate in a range of 1 Torr up to 450 Torr, with the exact pressure range being gas composition dependent. The example range of 1 - 450 Torr was tested with argon. Quantus HP100 is designed and manufactured to withstand exposure to corrosive and aggressive gases and it is recommended to review the use case with INFICON experts. Quantus HP100 has two main sections, an Electronic Control Module (ECM) and a Microplasma Sensor Cell (MSC). The ECM occupies the larger portion of the housing, while the MSC occupies the smaller portion of the housing.

2.8.3 Quantus HP100 Microplasma Sensor Cell

Quantus HP100 creates a plasma by coupling energy into the gas utilizing an antenna (patent pending) in the MSC. This provides Quantus HP100 with its unique operating capabilities that allow the sensor to operate in corrosive and aggressive environments. The MSC can be replaced in the field.

2.8.4 Quantus HP100 Wetted Materials

The Quantus HP100 MSC materials that are exposed to the vacuum chamber are summarized in the table below.

Quantus HP100 MSC Component	Wetted Materials
Cell body	Stainless steel
Window	Sapphire
Antenna	Alumina
O-rings	Viton®
High-voltage pin	Stainless steel, alumina

2.8.5 Quantus HP100 Electronic Control Module

The Electronic Control Module (ECM) includes an optical spectrometer and control electronics. It is powered by a 24 V (dc) power supply, has two cooling fans and six status LEDs. Primary communication is through an Ethernet port. Auxiliary I/O is available through a 15-pin D-sub connector.

2.9 AUX I/O Connector

2.9.1 Auxiliary I/O Specifications

2.9.1.1 Mechanical

The auxiliary I/O connector on the ECM is a 15-pin D-sub male connector.
A 15-pin D-sub female connector is required for connection.

2.9.1.2 Electrical

2.9.1.2.1 Digital I/O

Signals I/O 0 to I/O 3 can be set or read by Quantus HP100. These four (input or output) bi-directional auto-sensing level shifters are TTL-compatible I/O connections rated for 0 to 5 V (dc) with 10 k-ohm pull-up impedance. As digital output connections, each can source a maximum of 0.5 mA. As digital input connections, each can sink a maximum of 1.0 mA. The user is responsible for limiting the input current to the 1.0 mA maximum. Digital I/O are queried approximately every millisecond, and are set to input by default.

2.9.1.2.2 Relay

A contact closure relay, single-pole double-throw (SPDT) is included in the Quantus HP100 ECM. Maximum current is 0.5 A, maximum voltage is 50 V (ac). The relay is controlled by FabGuard software. The normal (inactive) state is electrical continuity between pins 1 and 3, pin 2 open. The active state switches to continuity between pins 2 and 3, pin 1 open.

2.9.1.2.3 Valve Driver

The 24 V (dc) valve driver is powered by the Quantus HP100 ECM and is controlled by FabGuard software. The valve is open when the circuit is active, which is when pin 8 is set to 24 V (dc) by the Quantus HP100 ECM. The valve driver can support up to 120 mA of current draw at 24 V (dc). If a sufficient over-current condition persists for more than 15 microseconds, the valve controller will turn off.

2.9.2 Auxiliary I/O Pin Designations

AUX I/O 15-pin D-sub Connector	
Pin #	Signal
1	Relay NC
2	Relay NO
3	Relay common
4	I/O 2
5	I/O 1
6	I/O 0
7	Valve control return
8	Valve + 24 V (dc)
9	I/O 3
10	No connection
11	No connection
12	GND
13	GND
14	GND
15	GND

The D-sub connector with pin identification is shown below.
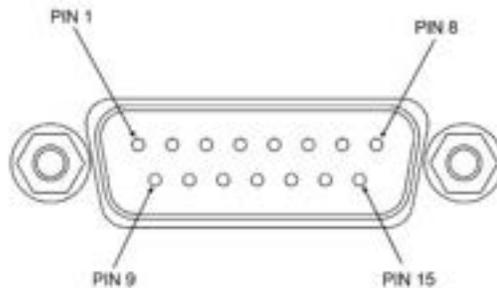
2.10 Quantus HP100 Specifications

2.10.1 Use

The instrument is for indoor use only. IP rating is IP XO.

2.10.2 Altitude Range

The instrument can be used up to an altitude of 6561 ft. (2000 m).

Contact INFICON for operation instructions at higher altitudes.

2.10.3 Maximum Humidity

The instrument can be used in up to 80% relative humidity (no condensation) at 31° C.

2.10.4 Pollution Degree

The instrument can be used at a pollution degree of 2 (per EN61010-1:2010).

2.10.5 Maximum Operating Temperature

The maximum ambient operating temperature is 50° C (104° F).

2.10.6 Minimum Operating Temperature

The minimum operating temperature is 0°C (41°F).

2.10.7 Storage Temperature

The storage temperature is -10-60°C (14-140°F).

2.10.8 Cleanroom Requirements

Quantus HP100 passes standard EN 61326-1:2020.

2.10.9 Quantus HP100 Physical Properties

The table below details the specifications for Quantus HP100 gas analysis system.
NOTE: All specifications are measured after a 1 hour warm-up period.

Parameters	Quantus HP100
Performance	
Technology	Optical emission spectroscopy with integrated microplasma, with microwave technology, spectrometer, and RF power supply
Spectrometer performance	200 to 850 nm wavelengths (UV-Vis) 16-bit full-scale resolution, 3648 pixels
Integration time	Minimum of 1 ms
Optical resolution	1.34nm
Sampling frequency	Maximum of 20 Hz
Detection limit	< 1 ppm (application dependent)
Gas Sampling Interface	
Process environment	1- 450 Torr for argon, and 1 - 120 Torr for nitrogen; operating range varies for other gas species
Vacuum fitting	KF-25
Maximum flange temp	80°C
Serviceability	Sensor cell is field replaceable
Facilities	
Operating temp range	0 to 50°C (non-condensing, sensor cell 80°C)
Power requirements	24 V (dc) @ 2.5 A (AC / DC converter available)
Power consumption	<30W (typical, steady-state operation) May exceed 50W during plasma ignition
Carrier gases	None required
Mounting options	Direct mount via KF-25 flange
Altitude Range	
The instrument can be used up to an altitude of 6561 ft. (2000 m). Contact INFICON for operation instructions at higher altitudes.	
Approximate Dimensions and Weights	
Dimensions	6.4 in. H x 6.0 in. W x 8.3 in. L (162 mm x 153 mm x 210 mm)
Weight	8.2 lb. (3.7 kg)

2.10.9.1 Quantus HP100 Physical Dimensions

System dimensions: 6.4 in. H x 6.0 in. W x 8.3 in. L (162 mm x 153 mm x 210 mm)
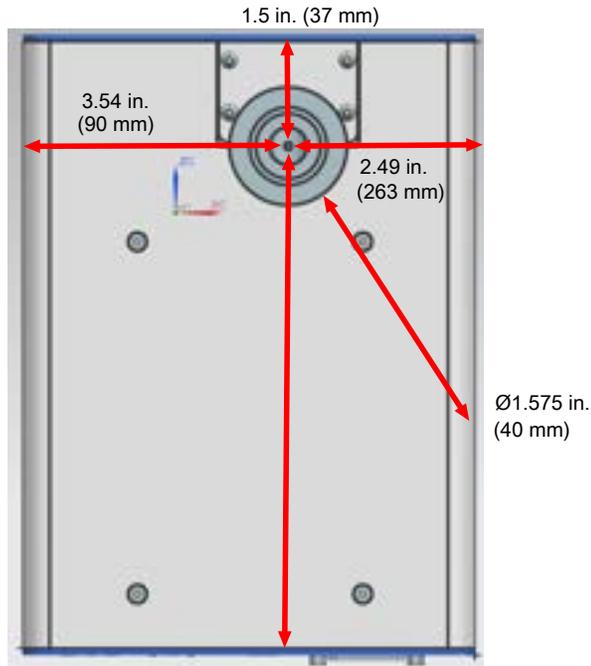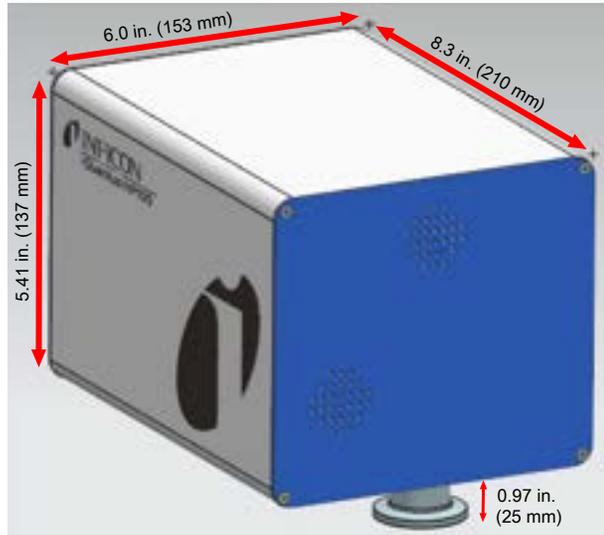
3 Installation

3.1 Quantus HP100 Precautions

Before you begin:

- CONFIRM that use of a microplasma will not adversely affect the gases, processes or equipment being monitored.

- FOLLOW all safety precautions.

- REVIEW the installation process thoroughly before beginning work.

⚠ **WARNING**

DO NOT operate the sensor without its protective enclosure.

⚠ **WARNING**

DO NOT touch the microplasma within the microplasma source cell's cavity.

⚠ **CAUTION**

DO NOT block the fan or vent holes on the Electronic Control Module.

⚠ **WARNING**

Quantus HP100 system must be electrically grounded through the KF-25 connection flange to the vacuum chamber or system to which it is installed. Failure to ensure proper electrical grounding could result in a shock hazard and/or personal injury.

3.2 Quantus HP100 Installation Requirements

Power: 24 V (dc) 2.5 A

Includes 80 – 264 V (ac) to 24 V (dc) converter with connector, 50/60 Hz compatible. Connector pin designations:

Pin #	Connection
1	Ground
2	Ground
3	+24 V (dc)
4	+24 V (dc)
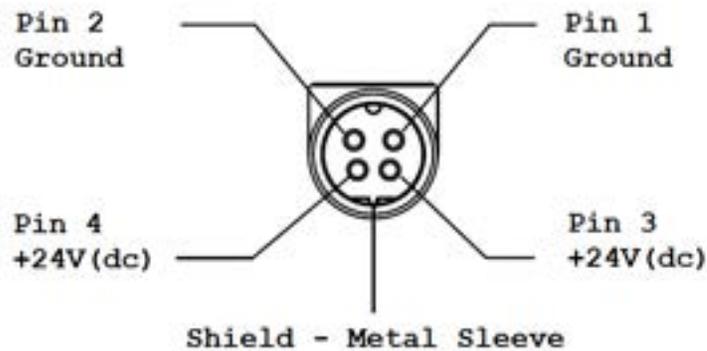
Vacuum Chamber Interface: KF-25 flange and clamp (provided).

Communications: Ethernet cable (provided) with a length up to 30 ft (9.1 m).

Computer Interface: A Microsoft Windows 10 or higher PC with an Ethernet interface is required to use FabGuard.

Auxiliary I/O: 15-pin D-sub interface.

3.3 Installation of Quantus HP100

Quantus HP100 installs quickly and easily. Listed below are the typical steps required to install Quantus HP100 and the sensor. Please note that your installation requirements may differ.

1. Remove the KF-25 clamp and centering ring from the sensor cell flange.

KF-25 clamp
Centering ring

2. Attach the sensor cell flange on the system using the KF-25 centering ring and clamp.
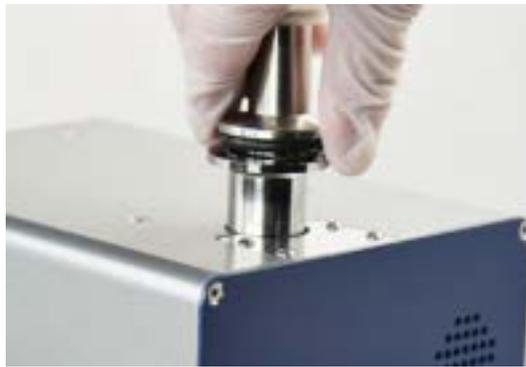
3. Attach 24 V (dc) power at the power connection point, and attach the Ethernet cable at the Ethernet connection point.

Ethernet   Power
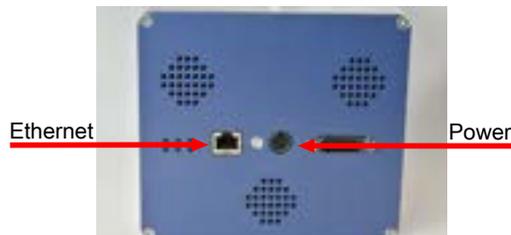
4. Quantus HP100 is electrically grounded through the KF-25 connection flange to the vacuum chamber, or system to which it is installed.

3.3.1 Installation Comments

⚠	**⚠ WARNING**
	The gas sensors utilize radio-frequency power supplies and high-voltage power supplies, and in their intended use may generate light emission from the ultra-violet to the infrared. High-voltage, radio-frequency, and ultra-violet exposure may be hazardous. It is the responsibility of the user to only operate the sensor when it is installed properly.

A proper installation meets the following criteria:

- Ensures that the environment is appropriate for operation of the sensors. The Quantus HP100 wetted materials are stainless steel, sapphire, Viton, and alumina. The user should evaluate if any chemicals, gases, or their byproducts, to which the sensor may be exposed present the potential for attack of these materials and if such attack would present a safety hazard. Should such a hazard exist, the user should ensure that proper safety monitoring capabilities are installed at the process tool and/or facility level (e.g., facility toxic or hazardous gas monitoring).

- Ensures that users cannot physically access the internal portions of the sensor in which the microplasma operates. Typically, the sensor is installed on a vacuum system whose containment vessel prevents access.

- Ensures that the user cannot directly view the microplasma, as UV emission may be present.

- Is protected from exposure of the interior of the microplasma sensor cell to other sources of light, including ambient light or light generated elsewhere in the process equipment. Any other light sources seen by the Quantus HP100 spectrometer will make data analysis difficult or impossible.

⚠ **WARNING**

Power SHOULD NOT be connected to the sensor unless the above conditions are met. It is the responsibility of the user to ensure that the above conditions are met, including thorough training.

⚠ **CAUTION**

Do not replace the power cord with an inadequately rated cord. The cord must be 10 A or higher.

DC power connector is intended to be used to remove power from the system. Ensure there is enough room to disconnect the power cord when needed.

Quantus HP100 requires a Class 1, limited power supply DC power supply of 24 V (dc), 2.5 A minimum rating. INFICON offers a 80 - 264 V (ac) to 24 V (dc) power converter which meets all power supply requirements. Should the user supply power independently, the user must ensure that the supply has at least the minimum capability and is short-circuit and over-current protected. At a minimum, the supply should be compliant with UL/CSA 60950-1.

Quantus HP100 sensors are intended to be used in clean, protected environments and are not to be used in outdoor or indoor installations where significant amounts of dust, oil, or other vapors are present, unless a separate provision is made to provide a suitable environmental enclosure. The sensors are intended to be used in cleanroom environments.

> ### ⚠ WARNING
>
> There are no user serviceable parts in either the ECM or MSC and the user should not attempt to open, disassemble or tamper with these components. Doing so will void the warranty and may either (1) render the product non-compliant with safety certifications and/or (2) expose the user to hazardous voltages or emissions.

3.3.2 Cleaning

Should cleaning be required, clean the enclosure exterior with mild detergents or alcohol applied with a towel or cloth. Cleaning of the interior portions of the MSC cannot be performed and the user should instead install a new MSC assembly.

3.3.3 Connecting the Ethernet Interface

Ethernet communications between the controller and Quantus HP100 are established using the 30 ft. (9.14 m) Ethernet cable provided with the system.

4 Connecting Quantus HP100

4.1 Introduction

Quantus HP100 uses Ethernet as its default communications method.

Quantus HP100 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.

4.2 General Networking Information

This section will discuss some of the general networking variables that can affect the
connection of Quantus HP100.

4.2.1 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 Quantus HP100, but allows for
dynamic IP addresses set through Dynamic Host Communication Protocol (DHCP).

**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 Quantus HP100, the IP address must not change during operation of Quantus HP100.**
>
> **Using DHCP, the host may generate a new IP address every time Quantus HP100 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 Quantus HP100 IP address is randomly changed during data acquisition, FabGuard will not automatically reconnect to the Quantus HP100 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 Quantus HP100 from losing communication and data.**

Quantus HP100 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 - 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.

4.2.2 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 below.

	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 profile	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 the table above, 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.

4.3 Quantus HP100 IP Address

By default, Quantus HP100 ships with an IP address of 192.168.100.11 and with a subnet mask of 255.255.255.0.

> **When connecting Quantus HP100 to an existing local network, there should be a static IP address for each Quantus HP100 being installed. Contact the network administrator for IP address assignments.**

4.3.1 Changing Quantus HP100 IP Address

The method of changing the Quantus HP100 IP address employs the INFICON Mass Spectrometer Search Utility (IMSSU), a standalone executable found on the software installation disk and the Quantus HP100 Manuals CD that ships with each Quantus HP100. 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 below.

When the IMSSU first opens, nothing will be displayed. The IMSSU detects all instruments 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 HP100 for Quantus HP100 sensors)
- Quantus HP100 serial number
- Current IP address of Quantus HP100

- MAC address of Quantus HP100

- DHCP status of Quantus HP100 (on or off)

- Description (which is user editable)

4.3.1.1 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 below, and the different functions are described in the following sections.

Changing Quantus HP100 IP Address

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

The **TCP/IP Properties** window will display:

- Quantus HP100 MAC Address

- The current Quantus HP100 IP address

- A **Change To** text box, to enter the new Quantus HP100 IP address

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

To change the IP address, type the new IP address in the **Change To** box and click **Apply**. Quantus HP100 will automatically reboot and will return online with the new IP address.

Alternatively, the IP address can be automatically assigned to Quantus HP100 by selecting **DHCP On** (*this is not recommended*).

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 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 Quantus HP100. 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

4.3.2 Changing the Computer IP Address

An alternative to changing the Quantus HP100 IP address is to change the host computer's IP address to allow for communication between the host computer and Quantus HP100. To change the computer's IP address, follow these instructions:

4.3.2.1 Windows 10 Instructions

> ℹ **Changing the IP address of the host computer requires administrator rights. You will need to use an administrator account 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 10 desktop.
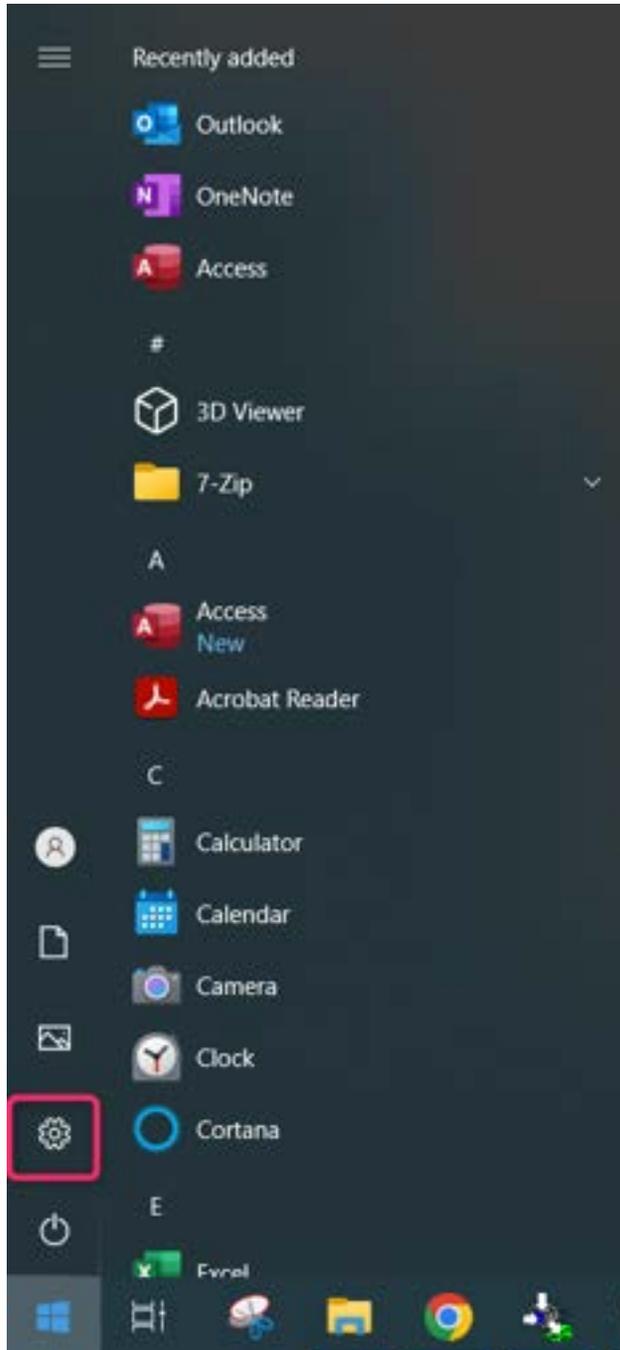
2 In the Window Settings window, click **Network & Internet**.
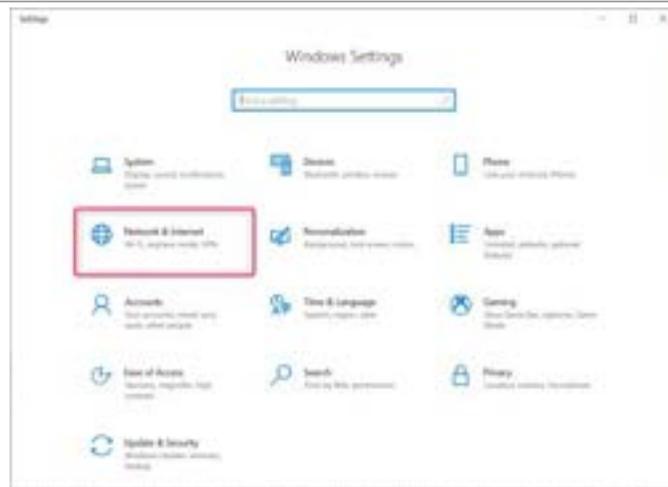
3 On the network status and tasks window, click **Change adapter options**.
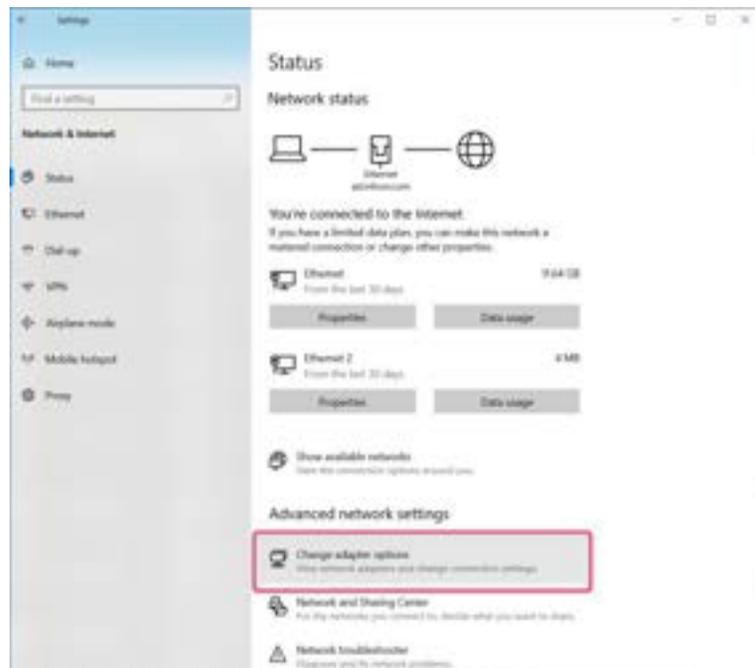
4 If the host computer is connected to Quantus HP100 through the Ethernet port of the computer, right-click **Local Area Connection** and select **Properties**.
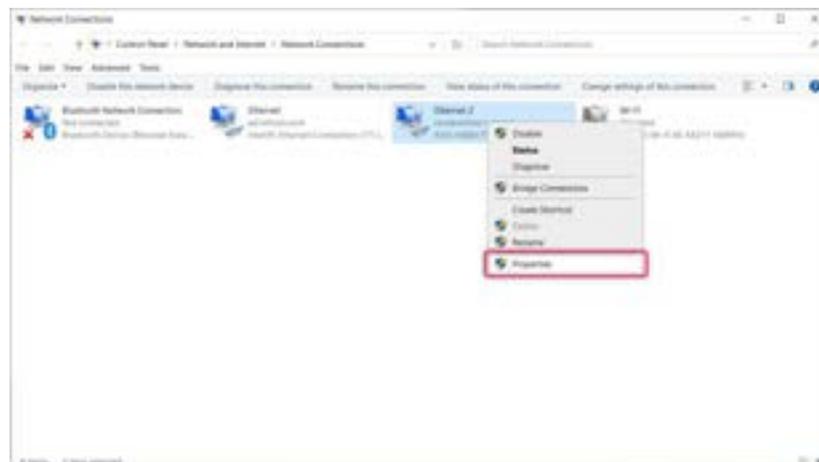
5   Select **Internet Protocol Version 4 (TCP/IPv4)**, then click **Properties**.
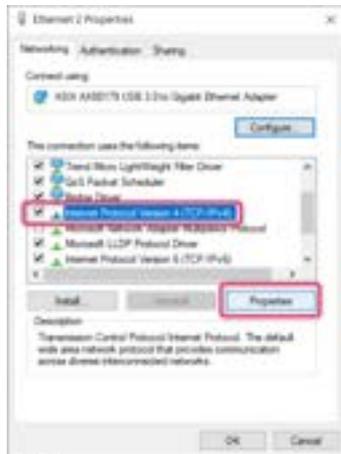
6   In the TCP/IPv4 properties menu, select **Use the following IP address**.
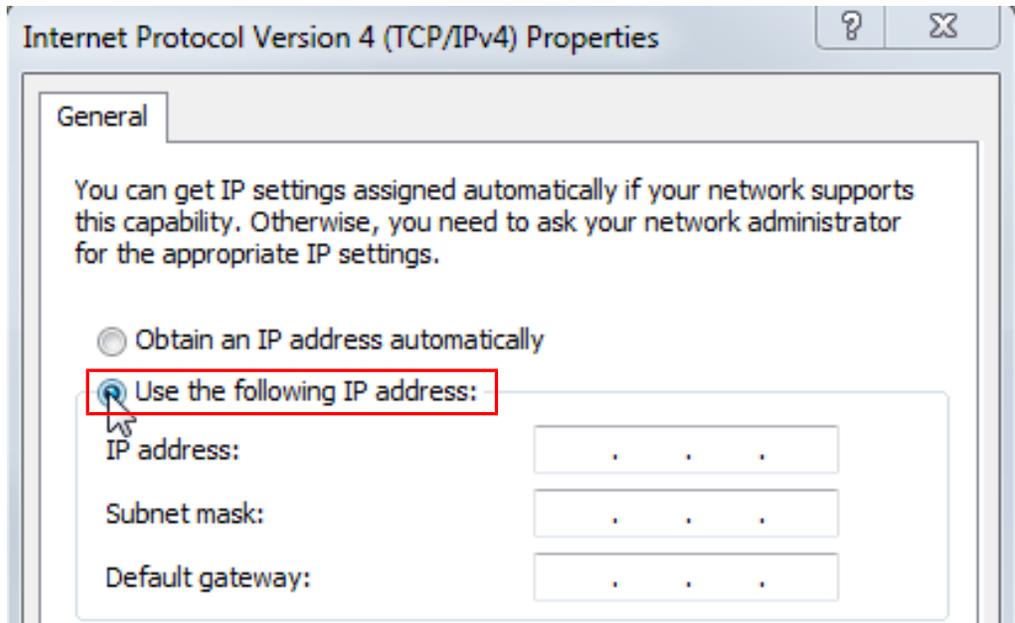
7   In **IP address:** type **192.168.100.XXX**. The last octet can be any number as long as it is unique to the network.

8   In **Subnet mask:** type **255.255.255.0**.

9   Click **OK**.
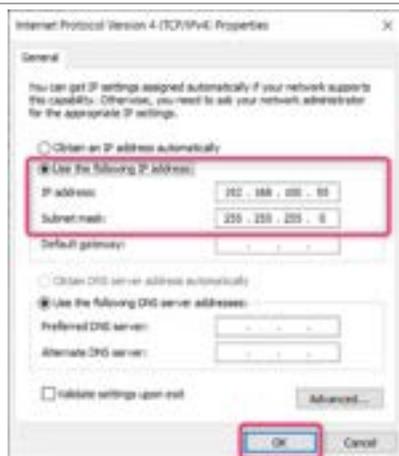
10 The IP address will now be set to the manual IP address chosen in step 7. Exit all of the menus and then connect to Quantus HP100.

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.

4.4 Connecting Quantus HP100

Before connecting Quantus HP100, decide:

Is Quantus HP100 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?

Is more than one Quantus HP100 sensor being installed at the same time?

4.4.1 Connecting a Single Quantus HP100

4.4.1.1 Single Quantus HP100 Direct Connection Installation

When installing a single Quantus HP100 on a private network or directly connected to a computer, changing the IP address of Quantus HP100 is only necessary if the computer being used to connect to Quantus HP100 has a different network prefix than Quantus HP100.

The network prefix of Quantus HP100 is **192.168.100.x**. The IP address of the host computer used to control Quantus HP100 must have a subnet mask of **255.255.255.0** and a network prefix of **192.168.100.x**.

If this is not the case, change the computer IP address to match the network prefix of Quantus HP100. For example, giving the computer an IP address of **192.168.100.16** will allow Quantus HP100 to communicate directly with the computer. Refer to Changing the Computer IP Address [▷ 27].

4.4.1.2 Installing a Single Quantus HP100 on an Existing Local Network

When installing a single Quantus HP100 on an existing local network, the default IP address of Quantus HP100 may not be compatible with the network.

Quantus HP100 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 Quantus HP100. Refer to Changing the Computer IP Address [▷ 27].

4.4.2 Connecting Multiple Quantus HP100 Sensors

Since each Quantus HP100 is shipped with the same default IP address, the IP address of each Quantus HP100 must be changed one at a time so that each sensor has a unique IP address. Refer to Changing the Computer IP Address [▷ 27]

⚠ CAUTION

Do not connect multiple Quantus HP100s 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.

4.4.2.1 Installing Multiple Quantus HP100s Directly to a Host Computer

If multiple Quantus HP100 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. Quantus HP100 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.

4.4.2.2 Installing Multiple Quantus HP100s on an Exisiting Local Network

If multiple Quantus HP100 sensors are to be connected to an existing local network, use an Ethernet switch instead of a router.

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

Since Quantus HP100 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.

5 Operation

5.1 Introduction

Operation of Quantus HP100 is controlled by FabGuard analysis software. Refer to FabGuard user documentation and INFICON applications support for more information regarding sensor setup and operation.

Quantus HP100 is designed to ignite its plasma over a pressure range of 1 Torr - 450 Torr for argon, and 1 Torr -120 Torr for nitrogen; operating range varies for other gas species. However, the ability to ignite plasma can be affected by the species of gas present. Therefore, the pressure range for plasma ignition or for sustaining the plasma may vary depending on the application.

Optical spectra acquired by the Quantus HP100 are analyzed by FabGuard software.

5.2 Sensor Status LEDs

Quantus HP100 is equipped with six green LEDs to indicate sensor status.

5.2.1 Descriptions of Sensor Status LEDs

The Quantus HP100 sensor status LEDs are summarized in the table below. When 24 V (dc) power is applied to the sensor, the 24 V and 5 V LEDs illuminate. During initial power-up, the other four LEDs flash several times to indicate that the LEDs are functioning.

LED Label	Description
24 V	24 V (dc) power present
5 V	5 V (dc) power present
RF	RF amplifier enabled - RF power being delivered to the antenna to start, or sustain, the microplasma.
ON	Microplasma on - light is being detected from the microplasma.
ERR	Hardware error
SS	Spread spectrum (dithering) - frequency modulation, as described in Spread-Spectrum (SS) [▷ 35]

⚠ **CAUTION**

If no LEDs illuminate after power is applied, then a fault in the sensor is likely to have occurred. Contact INFICON for assistance.

5.3 Spread-Spectrum (SS)

When illuminated, the LED SS indicates that Quantus HP100 is operating in spread spectrum mode, a form of frequency modulation also known as dithering. Spread spectrum is the default mode of operation for Quantus HP100. In this mode, the sensor modulates the RF drive frequency around the resonance frequency of a given MSC.

6 Accessories and Spare Parts

6.1 Quantus HP100 Spare Parts

Part Number	Description
962-468-G1	HP100 - standard and corrosive environment cell
962-401-G1	Power supply - 80–264 V (ac) @ 50/60 Hz to 24 V (dc)

6.2 Isolation Valve Kit

The isolation valve kit is available as an accessory for Quantus HP100.
This kit includes a pneumatic right-angle or in-line valve and a control cable to interface the valve directly to the Quantus HP100 Electronic Control Module.

6.2.1 Quantus HP100 Accessories

Part Number	Description
962-020-G1	KF-25 right angle isolation valve kit
962-020-G2	KF-25 right angle isolation valve kit with Kalrez o-ring
962-437-G1	KF-25 in-line isolation valve kit
962-437-G2	KF-25 in-line isolation valve kit with Kalrez o-ring

7 Maintenance

7.1 Introduction

The Microplasma Sensor Cell (MSC) contains components for igniting and sustaining the microplasma. The MSC can be replaced when necessary. In order to replace the MSC, vacuum must be broken. The frequency of the new MSC, if different from the previous MSC, must be updated at the Sensor Configuration Screen for this sensor, using FabGuard software. The MSC can be returned to INFICON for refurbishment for subsequent re-use on either the same Quantus HP100 or another Quantus HP100.

7.2 Replacing the Microplasma Sensor Cell (MSC)

Tools Required
- 2 mm hex driver
- 2.5 mm hex driver
- 5/16 in. wrench

> ⚠ **CAUTION**
>
> Keep the inside of the MSC clean. Do not contaminate the inside of the MSC because it will be exposed to the process chamber or pump line to which it is connected.

1. Remove Quantus HP100 from the chamber or system it is installed on by removing the KF-25 clamp and centering ring. To remove the KF-25 clamp and centering ring, turn the wingnut counterclockwise. Keep the clamp and centering ring for re-installation of Quantus HP100. Keep the centering ring clean.

KF-25 clamp

Centering ring

2. Using a 2 mm hex driver, remove the front end plate by removing the four screws. Keep the front end plate and screws for re-assembly at the end of this procedure.

3. Using a 2 mm hex driver, remove the flange plate by removing the four screws. Keep the flange plate and screws for re-assembly at the end of this procedure.

Flange plate

4. Using a 5/16 in. wrench, disconnect the RF cable from the MSC.

RF cable
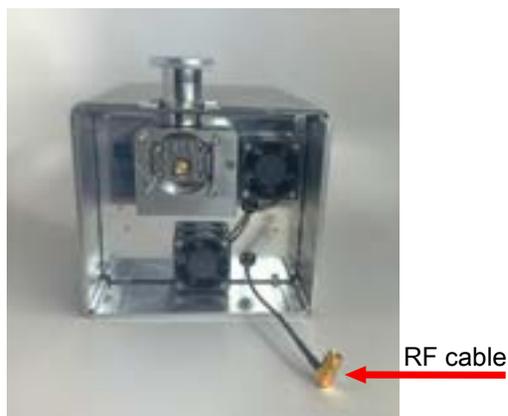
5. Using a 2.5 mm hex driver, unfasten the four screws at the face of the MSC and then remove the MSC from the system.
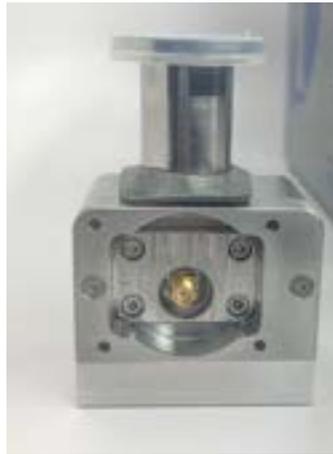
6. Leave Quantus HP100 in its current orientation. Remove and discard the EMI gasket around the flange.

EMI
Gasket

7. Remove the adhesive tape on the back of the new EMI gasket. Stretch the EMI gasket around the flange of the new MSC, with the adhesive side down and the cutout facing the spectrometer side. The cut out on the EMI gasket should align with the screw on the flange.

8. Place the gasket over the flange in the orientation, shown below.

9. Carefully install the new MSC by slowly sliding it into the housing. Be careful to do this slowly, without too much force, to ensure the connectors are not damaged and are properly mated. Use the holes on the MSC and line them up with the corresponding holes within the sensor. Fasten the corresponding screws using a 2.5 mm hex driver.
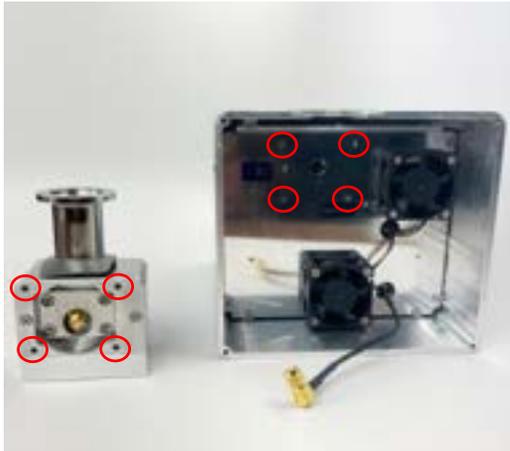
10. Read the cell frequency, in units of MHz, from the label on the new cell. Make note of this frequency and update it at the Sensor Configuration Screen for the Quantus HP100 sensor using FabGuard software.

11. Using a 2 mm hex driver, reinstall the flange plate with the four screws. Ensure the front face of the flange plate is flush with the surface on the enclosure.

Flange plate

12. Stick the adhesive EMI gasket to the flange plate and the enclosure surrounding the flange of the MSC.

13. Using the 5/16 in. wrench, reconnect the RF cable to the MSC. Be sure not to overtighten the cable or damage could occur to the MSC.
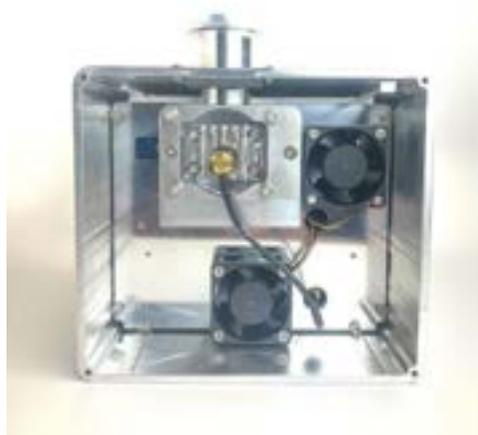
14. Using a 2 mm hex driver, install the front end plate with the four screws.

15. Update the MSC frequency at the Sensor Configuration Screen for the Quantus HP100 sensor using FabGuard software. Refer to FabGuard user documentation or contact INFICON applications support for more information regarding sensor configuration.

8 Appendix

8.1 Theory

8.2 Introduction to Optical Emission Spectroscopy

Quantus HP100 gas analysis system utilizes optical emission spectroscopy to monitor gases present in a chamber, delivery line or pump line. This chapter will discuss the theory behind optical emission spectroscopy and then briefly discuss how Quantus HP100 utilizes these phenomena for detecting leaks, contaminants, process changes, or process endpoints.

8.3 Origin of Optical Emission Theory

In the early 1900s, Neils Bohr redefined atomic physics with the Bohr model of the atom. His theory stated that atoms had discrete, quantized energy levels where electrons can exist. He also noted that the electrons can excite to higher energy levels if they absorb an energy equivalent to the difference in energy between the two levels. The electron then can exist inside of the "excited" energy level, but will eventually relax to the unexcited state. When the electron drops from the excited energy level to the unexcited level, the energy that was absorbed for the excitation must be released. This energy is released in the form of a single photon that has energy equivalent to the difference between the excited and unexcited energy states. A visual depiction of the different quantum energy levels is illustrated below.
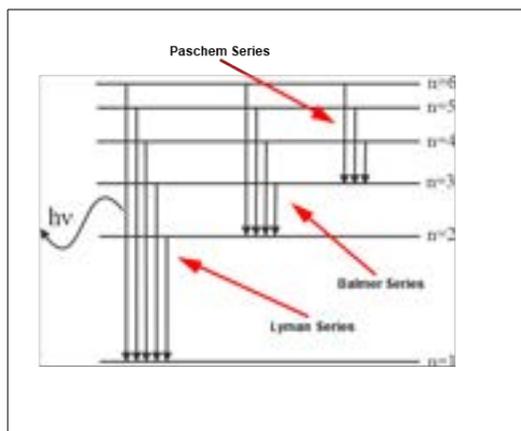
There are three basic series that are defined for the hydrogen atom: the Lyman Series, the Balmer Series and the Paschen Series. The Lyman Series includes all of the photons generated when electrons go from an excited state back to the most unexcited state, n=1. The photons generated in the Lyman Series are 94 nm, 95 nm, 97 nm, 103 nm and 122 nm which are all in the UV range of the electromagnetic spectrum. The Balmer Series is the more easily measured series and includes all of

the photons generated when electrons go from an excited state down to a less excited state, n=2. The photons generated in the Balmer Series are 410 nm, 434 nm, 486 nm and 656 nm which are all in the visible range. A visual representation of the Balmer Series is presented below.
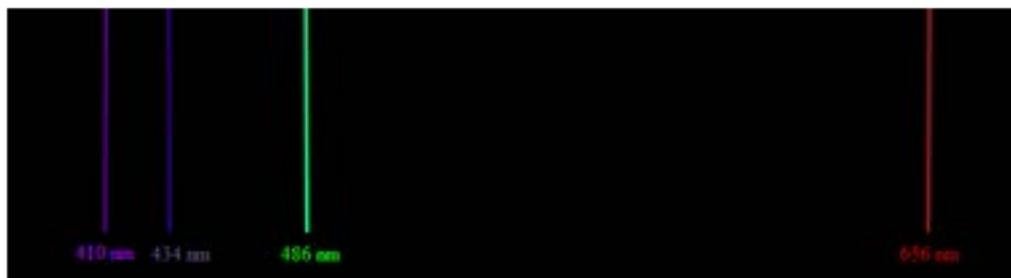
The third series, the Paschen Series, includes all of the photons generated from relaxation from an excited energy state to the n=3 energy state. This produces photons with wavelengths of 1084 nm, 1282 nm and 1875 nm which are all in the IR range of the electromagnetic spectrum.

The energy of the photon emitted by the gas can be determined by the following equations:

$$E = h\nu \qquad [1]$$

$$\nu = \frac{c}{\lambda} \qquad [2]$$

$$E = \frac{hc}{\lambda} \qquad [3]$$

Where E = energy, ν = frequency, c = the speed of light (3.00E8 m/s), λ= wavelength and h = Planck's constant (6.626E-34 Js).

Since the energy is quantized, only a single wavelength of light is emitted for each relaxation. This produces a line in the optical spectrum. Since each element or molecule has a specific set of energy levels, each element or molecule has a unique line spectrum. Also, because each element or molecule produces photons independently, the number of photons of a certain wavelength is related to the concentration of a specific element or molecule.

8.4 Complex Optical Emission Spectra

Thus far, the only optical emission spectra discussed has been that of monatomic hydrogen. Monatomic hydrogen, of course, has a very simple atomic structure including only one electron. As elements increase in complexity or combine with other elements to form molecules, more electrons are given the opportunity to exist in more energy states producing complex spectra. This section will discuss the two different reasons for complex spectra.

8.4.1 Increasing Numbers of Electrons

Multi-electron systems baffled Neils Bohr during his lifetime, and unfortunately, such is still the case today. Due to this, the underlying physics, mathematics and chemistry that define emission spectra of multi-electron elements include a multitude of assumptions and estimations. However, that is on the theoretical side of science. For our needs, only one rule is important: as elemental complexity increases, so does the complexity of an element's emission spectrum or as the atomic number increases, so does the complexity of the atomic emission spectrum. This can be seen below, which shows emission spectra of both oxygen and argon. When you compare these spectra to the hydrogen spectrum Origin of Optical Emission Theory [▶ 42], it's easy to see how the complexity increases.
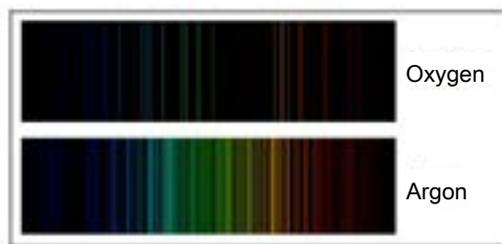
Remember that each electron can exist in each energy state. Because the electrons have different energy based on spin and ground state configuration, a multitude of different energy photons are released when the electrons relax to a non-excited state.

The other thing to note is that many of these different atomic emission lines have very similar wavelengths (i.e., oxygen has lines at 394.729 nm, 394.748 nm and 394.759 nm). Depending on the resolution of an instrument, these could appear as three distinct lines or just as one line at 394.7 nm with the intensity of all three lines added together.

Additionally, although each spectrum is unique for a given atom, that does not mean that two elements cannot have overlapping lines. For instance, argon has lines at 394.6097 nm and 394.8979 nm. Again, depending on the instrument, an argon/oxygen mix could show 5 distinct lines at 394.6097 nm, 394.729 nm, 394.748 nm, 394.759 nm and 394.8979 nm or it could show one line at 395 nm that includes the intensity of all 5 lines.

8.4.2 Molecular Combinations of Atoms

When atoms combine to form molecules, their orbitals combine to form new bonding orbitals. These bonding orbitals create more energy states that electrons can exist in. Since there are more energy states, there are more chances for electrons to excite and relax and then release photons. This can create very complex optical emission spectra. The discussion of the theory is outside of the scope of this manual, but it's worth noting that molecules have more complex spectra than elements.

8.5 Quantus HP100 and Optical Emission Spectroscopy

Due to each element or molecule producing their own unique spectra and the amount of photons being related to the concentration of a specific element or molecule, Optical Emission Spectroscopy can be used to detect changes in the relative concentration of gases present in a chamber, gas line or process. In order to utilize Optical Emission Spectroscopy, the electrons in the gas have to be excited to higher energy states. This is accomplished by the proprietary microplasma cell of the Quantus HP100 sensor. Inside the MSC the gas molecules are energized to excite the electrons to higher energy levels. When the electrons relax, photons of light are emitted as described above. These photons are then divided according to their wavelength and detected by a spectrometer in the Quantus HP100 system. This allows INFICON FabGuard analysis software to monitor, as a function of time, the intensity versus wavelength optical emission spectra generated in the MSC. Analysis of the optical spectra versus time provides for the detection of leaks, contaminants, process changes or process endpoints. Note that quantitative determination of concentration is not generally possible because the intensity of different wavelengths in the optical emission spectrum depends on the concentration and energy distribution of electrons in the plasma as well as the concentration of the species of interest.

9 Declaration of Conformity

ΠINFICON

DECLARATION OF CONFORMITY

This declaration is issued under the sole responsibility of the manufacturer INFICON. The object of the declaration is to certify that this equipment, designed and manufactured by:

INFICON Inc.

Two Technology Place

East Syracuse, NY 13057

USA

is in conformity with the relevant Community harmonization legislation. It has been constructed in accordance with good engineering practice in safety matters in force in the Community and does not endanger the safety of persons, domestic animals or property when properly installed and maintained and used in applications for which it was made.

Equipment Description: Quantus HP100

Applicable Directives:		
2014/35/EU (LVD)	Electrical Equipment (Safety) Regulations 2016 (UK)
2014/30/EU (EMC)	Electromagnetic Compatibility Regulations 2016 (UK)
2015/863/EU (RoHS)	Substances in Electrical and Electronic Equipment Regulations 2012 (AS AMENDED)

Applicable Standards:

Safety: IEC 61010-1:2010/AMD1:2016 3rd Edition: Listing # E115486

Emissions: EN 61326-1:2020 (Radiated & Conducted Emissions)

(EMC – Measurement, Control & Laboratory Equipment)

CISPR 11:2015/AMD2:2019
EN 55011:2016/A11:2020   Emission Standard for Industrial, Scientific and Medical (ISM) radio RF equipment
FCC Title 47 CFR Part 18 Class A emission requirements (USA)

Immunity: EN 61326:2020 (Industrial EMC Environments)
(EMC – Measurement, Control & Laboratory Equipment)
Immunity per Table 2

SEMI: SEMI S2-0821 Compliant

CE and UKCA Implementation Date: October 18, 2022

Authorized Representatives:

Andrew Klamm   Digitally signed by Andrew Klamm Date: 2023.08.09 14:24:15 -04'00'

Samuel Carroll   Digitally signed by Samuel Carroll Date: 2023.08.09 14:11:45 -04'00'

Andrew Klamm
Quality Manager, ISS

Samuel Carroll
Vice President of Engineering

ANY QUESTIONS RELATIVE TO THIS DECLARATION OR TO THE SAFETY OF INFICON'S PRODUCTS SHOULD BE DIRECTED, IN WRITING, TO THE AUTHORIZED REPRESENTATIVE AT THE ABOVE ADDRESS.