



Qrometric
Industrial and scientific metrology



Operation and Maintenance Manual

V1.0

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Qrometric Ltd

Unit 10
Hove Enterprise Centre
Portslade
BN41 1UY
United Kingdom

T: +44 20 7099 5807

info@qrometric.com

www.qrometric.com

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1 Safety Instructions

IMPORTANT

PLEASE READ ALL SAFETY INSTRUCTIONS CAREFULLY



- Check all connections carefully before use
- Disconnect power supply before opening the instrument housing
- In the event of damage, **DO NOT** use the instrument
- The FPG's power connection must be earthed



Further safety instructions are provided where necessary and clearly indicated by the two symbols shown either side of this statement.



2 Introduction

2.1 Scope of Document

The FPG is a self-contained and portable dew/frost point generator for calibrating dew/frost point instrumentation. This instruction manual applies to all three FPG Models: FPG-60, FPG-80 and FPG-100. It is also available online at www.qrometric.com.

2.2 Terminology and Conventions

There are many different terms and conventions used in the field of operation of the FPG. This manual assumes the following definitions:

- **Humidity** is a generic term relating to the concentration of water in the gas phase (or vapour) in another (matrix) gas. It is sometimes used interchangeably with 'moisture' though this is strictly incorrect, as moisture refers to water in the liquid phase. Given the conditions, it might be more sensible to refer to 'dryness' but this is rarely used.
- **Dew Point or Frost Point Temperature** is a common measure of humidity. It is sometimes referred to as the dew point or dew/frost point temperature. This manual uses the convention 'dew point' above 0°C and 'frost point' below 0°C – that each is a temperature with a unit '°C' is assumed.

It should be noted that *below* 0°C the *same* humidity condition can be described in terms of a dew point or a frost point temperature, but that the values are different. For a full explanation, please refer to the following guide published by the UK National Physical Laboratory, which also details other humidity metrics, including parts per million (by volume) or PPMv:

<https://www.qrometric.com/wp-content/uploads/2021/12/NPL-Guide-to-the-Measurement-of-Humidity.pdf>

An online calculator can be found at <https://www.qrometric.com/calculator/> which can be used to convert between the different humidity parameters, including dew point and frost point temperatures and PPMv, etc.

- **Hygrometer** is a generic term that refers to an instrument that measures humidity. There are many different technologies that are used, including chilled mirror hygrometers (CMH), optical hygrometers, Phosphorous Pentoxide cells, microwave resonator elements and capacitive substrate sensors, including Aluminium Oxide and thin film polymers.

- **Moisture Analyser** is a generic term that refers to an instrument that measures humidity, though again, strictly speaking it is not moisture that is being measured.
- **Dew Point Sensors** typically use Aluminium Oxide or thin film polymer substrates whose capacitance changes sensitively with humidity conditions below 0°Cfp – they usually configured to provide measurements in terms of dew/frost point (temperature).
- **Chilled Mirror Hygrometers (CMH)** are considered one of the best reference instrument instruments for measuring humidity – they are sometimes referred to as ‘dew point meters’.
- **Optical Hygrometers** employ laser spectroscopic techniques to measure humidity – there are a number of different types, including cavity ring-down, tuneable diode, etc.

2.3 Introducing the FPG

The FPG generates precisely controlled dew/frost point conditions that can be used for calibrating dew point sensors, and most types of hygrometers, from ambient dew point conditions to frost point temperatures as low as -100°C.

The FPG uses a temperature-controlled saturator to generate a stable water vapour pressure (and associated dew point) within a closed-loop. An integrated sample pump maintains a continuous flow through the saturator, the 3-port dew point probe manifold and the external sample connection. At equilibrium, the saturator temperature and system pressure provide humidity reference conditions to which hygrometers can be compared and calibrated. The temperature of the saturator controls the dryness of the gas, which is measured as dew/frost point temperature. It has a stabilisation time of 20 minutes, given a step change of 20°Cdp/fp.

As long as the loop is properly sealed (see [section 6.1.3](#)), the total amount of water in the system remains fixed throughout operation, whatever the programmed condition. The dew point temperature condition is defined by the saturator temperature – the water not in the vapour phase is condensed on the saturator. The water in the system is derived from the humidity in the matrix gas with which the system is initially purged (usually ambient air). It is important this is done with the saturator temperature set above its dew point temperature (see [section 5.2.3.2](#)).

The FPG is completely self-contained, transportable and requires only mains power to function. Coupled with the rapid set point change and stabilisation time, calibrations can easily be performed at the location where the hygrometers are normally installed.



The FPG must be used and serviced following the instructions and warnings provided in this manual. Any use of the FPG contrary to manufacturer's instructions for use will put operator safety at risk and compromise health and safety in the workplace.



2.4 Remote API

The FPG comes standard with an Application Programming Interface (API) which is a text-based, remote command interface connected through the FPG Ethernet port. FPG data can be captured and set points defined using custom scripts or third-party software, including Calibry Lab-in-a-Box automated calibration software.

2.5 Options, Accessories and Extras

A range of options, accessories and extras (including calibration) can be purchased for the FPG. Full order code information can be found at the end of this manual.

3 FPG Quick Start

This chapter provides the first steps and most important information needed to start using your FPG. It should only be used as a general overview and not as a substitute for reading the complete manual. To gain a thorough understanding, please read the other chapters, taking careful note of the indicated warnings.

3.1 Unpacking the FPG

The FPG will be delivered to you in a cardboard transportation box or, if ordered, a custom soft padded transport bag or hard transit case. It is recommended to keep the delivery packaging in case of future need for transport for calibration, repair or storage.

Typically included:

1. FPG transportable dew/frost point calibrator
2. Power cable
3. Sample loop connection: FPG-60, 6 mm Swagelok Tube Fitting or FPG-80/FPG-100, ¼" VCR Metal Gasket Face Seal Fitting
4. Adjustable torque screwdriver with 3 mm Hex bit
5. Optional probe adaptors
6. Optional second PRT for independent measurement of saturator temperature
7. Calibration certificate



Before you start operating the FPG, carefully remove all items from the case and visually check for any signs of damage. Check the contents included matches up to the delivery note.

IF YOU FIND ANY ITEMS TO BE MISSING OR DAMAGED, PLEASE CONTACT YOUR SUPPLIER IMMEDIATELY.



Make sure that the power rating on the rear label corresponds to your local power supply specification – an incorrect power rating may cause damage to the FPG.



3.2 Locating the FPG

Before proceeding, ensure that:

1. The unit is placed level, horizontally and is stable on its four rubber feet.
2. The FPG has at least 10 mm clearance underneath and at least 100 mm at the rear and side to allow sufficient air flow.
3. Access to the electrical mains connector at the instrument rear is adequate.

3.3 Mains Supply

The FPG requires a source of mains power. Please ensure the power rating of your supply matches the instrument's specifications. When you have checked this, you should:

- Plug the supplied AC power cord into the rear panel of the FPG.
- Plug the other end of the power cord into a mains AC outlet.
- Turn the power switch to ON (it is located to the left of the AC power connector).

3.4 Closed-Loop Operation

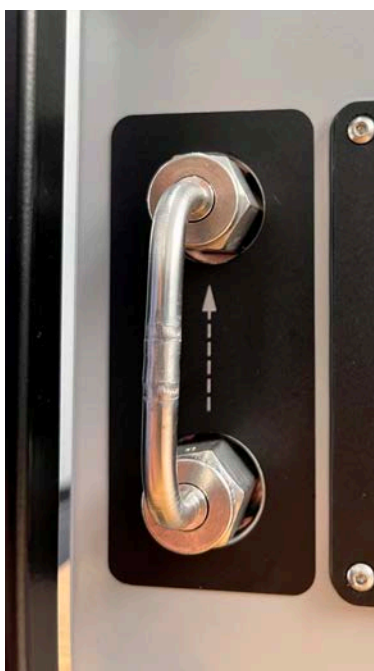


The FPG will only function correctly if operated as a closed-loop system. This means each of the three dew point sensor apertures on the front panel manifold need to be firmly sealed, either with its supplied bung or a sensor and the rear sample loop circuit must be completed (see [section 6.1](#)).



The FPG operates as a closed-loop with gas flow established by an internal pump. The circuit must not be open, otherwise ambient humidity will be drawn into the FPG and this will condense as ice and could eventually block the internal saturator. Should this happen, the FPG saturator will automatically shut off the pump and saturator temperature control. Please follow the drying out procedure in these circumstances (see sections [5.2.3.2](#) and [6.3.6](#)).

For basic operation with no external devices connected, the rear panel sample U-loop connection must be in place as shown below:



Depending on the configuration set-up (see [section 6.4](#)), the U-loop can be removed to allow connection to other instruments.

The FPG is now ready to turn on.

3.5 Powering on the FPG

Press the 'ON' button on the front panel of the FPG.

The display will then power up and the FPG home screen will appear.

If nothing happens, check the power source and that the above steps have been correctly followed.

3.6 Shutting Down the FPG

It is important that the correct shut down procedures are followed to ensure no damage occurs to the instrument. Power should be turned off using the PG interface or by pressing the front panel button. **DO NOT pull plug out or switch off at power source while the FPG is running.**



DO NOT switch off at rear, pull plug out or switch off at power source before the FPG has finished shutting down.



3.7 Transporting the FPG

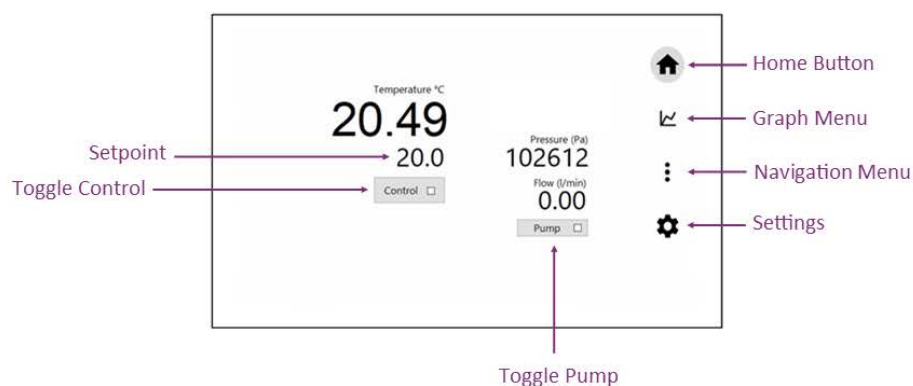


When the FPG is being prepared for transport, the U-loop **MUST** be reinstalled. It is very important to **NOT** stand the FPG on its rear handles with the VCR-tube fitting adaptors fitted. This is because the VCR-tube fitting adaptors protrude out further than the handles. Therefore, the adaptors are exposed to collision, which can result in damage to the internal pipework. **This is NOT covered by warranty.**

3.8 Basic Control

3.8.1 Home Screen

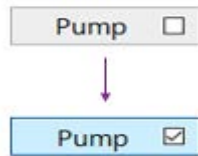
Once powered on the FPG will display the home screen:



The largest number (20.49) is the measured saturator temperature.

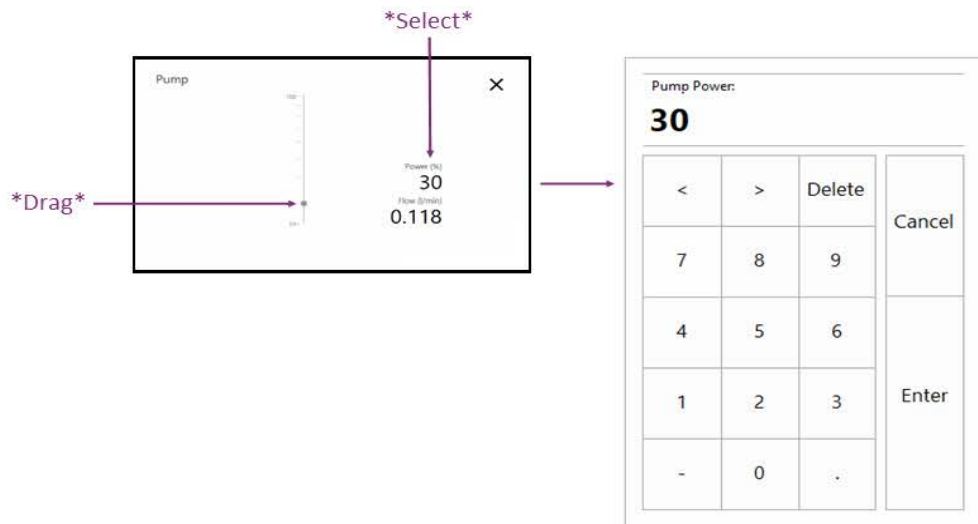
3.8.2 Flow

To establish gas flow through the circuit, turn on the internal pump using the toggle button:



When the pump is on, its button will turn blue and the check box will be ticked.

Flow rate through the system can be adjusted by changing the pump power. Press on the number to access the pump power setting. This can be set by pressing the 'Power' value and typing a number into the displayed keypad, or drag the slider.



3.8.3 Saturator Temperature and Control

To set a saturator temperature, click the set point number and enter a value on the screen. Please note that the FPG has no water source, therefore, it will not generate conditions above ambient dew point.

To turn on control of the temperature, click the CONTROL button, which will toggle to ticked and blue when on (as illustrated below):



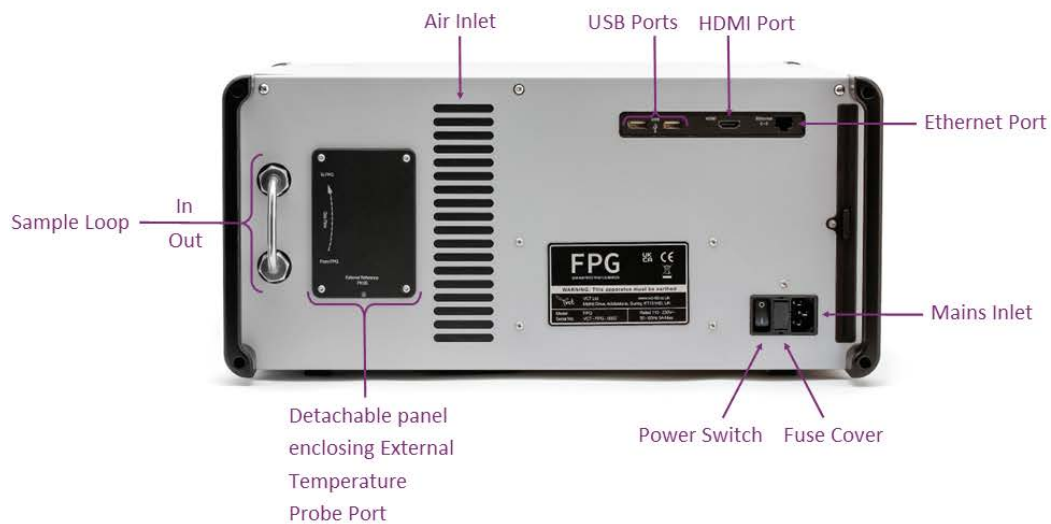
Press ENTER and ensure CONTROL is on as shown. Stabilisation is typically ~20 minutes when using 20°C step changes set out at the end of this manual.

4 FPG Physical Layout

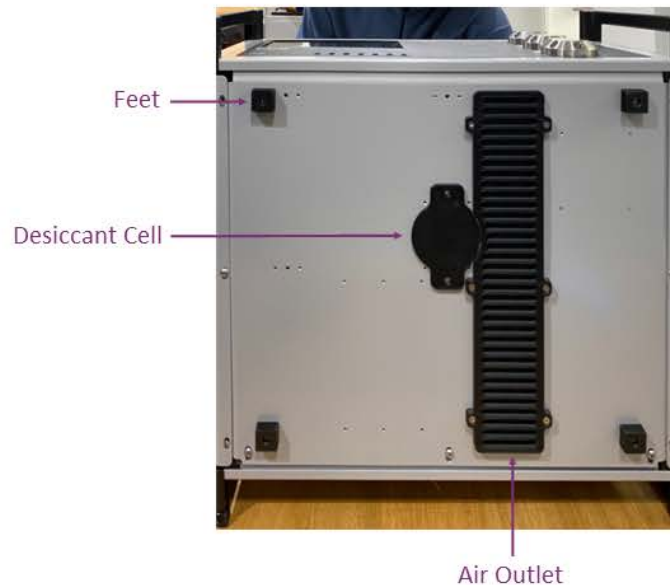
4.1 Front and Side Panel



4.2 Rear Panel



4.3 Underside



4.4 USB Ports

The FPG's front panel includes seven USB ports, which can be used for plugging in an external keyboard and/or mouse. They currently serve no other purpose but are provisioned in case of future feature development.

4.5 Configurable Probe Ports

There are a number of probe adaptors available for most manufacturers' dew point probes.

Please see Chapter 12 for further details and order information.

4.6 Rear Panel

The rear panel of the FPG comprises:

1. Power inlet and switch
2. External sample loop connections
3. Ethernet network port
4. USB ports ×2
5. HDMI port
6. Detachable panel, beneath which there is located:
 - a. External temperature probe port
 - b. USB port (service use only)

4.6.1 Sample Gas Connections

The fundamental physics at the heart of the FPG mean it can be used for traceable calibration without the need for a transfer standard hygrometer. However, as is the case in temperature calibration, a reference measurement is often used to improve confidence and reduce uncertainty. For this reason, the FPG includes external sample loop fittings so the user can validate performance at any time by connecting a reference instrument such as a dew point mirror. If no external instrument is connected or if the FPG is being prepped for transit, the provided U-loop pipe should be connected.



The inlet and outlet connections are located on the rear panel of the instrument as shown above. The inlet is the top connection and the outlet is the bottom connection. Connections are 6 mm Swagelok for the FPG-60 or 1/4" VCR for the FPG-80 and FPG-100.

4.6.2 USB Port on Cable



For service use only.

4.6.3 Network Port

The rear panel of the FPG includes an Ethernet network port to allow the user to connect the instrument to a network and allow for remote API access and screen sharing.

4.6.4 Power Switch

The main power switch is on the rear panel of the FPG and located to the left of the power plug.

4.6.5 Power Plug

The supplied power cable is to be connected to the power socket on the instrument rear panel. The supported power supply voltage is 100...250 VAC 50/60 Hz. Power requirements can be found on the label on the rear panel of the FPG.

4.6.6 USB Ports

The FPG's rear panel includes two rear USB ports and seven front USB ports adding the ability to plug in a keyboard and/or mouse if this is preferred to the touchscreen. There is scope for future functional expansion.

4.6.7 HDMI Port

The HDMI port is in place for future functional firmware upgrades to display integrated software.

4.6.8 Air Filters

On the far-right of the rear panel. These can be periodically removed and cleaned with a vacuum cleaner.

5 FPG User Interface

5.1 Front Panel

The front panel of the FPG consists of:

1. A full colour LCD touchscreen
2. Seven USB ports
3. Power button
4. Three configurable probe ports

Once the Power button has been pressed and the unit has powered up, the display will be activated and operational within a few seconds. To select menus or buttons on the screen, simply touch the desired key on the screen itself. A mouse and keyboard can also be connected via the integrated USB ports. The figure below shows the front panel and a sample display configuration.

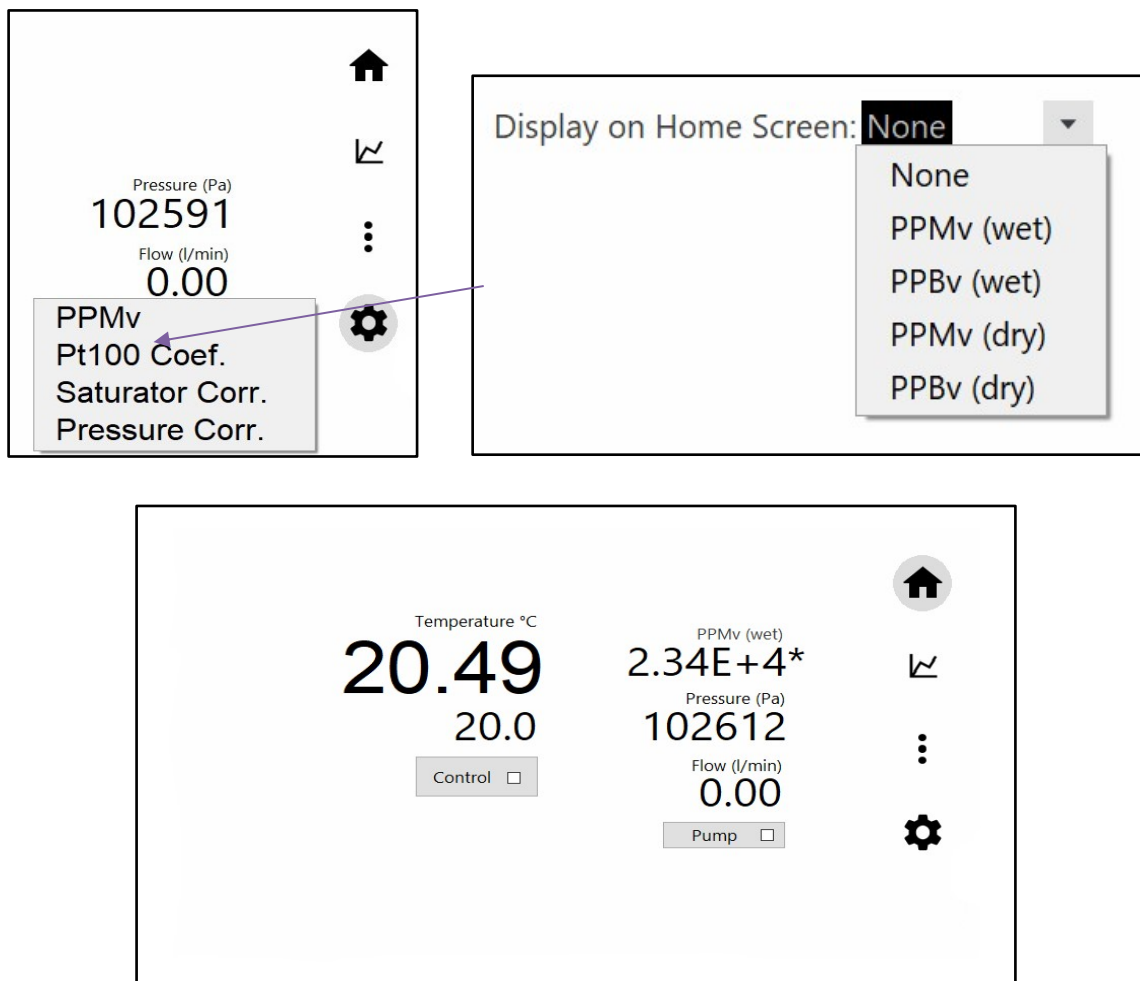


5.2 LCD Touchscreen

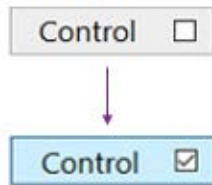
The FPG includes a full colour, LCD touchscreen. This section explains how to navigate the touchscreen's various functions in order to get the most out of your device. You can select a function from the menu by simply touching the relevant point on the touchscreen with either your finger or a stylus – **please note that sharp objects should NOT be used as they can damage the touchscreen.**

5.2.1 Home Screen

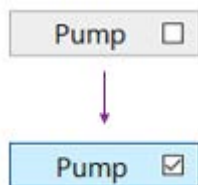
The FPG can measure its internal temperature and pressure, as well as gas flow rate. Measured temperature, pressure and flow is displayed on the home screen which can be customised to also include a calculated PPMv or PPBv of both the wet and dry variation. This is done by selecting Settings -> PPMv and then selecting from the drop-down options as shown below. You can return to the Home Screen at any time by pressing the HOME button represented by a house/home icon or by pressing the 'X' where appropriate.



5.2.1.1 Toggle Control and Pump



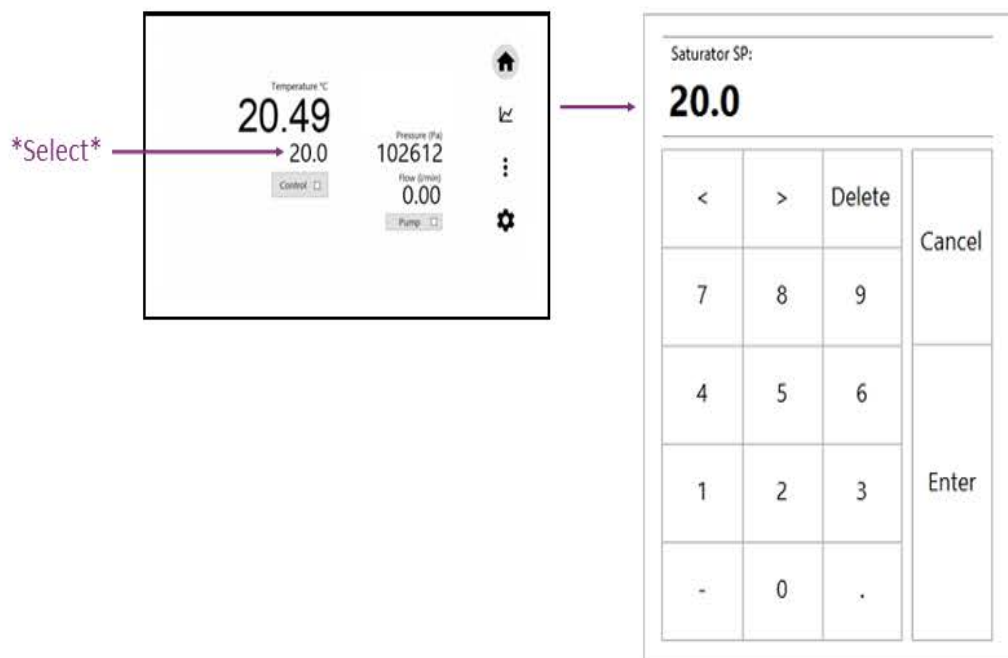
Control can be switched on and off with a simple tap of its box to tell the instrument to actively cool or warm to the set point.



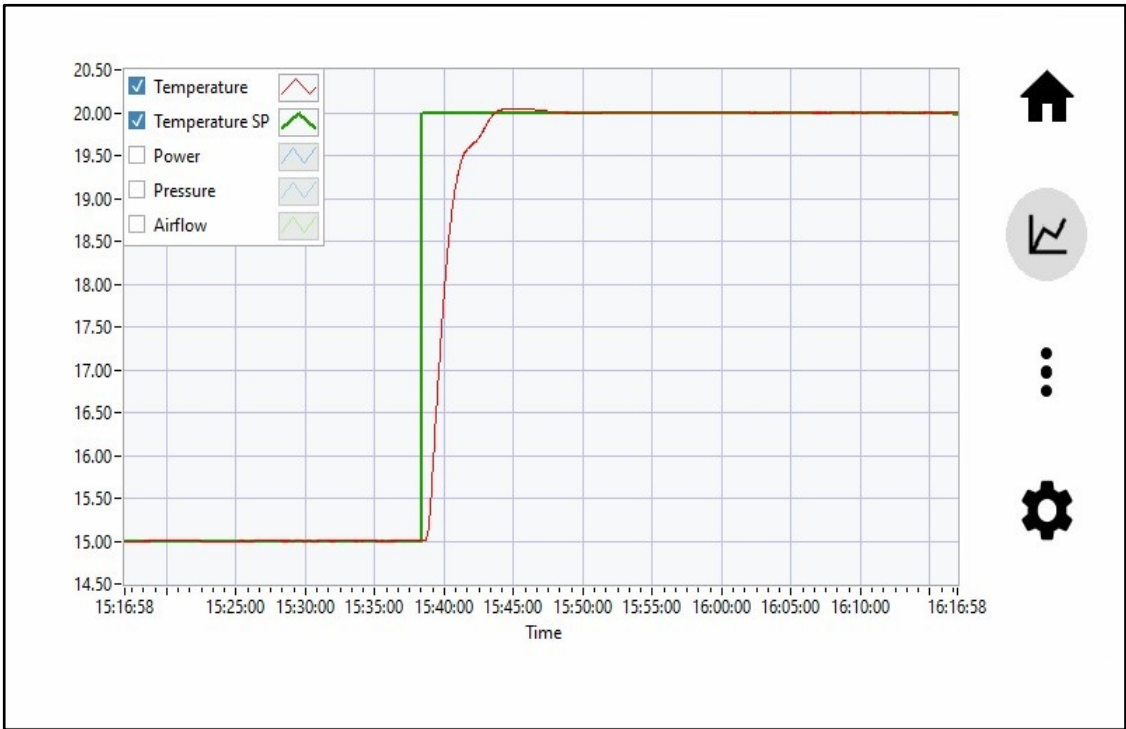
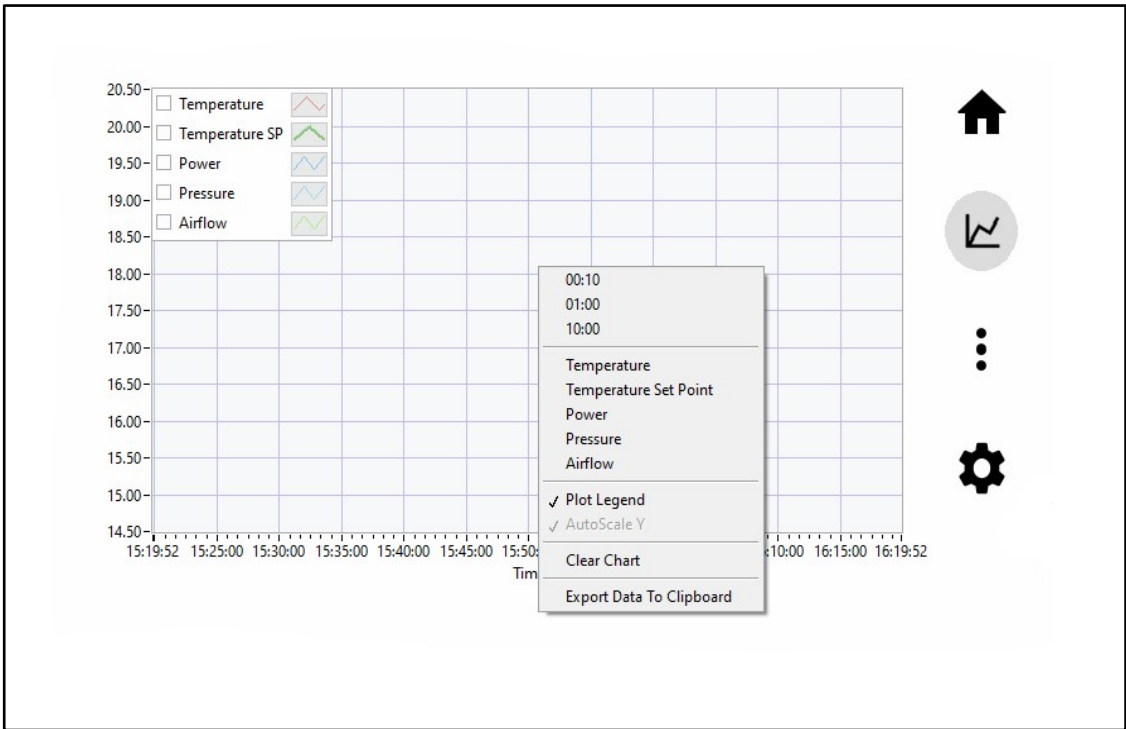
The FPG includes a pump to move air between its chamber and through external instrument. It can be toggled with a simple tap.

5.2.1.2 Change Set Point

The saturator set point can be adjusted by clicking the set point value to bring up the number pad shown below. The user then keys in the desired value and hits enter. The FPG will then cool or warm to this temperature, provided 'Control' is on.

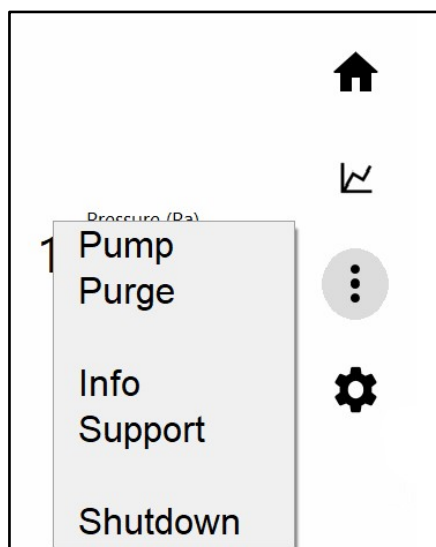


5.2.2 Graph Menu



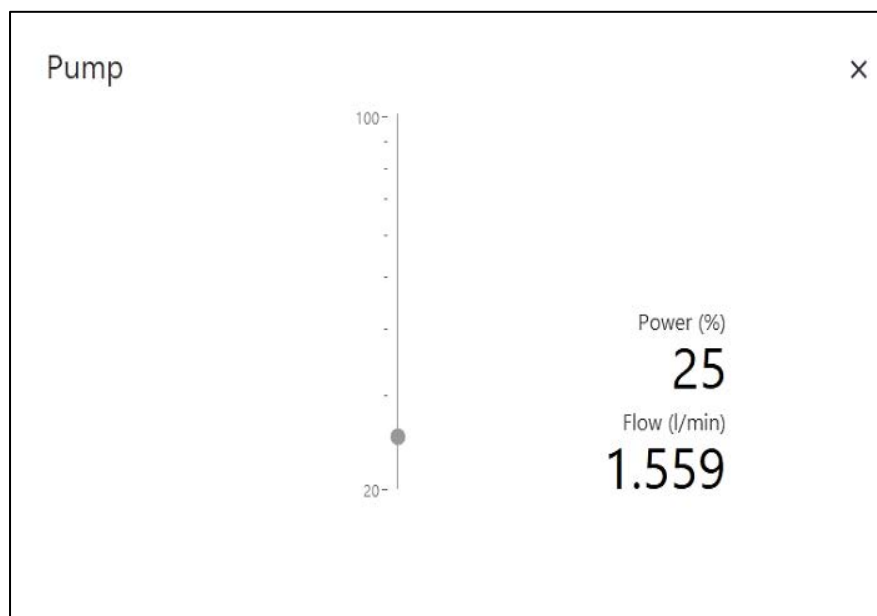
5.2.3 Navigation Menu

The FPG includes a navigation menu represented three vertical dots. From the navigation menu, the user can access the air flow pump settings, purge menu and system information or shut down the unit.



5.2.3.1 Air Flow Pump

The FPG incorporates a configurable gas pump, whose power can be varied to adjust flow rate between the FPG and external instruments.



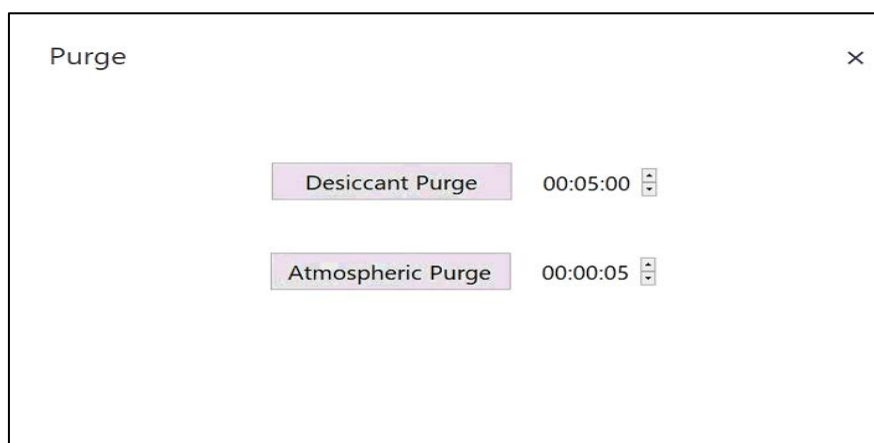
5.2.3.2 Purge

There are various circumstances when the gas circuit needs to be dried out and/or purged with fresh gas. These include:

- contamination in the system (perhaps due to dirty probes in the manifold);
- liquid water in the saturator (when saturator is at ambient temperature) due to gradually ingress of ambient humidity into the system due to leaks;
- preparing the FPG for transit.

The atmospheric purge includes a HEPA (99.9% at 0.3 micron) filter and will refill the gas circuit with fresh ambient air. The desiccant circuit will run the gas in the FPG through the desiccant cell and (with new desiccant) will dry down the circuit to about -40°Cfp.

On the 'Purge' menu, select the desired purge type, and appropriate duration. On pressing the button, the appropriate solenoid valve will open and the timer will count down. The user must stay on this Menu for the purge to take place, leaving the menu will pause the purge timer.

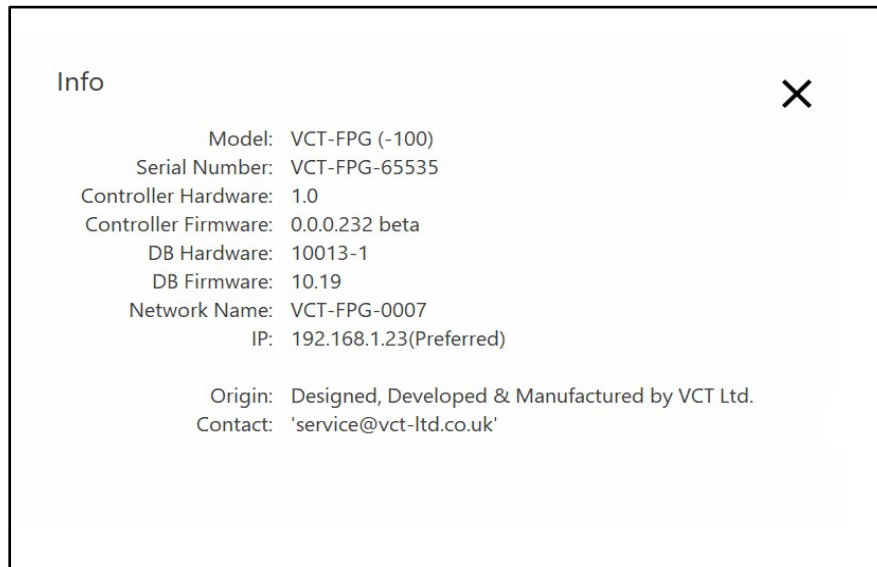


Purge Type	Duration
Desiccant Purge	00:05:00
Atmospheric Purge	00:00:05

Please note that the FPG pump needs to be on to drive flow through the FPG desiccant and atmospheric vents, however, there will be a net system pressure drop of circa 50 mbar with the pump on. To equalise pressure with ambient conditions, run a momentary atmospheric purge with the pump off.

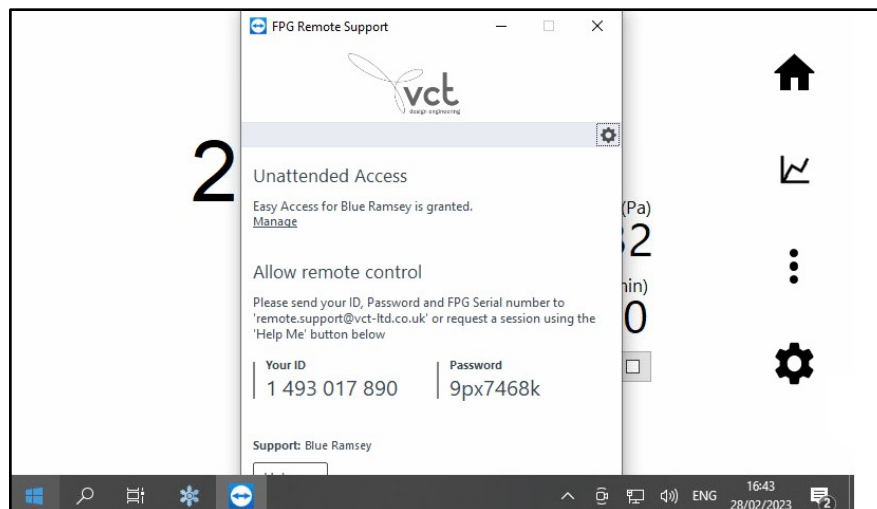
5.2.3.3 Info

System info can be accessed through the navigation menu. You can confirm your FPG model and serial number, both can also be found on the rear of the unit. The instruments current firmware versions can be seen here along with network information. Finally, the page includes contact details for the manufacturer; your supplier will provide you with the contact details needed for FPG service and support.



5.2.3.4 Support

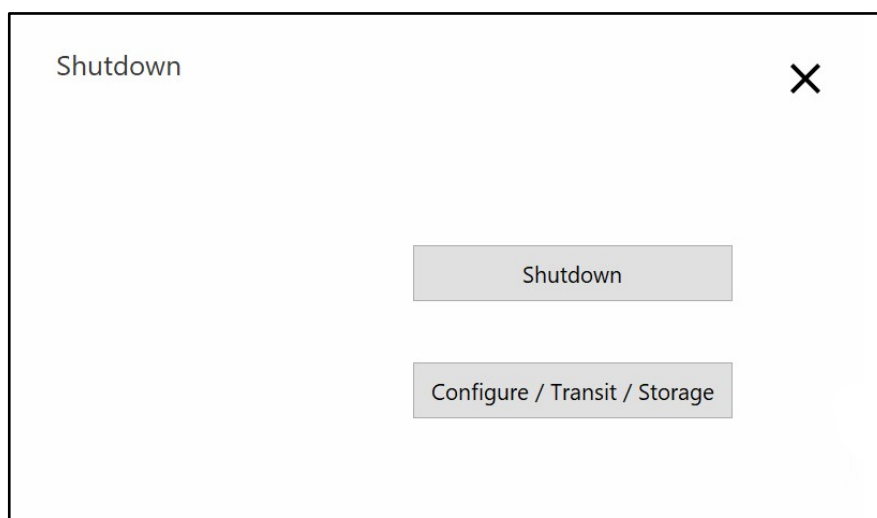
Should remote support/diagnostics be required, and an internet connection is available, Qrometric is happy to provide remote support via Teamviewer. Please see [section 9.2](#) for details on connecting the FPG to your network:



Contact support@qrometric.com if remote support is required.

5.2.3.5 Shut Down

The system can also be shut down through the navigation menu, this is the preferable method of shutting down the FPG as it greatly decreases the risk of mechanical damage. The front power button is also a reliable way of powering down the FPG. **DO NOT power down the FPG by using the rear switch, pulling out the power cable or switching off at the mains as this may damage your instrument.**

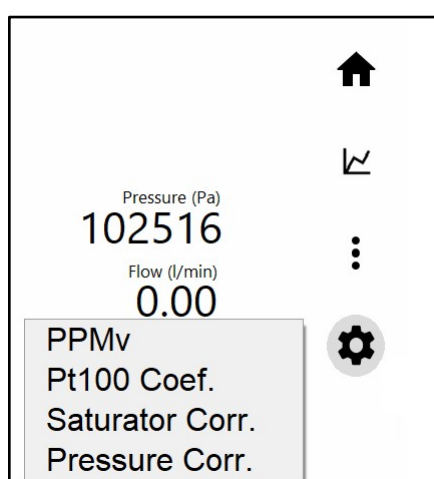


5.2.4 Settings Menu

The FPG settings menu can be accessed by selecting the cog icon on the right-hand side. From here, settings can be changed to display PPMv and Pt100 Coefficients and Saturator Corrections can be viewed and adjusted.

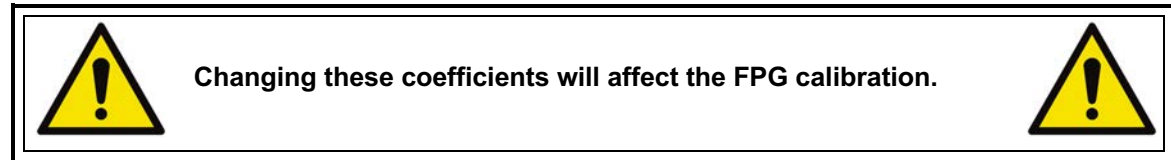
5.2.4.1 Parts per Million by Volume (PPMv) / Parts per Billion by Volume (PPBv)

If you require the water vapour ratios PPMv (wet or dry) or PPBv (wet or dry) to be displayed on the FPG home screen, you can choose to display this as shown below. Please note, this is a value calculated from the FPG saturator temperature and pressure measurements.



5.2.4.2 Pt100 CVD Characteristics

The saturator control is via a 1/10th DIN PT100. Associated CVD coefficients are entered during production.



Please note a future release will password protect this section. Qrometric has a record of the factory coefficients should they be inadvertently changed. Please contact support@qrometric.com in this circumstance.

Pt100 CVD Characteristics

R₀

100.0042

A

3.915E-3

B

-4.8888E-7

C

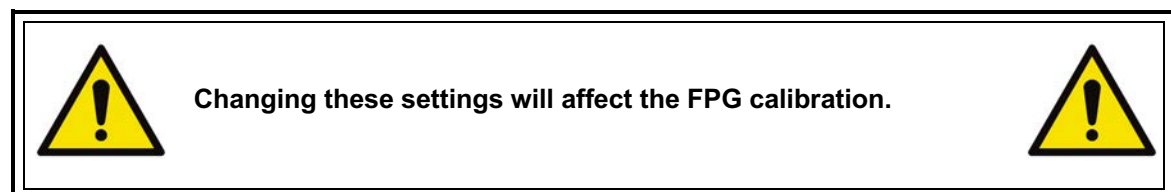
-5.0512E-12

Comment

SU62459-9
22/12/2022

5.2.4.3 Saturator Correction

Corrections to the Saturator Temperature determined from the calibration of FPG can be applied here.



✕

Pt100	Reference
0	0
0	0
0	0
0	0
0	0
0	0
0	0

Apply
✕

Uncorrected
21.289

Corrected
21.289

Comment

It is not recommended to apply corrections but instead record any drift in the calibration over time, to build up historical trend data.

5.2.4.4 Pressure Sensor Calibration

The internal pressure sensor can be calibrated by comparison to a reference measurement between the range 80...120 kPa. The internal pump must be off during calibration for optimal results. Any calibration corrections can be applied through this screen.

✕

Pressure Correction

Uncorrected	Reference
0	0
0	0
0	0
0	0
0	0
0	0
0	0

Apply:
✕

Uncorrected
102487

Corrected
102487

Comment

6 Set-Up and Operation: Best Practice

The FPG generates stable dew point conditions which can be used for calibrating humidity instrumentation that measure from ambient conditions down to trace levels. There are various different configurations in which it can be used. Each has advantages and disadvantages, so care should be taken in choosing the most suitable set-up.

6.1 Connections to the FPG

For the manifold and rear ports on the FPG-80 and FPG-100, VCR gaskets are employed. These are single-use consumables that should be replaced every time a connection is remade. Careful handling of the gaskets and VCR faces should be observed to ensure no finger marks/grease is transferred to them. The wearing of nitrile gloves is recommended.

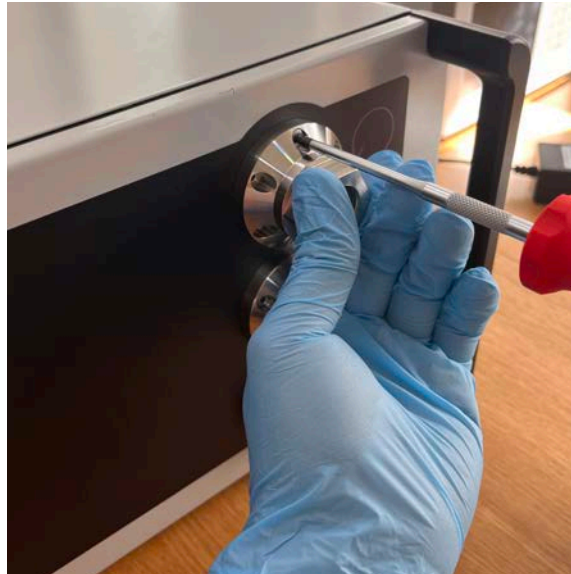
6.1.1 Manifold Caps and Adaptors

The FPG has three manifold ports. It is delivered with each of these closed with a manifold cap. The manifold caps can each be replaced with a probe adaptor with thread and insertion depth appropriate to the dew point sensor test instruments to be calibrated.

To remove a cap, unscrew each of the 6 mm x 3 mm hex screws and carefully remove the cap. Note the magnetic alignment plug and VCR gasket. Discard the VCR gasket, noting the impression on it that each VCR face has made.



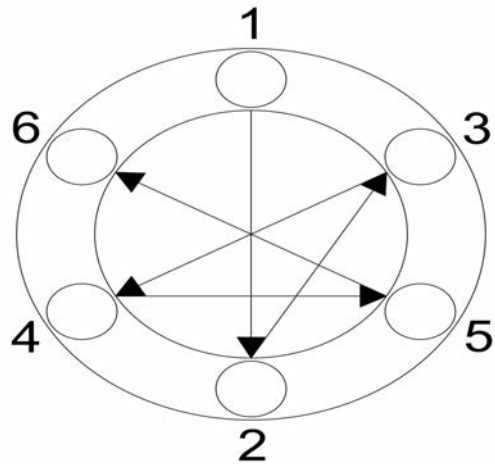
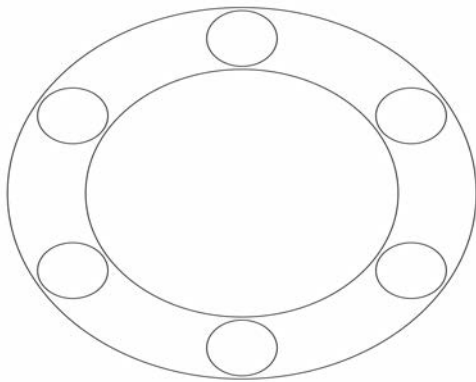
The image above shows what a mis-aligned gasket looks like after removal. The impression on the gasket should be a complete circle to make a proper seal. The following instructions describe how best to achieve that.



When fitting the VCR gasket in the manifold, it is important to press the manifold cap/probe adaptor against the gasket and FPG to ensure that the gasket sits properly.



To secure the manifold caps or probe adaptors, follow the below bolting patten to ensure uniform contact and seal on the VCR gasket.



The first step is to finger tight all the bolts, following the pattern as shown above.

After doing up all the bolts finger tight, set your torque driver to 1 Nm and tighten all the bolts using the same bolt pattern. Then tighten the bolts to 3 Nm, again repeating the same bolting pattern.

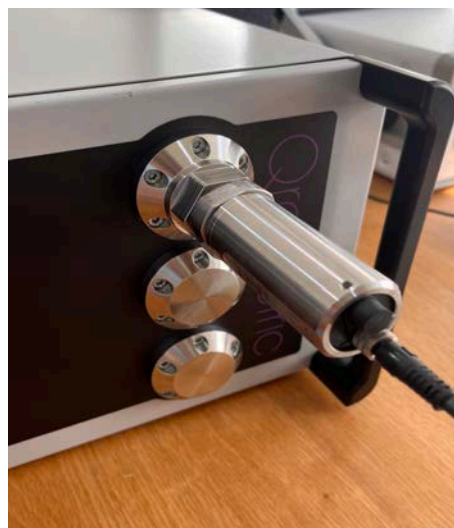
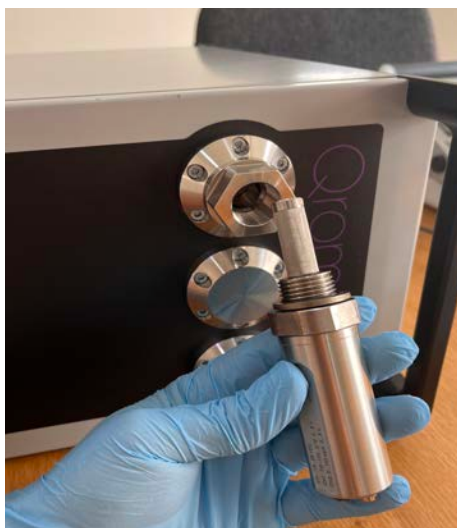
For good practice, we recommend doing a final check by applying a circular pass of the bolts to make sure that the bolts are at the required torque.

SUMMARY:

- Finger tight star pattern
- 1 Nm star pattern
- 3 Nm star pattern
- 3 Nm final check circular pass

6.1.2 Manifold Connections

Once the probe adaptor has been securely installed, the probe can be screwed in:





To prevent the probe adaptor from turning when the probe is being tightened, hold the adaptor in position with a 30 mm spanner on the hex section and tighten the probe accordingly.



6.1.3 Sample Loop Connections

On the rear of the FPG is the sample loop which during basic operation completes the recirculating gas circuit. On the FPG-100 and FPG-80 models, these ports are ¼" VCR face seal fittings. The loop can be removed and, in its place, attached adaptors and associated pipework to attach a sampling hygrometer, either to be calibrated itself, or to verify the FPG performance. It is essential that the loop is completed: **NOTE: THE FPG CANNOT CREATE A FLOW OF GAS WHICH IS VENTED TO ATMOSPHERE.**



To remove the loop, carefully loosen and remove the VCR nuts using a 3/8" spanner. Discard the VCR gasket on each face seal, noting the impression on each the fitting has made.

The FPG is supplied with a pair of either VCR- ¼" or 6 mm Swagelok tube fitting adaptors and two VCR Swagelok NI-4-VCR-2-ZCT-VS Side-Load gaskets – these are preferable to Retainer or Non-Retained types, which are easy to misalign.



Side Load VCR Gasket

Swagelok P/N NI-4-VCR-2-ZCT-VS

A good fitting is important for FPG operation and new gaskets should be used every time a new connection is established.

When fitting new gaskets, you must wear nitrile gloves to preserve the cleanliness of the contact surfaces:



New VCR fittings can be attached either directly to VCR fitting on rear of the FPG, or onto the Swagelok face seal VCR fitting itself:



To avoid system leaks, ensure that the gasket is fully pressed down into the right position:



Misaligned Side Load VCR gasket

Check that there is not a gasket on both the male and female VCR fittings:



Best practice when tightening VCR fittings can be found on page 19 of the following link:

<https://www.swagelok.com/downloads/webcatalogs/EN/MS-01-24.PDF>

Care must be taken in selection of sample tubes to connect the FPG to external instruments to reduce the risk of leaks and measurement errors. For the optimal performance, stainless steel should be used throughout, especially when operating below -50°Cfp. High-quality PTFE tubing, e.g. Polyflon FEP is a reasonable alternative above -50°Cfp.



With VCR-tube fitting adaptors attached, DO NOT stand the FPG on its rear bracket. This will damage the internal pipework and is not covered by warranty (see [section 3.7](#) for guidance on transporting the FPG).



6.1.4 External Temperature Probe

The rear of the FPG has a port on the rear for a 3 mm diameter x 100 mm long external temperature probe so that an independent measurement of saturator temperature can be made, and which itself can be used as a dew point reference value (see section 6.4 Example Set-Ups).

The optional Q-FPG-PRT2 is a 10th din Pt100 which is supplied with CVD coefficients and 17025 calibration. It is supplied with a 5-pin LEMO connector (FGG.1B.305.CLAD52) with wiring appropriate to plug into an MBW T12 temperature bridge or external temp port of any MBW chilled mirror hygrometer.

To insert the probe, the saturator temperature must be heated up above ambient dew point temperature. Then remove the rear cover:



Insert probe into aperture as far as it will go:



Reaffix cover with the cable extending below and plug into temperature bridge or external temperature port on reference hygrometer, being sure to enter the probe CVD coefficients in the appropriate interface:



For transportation, the probe can be stowed behind the rear cover:



6.2 Applications and Calibration Scenarios

The FPG's primary intended use is for the calibration of dew point sensors and hygrometers designed to measure dew point temperatures below 0°C.

The following describes examples of typical FPG applications and some issues to consider. For further advice on any given application, please contact QROMETRIC or your supplier.

6.2.1 Test Instrument Configuration

- Test instruments can be screwed into the front panel manifold into each of three configurable probe ports. Adaptors for different probe types are available for purchase.
- Up to three sampling hygrometers can be attached to the rear sample loop in parallel.
- Multiple sampling hygrometers can be attached to the rear sample loop in series.
- An external manifold can be attached to the rear sample loop.

For example set-ups, see [section 6.4](#).

6.2.2 Reference Values

Reference value can be determined in three different ways:

- Internal saturator temperature (control) probe.
- External saturator temperature probe (optional).
- External sampling hygrometer (e.g. chilled mirror hygrometer) (optional).

For a discussion on reference calibration and traceability, see [section 7.1](#).

You can use the FPG as the reference to calibrate several devices attached to the sample loop or use one external loop device as the reference to calibrate others.

Using an independent humidity reference is always preferred, however, is not always practical.

An independent reference measurement will always give the most reliable reference value and will indicate if there are any issues, leaks, or if there is a prolonged time needed for stabilisation. Bear in mind however, that the reference itself will require time to stabilise, and will add to the system volume and increase time for equilibrium to be reached (see [section 6.3.1](#)).

6.3 Set-Up: Considerations

6.3.1 System Qualification

As with any calibration system, it is important the user qualifies its performance to satisfy themselves of its performance. The FPG has undergone extensive testing and as long as the integrity of the external gas circuit is satisfactory, and the system has been purged been dried out and purged with ambient air, according to the instructions below, the generated condition will correspond to the saturator temperature within the uncertainties described in the specification and the system can be used without an external reference with confidence. However, this should be confirmed, either by the user with an external reference or by sending the FPG for calibration at regular intervals.

6.3.2 Measurement Range

The three models of the FPG reach different lowest set point values: -100°C, -80°C and -60°C. Be aware that the accuracies measured within these ranges also changes with accuracy of $\pm 0.1^\circ\text{C}$, $\pm 0.2^\circ\text{C}$ and $\pm 0.5^\circ\text{C}$ for -60...0°C, -80...-60°C and -100°C respectively (see [section 11](#)).

The highest attainable dew point value is determined by the dew point of the gas initially in the FPG gas circuit when the saturator is not cooling. The gas can be refreshed with new gas by running an atmospheric purge (see below). With fresh gas in the system, the maximum dew point attainable will be then be just below ambient dew point.

6.3.3 Volume of System

With only the sample loop completion U-loop in place, the internal gas volume of the FPG is about 80 ml. It should be noted when using devices attached to the external sample loop, the total volume of the gas circuit depends on the number and internal volume of the connected instruments and so will affect the time taken to reach equilibrium when set points are changed.

6.3.4 Stabilisation Time

Measurement of dry gases requires careful consideration of sampling components.

The drier the set point (i.e. the lower the dew point), the longer the system will take to reach equilibrium. The effect of moisture desorption from the internal surfaces of the gas circuit needs to be considered. For faster stabilisation time, the external loop sample tubes should be as short as possible and constructed from stainless steel. For best results, an independent measurement of the condition should be included, though this measurement itself will increase the gas circuit volume and the time to reach stability.

Further, it is important to factor the stabilisation time of the test hygrometers. Different dew point probes and their associated filters will take different times to come into equilibrium with the FPG manifold condition. With external sampling hygrometers, the desorption/adsorption of internal walls of the associated pipework needs to come into equilibrium as well as the instruments themselves. Make sure the test instrument measurements have stabilised before moving to a new calibration point.

NOTE: It is best practice to start with the lowest dew point condition and work upwards.

6.3.5 Gas Circuit Integrity

For optimal performance the FPG gas circuit needs to be completely sealed with no leaks.

At very low dew points, if there are connections – either on the external loop or the manifold – that are compromised, ambient humidity will ingress into the gas circuit and ice will build up on the saturator and eventually the adjacent pipework will become blocked.

In the event of such a blockage the pump will cut out and the FPG will indicate it needs to be dried out (see [section 5.2.3.2](#)).

When a new system configuration is set-up, the easiest way to test its integrity is to observe the decrease in pressure as the saturator is cooled to a low temperature.

The expected pressure drop in the system will depend on its total volume – which depends on what's attached to the sample loop. With the minimum system volume, i.e. with only the sample loop completion U-loop in place, and manifold caps, not adaptors, the pressure in the system – from when change from ambient temperature and pressure to -80°C – should drop by about 60 hPa. When held at this condition, **THE SYSTEM SHOULD MAINTAIN THIS PRESSURE**. If the pressure does not drop by an equivalent amount or starts to rise up once the saturator temperature stabilises, there is a leak. If it maintains the lower pressure, then the system can be considered gas tight.

If there are leaks, the FPG will continue to generate dew point conditions that correspond to the saturator temperature, there may, however, be an impact on the generated condition.

BASE HUMIDITY IN GAS CIRCUIT

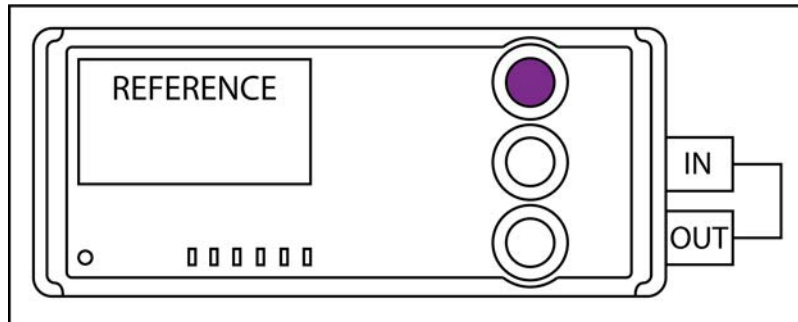
It is good practice to measure the base humidity in the gas circuit using a hygrometer connected to the external sample loop before and after a measurement run. To do this set the saturator temperature to 20°C. With the saturator at this condition, if the measured dew point is above 15°C, it is likely there has been a leak of ambient humidity into the system when the saturator was cooling, which has condensed onto the saturator. To dry this out, run the desiccant purge until the measured dew point is below ambient dew point conditions, then run an atmospheric purge to refresh the FPG gas circuit.

6.3.6 Sample Gas Flow

The FPG's integrated pump allows for sample gas to be flowed through the system. Generating flow through any system requires a pressure differential, the magnitude of which increases with FPG pump power. The differences in pressure between the saturator and the test instrument cause differences in the dew/frost point and hence and uncertainty in the measurement. This effect has been evaluated by placing pressure sensors in various positions around the gas circuit and determining the consequential uncertainty contribution. Further details of this can be found in [section 6.5](#).

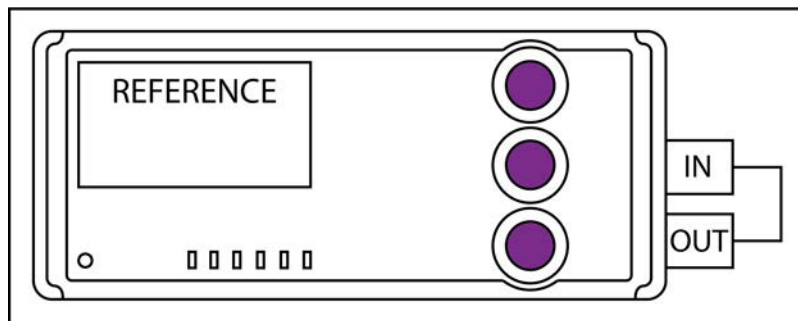
6.4 Example Set-Ups

6.4.1 FPG Stand-Alone: 1 x Dew Point Sensor in Manifold (FPG as Reference)



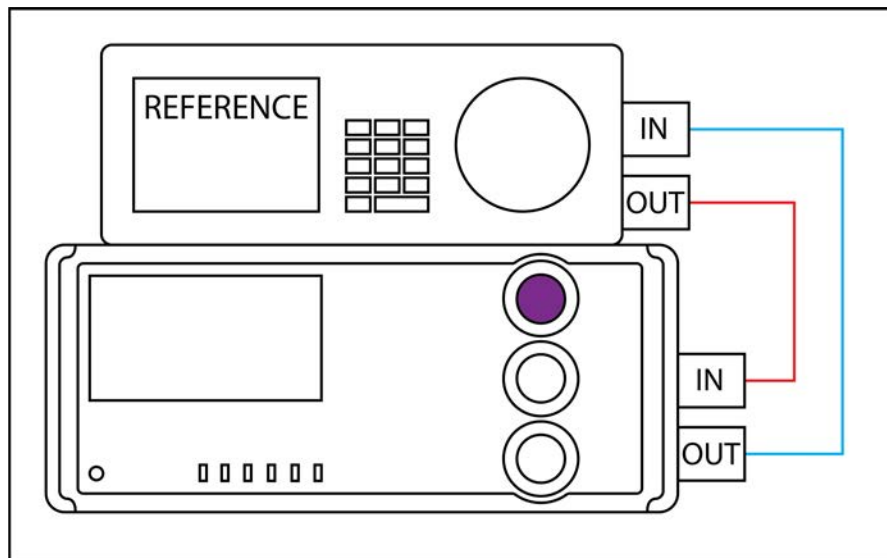
- **Advantages:** No external sample loop volume = fast stabilisation time, low uncertainty, easily transportable.
- **Disadvantages:** No independent verification of generated condition.
- **Optional:** Independent verification of saturator temperature using external PRT.

6.4.2 FPG Stand-Alone: 3 x Dew Point Sensor in Manifold (FPG as Reference)



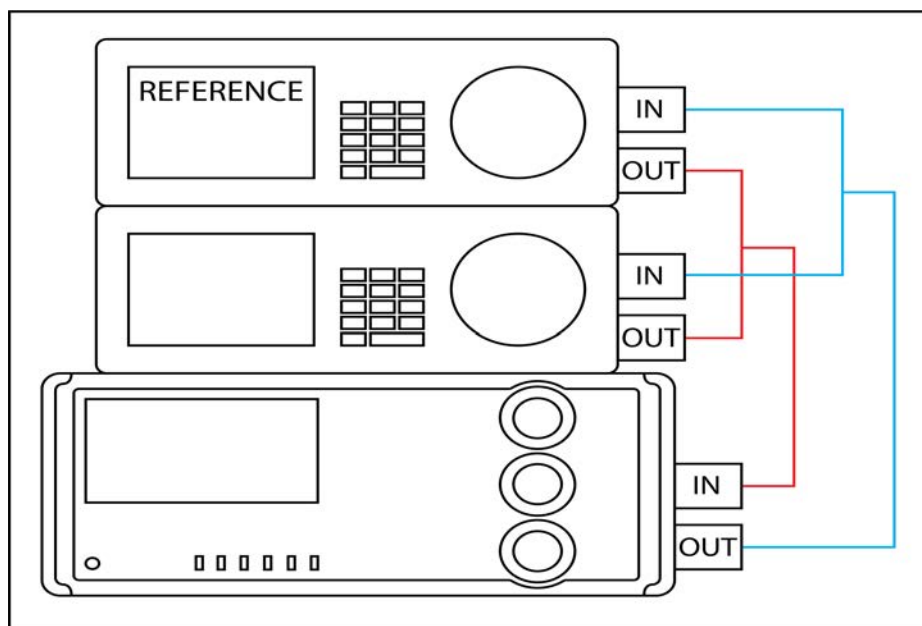
- **Advantages:** No external sample loop volume = fast stabilisation time, low uncertainty, easily transportable.
- **Disadvantages:** No independent verification of generated condition.
- **Optional:** Independent verification of saturator temperature using external PRT.

6.4.3 FPG: 1 x Dew Point Sensor in Manifold (External Reference on Sample Loop)



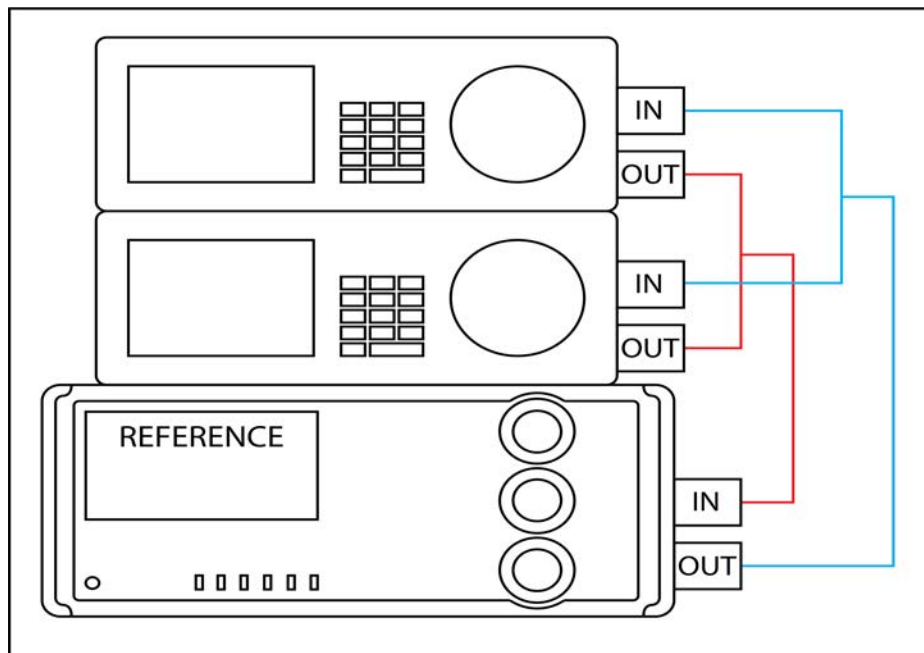
- **Advantages:** Relatively small sample loop volume, reasonable stabilisation time, low uncertainty, independent verification of dew point, no need to calibrate FPG.
- **Disadvantages:** More difficult to transport.
- **Optional:** Independent verification of saturator temperature using external PRT.
- **Considerations:** The difference in the pressure between saturator and sampling hygrometer (and its effect on dew point), though minimal, should be evaluated (see [section 6.5](#)).

6.4.4 FPG: No Sensors in Manifold, 2 x Hygrometers in Parallel on Sample Loop (One as Reference to the Other)



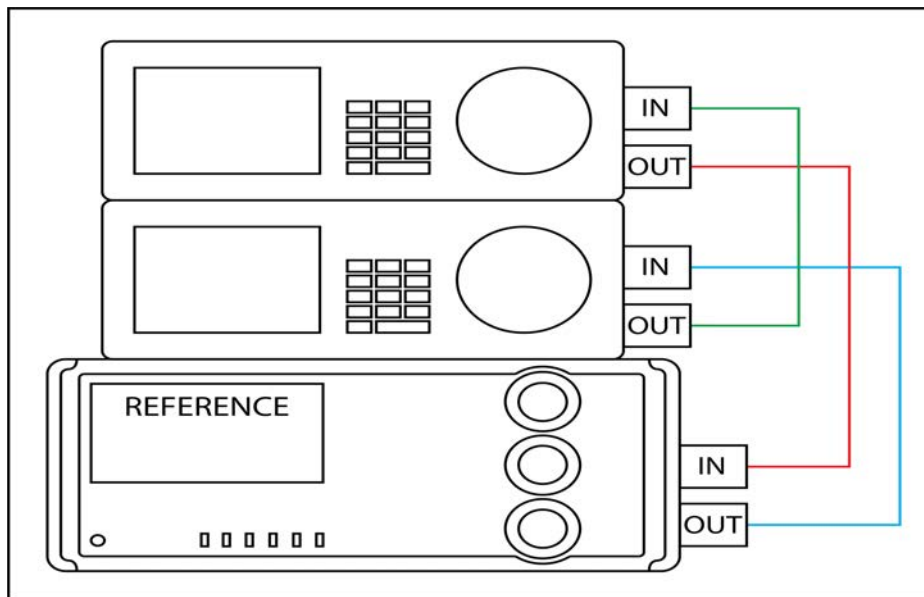
- **Advantages:** Low uncertainty, independent verification of dew point, no need to calibrate the FPG.
- **Disadvantages:** Higher pump power to drive larger flow means potential difference between generated and measured value (see [section 6.5](#)). Larger system volume means longer stabilisation time.
- **Optional:** Independent verification of saturator temperature using external PRT.
- **Considerations:** Differences between generated and measured values don't matter when one hygrometer is used as a reference to the other, and the pressures will be the same if pipe-work is kept at similar lengths.

6.4.5 FPG: No Sensors in Manifold, Two Sampling Hygrometers in Parallel on Sample Loop (FPG as Reference)



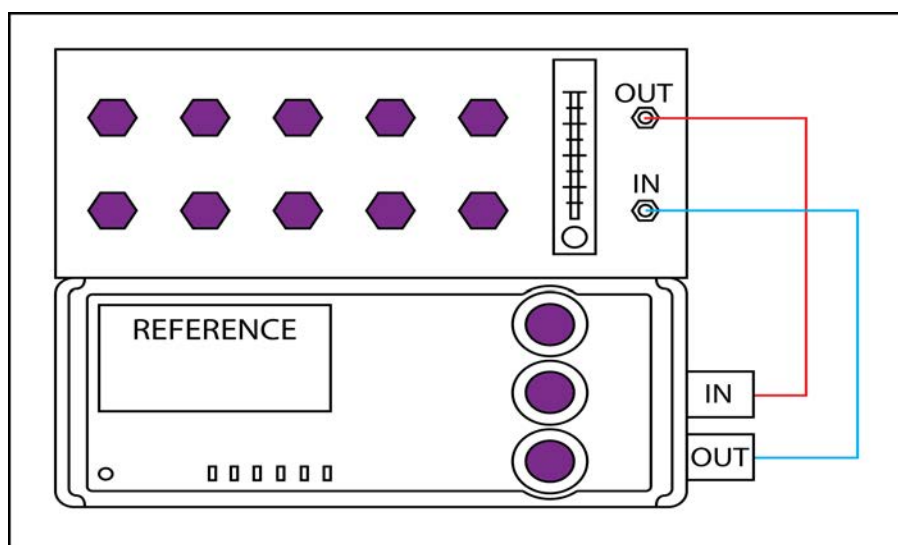
- **Advantages:** Multiple external hygrometers simultaneously.
- **Disadvantages:** Higher pump power to drive larger flow means potential difference between generated and measured value needs to be evaluated. Larger system volume means longer stabilisation time.
- **Optional:** Independent verification of saturator temperature using external PRT.
- **Considerations:** Difference in generated dew point due to pressure difference can be calculated out if pressure sensors are calibrated or factored into uncertainty calculations (see [section 6.5](#)).

6.4.6 FPG: No Sensors in Manifold, Two or More Sampling Hygrometers in Series on Sample Loop (FPG as Reference)



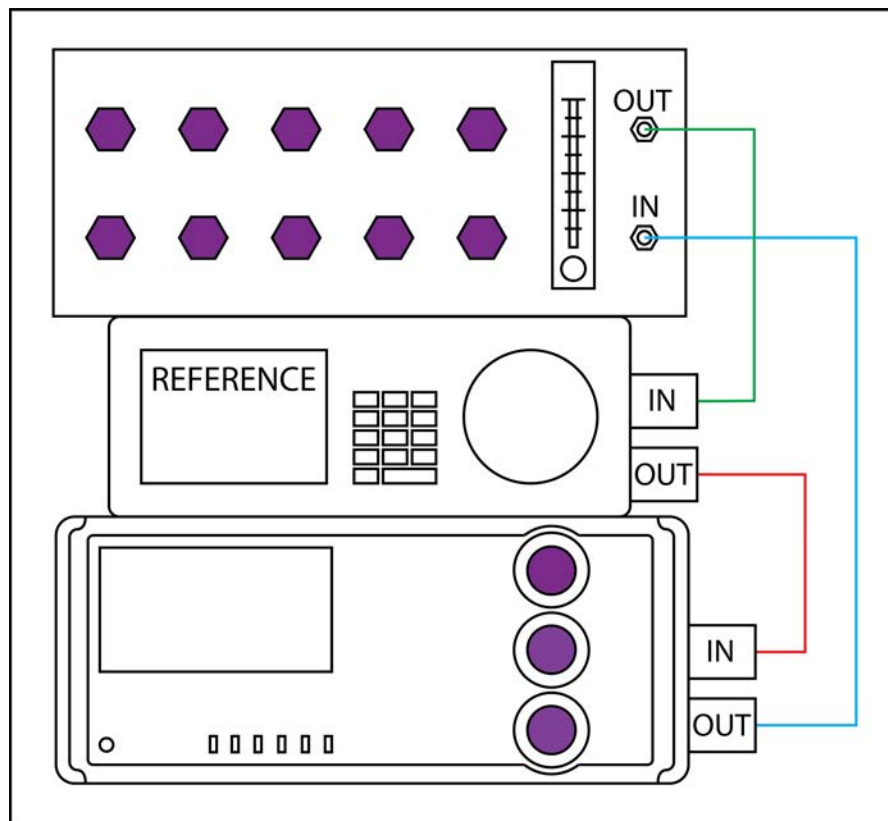
- **Advantages:** Multiple external hygrometers simultaneously. Series means pump power/flow rate can be kept relatively low.
- **Disadvantages:** Pressure drops across the system need to be evaluated. Much larger system volume means much longer stabilisation time.
- **Optional:** Independent verification of saturator temperature using external PRT.
- **Considerations:** Difference in generated dew point due to pressure difference can be calculated out if pressure sensors are calibrated or factored into uncertainty calculations (see [section 6.5](#)).

6.4.7 FPG: 3 x Dew Point Sensors in Manifold, External Manifold Fully Populated (FPG as Reference)



- **Advantages:** Multiple external hygrometers simultaneously. Series means pump power/flow rate can be kept relatively low.
- **Disadvantages:** Pressure drops across the system need to be evaluated. Much larger system volume means much longer stabilisation time. Any leaks in the any ports will impact the conditions experienced by probes downstream in the loop. No independent verification of generated condition.
- **Optional:** Independent verification of saturator temperature using external PRT.
- **Considerations:** Difference in generated dew point due to pressure difference can be calculated out if pressure sensors are calibrated or factored into uncertainty calculations (see [section 6.5](#)).

6.4.8 FPG – 3 x Dew Point Sensors in Manifold, External Manifold with up to 10 Dew Point Sensors (plus Additional [Reference] Hygrometer in Series)



- **Advantages:** Multiple external hygrometers simultaneously. Series means pump power/flow rate can be kept relatively low.
- **Disadvantages:** Pressure drops across the system need to be evaluated. Much larger system volume means much longer stabilisation time. Any leaks in the any ports will impact the conditions experienced by probes downstream in the loop.
- **Optional:** Independent verification of saturator temperature using external PRT.
- **Considerations:** Difference in generated dew point due to pressure difference can be calculated out if pressure sensors are calibrated or factored into uncertainty calculations (see [section 6.5](#)).

6.5 Example Calibration Procedure

6.5.1 Stand-Alone FPG Without External Reference

1. Set-up test instruments according to above.
2. Start with the FPG saturator temperature set to 20°C.
3. Run Desiccant Purge for 10 minutes.
4. Run Atmospheric Purge for 1 minute.
5. Set lowest value of saturator temperature and allow to stabilise.
6. Set profile in ascending steps.
7. Start and log data using MBW GeckoR2.
8. At end of run, set the FPG saturator temperature to 20°C.

6.5.2 FPG with External Reference

1. Set-up test instruments according to above.
2. Start with the FPG saturator temperature set to 20°C.
3. Measure dew point in system.
4. Run Desiccant Purge if system dew point is higher than ambient dew point conditions.
5. Run Atmospheric Purge for 1 minute.
6. Set lowest value of saturator temperature and allow to stabilise.
7. Set profile in ascending set points.
8. Start and log data using MBW GeckoR2.
9. At end of run, warm up FPG saturator temperature to 20°C.
10. Measure dew point in system.

If the dew point of the system at the end of the run (step 10) is higher than at the beginning (step 3) then there has been a leak and an ingress of ambient humidity into the system.

6.6 Uncertainty Framework

Table 1: FPG Uncertainty Framework for the Generated Condition at -60°C

FPG Uncertainty at -60 °C							
Uncertainty Contributions	Type	Value	Units	Sensitivity	Distribution	Divisor	Std. Un.
Temperature Effects							
FPG SatT control PRT calibration uncertainty	B	0.040	°C	1.00	Normal 2s	2.00	0.020
FPG SatT control PRT drift	B	0.005	°C	1.00	Rectangular √3	1.73	0.003
FPG SatT control PRT stem conduction	B	0.005	°C	1.00	Rectangular √3	1.73	0.003
FPG SatT control PRT self-heating and residual heat fluxes	B	0.005	°C	1.00	Rectangular √3	1.73	0.003
FPG SatT control uncorrected deviations	B	0.005	°C	1.00	Rectangular √3	1.73	0.003
FPG Display Resolution	B	0.0005	°C	1.00	Rectangular √3	1.73	0.000
FPG SatT Repeatability	A	0.004	°C	1.00	Normal 1s	1.00	0.004
Temperature Effects combined uncertainty							0.0212
Saturator Contributions:							
Saturation efficiency	B	0.0001	°C	1.00	Rectangular √3	1.73	0.000
Saturator contamination	A	0.001	°C	1.00	Normal 1s	1.00	0.001
Temperature gradient between saturator surface and PRT	A	0.01	°C	1.00	Normal 1s	1.00	0.010
Saturator Temperature homogeneity	A	0.01	°C	1.00	Normal 1s	1.00	0.010
Saturator Temperature stability	A	0.001	°C	1.00	Normal 1s	1.00	0.001
Saturator Contributions combined uncertainty							0.0142
Pressure Effects							
FPG internal pressure sensor calibration uncertainty	B	70	Pa	0.00006	Normal 1s	1.00	0.004
FPG internal pressure sensor drift	B	300	Pa	0.00006	Rectangular √3	1.73	0.010
FPG pressure resolution	B	0.5	Pa	0.0001	Rectangular √3	1.73	0.000
FPG internal pressure sensor repeatability	A	300	Pa	0.00006	Rectangular √3	1.73	0.010
Stability	B	150	Pa	0.00006	Normal 1s	1.00	0.009
Pressure differences between Saturator and Manifold	A	460	Pa	0.00008	Normal 1s	1.00	0.035
Pressure Effects combined uncertainty							0.0394
Flow Effects							
Flow dependency related to Pressure differentials	A	390	Pa	0.00008	Normal 1s	1.00	0.030
Flow Effects combined uncertainty							0.0299
Other Uncertainties							
Internal sorption/desorption/leaks effects	B	0.5	Pa	0.0001	Rectangular √3	1.73	0.00003
Flow Effects combined uncertainty							0.0000
FPG combined uncertainty							0.06
FPG expanded uncertainty							95% confidence 0.11

Table 2: Uncertainty Framework for Calibrating an FPG Using an External Mirror at -60°C

FPG Uncertainty Framework - with an external reference at -60 °C							
Uncertainty Contributions	Type	Value	Units	Sensitivity	Distribution	Divisor	Std. Un.
Reference Mirror							
Calibration Uncertainty	A	0.20	°C	1.00	Normal 2s	2.00	0.100
Drift	B	0.02	°C	1.00	Rectangular √3	1.73	0.012
Contamination	B	0.01	°C	1.00	Rectangular √3	1.73	0.004
Temp Gradients across mirror	B	0.01	°C	1.00	Rectangular √3	1.73	0.006
Resolution	B	0.0005	°C	1.00	Rectangular √3	1.73	0.000
Repeatability	B	0.05	°C	1.00	Normal 1s	1.00	0.050
Stability	B	0.01	°C	1.00	Rectangular √3	1.73	0.006
Mirror combined uncertainty							0.11
Mirror expanded uncertainty							95% confidence 0.23
FPG							
FPG Display Resolution	B	0.0005	°C	1.00	Rectangular √3	1.73	0.000
FPG SatT Repeatability	A	0.004	°C	1.00	Normal 1s	1.00	0.004
Saturator contamination	A	0.001	°C	1.00	Normal 1s	1.00	0.001
Saturator Temperature stability	A	0.001	°C	1.00	Normal 1s	1.00	0.001
Pressure differences between Saturator and Mirror	A	460	Pa	0.00008	Normal 1s	1.00	0.035
Flow dependency	A	390	Pa	0.00000	Normal 1s	1.00	0.000
Internal leaks and desorption effects	B	0.5	Pa	0.0001	Rectangular √3	1.73	0.000
FPG combined uncertainty							0.04
FPG expanded uncertainty							95% confidence 0.07
OVERALL Expanded Uncertainty							95% confidence 0.30

Table 3: Uncertainty Framework for Calibrating an External Mirror Against a Second External Mirror at -75°C

FPG Uncertainty Framework - calibrating by comparison one mirror to another in parallel at -75°C							
Uncertainty Contributions	Type	Value	Units	Sensitivity	Distribution	Divisor	Std. Un.
Ref Mirror							
Calibration Uncertainty	A	0.05	°C	1.00	Normal 2s	2.00	0.025
Drift	B	0.02	°C	1.00	Rectangular $\sqrt{3}$	1.73	0.012
Contamination	B	0.01	°C	1.00	Rectangular $\sqrt{3}$	1.73	0.004
Temp Gradients across mirror	B	0.01	°C	1.00	Rectangular $\sqrt{3}$	1.73	0.006
Resolution	B	0.0005	°C	1.00	Rectangular $\sqrt{3}$	1.73	0.000
Repeatability	B	0.05	°C	1.00	Normal 1s	1.00	0.050
Stability	B	0.01	°C	1.00	Rectangular $\sqrt{3}$	1.73	0.006
Mirror combined uncertainty							0.0578
Mirror expanded uncertainty						95% confidence	0.1156
IUT Mirror							
Resolution	B	0.0005	°C	1.00	Rectangular $\sqrt{3}$	1.73	0.000
Stability	B	0.01	°C	1.00	Rectangular $\sqrt{3}$	1.73	0.006
Pressure differences between mirrors	B		Pa		Rectangular $\sqrt{3}$	1.73	0.000
Internal leaks and desorption effects	B	0.5	Pa	0.0001	Rectangular $\sqrt{3}$	1.73	0.000
IUT combined uncertainty							0.0058
IUT expanded uncertainty						95% confidence	0.0116
OVERALL Expanded Uncertainty						95% confidence	0.13

Uncertainty frameworks for various FPG configurations have been built and each contribution quantified.

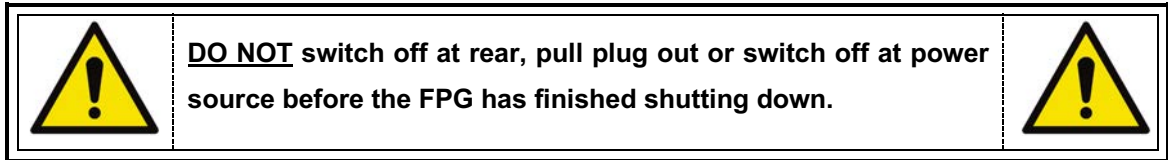
As dew/frost point is pressure dependent, differences in pressure between the saturator and the test point cause differences in the generated dew/frost point. To evaluate the magnitude of this effect and the consequential uncertainty contribution, calibrated pressure sensors were fitted to the front manifold, rear panel and external loop. Pressure differences were measured, and the effect converted to a dew point within the uncertainty budget using the sensitivity conversion. In saturator-based humidity generation systems, the effect of surface contamination can be to modify the partial water vapour pressure at the saturator surface, and therefore within the sample loop. Possible contaminants include salts or hydrocarbons, either present in the sample gas, or transferred from contaminated instruments under test. This effect has not yet been fully evaluated with the FPG, but saturator contamination effects are the subject of a separate study by Bell, Stevens et al. (1992 Meas. Sci. Technol. 3 943). Based on a 4-wire PRT technology, standard contributions for PRT drift, stem conduction, self-heating and repeatability to the uncertainty budget are shown.

If the user wishes to calibrate a probe within the FPG manifold, **Table 1** shows the estimated uncertainty on the condition being generated within the manifold ports.

The FPG itself is calibrated by comparison to a reference dew point mirror and the uncertainty contributions for this procedure can be seen in **Table 2**. As is commonly the case, the reference itself provides a larger contribution than the under test FPG (see [section 6.4](#)). The FPG can also be used to calibrate one external instrument against another with the uncertainty framework for this shown in **Table 3**.

6.7 Switching Off the FPG

It is important that the correct shut down procedures are followed to ensure no damage occurs to the instrument. The FPG can be shut down through the settings menu or via the POWER button on the front panel. **DO NOT pull plug out or switch off at power source while the FPG is running or shutting down.**



7 Calibration & Maintenance

7.1 Calibration

A factory calibration by comparison with a chilled mirror hygrometer is carried out on all new instruments along with a certificate reflecting this.

The standard procedure for calibrating the FPG is detailed on the certificate. A pump power of 30% is used.

The external Pt-100 provided is calibrated specifically to your instrument with its CVD coefficients inputted. Changing the external probe used will require these coefficients to be changed, losing any calibration history.

Your FPG can then be periodically calibrated at an accredited lab providing you with traceability and tracking of your FPG's long-term performance.

The user is also encouraged to carry out measurement cross checks periodically to ensure confidence in their measurements.

It is possible to adjust the FPG's saturator temperature coefficients and apply corrections to the saturator. This is not recommended. The factory calibration is based on coefficients determined during production. Please contact support@qrometric.com should original values be required.

See [section 5.2.4.2](#) for more details.

7.2 Desiccant Cell

To replace the desiccant, please follow the procedure set out below.

First, locate the desiccant cell cover on the underside of the FPG (see images below). Using a 2 mm Allen key, remove the two bolts holding the cover down:



Now the cover is removed, you can pull the desiccant cell out from its slot:



To remove the lid of the desiccant cell, use a thin narrow flat head screwdriver, push in the black locating tabs whilst pulling the lid at the same time.

The remove the layer of cotton that keeps the desiccant granules in place and pour them out. When refilling the desiccant cell use the line as a guide to fill up to.

Before putting the desiccant cell back into its slot on the underside of the FPG, make sure that the lid is securely in place and is pressed up against the cotton.

7.3 Contamination

Contaminants within the sample tubes and their connections can cause errors in measurements and calibrations. To prevent dust and other contaminants entering the system, ensure the gas inlets and outlets on both the FPG and attached instrument are plugged when not in use or that the sample U-loop is attached.

There is further possibility that contamination is introduced into the system by dirty probes or hygrometers. This may manifest in a mirror fouling on an external dew point mirror which would result in a steadily increasing measurement, that would be reset by mirror cleaning.

To purge the system with fresh gas follow the instructions in [section 6.3.6](#).

In extreme cases of contamination, the desiccant can be replaced by granular activated carbon (GAC) and a long purge using the desiccant purge circuit performed.

7.4 Exterior Cleaning

7.4.1 Front Panel

The front panel of the FPG can be wiped clean with mild cleaning fluid and a cloth. The LCD screen can be cleaned with glass cleaner and a cloth to remove fingerprints and other marks. Cleaning is best done with the instrument powered down as marks on the screen often become more visible.

7.4.2 Rear Panel

The rear panel of the FPG does not generally require cleaning. The fan grills, however, should have any dust or debris removed to ensure air flow is maintained. Compressed air or a vacuum cleaner may be appropriate.

7.4.3 Side and Top Panels

The left side panel includes fan grills so should be cleared of dust and debris periodically, as above. Otherwise, the user can use mild chemicals and a cloth to remove any unwanted stains and marks from the sides and top of the FPG.

8 Installation

8.1 Facility Requirements

8.1.1 Environmental

The FPG is a laboratory grade instrument and works best when external conditions are stable and within a particular range. If possible, it is best to operate your FPG under the following conditions:

- Operating Temperature 15°C to 35°C
- Operating Humidity 5% to 95%RH non-condensing

8.1.2 Power Source

The universal power supply cable required by the FPG is included in your order as standard. Your facility itself must be able to supply the FPG with 100...250 VAC at 50/60 Hz. **The power source MUST be earthed.**

8.1.3 Instrument Cooling

Ensure the FPG has at least 10 mm clearance underneath and at least 100 mm at the rear and side to allow sufficient air flow and that there is nothing obvious blocking the fan grills such as dust and debris.

8.2 Preparation for Use

Prior to use, ensure the FPG is safely and securely bench mounted before connecting any of its external cables or tubing.

Before proceeding with, ensure that:

1. The unit is placed level, horizontally and is stable on its four rubber feet.
2. The FPG has at least 10 mm clearance underneath and at least 100 mm at the rear and side to allow sufficient air flow.
3. Access to the electrical mains connector at the instrument rear is adequate.

The FPG itself is W450 mm x D300 mm x H180 mm and an area of at least W480 mm x D330 mm x H200 mm is available to allow sufficient air flow and access to the instrument.

8.3 Preparation for Transit

Care should be taken when prepping the FPG for transit.

1. Set the temperature to 20°C and allow to stabilise.
2. Once at ambient remove no caps and sample loop and run atmospheric purge for five minutes to remove any condensation from the saturator.
3. With sample loop in place, run a five-minute desiccant purge to ensure the unit is shipped dry.
4. Follow the shut down procedure outlined above.

Other considerations:

- Ensure sample loop is connected to prevent excess moisture or contamination entering the gas pathway.
- Be careful that the external PRT wire is not bending at a sharp angle anywhere along the cable.

If the FPG needs to be shipped, ensure it is in its original packaging. The soft case is suitable for hand carry only. For air or road shipping, a sturdy cardboard box should be used with at least 100 mm of packing material. A hard transit case is also available for purchase with your FPG.



With VCR-tube fitting adaptors attached, **DO NOT** stand the FPG on its rear bracket. This will damage the internal pipework and is **NOT** covered by warranty (see [section 3.7](#)).



9 Remote Communication

9.1 Communication with the FPG

The FPG can be remotely controlled, and its information accessed using a series of API commands which ultimately allows integration with third-party logging and calibration software or user created software using a series of commands which can be found below.

The FPG must be connected to a local network via the Ethernet port at the rear of the unit or an optional Wi-Fi adaptor. Your controlling device (most likely a PC) needs to be on the same Local Area Network (LAN) as your FPG.

Off-site connections are possible from external networks using TeamViewer.

9.2 Connecting to Network

9.2.1 Hardwired (Ethernet)

Simply plug in the FPG to your network via a RJ45 patch (standard straight through) network cable. The FPG's IP address is displayed in the Info page within the Navigation Menu.

9.2.2 Wi-Fi

Most Wi-Fi adaptors are compatible with the FPG, though their configuration is beyond the scope of this document. Once configured, the FPG's IP address is displayed in the Info page within the Navigation Menu.

9.2.3 DHCP vs Fixed IP

By default the FPG network adaptor is configured to automatically obtain an IP address via DHCP.

An interface for configuring a fixed IP will be included in a future firmware update.

Please contact support@qrometric.com if this is required immediately and a work around will be implemented for you.

9.2.4 Direct Connection to PC

Using a fixed IP address, it is possible to create a direct connection to the Ethernet port of a PC/laptop, by creating an independent LAN. The configuration of this is beyond the scope of this document. For assistance in this regard, please contact support@qrometric.com.

9.3 API Commands

API Commands are sent and received to the FPG IP address via port 6341.

This section explains API commands with examples as well as including a full list of possible commands. Anything that can be accessed or performed using the touchscreen can also be sent as a command and vice versa. They can be executed via either a numeric, short or long form, for example,

19

SPR

Saturator Power

all execute the same command.

Multiple commands can be executed at once using commas to separate, for example,

24,26,27

will return a string x,y,z, where x,y,z are the responses for their respective commands, 24,26,27.

9.3.1 Read Only Commands

Commands that simply request information, queries, only read data from the FPG and will not write to it. They are identified by an R in the table below.

9.3.1.1 Digital Response: 1 or 0

If simply checking a status (such as whether Control is on/off) a response of 1 or 0 will be returned.

For example,

STC

asks for the status of the Saturator Temperature Control. Returning a value of **1** means that Control is set to on while **0** means it is off.

The following table is useful as a quick guide:

Returned Value	Meaning
1	Yes or On
0	No or Off

9.3.1.2 Numerical Responses

Formats of numerical responses will vary, full detail can be found in the command table. The FPG will never send the units of a given value so the user must assume units based on their request and the table to follow.

For example,

STP

requests the saturator temperature and may return a value of **-15.348**. The user must then make the educated assumption that the units are °C or use the API reference table.

9.3.1.3 Text Responses

Some queries will return a string of text. This may include letters, numbers and symbols.

For example,

CHV

might return a string of letters, numbers and symbols such as **PA14TK1n**, this is the controller hardware version.

9.3.2 Read/Write Commands

Some read commands can become write commands provided that a variable is provided.

For example,

STS

will return the saturator temperature setpoint. It can be changed into a write command by simply adding the desired new value:

STS=20.0

which will change the setpoint to 20.0°C.

9.3.3 Write Commands

Currently, there is only one command that is write only. It is shown below:

SHD

It is used to simply shut down the FPG so, understandably, has no read functionality.

9.3.4 Full Command List

Numeric	Short Form	Long Form	Read/Write	Comment
01	ID	Identity	R	Returns: Model, Serial Number, Manufacturer
02	GEN	General	R	Returns: Saturator Temperature, Saturator Control, Saturator Setpoint, Pressure, Air Flow, Errors and Warnings
03	INF	Information	R	Returns: Model, Serial Number, Device Network Name, Driverboard Serial Number, Errors and Warnings

Numeric	Short Form	Long Form	Read/Write	Type	Format	Example	Units
11	STP	Saturator Temperature	R	DBL	%.3f	-15.348	°C
13	STC	Saturator Temperature Control	R/W	INT		1 (0/1)	
14	STS	Saturator Temperature Setpoint	R/W	DBL	%.2f	-20.00 (-100 to 20)	°C
19	SPR	Saturator Power	R	DBL	%.2f	-45.92	%

21	PPR	Pump Power	R/W	DBL	%.0f	25 (20 – 100)	%
22	PCT	Pump Control	R/W	INT		1 (1/0)	
24	AFL	Air Flow	R	DBL	%.2f	1.35	l/min
26	PRS	Pressure	R	DBL	%.0f	93791	Pa
27	PTP	Pressure Temperature	R	DBL	%.2f	25.38	°C

31	DTS	Date and Time Stamp	R	String	Y-m-d H:M:S	2021-10-18 11:10:30	
32	DCC	Desiccant Cell Condition	R	INT		1 (0/1, 1=OK)	
35	TPU	Temperature Units	R	String	2 chr		°C

41	DHV	Driver board Hardware version	R	String		5.1	
42	DFV	Driver board Firmware version	R	String		8.4	
43	CHV	Controller Hardware version	R	String		PA14TK1n	
44	CFV	Controller Firmware version	R	String		1.0.0.75	
45	DSN	Driver board Serial Number	R	String		0003	
46	DNN	Device Network Name	R	String		FPG-0003	
47	MDL	Model	R	String		FPG(-100)	
48	IDN	Serial Number	R	String		0003	

90	ERR	Errors & Warnings	R	String	Err1;Err2;Err3		
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101	SHD	Shut Down	W				
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112	ABT	About	R	String			
-----	-----	-------	---	--------	--	--	--

	?	Help	R	String			
--	---	------	---	--------	--	--	--

9.4 Third-Party Control Software

9.4.1 Calibry

QROMETRIC has worked with Whitestone Technology to create a full integration with their testing and calibration laboratory management software, Calibry. Full automated calibration procedures using the FPG, including automated uncertainty calculation and certificate generation, are easily performed. The use of Calibry and the FPG is documented in a separate user manual available on request from support@qrometric.com.

The full Calibry suite is a cloud based and available as a 'software-as-a-service' subscription.

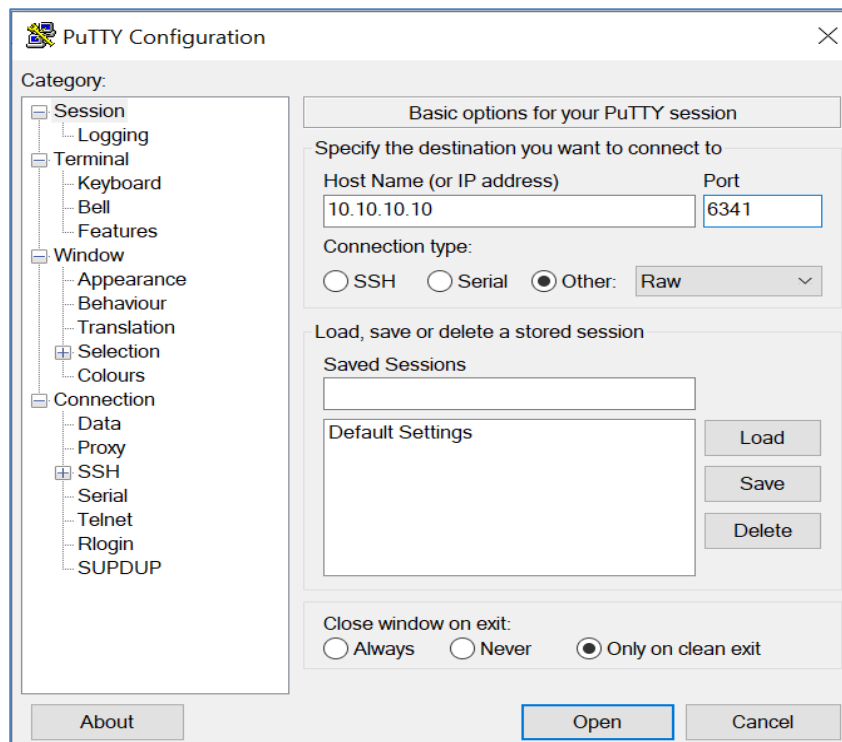
There is a stand-alone version, which just works with the FPG, with preconfigured calibration procedures, known as Calibry Lab-in-a-Box.

For further details please contact info@qrometric.com.

9.4.2 Command Line Interfaces – PuTTY

Command line interfaces such as PuTTY can also be used to send text based commands to the FPG. Enter the FPG's IP address, found under 'Info' and enter Port 6341. Click 'Open' and PuTTY's command line interface will then open. Connection needs to be of type Raw.

[Download PuTTY: latest release \(0.78\) \(greenend.org.uk\)](http://greenend.org.uk)



9.4.3 TeamViewer

If the LAN connection is on the Internet, the FPG interface can be accessed remotely via TeamViewer (separate license required) to remotely control the FPG. The TeamViewer ID and password are displayed in the 'Support' section of the interface (see [section 5.2.3.4](#)), TeamViewer can also be used on an internal LAN via the local IP address.

9.4.4 MBW GeckoR2

FPG works with MBW GeckoR2 software which can be downloaded from:

https://www.process-insights.com/download/GeckoR2_Release_0-9-7-3198_2022-03-23.zip

Though it is not a supported product, there is a special configuration file required to enable the FPG communication which is available on request from support@grometric.com.

10 Error Messages

11 Specifications

Specifications:

MODEL	RANGE	PRECISION
FPG-60 FPG-80 FPG-100	-60...5°C -80...5°C -100...5°C maximum generated dew point is dependent on the atmospheric dew point	±0.1...0.05°C ±0.2...0.05°C ±0.5...0.05°C
Sample Flow Rate System Pressure	0.5...15 LPM 800...1200 mbar	
Generator type	dew/frost point, condensation saturator, closed-loop	
Stabilisation time	20 minutes, 20°C set point change	
Dry down time	45 minutes, ambient to -80°C	
DP Probe adaptor	316 Stainless steel, Nitrile O rings, 3x FPG-PA1 included	
DP Probe thread	G ½" standard, other options as below	
Sample loop connections	FPG-60 Swagelok® 6 mm FPG-80/100 Swagelok® VCR	
User interface	7" Touchscreen LED	
Monitor interface	HDMI	
Instrument interface	USB	
Power	100...250 VAC 50/60 Hz	
Case Material	Aluminium, powder coated	
FPG-60/80/100 In box (with soft bag)	Dimensions W450 mm x D300 mm x H180 mm W580 mm x D580 mm x H530 mm	Weight 22 kg 24 kg

We (QROMETRIC) reserve the right to change design or technical data without notice.

12 Ordering Information

ORDERING INFORMATION		
Order Code:	FPG Models:	
Q-FPG-60	FPG Transportable dew/frost point calibrator -60...5°C	
Q-FPG-80	FPG Transportable dew/frost point calibrator -80...5°C	
Q-FPG-100	FPG Transportable dew/frost point calibrator -100...5°C	
	Dew point probe adaptors (Others available on request)	Recommended probe length range (including thread)
FPG-PA0	Probe port cap	n/a
FPG-PA1	G 1/2" thread (standard)	Up to 50 mm
FPG-PA2	5/8" UNF thread	Up to 50 mm
FPG-PA3	3/4" UNF thread	50 mm to 70 mm
FPG-PA4	NPT 1/2" thread	Up to 50 mm
FPG-PA5	M14 x 1.25 mm pitch thread	50 mm to 80 mm
FPG-PA6	G 1/2" thread (long)	50 mm to 70 mm
	Options and Accessories	
Q-FPG-TB	Soft padded transport bag	
Q-FPG-TC	Transit case, suitable for air freight	
Q-FPG-PRT2	Saturator second PRT, including Lemo connector and ISO17025 calibration	
Q-FPG-FS-TCAL	Factory service and recalibration, 5 points (includes 12-month warranty extension)	
Q-FPG-DC	Desiccant cell	
	Consumables	
Q-NI-4-VCR-2-ZCT-VS	Rear VCR gasket (pack of 30)	
Q-NI-4-VCR-2-ZC-VS	Rear VCR gasket (single)	
Q-SS-12-VCR-2-VS	Front manifold gasket	
Q-SS-4-WVCR-6-6Mo	Rear VCR -> 6 mm Swagelok® adaptor	
Q-SS-4-WVCR-6-400	Rear VCR -> 1/4" Swagelok® adaptor	