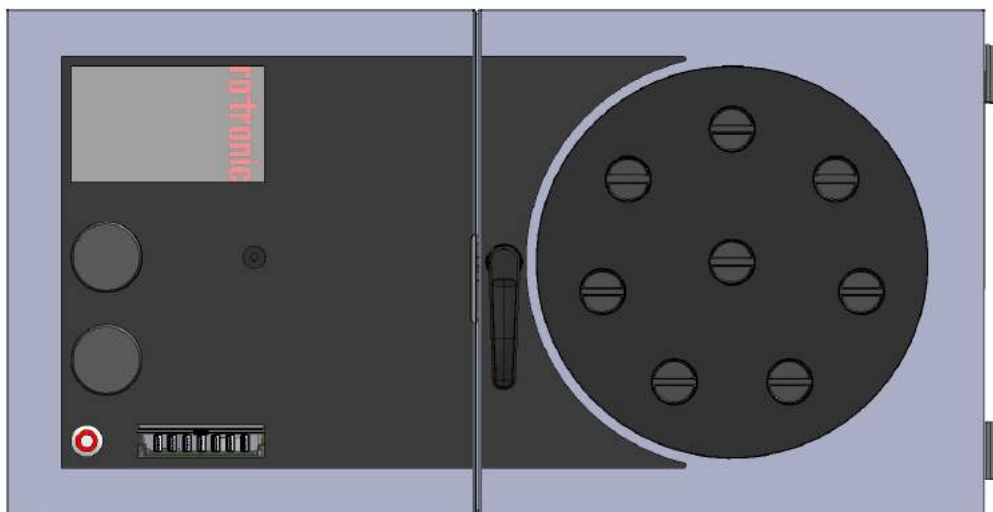


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HygroGen2: Humidity and Temperature Generator with AutoCal, MBW External Reference, Remote Screen Share, RemoteAPI and Range Extension options. Instruction Manual <small>Document title</small>	Instruction Manual for Software Version 3.0 <small>Document Type</small>

HYGROGEN2



Instruction Manual HG2-S and HG2-XL

E-M-HG2-S-XL-V3.0 Document code	Rotronic AG Bassersdorf, Switzerland Unit
HygroGen2: Standard Supply Package Document title	Advisory Notice Document Type

Contents of the Standard Supply Package HG2-S:

- HG2-S HygroGen2 generator
- HG2-DES Desiccant cell filled with molecular sieve (pre-installed)
- IEC mains cable
- HG2-FILL Water fill syringe (with tube)
- HC2-S-S HC2-S control probe (pre-installed) with calibration certificate¹
- Sample Loop connector cover plugs
- This Manual
- Chamber door (according to customer's order)²
- HW4 software ID number
- USB memory stick including saved test data and user manual

Contents of the Standard Supply Package HG2-XL:

- HG2-XL HygroGen2 generator with integrated door
- 2 x HG2-DES Desiccant cells filled with molecular sieve (pre-installed)
- IEC mains cable
- HG2-FILL Water fill syringe (with tube)
- HC2-S-S HC2-S control probe (pre-installed) with calibration certificate¹
- Sample Loop connector cover plugs
- This Manual
- HW4 software ID number
- USB memory stick including saved test data and user manual

¹ The calibration certificate included will vary according to the country of supply.

² In some countries, the chamber door is delivered with the HygroGen2. Due to the diversity of chamber doors and bungs, these are normally ordered separately and may be delivered in separate packaging.

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1 Scope of Document

This instruction manual refers to both HygroGen2 models: HG2-S and HG2-XL, running software version 3.0. To determine the software version that your instrument is running, please refer to the [Settings Screen](#) as shown in [section 3.4.5](#). For version 1.x.x, the software revision number is displayed by pressing the “HG Info” button; for version 2.0, select “Info” from the “Service” drop-down menu; for version 2.1 and later, select “HygroGen2 Info” from the “Support” drop-down menu. Equivalent manuals are available on www.rotronic.com for HygroGen2 instruments running software versions 1.x. and 2.x.

For instructions on how to upgrade to version 3.0 please see [Section 3.2](#).

1.1 Introducing the HygroGen2

The HygroGen2 is a generator of controlled relative humidity and temperature environments, primarily for use in calibrating humidity instrumentation, but is also well suited to the calibration of temperature instrumentation, particularly those used for the measurement of temperature in air.

It is a completely self-contained, portable unit requiring no external resources except mains power. This allows technicians to perform calibrations in the laboratory, workshop or on-site.

The HygroGen2 is available in the standard HG2-S version - with 2 litre chamber – and, as of 2016, a larger HG2-XL - with 20 litre chamber.

The HygroGen2 uses a mixed flow method for generating the %rh required by the user. A desiccant cell provides a source of low humidity and a piezoelectric humidifier generates high humidity. A Peltier element is used for heating and cooling the chamber. Measurement and control is provided by a combination of a ROTRONIC HC2-S probe, an embedded Platinum Resistance Thermometer (PRT) and a multi-loop controller. Set-points are entered using the touchscreen front panel display.

1.2 Temperature and Humidity References

The HygroGen2 creates stable temperature and humidity conditions uniformly within its test chamber. Instruments under test (IUTs) are inserted through the chamber door, or placed directly inside, and compared to a reference to calibrate and monitor their performance so that any appropriate adjustments can be made.

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There are three main relative humidity (RH) calibration reference types that can be used with the HygroGen2. Each has its own advantages and disadvantages, so the reference chosen should be determined by the uncertainty of measurement required.

- Internal control RH probe reference
- External RH probe reference
- Chilled Mirror Hygrometer reference

Corresponding temperature references integrated in the above may be used or additional external temperature references employed (for example, platinum resistance thermometers (PRTs)).

It is vital to consider the comparison of temperatures measured by the reference, the HygroGen2 and IUTs. Because RH is significantly dependent on temperature, temperature measurement should be optimised to get meaningful RH results.

For more details, please see [A1: Calibration Reference Options](#) and [Appendices D1 to D4](#) on Uncertainty.

1.3 Optional Enhanced Features: AutoCal, External Reference, Range Extensions and Remote Control

With the introduction of software version 2.0, the HygroGen2 comes with optional Enhanced Feature upgrades: AutoCal and RH/Temperature Range Extensions. Version 2.1 has more additions to the Enhanced Features range: AutoCal+ and Remote Control. Further enhancements are in development and will be released in subsequent versions.

All Enhanced Features are activated by the application of a licence key, available via your ROTRONIC dealer, and can be added to any HygroGen2. Older units with serial numbers prior to HG2-VCT-1280 may require a service in order to enable network features required for Remote Control.

Low Temperature and Humidity Range Extensions extend the limits of points that can be set on the instrument, creating chamber conditions down to -5 °C and from 2 %rh up to 99 %rh.

AutoCal allows you to pre-program a series of set-points and times, and record the instrument's progression through them in a PDF Calibration Certificate which is written to an external USB disk drive. Any values recorded on ROTRONIC HC2-S probes attached to the HygroGen2 via USB adaptors are recorded in the certificate. Probes can be set to automatically adjust to match the HygroGen2 reference probe at predetermined values.

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Remote Screen Share (Formerly Remote Control) gives the ability to remotely control the HygroGen2 over a network using the open source VNC protocol.

RemoteAPI gives the ability to remotely control and interrogate the HygroGen2 using a series of text based commands over a network; users can write their own software to log and control the HygroGen2.

MBW External Reference (formerly AutoCal+) extends the functionality of AutoCal and RemoteAPI, by integrating MBW/RHS chilled mirror hygrometers (supplied separately) as the external reference.

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2 Setting up the HygroGen2

2.1 Physical Location

To ensure correct operation please ensure that:

1. The unit is level and stable;
2. There is at least 15 mm clearance underneath and at least 100 mm at the back of the unit to enable adequate air flow;
3. There is adequate access to the electrical mains connection at the rear of the unit.

Note: The feet on the rear panel are for standing the unit for service purposes and to ensure a sufficient air gap behind the unit. The unit will not operate in the vertical position.

2.2 Electrical Supply

i. Power Isolation

The unit is supplied with a mains cord set. The unit should be disconnected from the electrical supply before the unit is moved, cleaned or has water added or removed.

ii. Earthing

This unit must be earthed. Provision for the safety earth is made through the electrical mains connection (see Figure 2(8) below) to which all parts of the unit requiring earthing are internally connected. An earthed electrical supply is required.

iii. Earth Leakage Current

Due to RF filtering, there is an earth leakage current, within the limits specified in EN 61010-1:2001. This may affect mains power circuits protected by Residual Current Device (RCD) or Ground Fault Detector (GFD) type circuit breakers (particularly if used in multiples or with other equipment with an earth leakage current on the same supply circuit).

iv. Overcurrent Protection

To protect the internal circuitry against excess currents, the mains supply to the unit must be connected with the mains cord set provided with the unit and to an appropriate mains supply.

v. Voltage Rating

The unit is designed to work within the limits of a 110-230 VAC 50-60 Hz mains supply with voltage fluctuations up to $\pm 10\%$ of the nominal voltage. The unit is rated impulse-withstand (overvoltage) category II of IEC 60364-4-443. Where occasional voltage transients over 2.5 kV are expected or measured, it may be necessary that the power installation to the unit includes a transient limiting device.

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vi. Mains Filtration

If there is risk of power spikes or breaks, it is recommended that an Uninterruptable Power Supply (UPS) is used to provide continued power and mains filtration. This should be rated according to the HygroGen2 power specifications (see [Appendix B3](#)) and the time required to run/shut down during power outage.

vii. Conductive Pollution

The unit is rated Pollution Degree 2 and must not be operated in environments where conductive pollutants (for example, carbon) may enter the unit. This includes excessive moisture ingress.

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2.3 HygroGen2 Assembly

2.3.1 HG2-S

- 1) Power switch
- 2) USB ports (7)
- 3) Touch screen controller
- 4) Water port
- 5) Desiccant cell
- 6) Chamber door
- 7) Probe aperture bung
- 8) Handle



Figure 1: Front of HygroGen2-S

- 1) Sample loop return
- 2) Sample loop outlet
- 3) USB ports (2)
- 4) DVI monitor interface
- 5) Ethernet socket
- 6) Type label
- 7) Fan outlet
- 8) Electrical mains connection
- 9) Power switch



Figure 2: Rear of HygroGen2-S

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i. HygroGen2-S Doors

The HygroGen2-S does not come supplied with a door. There are various standard and customized versions available, depending on the intended use for the instrument, the use of an external reference (see [Appendix A1.2](#)) and the instruments under test. Figure 1(6) above shows the 15 mm 5-port version (part code: HG2-D-11111). Other options are listed in [Appendix B4](#).

To access the HygroGen2 chamber, remove the door. Grip firmly and twist the door anti-clockwise. In the event that this proves difficult, cool the chamber first. Occasional instrument application of silicone grease around the door “O” ring seal will ease movement.

Replacement can be in any position and requires only a gentle clockwise twist.

Before using your HygroGen2, make sure that the door is secured and that all probe apertures not in use are sealed with a bung (see Figure 2(7) above) or an appropriate alternative seal.

ii. Desiccant Cell

The unit should be supplied with the desiccant cell in place (see [Figure 1\(5\)](#) above). For further details and best practice for desiccant handling, please see [section 8.2](#).

iii. External Sample Loop

Unless an external sampling system is to be used (see “External Sample Loop Operation” in [Appendix A1.3](#)), ensure the sample loop caps (Figure 2(1) and (2) above) are firmly secured.

iv. HC2-S Control Probe

The HygroGen2 chamber conditions are monitored and controlled by a ROTRONIC HC2-S HC2-S-S RH and temperature probe. Depending on the circumstances and whether external references are being used (see [Appendix A1.2 External RH Probe Reference](#)), this probe may need to be removed for regular calibration.

See [Section 8.1.1](#) for details on removing the control HC2-S probe.



Note: For speed of response, this probe must be employed without a protective filter.

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2.3.2 HygroGen2-XL

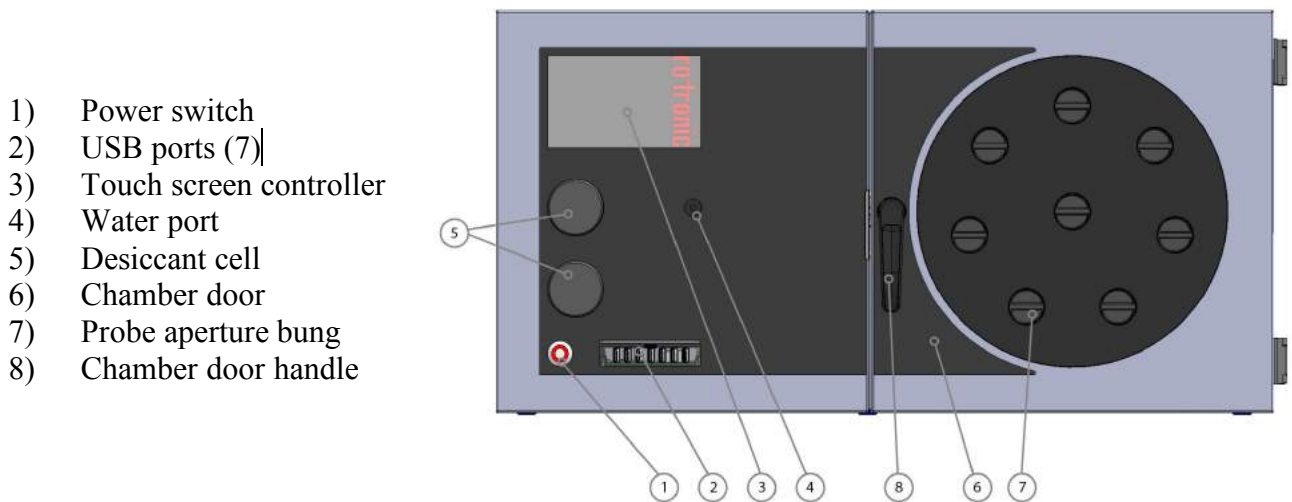


Figure 3: Front of HygroGen2-XL

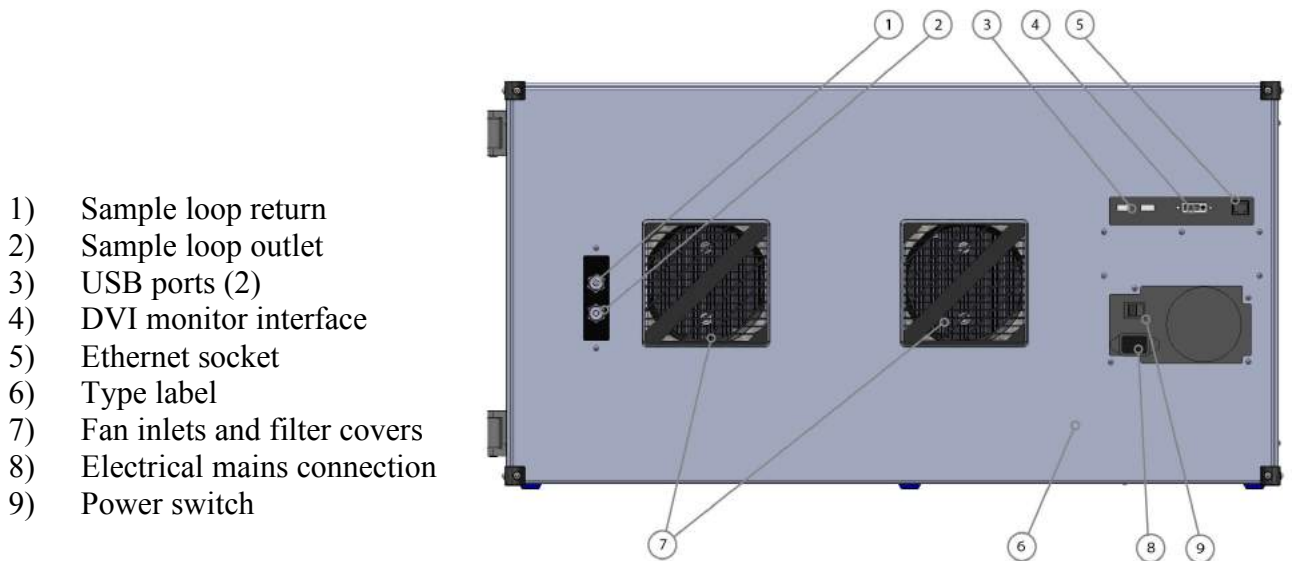


Figure 4: Rear of HygroGen2-XL

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i. HygroGen2-XL Door

The HygroGen2-XL is supplied with a door, though customised versions are available. At the time of preparing this manual, the standard configuration has 8 x 30 mm ports; there is also a 19 x 30 mm port version available.

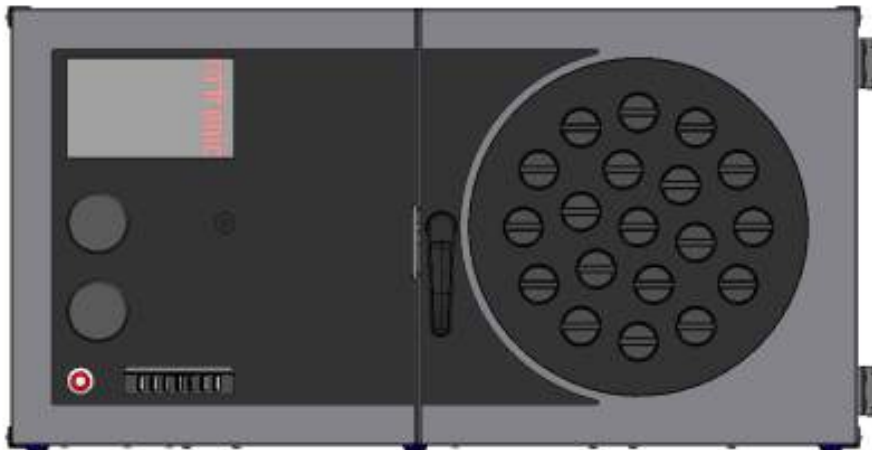


Figure 5: HygroGen2-XL with 19 x 30mm ports

Before using your HygroGen2, make sure that the door is secured and that all probe apertures not in use are sealed with a bung or an appropriate alternative seal.

ii. HygroGen2-XL Shelves

The HygroGen2-XL has three removable shelves, which secure into clips at the back of the chamber and rest on lugs at the front. Secure each shelf into the clips at the back and lower the front of the shelf into place.



Figure 6: HygroGen2-XL shelving system

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iii. HygroGen2-XL Cable Management

For devices placed wholly inside the chamber, it is recommended to secure cables to the shelves using cable-ties and run the cables through a spare port in the door. The port can be sealed using either a cable-gland bung, e.g. HG2-B8-L or some other appropriate sealing/insulation.

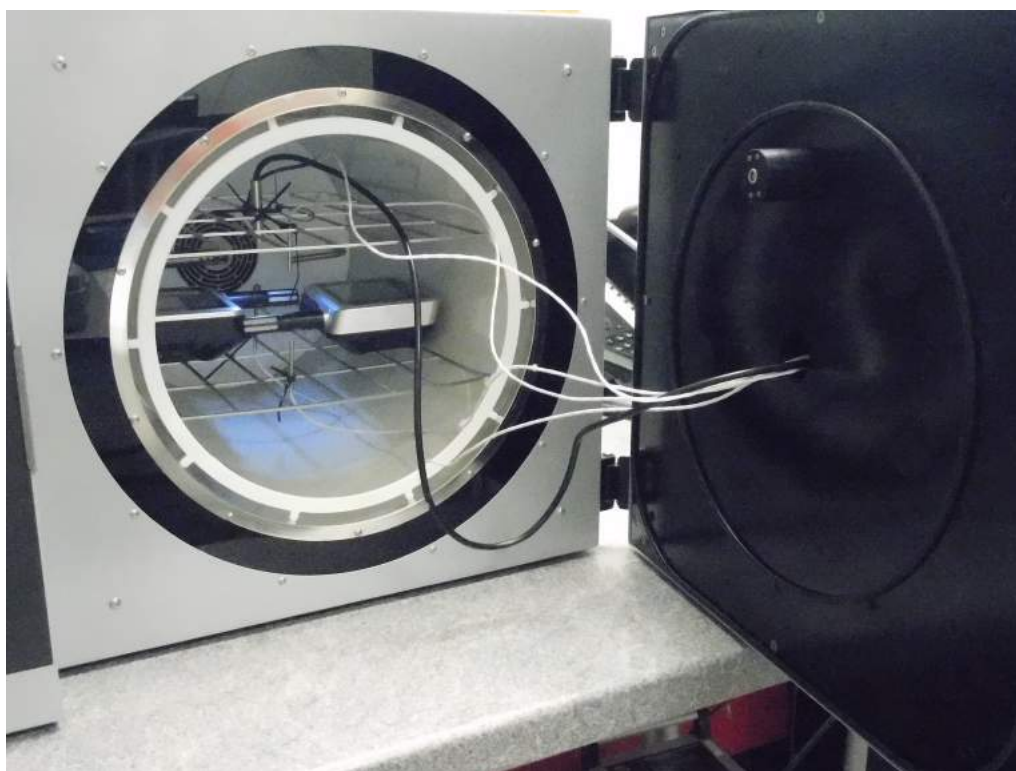


Figure 7: HygroGen2-XL cable management through chamber door

iv. Desiccant Cells

The HygroGen2-XL is supplied with two desiccant cells in place ([Figure 3\(5\) above](#)). The instrument will use the top desiccant cell by default and automatically switch over to using the bottom one, should the top one need recharging. The instrument will display “Desiccant Low” and the desiccant cell can be removed and recharged. Should it be left, and the bottom one become equally run down, the instrument will continuously switch between the two cells; the drying function will be impaired until at least one is recharged. The desiccant cell currently in use is displayed on the Settings screen on the desiccant level indicator.

Please note the desiccant indicator will only give a meaningful reading after it has been running for more than -15% power for more than a minute through a particular cell. For further details and best practice for desiccant handling, please see [section 8.2](#).

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v. External Sample Loop

Unless an external sampling system is to be used (see “External Sample Loop Operation” in [Appendix A1.3](#)), ensure the sample loop caps (Figure 2(1) and (2) above) are firmly secured.

vi. HC2-S Control Probe

The HygroGen2 chamber conditions are monitored and controlled by a ROTRONIC HC2-S HC2-S-S RH and temperature probe. Depending on the circumstances and whether external references are being used (see [Appendix A1.2 External RH Probe Reference](#)), this probe may need to be removed for regular calibration.

See [Section 8.1.2](#) for details on removing the control HC2-S.



Note: For speed of response, this probe must be employed without protective filters.

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2.4 Water Reservoir

The HygroGen2 requires 50-80 ml of demineralised water in the internal reservoir. Either reverse osmosis (RO) or de-ionised water is recommended. It is NOT recommended to use distilled water as this readily absorbs atmospheric CO₂ to form carbonic acid which can corrode components within the humidifier.

Insufficient water will deactivate the humidification system. As long as extreme care is taken not to overfill the water reservoir, the HygroGen2 may be filled and emptied either with the unit powered up or shut down.

i. To fill the HygroGen2:

- a. Insert the tube of the dosing syringe, with the plunger fully depressed, 10 mm into the water port and extract any residual water by drawing out the plunger.
- b. Depress the collar on the water port (Figure 1(4) above) and remove the dosing syringe tube. Wipe up any spilt water with an absorbent cloth immediately.
- c. Fill the dosing syringe with 80 ml of demineralised water. Insert the end of the dosing syringe tube firmly back into the water port and discharge the syringe steadily. (If water leaks during this operation the filler tube is not correctly inserted in the water port.)
- d. Depress the collar on the water port to remove the dosing syringe tube. Wipe up any spilt water with an absorbent cloth immediately.
- e. A water level indicator is shown in the Settings Screen (see [section 3.4.5](#)).



Figure 8: How to fill and empty the Water Reservoir

Caution: Do not overfill the HygroGen2

Overfilling of the unit will result in poor humidification and, in extreme cases, water may be pumped into the chamber. If the HygroGen2 is overfilled, the humidifier should be fully emptied and then refilled with 50-80 ml of water (as described above). If there is water present in the chamber of the HygroGen2, this should be removed using an absorbent cloth. Ensure the

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HygroGen2 is switched off and the mains power unplugged before manually drying the chamber.

ii. To empty the HygroGen2:

- a. Insert the tube of the dosing syringe, with the plunger fully depressed, 10 mm into the water port and extract any water by drawing out the plunger.
- b. Depress the collar on the water port to remove the dosing syringe tube. Wipe up any spilt water with an absorbent cloth immediately.
- c. Water discharged from the HygroGen2 may be stored safely and reused at a later date.



Note: The HygroGen2 should always be emptied if it is being shipped or stored (see [section 5.3 Preparing the Unit for Transit or Storage](#)). This will prevent ingress of water into the chamber should the unit be inverted and prevent possible frost damage.

iii. Ultra-violet sterilisation lamp

As a precaution against any microbial and algae water contamination, HygroGen2 incorporates an Ultra Violet (UV) sterilisation lamp within the water reservoir. No user intervention is required - HygroGen2 auto-cycles the process.



Under no circumstance should the water reservoir be opened by non-qualified personnel. Direct exposure to UV lamps can cause burns or blindness.

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3 HygroGen2 - Basic Operation

This applies to all HygroGen2 models. For details on the operation of optional Enhanced Features, see [section 4](#).

3.1 Switching On

- a. Ensure the electrical mains supply is correctly plugged in and switched on.
- b. Switch the unit on by pressing the Power Switch (see Figure 1(1) above) once.
- c. The fans within the unit will switch on giving an immediate audible indication the unit is powered.
- d. The controller will power up and display the controller home screen (as shown in Figure 12).

On power up:

- The temperature and humidity set-points default to the last set values.
- The temperature and humidity control defaults to the last set condition.

If the “Low Water Level” alarm is displayed, then the unit should be filled as described in [section 2.4](#). Humidification is disabled until water is filled.

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3.2 Upgrading HygroGen2 Firmware

To determine the latest version of the HygroGen2 firmware, please consult the ROTRONIC website:

<https://www.rotronic.com/en-gb/humidity-measurement-feuchtemessung-temperaturmessung/humidity-measurement-feuchte-messung/humidity-calibration-kalibrierung/hygrogen2/hygrogen2-s.html>

The firmware version your HygroGen2 is running can be determined via the Settings screen, selecting the “Support” drop-down menu and choosing “HygroGen2 Information”. For further details see [Section 3.4.7](#).

3.2.1 Updating HygroGen2 firmware from earlier version 1.x or 2.x

If upgrading from version 1.x or 2.x a FULL CLEAN INSTALL is required. Please see separate documentation:

<https://www.dropbox.com/s/73u16w6sd5167fp/E-M-HG2-S-V3.0-Installation%20instruction.pdf?dl=0>

3.2.2 Updating HygroGen2 firmware from earlier version 3.x

- a. On a PC, download the latest version 3.x.x.x of the HygroGen2 Controller Software via <https://www.rotronic.com/en-gb/humidity-measurement-feuchtemessung-temperaturmessung/humidity-measurement-feuchte-messung/humidity-calibration-kalibrierung/hygrogen2/hygrogen2-s.html>

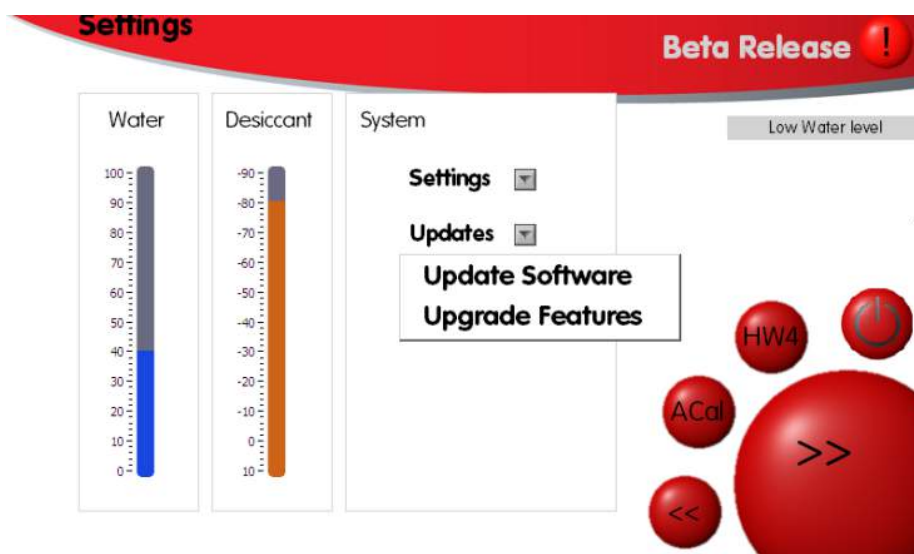
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- b. Unzip this file to the **root** of a USB stick.
The file structure should look like this when completed successfully:

Name	Date modified	Type	Size
bin	11/11/2015 12:29	File folder	
license	11/11/2015 12:29	File folder	
supportfiles	11/11/2015 12:29	File folder	
nidist.id	11/11/2015 12:27	ID File	1 KB
setup.exe	11/11/2015 12:27	Application	1,394 KB
setup.ini	11/11/2015 12:27	Configuration sett...	15 KB

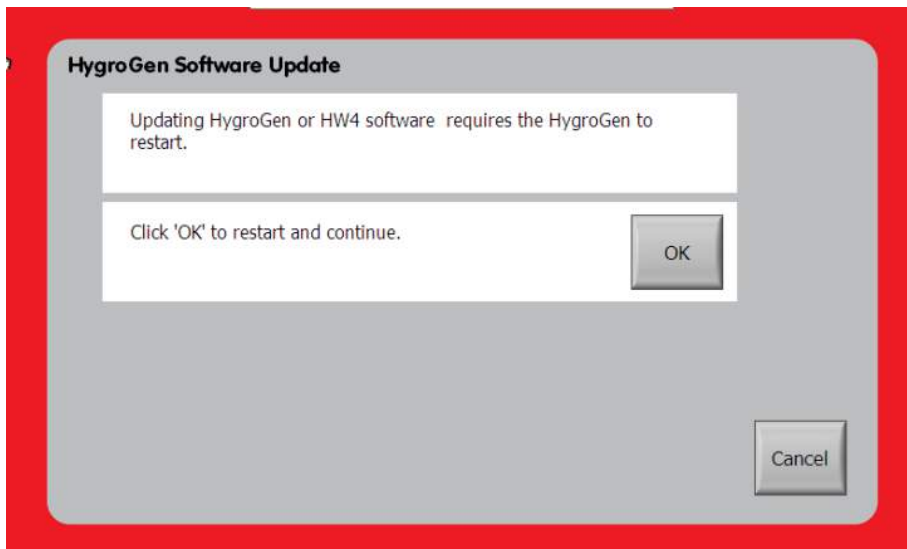
Any other file structure, or root director folder name will result in the HygroGen2 not finding the updater.

- c. If going on to update HW4, make a note of your HW4 serial number, by launching HW4 and clicking Registration on the startup screen (see [section 6.2](#) for further details).
- d. Reboot the HygroGen2 into Configuration Mode, by going into the Settings, then select “Update Software” from the “Updates” drop-down menu.

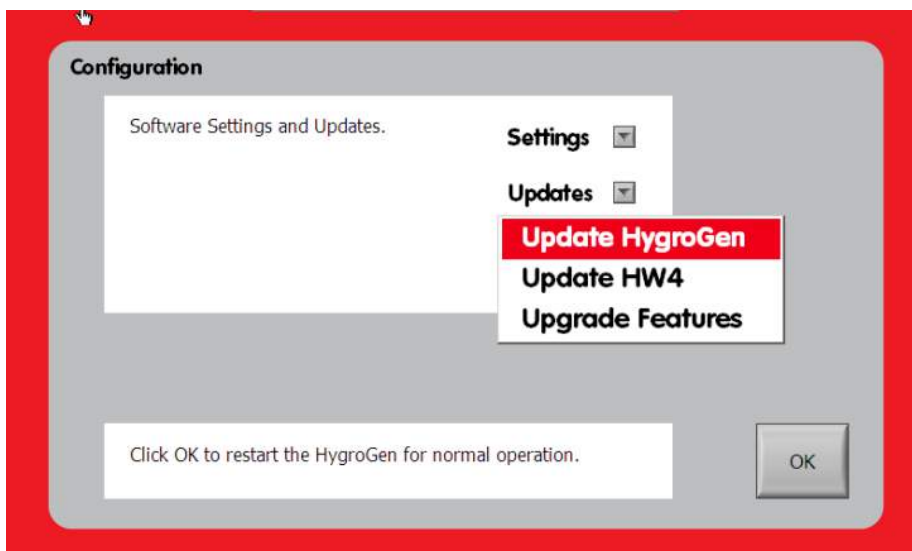


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- e. Click OK to reboot the HG2 into configuration mode.

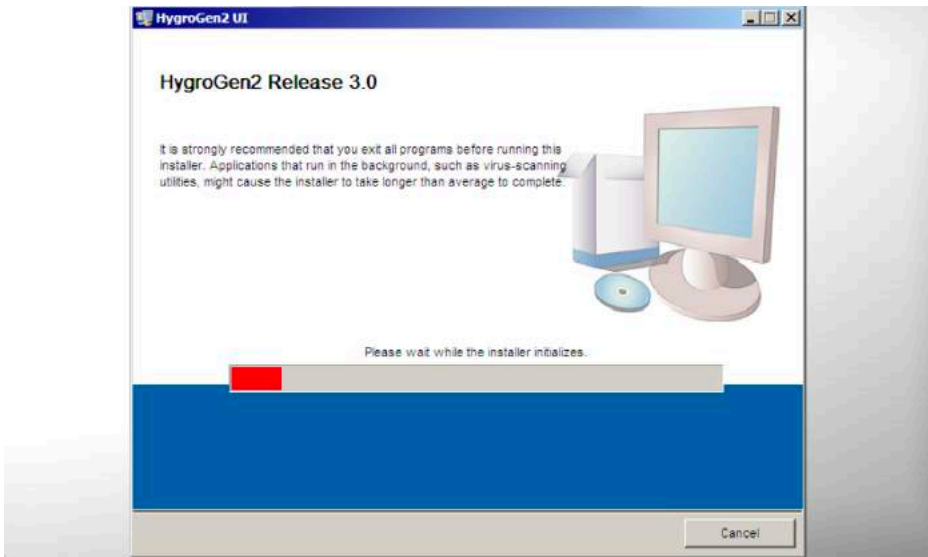


- f. Insert the USB stick into any port in the HygroGen2.
- g. Select “Update HygroGen“ from the “Updates“ drop-down menu.

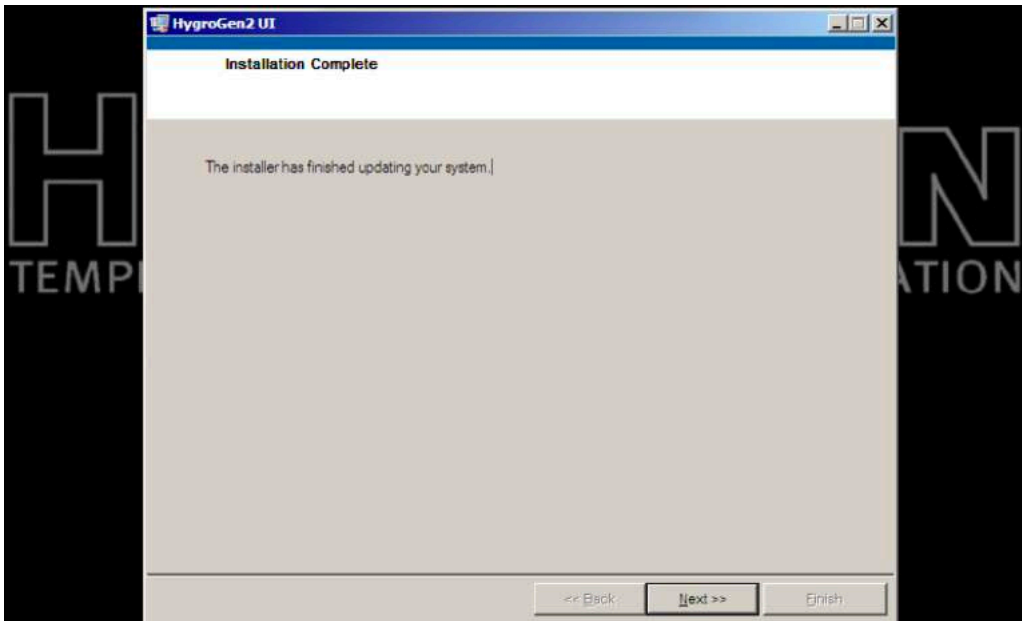


<p>E-M-HG2-S-XL-V3.0</p> <p>Document code</p>	<p>Rotronic AG Bassersdorf, Switzerland</p> <p>Unit</p>
<p>HygroGen2: Humidity and Temperature Generator with AutoCal, MBW External Reference, Remote Screen Share, RemoteAPI and Range Extension options.</p>	<p>Instruction Manual for Software Version 3.0</p> <p>Document Type</p>
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- h. The screen will go black and an installation interface appear. Follow the on screen instructions, and agree to the terms and conditions.



- i. At the end of the process, click Next and the HygroGen2 Configuration Mode page will reappear.



- j. Click OK to reboot into Operational Mode or continue below to update the built-in HW4 software.

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3.2.3 Updating HW4 version

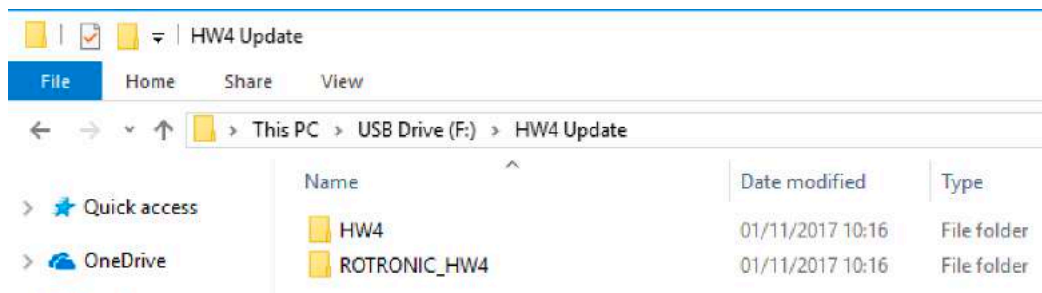
To determine the latest version available of the HygroGen2 built-in HW4 software, please consult the ROTRONIC website:

<https://www.rotronic.com/en-gb/humidity-measurement-feuchtemessung-temperaturmessung/humidity-measurement-feuchte-messung/humidity-calibration-kalibrierung/hygrogen2/hygrogen2-s.html>

The HW4 software version your HygroGen2 is running can be determined via the Settings screen, selecting the “Support” drop-down menu and choosing “HygroGen2 Information”. For further details see [Section 3.4.7](#).

Please ensure the HygroGen2 is running the latest version of the firmware before updating HW4 (see section above).

- a. If you have not already made a note of your HW4 serial key, please ensure you are in Operational Mode and launch HW4, and then identify the key selecting ‘Registration’ from the startup screen (see [section 6.2](#) for further details).
- b. On a PC, download [HW4 v3.8 for Hygrogen2](#).
- c. Unzip this file to the **root** of the same USB stick. The file structure should look like this when completed successfully:

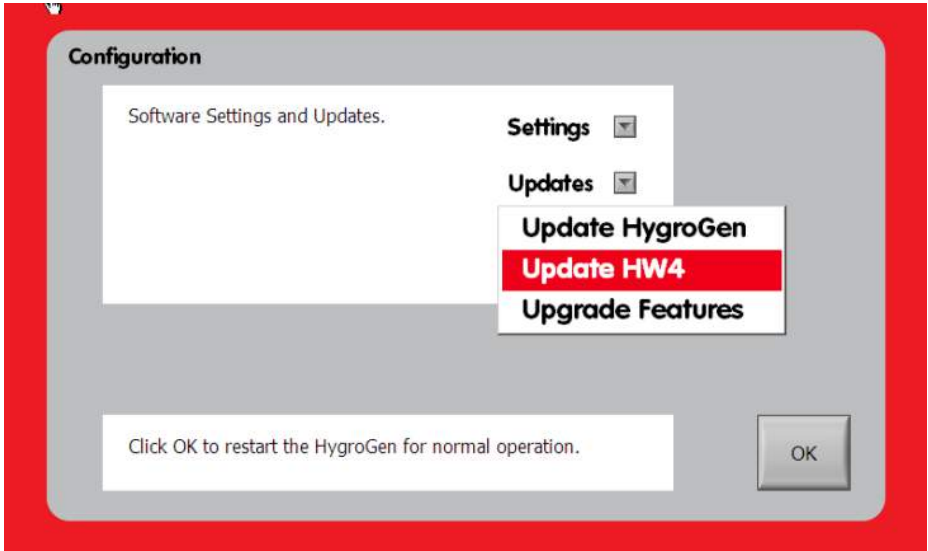


It is essential the folder in the root director is called “HW4 Update”.

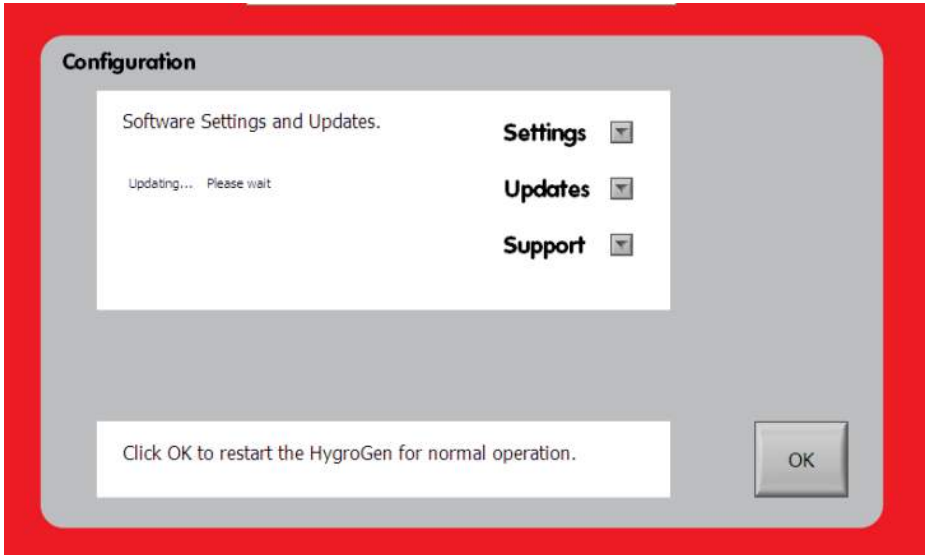
- d. Safely eject the USB stick from the PC.
- e. On the HygroGen2, if not already in Configuration Mode, go to the Settings Page and select “Update Software” from the “Updates” drop-down menu. Press OK and the HygroGen2 will reboot into Configuration Mode.

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f. Select Updates and then Update HW4.

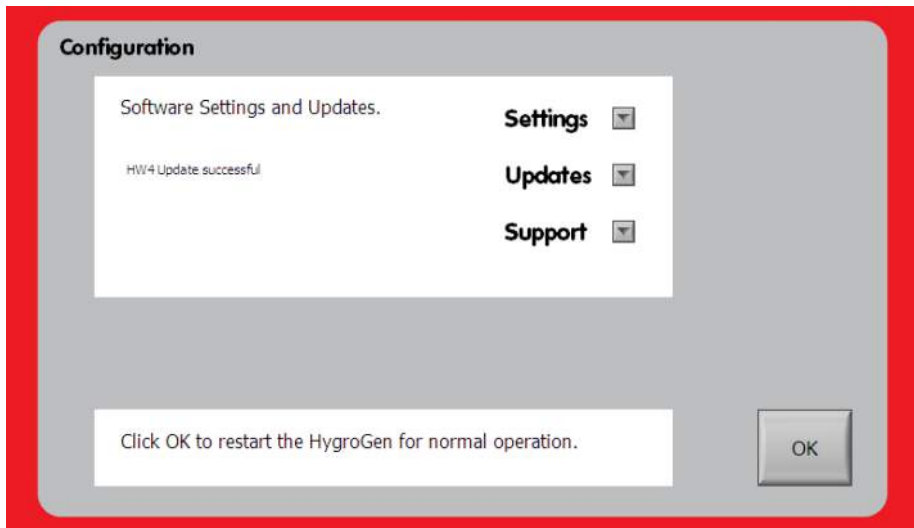


g. Observe the on-screen progress



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- h. When complete, the HG2 will report HW4 Update Successful.



- i. Click OK to reboot.
- j. The HygroGen2 will return to standard mode. Start HW4 and re-enter the registration code recorded previously to enable full operation.

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3.3 Configuration Mode Settings

Certain settings on the HygroGen2 must be made in Configuration Mode. From Standard Operation Mode, go to the Settings screen, then the “Settings” drop-down menu and select either “Network”, “Date and Time”, “Touchscreen”, or “Update Software”. All four options effectively do the same thing (i.e. reboot the HygroGen2 into Configuration Mode); press “OK” to restart the HygroGen2.

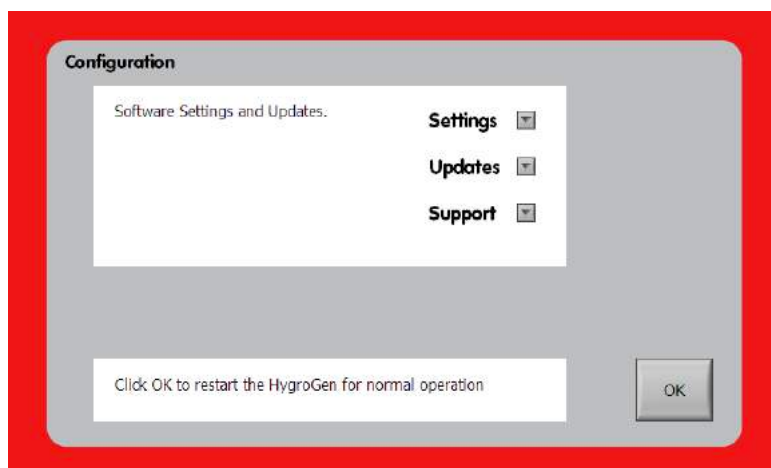


Figure 9: Configuration Mode

3.3.1 Network Settings

Prior to machine serial number VCT-HG2-1281, the network port on the back of the HygroGen2 was physically disabled. Since this unit, and for every unit that has received a service since January 2013, the network port has been physically enabled, but its functionality has been disabled in software.

As of v2.1, there is an option to enable the functionality, which is required for the Remote Control/Support Enhanced Feature. If you do not intend to use the Remote features, the Network functionality can still be enabled, to no disadvantage, but some organisations may stipulate it is turned off before the instrument can be used.

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By default, when v2.1 is installed, the network port functionality is disabled. To enable it, select “Network” from the “Settings” drop-down menu from within the Configuration Mode “Settings and Updates” screen.

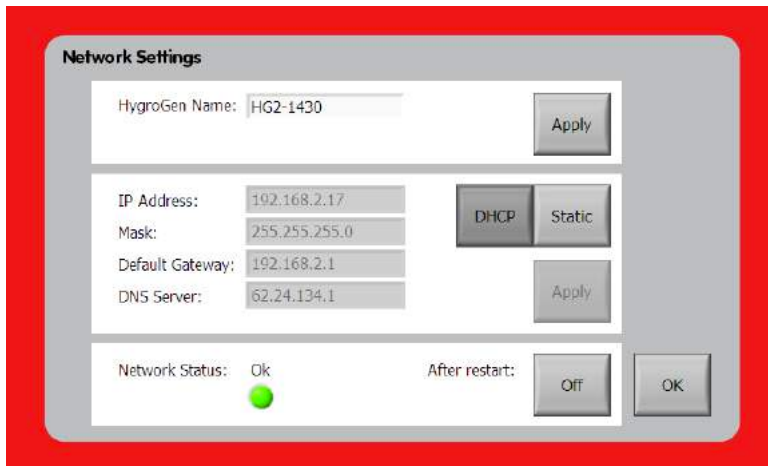


Figure 10: Network Settings

To turn *on* the functionality, press the “After restart” button so that it shows “On”. Review and accept the legal disclaimer that pops up in order to continue. Press OK to go back to the “Settings and Updates” screen and then press OK to restart. The instrument will restart *back* into Configuration Mode to complete the next step. When rebooted, please reselect “Network” via the “Settings” drop-down menu.

Plug the HygroGen2 into your network using a standard RJ-45 Ethernet cable. If network functionality is not configured, “Network Status” will show as “down”. If it *is* configured, and assuming the network cable is attached to other networking hardware, it will show as “OK”, otherwise it will show as “unplugged”.

PLEASE note: if your instrument has serial number VCT-HG2-1280 or earlier and has NOT been serviced since January 2013, your instrument requires a physical modification. Please contact your ROTRONIC distributor who will arrange for this operation to be performed. Without this modification, the Network Status will show as “unplugged” even if it is plugged in correctly. Please also note, physical modifications made by anyone other than Authorised Service Centres will void the HygroGen2 warranty.

With the HygroGen2 plugged into a network, IP settings need to be configured. Networking addressing can be set to obtain an address automatically via DHCP, if your network supports it, or manually via “Static”. Please contact your local IT administrator for advice, if unsure. You may be required to advise the network hardware (MAC) address of the instrument. This can be found in the “HygroGen2 Info” via the “Support” drop-down menu.

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The IP address assigned to your instrument will be reported in the Network Settings interface and via the “HygroGen2 Info” screen. The HygroGen2 will assign itself a network name/identity. This can be changed within the interface. It is recommended to change it to the instrument’s serial number, though local network policies may require something else.

Operation of the Remote Control functionality is described in [section 4.3](#).

3.3.2 Date and Time Settings

Date and time stamps are included in AutoCal and HW4 logged data.

To adjust these settings, select the “Date and Time” option from the “Settings” drop-down menu on the “Settings and Updates” screen.

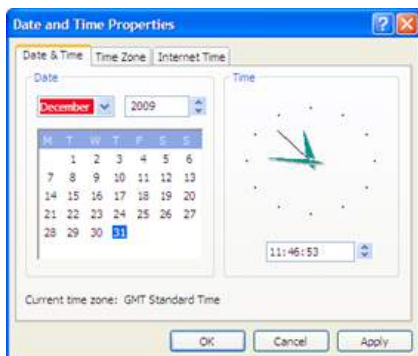


Figure 11: Date and Time Properties

3.3.3 International Keyboard

Please [Section 7.1](#) for details about configuring external input peripherals. NB Configuration mode is not required to alter this setting.

3.3.4 External Monitor

Please [Section 7.2](#) for details about configuring external output peripherals. NB Configuration mode is not required to alter this setting.

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3.3.5 Touch Screen Calibration

Should the touch screen calibration be significantly awry – which can happen when upgrading from version 1.x to version 2.0 – you can realign the touch screen calibration. You may wish to plug in a USB mouse to perform this step.

Select the “Touch Screen” option from the “Settings” drop-down menu on the “Settings and Updates” screen. Pressing the touch screen button will begin a four-point calibration. Press the cross in each corner of the screen as directed.

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3.4 HygroGen2 Touchscreen Interface

The HygroGen2 controller consists of four top level screens that are accessed using the forward or back buttons in a loop:

Please note: the Programmer Screen is replaced by the AutoCal Screen when AutoCal is activated. The standard Programmer functionality is still available, however. Please see [section 4.1](#) for more details.

3.4.1 Controller Home Screen

- 1) Menu (drop down)
- 2) Chamber temperature
- 3) Temperature set-point
- 4) Heating power
- 5) Temperature control
- 6) Chamber humidity
- 7) Humidity set-point
- 8) Humidification power
- 9) Humidity control
- 10) Previous screen
- 11) Prog/ACal function
- 12) HW4 software
- 13) Power off
- 14) Next screen

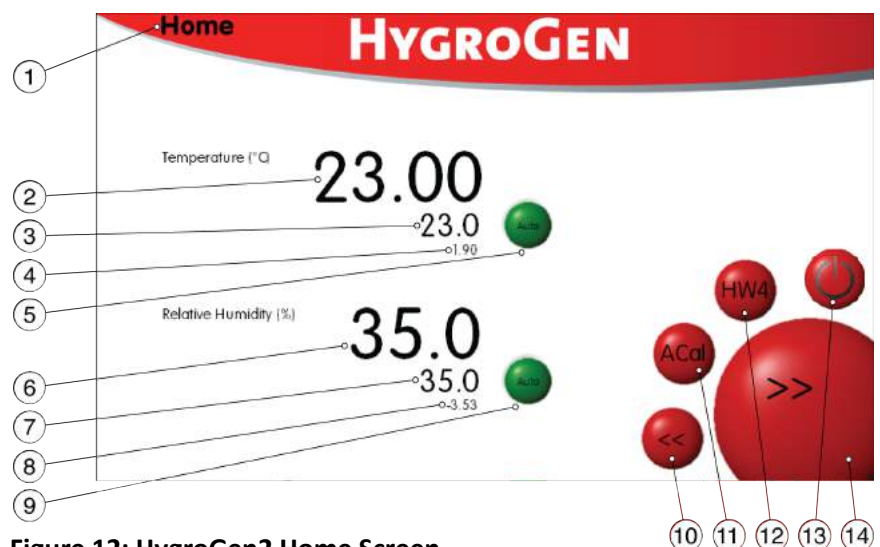


Figure 12: HygroGen2 Home Screen

i. Navigation (items 1, 10 & 14)

The user can navigate to different screens using the drop-down menu (item 1) or can scroll through the four main screens using items 10 & 11.

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ii. Temperature and Humidity Set-Points (items 3 & 7)

At any time, the user can change humidity or temperature set-points by simply touching the set-point on the screen. A pop-up will appear and either the touch screen or, when connected, the keyboard/mouse may be used to input desired values.

Note: To aid a smooth and efficient transition between temperature set-points, the controller is programmed to suspend humidification during changes in temperature. Once the chamber temperature is within 0.7 °C of the temperature set-point, the humidity control is activated.

When set-point combinations are programmed that resolve a low dew point condition (i.e. 0 °C, 5 %rh = -36 °C dew point), make sure that the desiccant is dry enough to achieve the desired value. Check the desiccant condition on the Settings screen (Figure 16) and consult maintenance records to establish when the desiccant was last changed. Stabilisation time to low RH conditions will be longer than normal as the chamber and internal surfaces need to be very dry.

iii. Temperature and Humidity Control (items 5 & 9)

The temperature and humidity control can be set to automatic or off. Automatic mode results in the unit attempting to adjust to the temperature (or humidity) in the chamber to match the set-point value. When switched off the HygroGen2 does not control the parameter.

When off, the control buttons are grey.

When on, but not stable, the control buttons are red.

When on and stable, the control buttons are green.

Temperature indicator is green when the control PT100 temperature sensor (see [Appendix A2](#)) is within 0.01 °C of the set-point and the control temp is within 0.01 °C of the internal (HC2-S) reference temperature sensor.

RH indicator is green when the RH reference is within 0.1%rh of the set point and the control RH is within 0.05 %rh of the internal (HC2-S) reference humidity sensor.

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3.4.2 Trend Screen

The Trend Screen shows the instrument's chamber conditions and the set-points the instrument is programmed to reach.

- 1) Trend
- 2) y-axis
- 3) Time axis
- 4) Trace selection

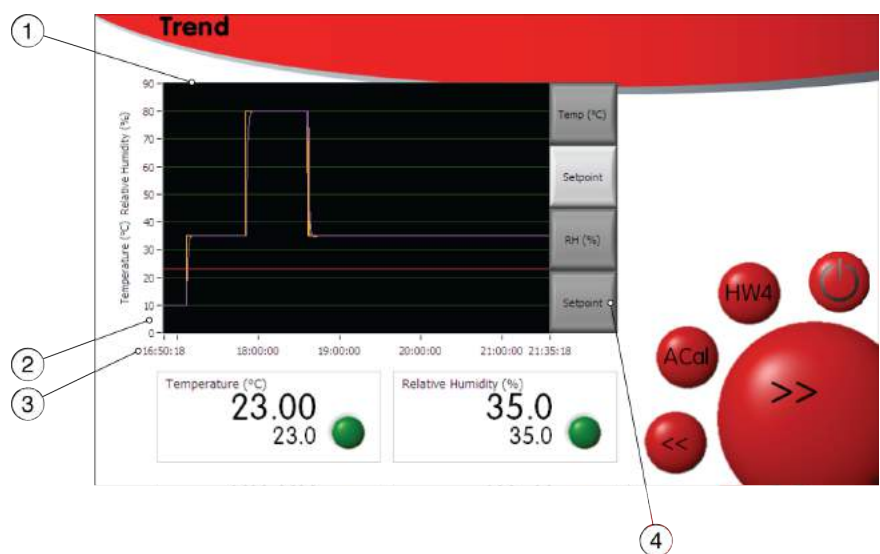


Figure 13: Trend Screen

i. Trace selection (item 4)

The traces displayed can be selected using the buttons (item 4)

ii. Trend Axes (items 2 & 3)

The y-axis (item 2) is self-scaling; the x-axis (time) (item 3) can be adjusted by clicking anywhere along it and typing in the desired timescale.

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3.4.3 Programmer Screen

The HygroGen2 programmer function enables the user to automate a sequence of RH and/or temperature set-points. If the AutoCal function is enabled the Programmer function is only available via the Home menu (Figure 12: item 1).

The HygroGen Programmer function can accommodate 20 programs with up to 200 steps each. Programs are edited via the Edit Program (Figure 15).

- 1) Program name & number
- 2) Program selection
- 3) Step selection
- 4) Run/stop program
- 5) Edit program



Figure 14: Programmer

i. Program Selection (items 1 & 2)

Item 1 identifies the program number and title. You can use the “<<” and “>>” buttons to scroll through the saved programs.

ii. Step Selection (item 3)

Use the Step Selection buttons (item 3) to select the program step at which the program will start. The temperature and humidity set-points (SP) for the selected step are displayed.

iii. Run/Stop (item 4)

Start the selected program running at the selected step using the “>” button. The total time the program has been running, and the time left on the current step are displayed. Use the Stop button to halt the program before it has completed.

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iv. Edit Program (item 5)

Use this button to go to the Edit Program screen (see Figure 15).

3.4.4 Edit Program Screen

- 1) Graphic indicator
- 2) Ramp/Soak control
- 3) Temperature set-point
- 4) Humidity set-point
- 5) Step duration
- 6) Insert step
- 7) Delete step
- 8) Scroll to view steps
- 9) Program title
- 10) Temperature tolerance
- 11) Humidity tolerance
- 12) Temperature only
- 13) Programmer

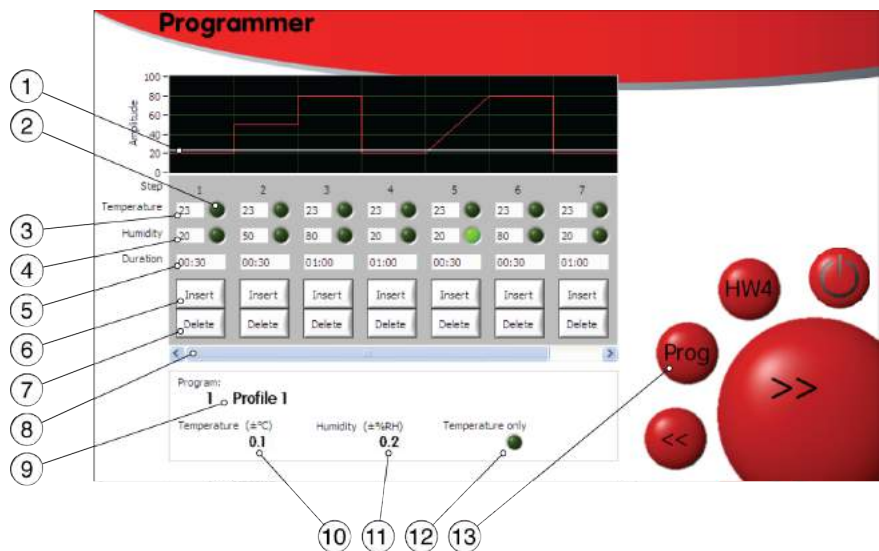


Figure 15: Edit Program

i. Select a Program to Edit

Select the desired program by clicking on the program button and entering the desired program number.

ii. Edit a Program Name

To edit the program name click on it (USB keyboard required) (item 9).

iii. Edit a Step

Each program comprises at least one step. Each step can be edited. Enter the desired step set-points and duration (items 3, 4 & 5). A graphical representation of the step is shown to help visualise the sequence.

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iv. Insert or Delete a Step (items 6 & 7)

Use the insert and delete buttons to add and remove steps. If there are more than 7 steps in the program use the scroll bar (item 8) to view.

v. Ramp or Soak (item 2)

Set temperature and humidity to either ramp or soak using item 2. A soak is where the HygroGen maintains the temperature and humidity in the chamber constant for the duration of the step, within the tolerances set (items 10 & 11). A ramp is where the HygroGen changes the selected set-point at a rate determined by the subsequent set-point value and the current step duration.

vi. Timing Tolerances (items 10 & 11)

For each program, temperature and humidity stabilisation values can be defined (items 10 & 11). Once the chamber conditions are within this tolerance, the step duration timing begins. If set to zero, no stabilisation criteria are applied and the timing of the step duration begins immediately.

vii. Temperature only Program (item 12)

Humidity timing and control can be removed from a program using the ‘Temperature Only’ button.

viii. Programmer Screen

Click the ‘Prog’ button (item 13) to return to the Programmer screen.

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3.4.5 Settings Screen

- 1) Water level display
- 2) Desiccant condition display
- 3) Settings menu
- 4) Updates menu
- 5) Support menu

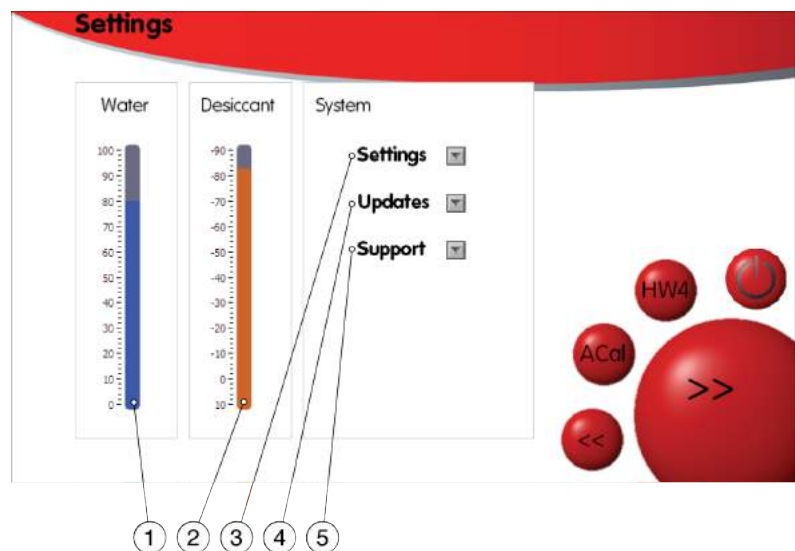


Figure 16: Settings Screen

The water level and desiccant level indicators show approximate levels only. The desiccant level indicator is updated only when the HygroGen2 is drying at more than 15% power and will take a few minutes to update. This is to ensure the desiccant sensor is reading the correct value. See [section 8.2](#) for more details.

The drop-down menus (items 3, 4 & 5) allow navigation to screens that are detailed later in this document.

i. Activation of Enhanced Features

Enhanced Features can be activated via the “Upgrade Features” option on the “Updates” drop-down menu in Configuration Mode, or via the Settings screen in Standard Operation Mode. See [section 4](#) for more details about Enhanced Features.

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ii. HygroGen Information

General instrument information including serial numbers, software versions, network parameters and enabled features can be found on the HygroGen Information screen. This can be found on the “Support” dropdown menu On the Configuration screen and the Settings screen (when in normal use).

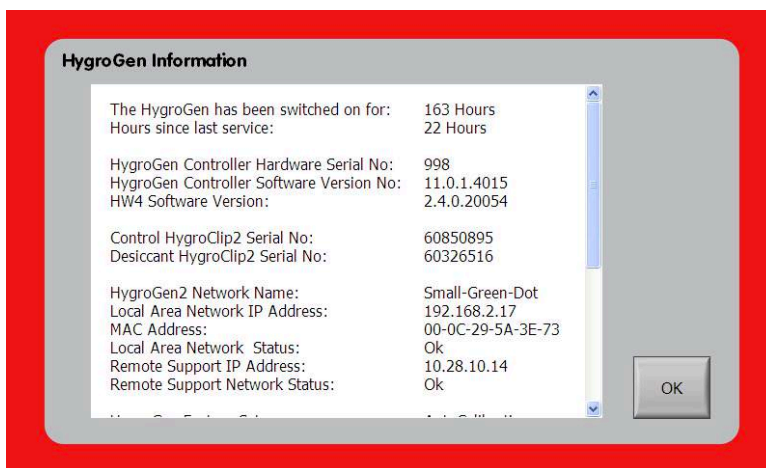


Figure 17: HygroGen Information

iii. Remote Support



Figure 18: Remote Support

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Your HygroGen2 can be configured so that ROTRONIC support engineers can connect to your HygroGen2 and to its support network so that *they* can remotely control your HygroGen2.

The feature requires the HygroGen2 to be connected to a network, and the instrument to be appropriately configured for network access. See section [Section 3.3.1 Network Settings](#).

To enable the Remote Support functionality, select the “Remote Support” option from the “Support” drop-down menu on the Settings screen. The “On”/“Off” button enables/disables the functionality.

Please note, the Remote Support functionality establishes a Virtual Private Network (VPN) tunnel back to the Rotronic support network. Outgoing VPN connections must be permitted on your local network for it to work. Some IT administrators may block this functionality.

If the HygroGen2 can establish a connection back to the support network, it will show “Connected” in green. Please advise your Rotronic support representative of the Remote Support IP address so that they can connect to your instrument.

Please note: the Remote Support connectivity **will remain active until it is disabled**, even if the HygroGen2 is rebooted.

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iv. Connections to Network File Servers

With the HygroGen2 connected to a LAN, the instrument has the ability to connect to a network file server for the storage of HW4 log files (see [Section 6.4](#)) and [Enhanced Feature] AutoCal calibration data (see [Section 4.1](#)).

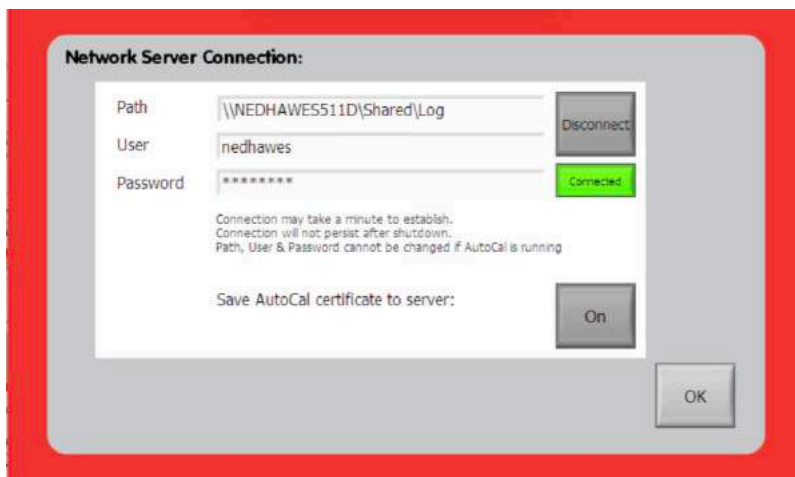


Figure 19: Connection to Remote File Server

To connect to a network file server, select the “File Save Location” option from the “Settings” drop-down menu on the Settings screen. Enter the network file server path in the format “\\<server ip or network address>\folder” and enter the username and password for the file share.

If a successful connection is made, a green ‘Connected’ indicator appears. To establish a connection with a different file server, press the green ‘Disconnect’ button and put in the new server details.

Please note, for security reasons the network file server path and user credentials have to be re-entered every time the HygroGen2 is restarted.

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4 HygroGen2 Enhanced Features

There are up to six Enhanced Features currently available for the HygroGen2. There are various combination bundle packs available at discount rates; please see HygroGen2 datasheet for details or contact your ROTRONIC dealer.

Low Temperature and Humidity Range Extensions extend the limits of points that can be set on the instrument, creating chamber conditions down to -5 °C and from 2 %rh up to 99 %rh.

AutoCal allows you to pre-program a series of set-points and times, and record the instrument's progression through them in a PDF Calibration Certificate which is written to an external USB disk drive. Any values recorded on ROTRONIC HC2-S probes attached to the HygroGen2 via USB adaptors are recorded in the certificate. Probes can be set to automatically adjust to match the HygroGen2 reference probe at predetermined values.

Remote Screen Share (Formerly Remote Control) gives the ability to remotely control the HygroGen2 over a network using the open source VNC protocol.

RemoteAPI gives the ability to remotely control and interrogate the HygroGen2 using a series of text based commands over a network; users can write their own software to log and control the HygroGen2.

MBW External Reference extends the functionality of AutoCal and/or RemoteAPI, by integrating MBW/RHS chilled mirror hygrometers (supplied separately) as the external reference.

Please see the following sections for detailed descriptions of the operation of each of the Enhanced Features.

Feature Activation

HygroGen2 features are enabled by the application of an activation code. Please purchase an activation code for the desired features from your ROTRONIC dealer. **You will need to supply your HygroGen2 serial number (see rear of instrument) when ordering the code.** Alternatively, go to the Settings screen and select the appropriate feature from the Settings drop-down menu and supply the code as given in the format "XXXXXX.YY-Z-ABC".

To activate Enhanced Features on your HygroGen2, you will need a USB keyboard plugged into the HygroGen2 to type in the supplied code, which will be a 16-digit string of numbers and letters in CAPITALS. The code will activate all the features you have purchased. If you

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have previously purchased one or more features and you want to add another, a new code will be supplied enabling both/all features.

To activate the upgrade features, go to the Settings screen, select the “Updates” drop-down menu and choose “Upgrade Features”. Type in the supplied code, ensuring there are no extra characters or spaces at the end of the string. The green lights will light up displaying the purchased Enhanced Features, which will be available immediately.

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4.1 AutoCal

4.1.1 Top Level Menu and Programmer Function

With AutoCal activated, the AutoCal screen (see Figure 13) is displayed instead of the Programmer Function Screen. The standard Programmer functionality, as described in [section 3.4.3](#) is still available but is accessed via the drop-down menu in the top left hand corner of the screen.

4.1.2 AutoCal Reference

The standard version of AutoCal uses the internal control HC2-S as its reference. AutoCal+ is an extension to AutoCal which enables the selection of an external MBW/RHS dew point hygrometer as an external reference. For more details on using AutoCal+, see [section 4.2](#). For a more in-depth discussion of references and calibration traceability, please see Appendices [A1: Calibration Reference Options](#) and [A2: Temperature Control](#).

4.1.3 AutoCal Screen

As ROTRONIC probes are added via the USB ports, the individual probe slots are populated within the AutoCal Screen. During an AutoCal calibration run, probes can be adjusted, or not, as desired, for each probe. Select individual probes by selecting the “Adjust” button.

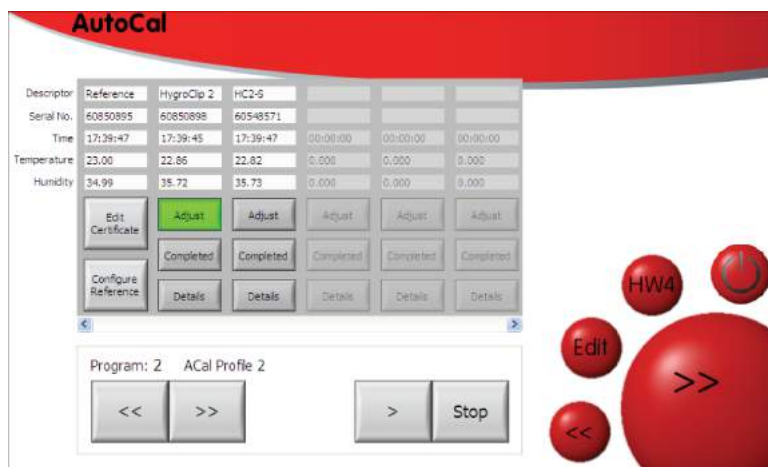


Figure 20: Adding HC2-S probes and selecting to adjust

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4.1.4 AutoCal Program Edit

Pressing the Edit button calls up the AutoCal Program Edit screen.

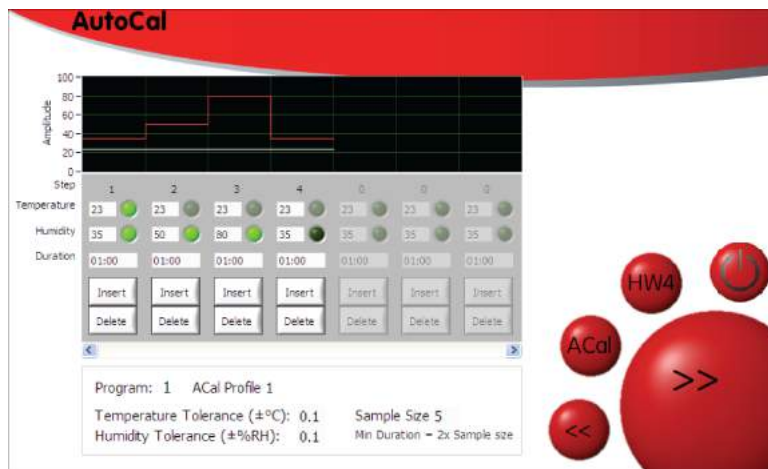


Figure 21: AutoCal Program Edit Screen

Set-points are programmed in an identical way to the standard Programmer. However, the green buttons take on a different function; they are now used to determine the *adjustment* points. Probes that are selected for adjustment within the [AutoCal Screen](#) will be adjusted at points that are selected here. Only one temperature point can be selected and must be selected as the first adjustment point. This is because of the way the HC2-S probes work: if temperature is adjusted, corresponding adjustments for RH are made at the same time. This policy is enforced by the software: greyed out buttons refer to options that are not possible, a dark green button is a point not selected for adjustment and bright green is a point selected for adjustment.

Points can be set for a minimum duration of 15 minutes; please ensure sufficient time is allowed for the probe to stabilise. A duration of at least an hour is strongly recommended, longer for extremes of temperature or RH. The timing of a set-point will begin when the *chamber* is within the set tolerance. Take particular care to allow sufficient time to allow for stabilisation of probes with particular protection filters applied.

It is not possible to select different adjustment points for different probes. If this is desired, please run a new program at a later time.

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4.1.5 Tolerance and Sample Size

As with the Standard Programmer, for each program, temperature and humidity stabilisation values can be defined. Once the chamber conditions are within this tolerance, the step duration timing begins. If set to zero, no stabilisation criteria are applied and the timing of the step duration begins immediately. The number of samples recorded in the AutoCal certificate can also be defined from 5 to 50; working backwards from the end of each set-point duration, values for temperature and humidity are recorded on the calibration certificate every 2 minutes for the number of samples selected. This determines the minimum set-point duration above an absolute minimum of 15 minutes.

To change these parameters, click the number next to each one. For example, for Sample Size: (as an example, in figure 15, the number '20'). This will show the number entry window:

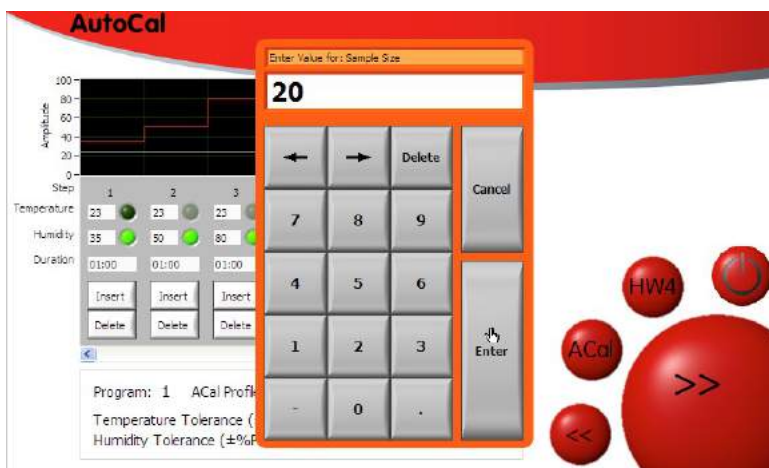


Figure 22: Number Entry Window

4.1.6 AutoCal Operation and Best Practices

Once the program and adjustment points are determined, programs are started by pressing the “Play” (>) button. After a successful run, provided AutoCal has successfully communicated with the probe under test for every selected sample point at every set-point, AutoCal saves a time-stamped PDF calibration certificate to a USB drive plugged into the HygroGen2, or an external network drive (see [Section 3.4.5.iv](#)). The same information is stored in a corresponding .csv file. If, for any reason, communication with the probe under test is interrupted (by unplugging the probe, for example), only the .csv file will be saved, with the associated data actually recorded. Included in each file is the program name, set- and adjustment-points, probe serial numbers and relevant calibration reference information. It is, further, possible to upload a custom logo and other user and reference information (see [section](#)

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[4.1.7](#)). A separate PDF is generated for each probe. NB: AutoCal will not run unless a USB drive is detected by the HygroGen2 or a network file share has been configured.

Before selecting a probe for adjustment, it is recommended to perform an initial assessment calibration run without adjustment selected. At the end of the run, examine the saved PDF calibration certificate and determine whether you want to re-run the program with adjustment selected.

At the first adjustment-point to be applied, AutoCal will initially delete any previously saved calibration points stored on the probe. This is recorded on the certificate. It will then apply the values of the reference probe as a corrected value. This value is determined at the instant the correction is saved and is not an average of the previously recorded points as shown in the calibration certificate; these are shown in the certificate to give the user an estimate of stability.

Please note, for probes with adjustment selected, AutoCal will *always* attempt to make an adjustment. If the correction is smaller than the resolution of the probe itself, the adjustment may not be applied.

If, at the end of the run, the probe has acknowledged all instructions it has been sent, the “Completed“ button will turn green on the AutoCal screen and the PDF is saved to the USB drive. Details of the probe’s progress throughout the run can be viewed via the “Details” button.

Please note, the performance of a HC2-S within its stated specification is based on temperature adjustment being made at 23 °C. AutoCal *does* permit the adjustment to be made at other temperatures. However, this is only recommended when the operational environment of the probe being adjusted is only ever at another specific temperature, e.g. a stability cabinet at 40 °C. Adjustments made at temperatures other than 23 °C risk comprising the probe’s ability to meet its specification within the range of optimal performance: 18 to 28 °C.

Please note that HW4 cannot be used at the same time as AutoCal.

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4.1.7 Customising the PDF Calibration Certificate



Figure 23: Edit AutoCal Certificate

The PDF certificate can be customised by selecting “Edit Certificate” from the [AutoCal Screen](#) (Figure 13) or selecting “AutoCal” from the Settings menu on the Settings screen. It is possible to enter user and company information and to upload a custom logo.

To upload a logo, save it as a file “logo.jpg” to the root directory of a USB stick. Insert the USB into the HygroGen2. The HygroGen2 will detect the file and display your image. Select “Upload Logo”. The logo will be uploaded to the unit and will appear automatically sized and positioned on the PDF certificate below the “Rotronic HygroGen” logo.

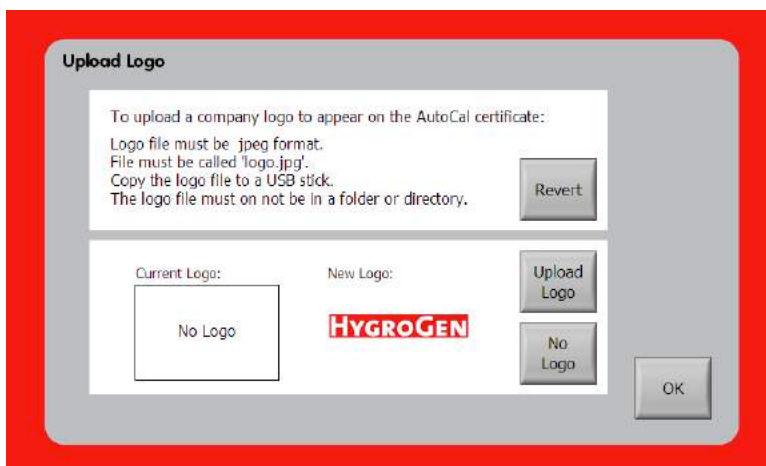


Figure 24: Upload Logo

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Enter company information in the Edit AutoCal Certificate Contact Information screen.



Figure 25: Edit AutoCal Certificate Contact Information

4.1.8 Reference Information

Information about the calibration of the reference probe itself can be entered by pressing “Configure Reference” in the [AutoCal Screen](#) (Figure 13) or selecting “Reference” from the “Settings” drop-down menu on the Settings screen,

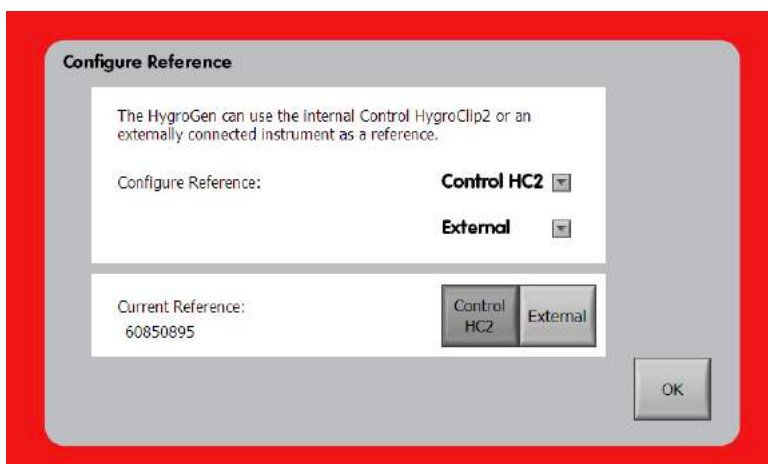


Figure 26: Edit AutoCal Reference

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and selecting the “Reference Info” from the “Control HC2-S” drop-down menu.

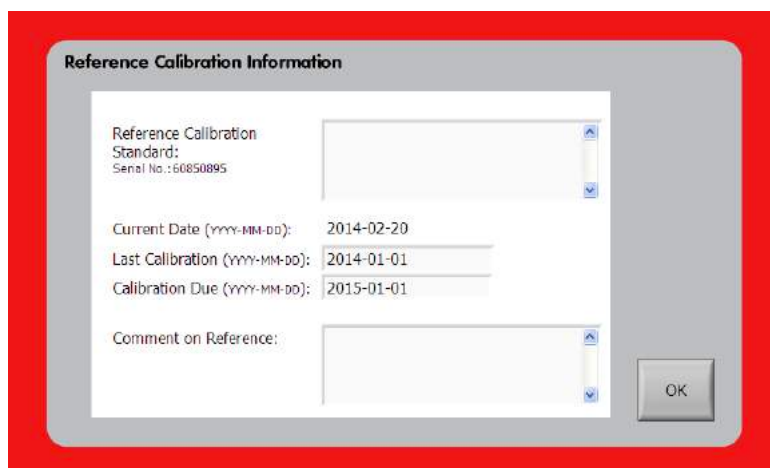


Figure 27: Edit AutoCal Reference Information

Reference calibration information can be entered here, including the last and next-due calibration dates and any comments.

When an AutoCal run is started, the user is warned should the reference calibration be out of date and prompted to update the reference information should the reference probe have been swapped out. The user is further asked to confirm that the operator name to be printed on the certificate does not require changing. If a probe that has previously been used and has reference information stored on the HygroGen2 is restored to the instrument, the information will automatically be reapplied.

4.2 External MBW/RH Systems Calibration Reference (AutoCal+)

To reduce further measurement uncertainties that can be achieved with the HygroGen2, ROTRONIC has worked with MBW (and its US affiliate company RH Systems), the world’s leading chilled mirror manufacturer to integrate their products into the HygroGen2. Particularly well suited is the MBW/RHS473 Dew Point Mirror, whose RP2 measuring head is designed to be directly inserted into the working volume of the HygroGen2 and works across its full range. Other models can be connected via the heated Swagelok sample ports on the rear of the instrument.

For an in-depth discussion on measurement uncertainty and the choice of calibration reference, please see [Appendix A1](#). There is also an Application Note, published by ROTRONIC which can be found via:

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<http://www.rotronic.co.uk/productattachments/index/download?id=901>

In order to calculate relative humidity (RH) from a dew point (chilled mirror) hygrometer, you also need to make continuous temperature measurements. All MBW/RHS instruments have the ability to record external temperature, the 473 with RP2 head combination has the temperature probe on the end of the head.



Figure 28: MBW/RHS RP2 Measuring Head

Relative humidity is calculated on MBW/RHS instruments using the Sonntag/Hardy equation. The same algorithm is implemented into the HygroGen2 (see [section 4.2.2](#)).

4.2.1 Connecting and Configuring MBW/RHS External Reference

Please also refer to the instruction manual appropriate to your MBW/RHS external reference.

Please use either an **Aten UC-232A USB-RS232** (you will also need a male-female RS-232 extension cable) or **Roline USB serial adaptor** (part number 12.02.1160) to connect the chilled mirror to any of the HygroGen2 USB ports.

Make sure the MBW/RHS reference hygrometer is plugged in, turned on and is connected to the HygroGen2 via the USB/RS-232 serial adaptor.

To configure an external reference, select “Connection” from the “External” drop-down menu.

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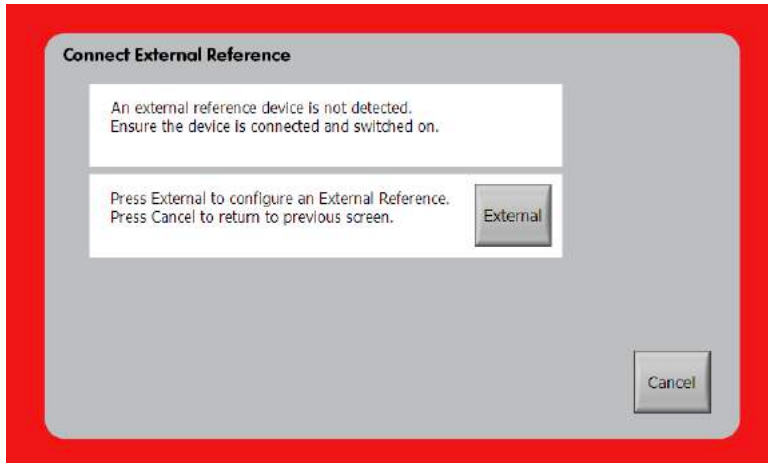


Figure 29: Connect External Reference

Once this is done, click “Scan” and your instrument should be detected. Click “Select” to use it, and then click OK.

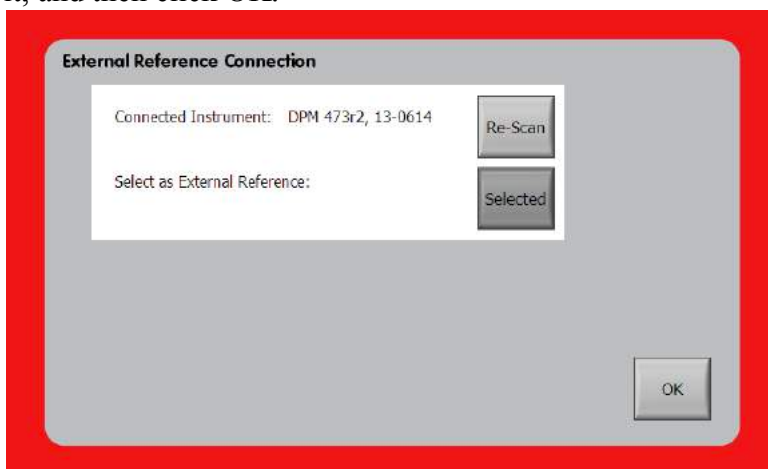


Figure 30: Scanning for Connected Devices

On the “Configure Reference” screen, select “External” as the current reference.

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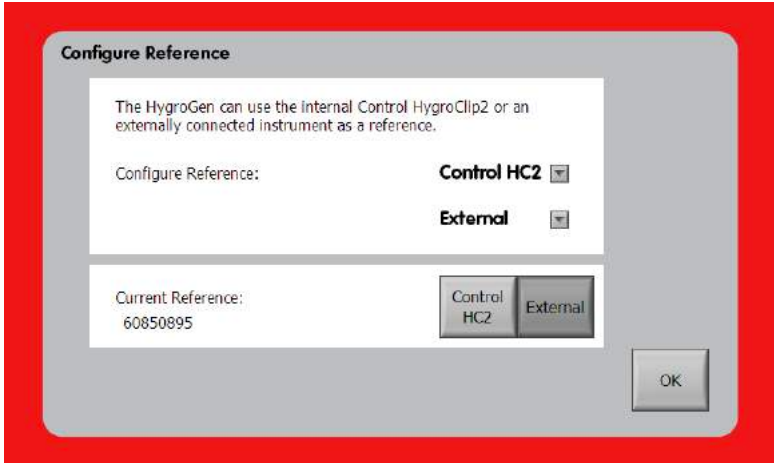


Figure 31: Select External Reference

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4.2.2 Measurement Type and Corrections

AutoCal+ (AutoCal used with MBW External Reference) gives you the choice between reading the RH value as determined by the external reference directly or by entering a table of dew point and external temperature probe corrections from the MBW/RHS dew point mirror's calibration certificate.

Please note that, by design, the MBW/RHS will not display corrected values itself. This is so that a calibration history can be built up, easily demonstrating the negligible drift over time of the chilled mirror instrument and so the drift component of an uncertainty budget minimised.

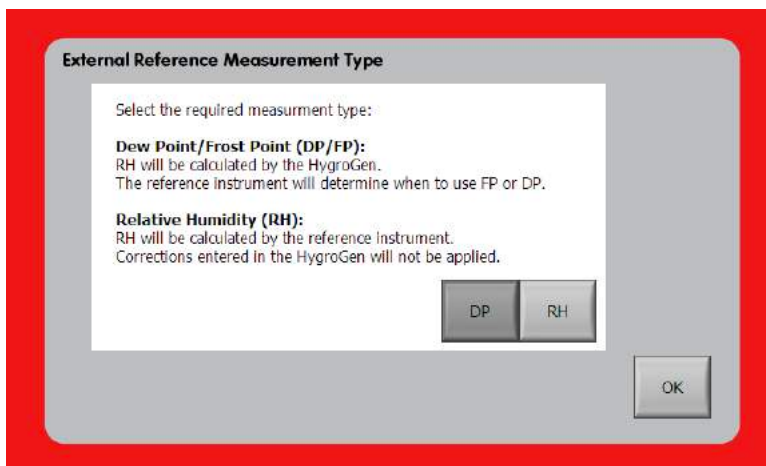


Figure 32: Measurement Type

Select the desired Measurement type: Dew Point or Relative Humidity. If selecting Dew Point, please proceed to the Corrections section to enter calibration certificate data. The choice is recorded on the certificate.

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4.2.3 Corrections

When getting your dew point hygrometer calibrated, **please request a dew point calibration** with corrections from your calibration supplier and a table of corrections for applied set-points for your external temperature probe. Note that some calibration labs may supply points below zero in terms of frost point. These need to be converted into dew point values. A useful tool to do this is the Psychrometric Conversion Utility that's part of HW4. See [Section 6](#). Enter the correction values from the instrument's calibration certificate via the two tables found via the "Corrections" option in the "External" drop-down menu and press the toggle button so that it displays "Applied".

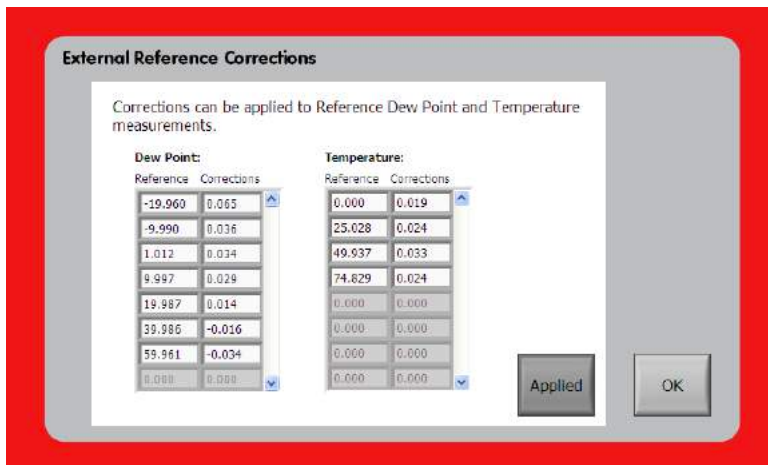


Figure 33: External Reference Corrections

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4.2.4 Calibration Info

Information about the calibration of your external reference can be entered via the “Calibration Info” option in the “External” drop-down menu.

Figure 34: Reference Calibration Information

Please note that if a different reference is used, the HygroGen2 will warn you to input new correction and calibration information for the new reference. Calibration corrections and information is stored on the HygroGen2 for each reference used and will be reapplied to the appropriate instrument if a reference is used again.

4.2.5 Advanced (Command Line interface)

The “Advanced” option in the “External” drop-down menu displays a command line interface to the MBW/RHS instrument. For details of available commands, see the MBW/RHS instruction manual.

4.2.6 Best Practices and Precautions

Please see the MBW/RHS documentation to learn more about the detailed operation of your dew point hygrometer. However, a few points to take particular note of:

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i. Dew/Frost control

Chilled mirror hygrometers work by precisely controlling the temperature of a mirror surface until the exact point that a dew (or frost) film forms. This dew (or frost) point is a *temperature independent* measurement of the humidity level in a gas at a particular pressure. A chilled mirror measures humidity only if mirror control is switched on. The HygroGen2 will report if mirror control is switched off.

ii. Mirror Cleaning

To make reliable measurements, it is very important that the mirror surface is clean, otherwise you will observe instability. Oil films and other contamination can condense onto the mirror surface, which can be transferred from dirty probes under test. See the MBW/RHS documentation for further details on mirror cleaning.

iii. Decontamination of HygroGen2 chamber

In certain circumstances the HygroGen2 chamber can itself become contaminated, and what appears to be a stable generated condition on the HygroGen2, is shown on the external MBW/RHS mirror to slowly drift upwards. This can be an indication of outgassing of oil based contamination that may have been absorbed within the internal mechanics of the HygroGen2. A mirror clean (either electronic or physical) that resets the drift to its original baseline will confirm the presence of contamination.

To mitigate this problem it is recommend to run the HygroGen2 at 60 °C >50 %rh for two or more days with the chamber filled with a tray of granular activated carbon (GAC).

Use as much GAC as practical. For the HG2-S use a suitable container that pretty much fills the chamber and fill that with GAC, for the XL use about three large lunch box style plastic containers filled with GAC.

Confirm afterwards that a mirror clean does not cause a step change in reading, and this will indicate the contamination has been removed.

iv. Super Cooled Water: Dew or Frost Films. Force Frost Threshold

With any condensing measurement, care needs to be taken for humidity conditions with a dew point at or just below freezing, typically in the range -7.0 – 0 °C. Super cooled water may exist on the mirror rather than frost and the temperature at which dew or frost films form is fractionally different. MBW/RHS instruments have a Force Frost function which engages below a pre-set value to ensure a frost rather than a dew film. The equivalent dew point value is then used by the HygroGen2 to make its RH calculation. A typical Force Frost threshold value might be -5 °C. It is recommended to use the Force Frost functionality, but avoid programming set-points with a dew/frost point between 0 °C and the threshold. See MBW/RHS documentation for more details. NB: there is a convenient psychrometric calculation utility

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within the built-in HW4 software (see [section 6](#)) to calculate dew points. E.g. at 23 °C, 15 %rh dew point is -5 °C, at 23 °C, 21.5 %rh dew point is -0.15 °C. So at 23 °C, avoid 15-22 %rh as a set point.

v. Extremes of Temperature and Humidity

As with any other reference or instrument under test that is inserted through the door, stem conduction should be considered at the extremes of the HygroGen2's measurement range.

A recommendation for conditions that are higher than 50 °C, 90 %rh, or 60 °C, 80 %rh is that the entire RP2 measuring head is mounted on the *inside* of the door. At these extremes, condensation will form at cold spots that can be introduced if there is thermal conduction with the ambient conditions.



Figure 35: Probe mounted on inside door surface

An HG2-B8-9 bung which has a 9-17 mm cable gland can be used to secure the head cable from the outside of the door and provides further insulation.

4.3 Remote Control

4.3.1 Remote Screen Share

The Remote Screen Share enhanced feature (note, in versions prior to 2.5 this was known simply as 'Remote Control'), the HygroGen2 interface can be manipulated remotely using the open standard VNC protocol and your preferred remote control device. Multiple connections to single or multiple HygroGen2s are supported.

The feature requires the HygroGen2 to be connected to a network, and the instrument to be appropriately configured for network access. See section [Section 3.3.1 Network Settings](#).

Any VNC viewer/client can be used. ROTRONIC recommends RealVNC.

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iOS: <https://itunes.apple.com/gb/app/vnc-viewer/id352019548?mt=8>

Android: <https://play.google.com/store/apps/details?id=com.realvnc.viewer.android>

Windows: <https://www.realvnc.com/en/connect/download/viewer/>

Apple Mac: OS X has a built-in VNC viewer via the Finder “Go” menu and “Connect to Server”.

Your remote control device needs to be on the same Local Area Network (LAN) and subnet as your HygroGen2. Off-site connections are possible from other networks using firewall traversal/port forwarding (port 5900) but configuration is required on your firewall and is beyond the scope of this document. Contact your IT support department if you wish to set this up.

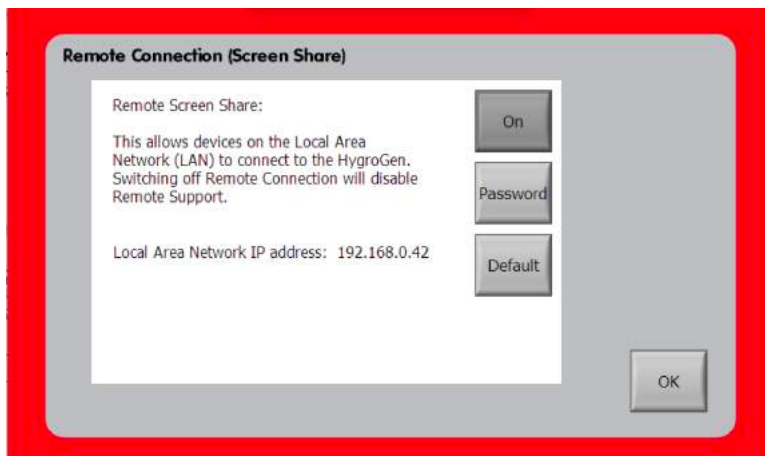


Figure 36: Remote Screen Share

To enable Remote Connection, go to the “Settings” drop-down menu on the “Settings” screen and select “Remote (Screen Share)”. The functionality can be toggled on or off by the “On”/“Off” button.

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To set the VNC password requires configuration mode. Please press the “Password” button to restart the HygroGen2. Once in Configuration Mode, reselect “Remote Connection” from the Settings drop-down menu and then press “Password”.

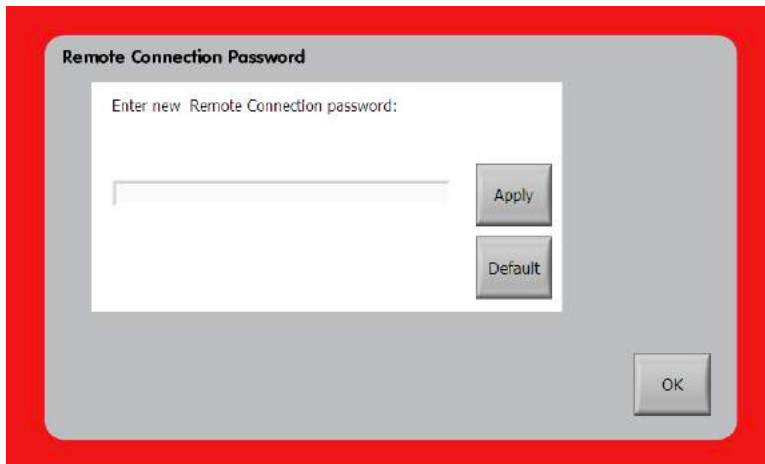


Figure 37: Set Password

In normal Operational Mode, the “Default” button *temporarily* resets the VNC password to a service default password, which will persist until the HygroGen2 is restarted. If in Configuration Mode, pressing “Default” will *permanently* set the VNC password to the service default password. You will need to set your password again via the “Password” button if this is pressed.

To connect your VNC client to the HygroGen2, enter the Local Area Network IP address as the server name in your VNC client, and the password as set in the previous section. You may receive a warning that the connection is not encrypted.

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4.3.2 RemoteAPI

The Remote Application Programming Interface (API) feature allows granular control and logging of the HygroGen2 using external software via a set of TCP/IP strings commands over the network. This allows integration with 3rd party calibration software platforms, e.g. Beamix or customised control software.

The feature requires the HygroGen2 to be connected to a network, and the instrument to be appropriately configured for network access. See section [Section 3.3.1 Network Settings](#).

The following description uses the Shell Client ‘putty.exe’ as an example command line interface, which is available as a free download for PC or Mac.

<https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html>

Commands are issued on port 6341 in RAW TCP/IP format to the IP address of the HygroGen2. Any bespoke client can be used which can issue commands in this format, e.g. National Instruments LabView.

To enable Remote Connection, go to the “Settings” drop-down menu on the “Settings” screen and select “RemoteAPI”. The functionality can be toggled on or off by the “On”/“Off” button.

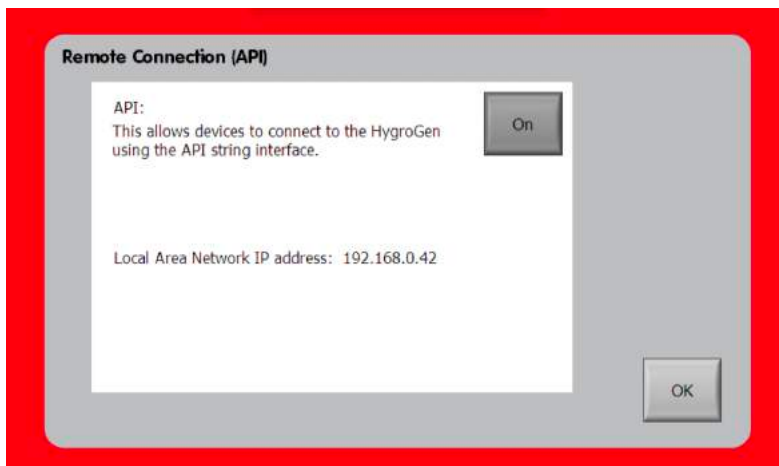


Figure 38: RemoteAPI

Your remote control device needs to be on the same Local Area Network (LAN) as your HygroGen2. Off-site connections are possible from other networks using firewall traversal/port forwarding (port 6341) but configuration is required on your firewall and is beyond the scope of this document. Contact your IT support department if you wish to set this up.

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Using the reported LAN IP address, establish a connection in RAW format on port 6341.

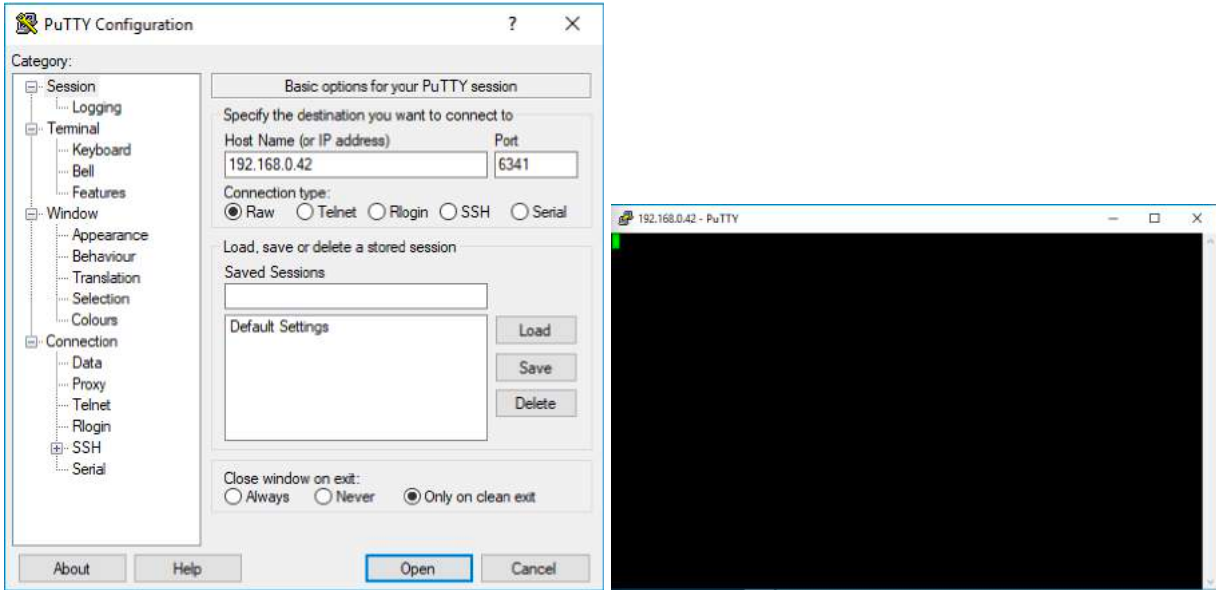


Figure 39: Putty – Example Command Line Interface

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At the command prompt, you can issue any of the follow series of queries or commands, which essentially mirror the touchscreen interface described in [section 3.4.1](#) and [section 4.2](#)

Command	Expected value	Description
Temp?	-5.00...60.00	Reports value of chamber temperature in degrees Celsius (fast PRT)
TempRef?	-5.00...60.00	Reports value of chamber temperature in degrees Celsius (slow HC2-S-S or MBW External Reference)*
TempControl?	1,0	Reports whether chamber temperature control is on (1) or off (0)
TempControl=x	1,0	Sets chamber temperature control to be 'x' on (1) or off (0)
TempSP?	-5.00...60.00	Reports value 'x' of chamber temperature set point in degrees Celsius
TempSP=x	-5.00...60.00	Sets value 'x' of chamber temperature set point in degrees Celsius
TempStable?	1,0	Reports whether chamber temperature is stable (1) [=green on interface] or unstable (0) [=red on interface] within set criteria
RH?	0.0...99.0	Reports value of chamber humidity in %rh [as reported by control HC2-S-S]
RHRef?	0.0...99.0	Reports value of chamber humidity in %rh [as reported by selected reference, either HC2-S-S or external MBW]*
RHControl?	1,0	Reports whether chamber humidity control is on (1) or off (0)
RHControl=x	1,0	Sets value 'x' of chamber humidity control to on (1) or off (0)
RHSP?	0.0...99.0	Reports value of chamber humidity set point in %rh
RHSP=x	0.0...99.0	Sets value 'x' of chamber humidity set point in %rh
RHStable?	1,0	Reports whether chamber humidity is stable (1) [=green on interface] or unstable (0) [=red on interface] within set criteria
Time?	YYYY-MM-DD hh-mm-ss	Reports date/time
Desiccant1DP?	-90...0	Reports estimate of desiccant level in degrees Celsius (dew point)
Desiccant2DP?	-90...0	Reports estimate of desiccant level of second desiccant cell (HG2-XL only) in degrees Celsius (dew point)
WaterLevel?	0..100	Reports water level sensor reading in ml
HC2-SSerial?	<text>	Reports serial number of control HC2-S-S
DesiccantHC2-SSerial?	<text>	Reports serial number of desiccant HC2-S-S

Continued

*note: these values will be with corrections applied if the MBW Reference is used, a correction table has been entered, and applied and RH calculations are based on dew point (not RH).

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(RemoteAPI command list – continued)

Command	Expected value	Description
Version?	<text>	Reports HG2 firmware version
ControllerSerial?	<text>	Reports HG2 hardware controller serial number
Name?	<text>	Reports HG2 NetBios network name as configured in Network Settings
Reference?	<text>	Reports whether the internal control HC2-S or an external MBW reference is configured to be the reference
<i>CorrApplied</i>	1,0	<i>Reports whether dew point corrections applied if MBW External Reference is used. NB Not yet implemented.</i>
<i>Calculation</i>	1,0	<i>Reports whether calculation is made on basis of RH or DP if MBW External Reference is used. NB Not yet implemented.</i>
<i>RefFile</i>	<text>	<i>Reports contents of reference information as entered in HygroGen2 interface. NB Not yet implemented.</i>
ExtRefSerial?	<text>	Reports model and serial number of external MBW reference
ExtRefTemp?	-20.0...70.0	Reports MBW external temperature in degrees Celsius (uncorrected)
ExtRefDP?	-20.0...70.0	Reports MBW external reference dew point in degrees Celsius (dew point)
ExtRefDPCorr?	-20.0...70.0	Reports MBW external reference dew point in degrees Celsius (dew point) with applied corrections
ExtRefFP?	-20.0...70.0	Reports MBW external reference frost point in degrees Celsius (frost point) (uncorrected)
ExtRefRH?	0.0..99.0	Reports MBW external reference humidity in %rh (uncorrected)
ExtRefControl?	1,0	Reports whether dew/frost control switched on (1) or off (0) on MBW external reference
ExtRefStable?	1,0	Reports whether dew/frost layer is stable (1) or not (0) on MBW external reference
E=	<text>	Passes command directly to MBW External Reference (see MBW manual for list)
Warning?	<text>	Reports any HG2 onscreen notifications, e.g. low water level
ProgramRun?	1,0	Reports whether if any programs running on HG2 (1 if yes, 0 if no)

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4.4 Range Extensions

Range extension allows the unit to operate down to -5 °C and 2 %rh and up to 99 %rh (between 10 °C and 45 °C). The unit is able to reach 90 %rh above 45 °C and below 10 °C.

Please be aware that it may take a long time to reach set-points at these extremes of temperature and humidity, and the unit may need to be individually adjusted to optimise performance. Ambient conditions will affect the performance of the HygroGen2 at low temperatures. Units that have not been serviced recently may not achieve these extremes. Control HC2-Ss that are not specifically calibrated for low temperature & RH operation may require adjustment. Expert adjustment of the control PID parameters may also be required. PID access is via the Service Menu, which is locked down for standard operation. For further information please contact hygrogen@rotronic.co.uk.

With the Humidity Range Extension the HygroGen2 may be further configured to allow set-points between 0 and 99.9 % RH (maximum 90 %RH below 10 °C). This is done from the Service menu on the Service screen. The performance and stability of the instrument as it approaches these extreme conditions is not guaranteed. Furthermore, the accuracy of the control probe needs to be borne in mind.

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5 General Operational Considerations

5.1.1 Water in the Chamber

Before using the HygroGen2, check that there is no visible water inside the chamber. If the last condition run by the HygroGen2 was at high humidity and the unit was not correctly shut down (see below), condensation may have formed. Remove excess water using absorbent tissue and initially run the HygroGen2 at an elevated temperature (40 °C) and low RH set-point to dry the system before calibrations are performed.

5.1.2 Below Ambient Temperature Operation

If the chamber is cooling (or maintaining a temperature below ambient), then the heat pump assembly inside the chamber will necessarily be below the chamber temperature. If the humidity in the chamber is high, the cool heat pump assembly can bring the local air temperature below the dew point, causing condensation to occur on the internal heat pump assembly. If run under these conditions for extended periods, condensation will collect in the chamber. This will not affect chamber performance within normal operating ranges (although it will increase the time to achieve low humidity). Water in the chamber can be removed using an absorbent tissue. Ensure the HygroGen2 is switched off before manually drying the chamber.

When operating the unit at high humidity and chamber temperatures of more than a few degrees below ambient, the following procedure will minimise condensation in the chamber during stabilisation:

1. Set the set-point temperature to approximately ambient.
2. Set the set-point humidity to 10 %rh and allow the HygroGen2 to stabilise.
3. Set the humidity control to Manual (as described in Automatic/Manual Mode in [section 3.4.1](#)).
4. Apply the temperature set-point to that desired and allow the HygroGen2 to stabilise.
5. Wait for the Humidity reading to fully stabilise (this may take 15-20 minutes).
6. Set the humidity control loop to Automatic.

It is recommended that the chamber door is not opened when the chamber temperature is below the ambient temperature as water vapour from the atmospheric air introduced will condense out into the chamber. The dehumidification of the chamber takes longer at lower chamber temperatures.

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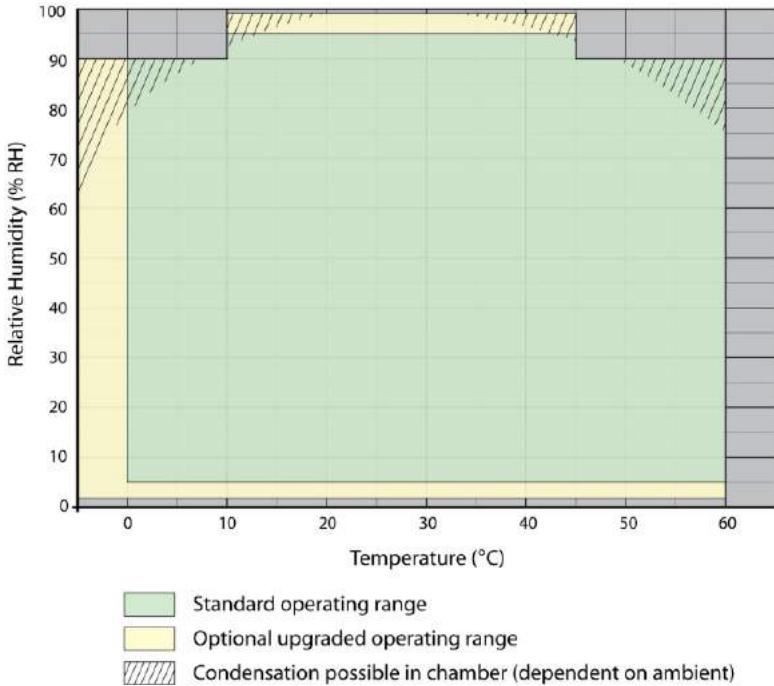


Figure 40: Humidity Map – Standard and Extended Ranges

5.1.3 Above Ambient Temperature Operation

At high temperature and high relative humidity conditions, it is necessary to allow the unit to stabilise to ensure minimal condensation. It is recommended that, for making measurements over 45 °C and 80 %rh, the HygroGen2 temperature be permitted to equilibrate for 20 minutes before high humidity is introduced. It is also recommended that, under these conditions, the desired RH level is achieved in incremental steps, allowing stabilisation at each step. If the unit is operated at high temperature and high humidity for prolonged periods, it is strongly recommended that the chamber is thoroughly dehumidified prior to switching the unit off.

5.1.4 Probe Insertion Depth

When adjusting or calibrating probes against a reference, make sure that the insertion depth of each instrument is the same for each probe. Using the same immersion depth substantially reduces the effect of any temperature and humidity gradients in the chamber.

The immersion depth of any probe inserted in the HygroGen2 should be within the limits of 100-150 mm (4-6”), measured from the inner side of the door. This will reduce the effect of room temperature via stem conduction on the probe.

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5.1.5 Protective Filters

Make sure you allow appropriate extra time for probes with particular protective filters. These probes require a longer time than the HygroGen2 to stabilise.

The Trend Screen displays the measured values over time (10 minute default on the x axis), so the user is able to observe whether the HygroGen2 is stable within the acceptance criteria.

5.1.6 Low Water Level Alarm

The unit will inform the operator if the water level in the reservoir is too low with a visual “Low Water Level” prompt on the controller screen. This prompt may be dismissed by following the on-screen instructions.

If the water level in the saturator falls below 20 ml, humidification is disabled to prevent damage to the humidifier. Humidification will not be re-activated until the water level is restored.

Replenish the reservoir according to the instructions in [section 2.4](#).

Note: If the “Low Water Level” message appears on the controller screen during use, the HygroGen2 can be topped up with 50 ml of demineralised water. This will bring the total water content of the reservoir to approximately 80 ml.

5.1.7 Water Level Indicator Calibration

The water level sensor may behave differently for different qualities of water. To ensure accuracy of the water level indicator, periodic calibration is advised. To access this feature, go to the Settings Screen and select “Water Level” from the “Settings” drop-down menu. Follow the on-screen instructions.

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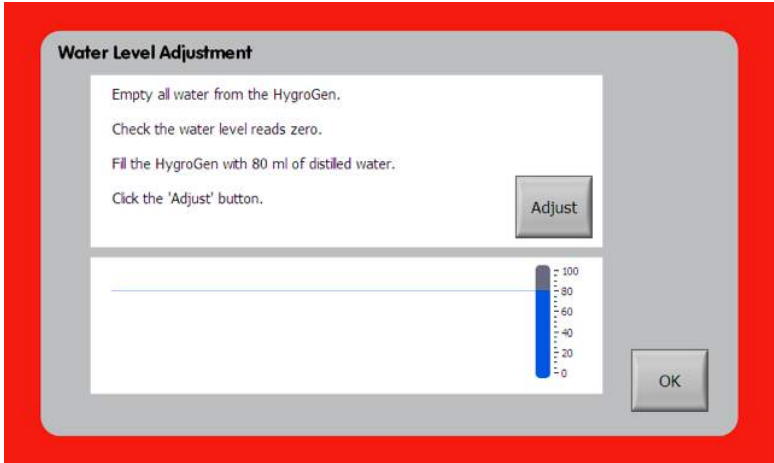


Figure 41: Water Level Adjustment

5.2 Switching off the HygroGen2



There are two Shutdown procedures; these are presented after you press the on-screen power button. It is important that these are observed; instrument faults attributable to incorrect Shutdown are not covered by the warranty.

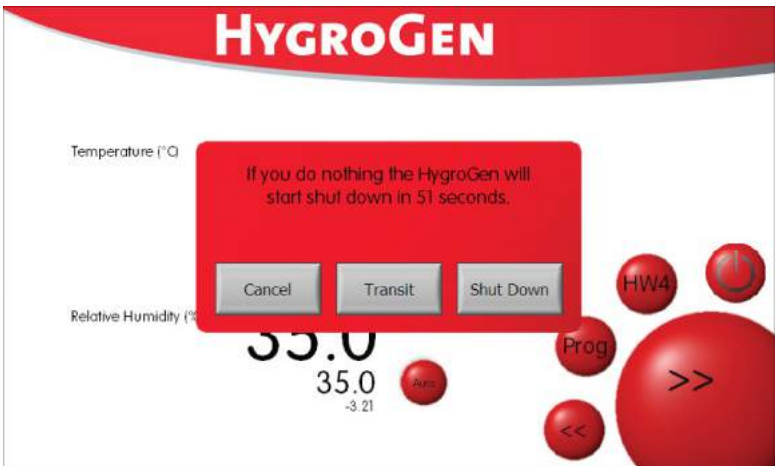


Figure 42: Shutdown Screen

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5.2.1 Shut Down

In normal circumstances use “Shutdown”. This dries the chamber to prevent residual water and isolates the humidifier from the chamber. Once correctly shutdown, the HygroGen2 is in a suitable condition for short- to medium-term periods without use. It is also put into a condition where it can be moved carefully in a horizontal position (e.g. on a trolley) to a different location (say, within a building).

Shutdown Procedure:

1. Press the “Power Off” button on-screen.
2. Select “Shut Down”.
3. Allow the HygroGen2 to shut down. The HygroGen2 will isolate the humidifier and cool/dry to ensure excess water is removed. This may take several minutes.



**DO NOT switch off at the wall before the HygroGen2 has shut down.
DO NOT switch off at the back of the HygroGen2 before it has shut down.**

5.2.2 Transit

Use “Transit” to shut down and condition the HygroGen2 if the unit is to be transported or stored for an extended period. The HygroGen2 will ask for the unit to be emptied of water. It will isolate the humidifier from the chamber and then cool/dry the chamber to ensure excess water is removed. This process may take several minutes.

Transit Procedure

1. Press the “Power Off” button on-screen.
2. Select “Transit”.
3. Empty water as prompted on-screen.
4. Allow the HygroGen2 to shut down. The HygroGen2 will isolate the humidifier and cool/dry to ensure excess water is removed. This may take several minutes.



**HygroGen2 will not switch off if the water is not emptied as requested!
DO NOT switch off at the wall before the HygroGen2 has shut down. Failure to do this may cause software corruption if running firmware version 1.x.**

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5.3 Preparing the Unit for Transit or Storage



Shut down the HygroGen2 according to the Transit Shutdown Procedure above. If the HygroGen2 needs to be shipped, always use the original double-layer cardboard packaging. The HG-TB transit bag is suitable for hand carrying only; for air or truck shipping, supplement the HG-TB with a sturdy cardboard box with at least 100mm of foam or other shock protection material surrounding all sides.



When shipping involves air transportation, either remove the chamber door, or at least one probe bung, to prevent condensation of any residual moisture when exposed to low aircraft hold temperatures.



Figure 43: HG-TB Transit Bag



Even having completely emptied the water reservoir, after transportation there may be a small amount of residual water that has drained into the chamber from the pipework. This is normal and can be simply wiped out with a lint-free cloth.

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6 HW4 Embedded

HygroGen2 comes with HW4 ROTRONIC device control software on its embedded PC. This provides the user with access to HW4 functionality to access ROTRONIC USB devices without the need for a separate PC.

HW4 features include:

- Psychrometric conversions
- Instrument configuration
- Data acquisition
- Measurement display and graphing
- Calibration and adjustment

HW4 does not work with other manufacturers' USB probes.

6.1 HW4 Set Up and Getting Started

For full functionality, HW4 requires an external monitor, keyboard and mouse to be connected to the HygroGen2 (see [section 7](#)). To start HW4, touch the HW4 icon. Drag the HW4 window onto a second monitor if available.

Any ROTRONIC HC2-S probes that are connected to the HygroGen2's USB ports using a ROTRONIC service cable, can be connected to HW4 using the "Search for USB Masters" command. For a full overview of the use and features of HW4, please refer to the full HW4 manual. This can be obtained from the Downloads section of www.rotronic.com.

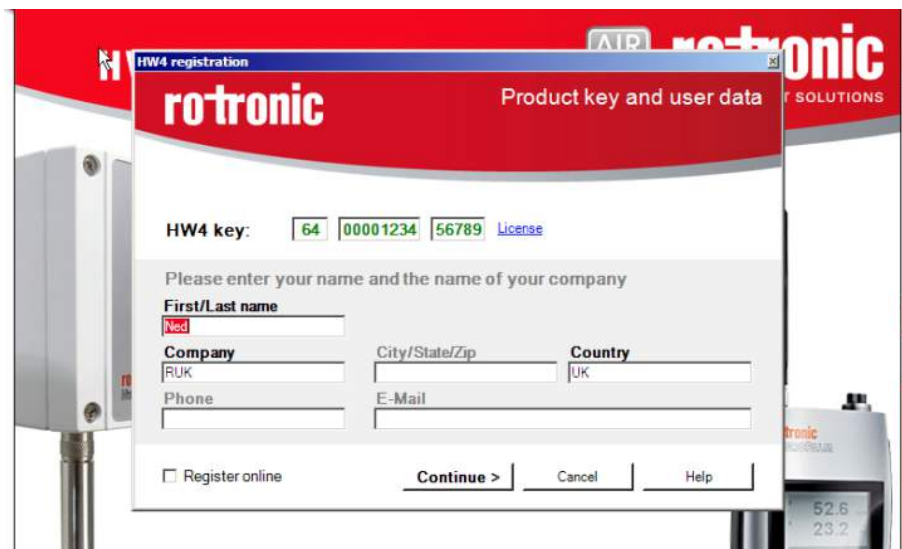
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6.2 HW4 Installation and Registration

HW4 is preinstalled and activated during HygroGen2 manufacture. The HW4 version number can be identified via the Settings screen of the HygroGen2. Select the “Support” drop-down menu and select HygroGen2 Info; please have this information available in the event that you require technical support.

You may also need the unique HW4 installation key which can be found as follows:

- i. On the HygroGen2, launch HW4. Click Registration on the startup screen.



- ii. Make a note of the serial number.
- iii. Click Cancel and close HW4.

To register your HW4 software and to assign your full contact details, visit www.rotronic.com and go to the “Software” Section. Software registration will ensure that you receive full support and notification of upgrades available. Do not try to register online via the HygroGen2 interface as this will not work.

6.3 HW4 Support

Support for HW4 is available via email. Please contact support@rotronic.ch including your full contact details, the HygroGen2 serial number and HW4 product key, and a description of your query or problem. You will receive a response within a maximum of two working days.

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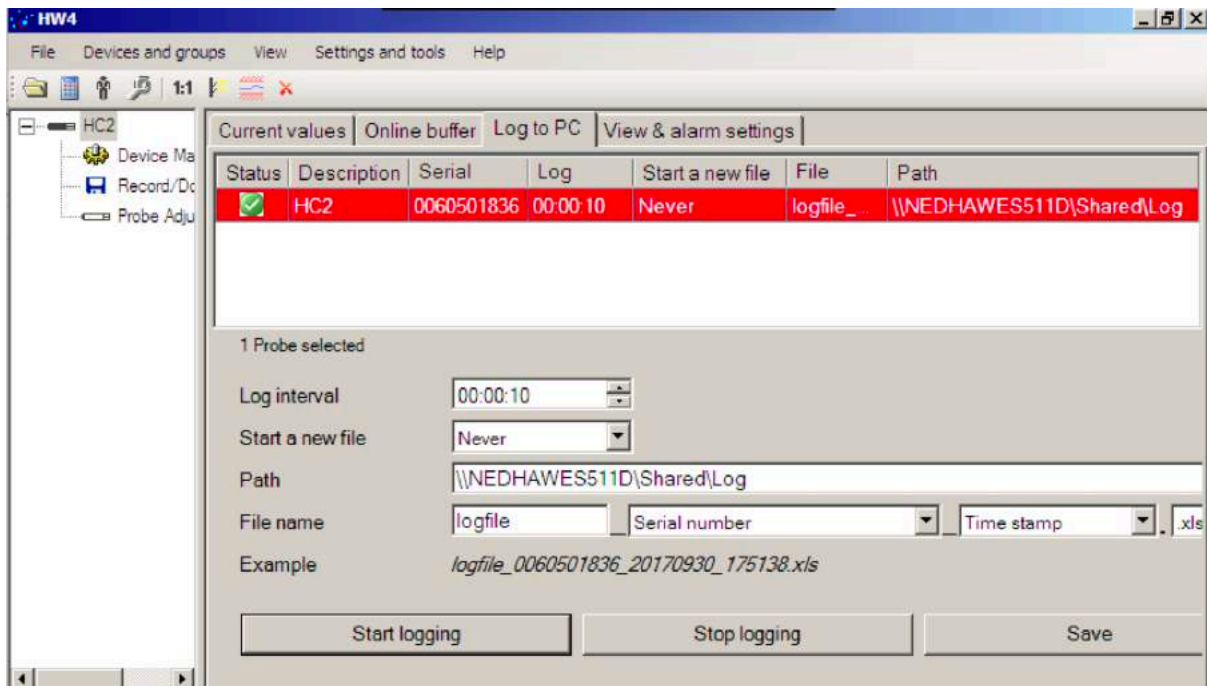
6.4 Data Logging in HW4

6.4.1 Test Instrument Data

HW4 can log to an inserted USB stick or to a network file share.

In HW4, click the instrument under test in the device tree and select Log to PC.

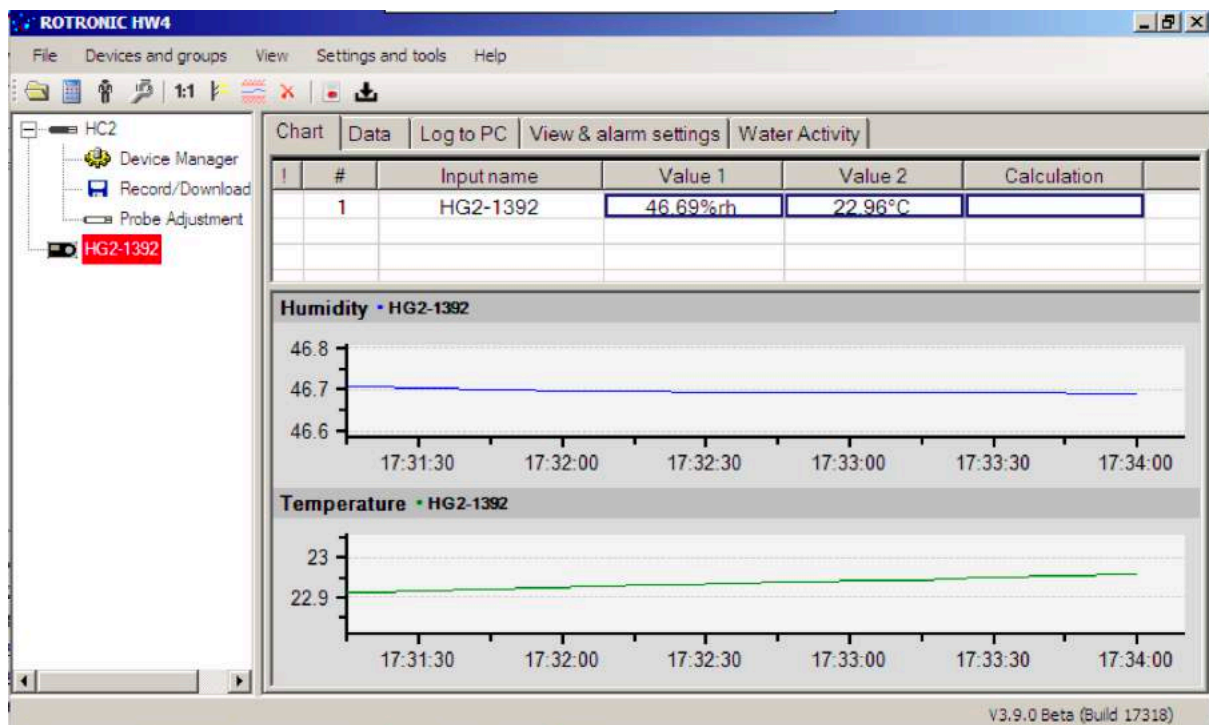
Choose either a local path to a USB stick, or configure a network file share, as described in [Section 3.4.9](#), and enter the required server path in the 'Path' field in HW4. For further details on HW4, please see ROTRONIC HW4 documentation.



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6.4.2 Control HC2-S [FEATURE PENDING HW4v3.9]

As of firmware version 3.0, HW4 can see and log the HygroGen2 control HC2-S.



HW4 automatically detects the HygroGen2 and adds it to the device tree. Should you not wish for it to be listed, delete it in the proscribed fashion as detailed in HW4 documentation.

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7 External PC Peripherals

7.1 USB Keyboard and Mouse

All standard user functions may be accessed using the HygroGen2 touch screen. However, if desired, any standard USB keyboard and mouse may be plugged in via front or rear USB ports to facilitate operation.

This is particularly useful for operating the embedded HW4 ROTRONIC device control software.

7.1.1 International Keyboard Layouts

Different international keyboards can be configured for the HygroGen2 via the Settings Page, “Settings” drop-down menu and selecting “Keyboard Setup”.



A standard Windows Keyboard Control Panel appears which can then be configured to use your keyboard layout of choice.

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7.2 External Monitor

Running the embedded HW4 software on the integrated screen is possible, but not practical, so an external DVI monitor connection is available on the rear of the HygroGen2. DVI monitors are widely available; no special configuration or size is required.

To configure the DVI monitor, use the following procedure:

1. Connect the HygroGen2 to the DVI monitor.
2. Plug in the USB keyboard and mouse.
3. Go to the Settings screen on the HygroGen2.
4. Select Monitor Set-Up – “Display Properties” appears.
5. Click on monitor 2 icon.
6. Select “Extend my Windows desktop onto this monitor”.
7. Click on “Apply”.
8. Screen resolution should be adjusted to suit the monitor connected.
9. Apply any changes and click “OK” to exit Display Properties.
10. Click on the HW4 icon.
11. HW4 will open on the HygroGen2 screen.
12. Using the mouse, drag the HW4 window so that it displays on the monitor.
13. You can now size the HW4 window to suit the connected monitor.

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8 Servicing and Maintenance

8.1 Control HC2-S Calibration

The control HC2-S may need to be removed for calibration. To minimise HygroGen2 downtime, alternative calibrated probes can be fitted in place of the existing probe, though careful control of the reference probe serial number used should be taken. When using the control probe as the reference in AutoCal, the serial number of the probe used will automatically be recorded within the calibration certificate.

8.1.1 Removing Control HC2-S HG2-S

To remove the control HC2-S, turn off the HygroGen2 control and remove the door. Reach into the chamber and unscrew the HC2-S from its mounting connector. Take care not to cross the threads on the collar when refitting.

8.1.2 Removing Control HC2-S HG2-XL

To remove the control HC2-S, turn off the HygroGen2-XL control and open the door. First, remove the Fast PT100 sensor, by gently pulling on the Lemo connector. Then do the same for the HC2-S control HC2-S. Unscrew the HC2-S from its housing.



Figure 44: HG2-XL Control HC2 and PT100 Sensor, and with latter removed

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Figure 45: Control PT100 and HC2 separated from Lemo housing

When replacing, take care not to cross the threads on the collar when refitting. Line up the Lemo connectors so the red spot faces forward and push back into place, first the HC2-S, then the PT100 sensor.

8.2 Desiccant

The HygroGen2 uses a desiccant when lowering humidity in the chamber. The desiccant condition is shown within the Settings screen. This shows an approximate indication of the dew point within the dryer cell.

If the HygroGen2 does not reach low RH set-points promptly, check the desiccant condition and replace as required.

The measured desiccant value is established when the dryer is active and a flow of air from the desiccant cell is passing over the desiccant sensor; this value is held when the dryer is active to provide the user with an indication of the desiccant condition even if the dryer is not used. To update the value, run the HygroGen2 on the lowest RH set-point (5 %rh) for at least 15 minutes.

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8.2.1 Changing Desiccant

Remove the desiccant cell from the HygroGen2 by pulling firmly on the cell cap (Figure 1(5)). The cell is held in place securely to maintain an air-tight seal; a gentle twist will help removal. Changing the desiccant should be undertaken in a ventilated area.

Observing the diagram below (Figure 36), remove the cap and pour out the used desiccant material and replace with new or regenerated material. Avoid exposing the replacement desiccant unduly to the atmosphere.

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Ensure that the cell is filled with as much desiccant as possible to ensure there are no air gaps. Remember to replace the foam insert (that fits between the cell cap and the desiccant) before replacing the cell cap and spring clip. Application of silicone grease on the desiccant cell cap "O" ring will help ease removal and refitting.



Figure 46: Desiccant Cell



Caution: Do not use dusty desiccants as the dust may be passed into the chamber.

8.2.2 Choice of Desiccant

The HygroGen2 is supplied from the factory filled with molecular sieve desiccant. Molecular sieve is preferred due to its higher performance in all temperature and humidity conditions and is longer lasting and can be regenerated through heating. Other desiccants including self-indicating silica gel and drierite can be used if desired; for further information, please contact hygrogen@rotronic.co.uk. Dusty desiccants should be avoided as particles may be passed into the HygroGen2 chamber. Replace or regenerate the desiccant whenever the drying performance of the HygroGen2 is deteriorating.

Material Safety Sheets for the desiccants supplied by ROTRONIC are available on request.

Regeneration of Molecular Sieve Desiccant

To regenerate molecular sieve, remove it from the desiccant cell and heat it at 175 °C for 3-5 hours in a dry environment (do not use a gas oven). After heating, allow to cool in a dry or sealed environment.

Performance of the regenerated desiccant can be measured in the HygroGen2 according to the method described above. Alternatively, replacement new desiccant can be ordered from ROTRONIC. Please contact your local dealer.

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8.3 HygroGen2 Cleaning

Prior to all servicing and maintenance procedures, the IEC mains cable at the rear of the HygroGen2 should be disconnected from the electrical mains supply.

8.3.1 External surfaces

The external surfaces of the HygroGen2 may be cleaned with a lint-free cloth dampened with a mild soap solution. Care must be taken not to allow fluids into any of the apertures on the unit.

8.3.2 Air Inlet Filters – HG2-S

The fan inlet filter can be cleaned using a vacuum cleaner applied to the exterior of the HG2-S side grill to remove any particulates. The filter material is replaced during servicing.

8.3.3 Air Inlet Filters – HG2-XL

The two air inlet filters on the back of the HG2-XL can be removed by unclipping the filter housing, and the plastic filters can be washed under a tap, and replaced when thoroughly dry.



Figure 47: HG2-XL Air inlet filter removal

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8.3.4 Chamber

Periodically, it is recommended that the internal surfaces of the HygroGen2 chamber sleeve are inspected and wiped clean of any visual residues using a lint-free cloth moistened with demineralised water. Care should be taken to avoid mechanical damage to the control probe and sampling tubes inside the chamber.

8.3.5 Purging internal pipes

Some humidity instruments are used in environments where chemical contaminants may be present. Should these transfer to the HygroGen2, this may result in drift of the RH control probe, which would become apparent during calibration. To purge the internal pipe work and chamber of the HygroGen2, replace the desiccant with Granular Activate Charcoal (GAC) and run the unit at 40°C and 5%rh for 6 hours. Any volatile compounds within the HygroGen2 will be absorbed into the GAC.

8.4 Annual Servicing of HygroGen2

The unit does not require routine user maintenance beyond that described in this Section.

For optimum performance, ROTRONIC recommends that the HygroGen2 is serviced every 12 months at an approved HygroGen2 service centre, details of which can be found in [Appendix C2](#) of this manual.



Under no circumstance should the unit be opened by personnel unauthorised by the manufacturer. Doing so will void the manufacturer's warranty and expose potentially dangerous electrical hazards.

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A1: Calibration Reference Options

Various calibration references can be used with the HygroGen2. These include the internal control probe, other RH probes, dew point chilled mirrors and platinum resistance thermometers (PRTs).

For traceable calibration, these references are themselves calibrated by accredited laboratories traceable to national standards.

For more information, please refer to The Guide to Uncertainty of Measurements (GUM) published by the UK National Physical Laboratory (or equivalent national standards documentation) and ISO/IEC 17025:2005 “General Requirements for the Competence of Testing and Calibration Laboratories”.

[Appendix D1](#) provides examples of uncertainty budgets for the HygroGen2 when using different calibration references. These are for guidance only and ROTRONIC accepts no liability in relation to their use.

A1.1 Internal RH Probe Reference

The display values on the HygroGen2 (which are derived from the control probe - as described in [Appendix A2](#)) can be used as the reference.

Advantages:

- No supplementary instruments are required.
- Fastest response - control is based on the reference value.
- Stability during calibration – the reference is continually optimising the control value.
- The reference probe can be easily replaced with another calibrated probe.
- HC2-S probes have the facility to be adjusted to agree with a calibration reference, meaning no corrections of the HygroGen2 display value need to be made in routine use.

Disadvantages:

- RH probes can drift over time, so regular checks need to be performed to achieve best measurement capability and a larger drift component included in an overall uncertainty calculation.
- Probe characteristics, such as hysteresis or temperature coefficients, must be included within the overall uncertainty budget.
- RH probes are less accurate than chilled mirrors.

Using the internal probe as your reference provides the most convenient option, but routine checks of the probe’s stability are required to ensure the quality of the calibration. Interim calibration checks against a traceable reference (e.g. ROTRONIC non-saturated salt

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solutions) should be carried out regularly and the results recorded in a probe calibration history.

Annual recalibration of the control probe by an accredited laboratory should be the minimum calibration regime. Interim calibration checks in combination with the annual calibration results will allow the key drift component of an uncertainty budget to be defined and documented.

A1.2 External RH Probe Reference

Any RH instrument placed through the HygroGen2 door can be used as the reference. This may be desired if your Quality System employs a particular RH probe with a long history. It may not be desirable to adjust this probe and use it as the control probe – a separate adjusted control probe may be more convenient.

The same disadvantages apply when using an external RH probe as a reference as when using the RH control probe: i.e. accuracy, susceptibility to drift, hysteresis, regular calibration requirement.

A1.3 Chilled Mirror Reference

To reduce calibration uncertainty, a chilled mirror instrument can be employed as the reference. This type of instrument is generally accepted as a secondary humidity transfer standard. Instruments should be maintained with an accredited (ISO 17025) calibration certificate. A chilled mirror can be used to validate the HygroGen2 calibration before and after on-site calibration using the internal RH probe as a reference.

Chilled mirrors measure “dew point“, which is a measure of water vapour concentration and is the temperature at which dew will form on a surface. Relative humidity can be derived from this value with a corresponding temperature measurement.

There are two types: an all-in-one probe which can be inserted through the HygroGen2 door, with integrated PRT temperature probe, e.g. MBW/RHS 473 with RP2 measuring head, and an external sampling head, for which the HygroGen2 external sample loop is employed (see section below).

Advantages of chilled mirror references:

- Best measurement capability.
- Instruments do not drift significantly.
- Operates over a broad range of humidity conditions.

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Disadvantages:

- Regular mirror cleaning is required to maintain best possible performance.
- Mirror measuring heads generate heat when cooling the mirror. Certain older chilled mirror probes fitted through the HygroGen2 door can introduce temperature gradients.
- For dew points above ambient conditions, sample lines must be heated to avoid condensation which can introduce instability.
- Chilled mirrors may be more expensive to calibrate than RH probes.
- Longer stabilisation time.

Without doubt, a chilled mirror reference can obtain the best possible calibration uncertainty, but they do require a good level of user expertise to ensure the best possible results. Always follow the chilled mirror manufacturer's best practice recommendations and check the instrument's compatibility with the HygroGen2 operating specifications.

Practical Guidance - Chilled Mirror Reference

Depending on the conditions being measured, some chilled mirrors do require a longer time to stabilise, sometimes up to 90 minutes.

Attention should be paid to the following:

- Some types of chilled mirror sensors have the tendency to over- or under-shoot, to "hunt" and can be off-the-mark for quite a long period of time.
- At values below freezing, the indications of chilled mirror instruments without a force frost feature can be ambiguous; readings may correspond to either the dew point or the frost point.
- Whenever measuring conditions result in a dew point that is higher than the laboratory conditions, heat the entire external sample loop, including the sensor head. Heating is required to avoid condensation.

For advice on choosing the most appropriate chilled mirror instrument, please consult your ROTRONIC dealer.

Chilled mirror probes

Chilled mirror probes of diameters up to 50 mm can be directly fitted through the HygroGen2 door. Depending on the diameter of the probe, a special adaptor or custom HygroGen2 door may be required, please contact your ROTRONIC dealer for guidance.

Chilled mirror probes are convenient for dew point ranges above ambient as they are immersed in the conditions and therefore condensation in sample lines need not be considered.

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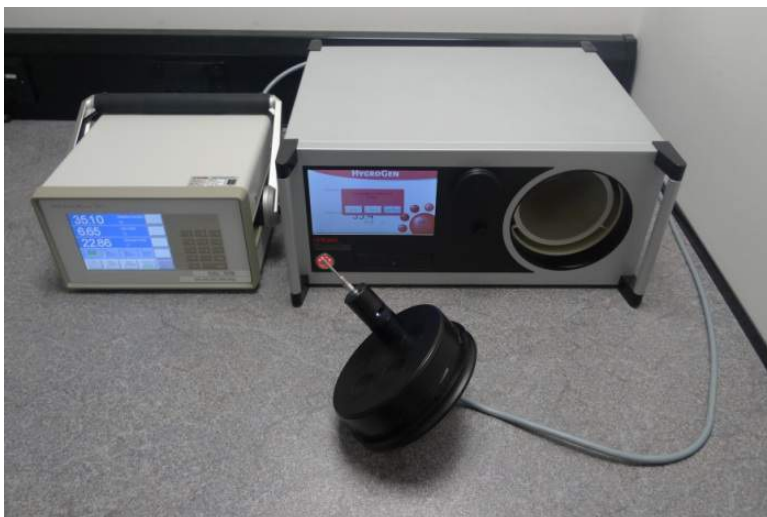


Figure 48: RP2 Head fully inserted into HygroGen2 door

Make sure the mirror is positioned so that moving air within the chamber flows over the mirror surface.

External sample loop operation

To use a HygroGen2 with a chilled mirror that has an external sampling head, connect via the heated sample loop points on the back panel (Figure 2, items 1 & 2). The HygroGen2 sample ports and internal tubing are automatically controlled to 5 °C above the chamber temperature to eliminate the possibility of condensation formation.

The connecting lines to the mirror must also be heated if the set chamber conditions create a dew point temperature higher than the ambient conditions. Make sure that your chilled mirror operating capability is within the required range. For humidity values with a dew point below ambient temperature, heated sample lines are not required.

Remove the blanking caps fitted to the sample loop Swagelok fittings and use nuts and olives to connect the sample tubes from the chilled mirror. 6 mm OD FEP or stainless tubing should be used to connect the sample loop out and return ports to the chilled mirror unit. If the mirror instrument does not have a built-in pump, flow meter and regulator, we recommend including these in the sample loop (after the mirror) to confirm the air flow rate required by the chilled mirror instrument (typically 0.5 l/min).

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Caution:



When tightening or releasing the Swagelok connectors do not apply torque to the nut/caps without using a spanner on the connector body to counteract it. Finger tighten and then apply a quarter turn with a spanner.

Replace the blanking caps when not using the sample loop.



Figure 49: HygroGen2/Chilled Mirror Set

If the chilled mirror instrument is being used in conjunction with a thermometer (in order to calculate relative humidity), the temperature probe should be positioned in the chamber. Care should be taken to ensure that insertion depth and stem conduction effects do not induce measurement errors.

A typical HygroGen2/Chilled Mirror set up is shown at Figure 38; note the heated sample lines to the rear.

Set the flow rate through the sample loop according the mirror instrument manufacturer's specifications. A lower flow rate will improve stability criteria but may influence measurement response time.

A2: Temperature Control

Temperature control within the HygroGen2 is performed by a fast response PT100 temperature sensor which is continuously referenced against the HC2-S control probe. The chamber is not considered stable (as indicated by the control indicator being coloured green) unless the reported temperature values are within the resolution of the control HC2-S. See also [Section 3.4.1.iii](#).

If a replacement HC2-S reference is put into the HygroGen2, and it gives a significantly different temperature reading, it may take a while - roughly 20 minutes for every 0.1°C discrepancy - the first time stability control is engaged, as the self-adjustment algorithm runs.

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A3: Validation – Requirements and Accessories

For an ISO 17025 calibration system, you will need to show evidence of qualifying your own system, and permanently logging temperature gradients within the chamber.

For this purpose, ROTRONIC has developed a special door with detachable mapping rig for the HG2-S:



Figure 50: HG2-D888888-Map

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And a PRT mounting ring that can be fitted permanently into the HG2-S chamber for continuous monitoring:



Figure 51: HG2-PRTring

We recommend the MBW T12 multi-channel thermometer for performing these tasks, which when used with the MBW/RHS dew point mirrors provide a calculated RH map of the entire space.

http://www.mbw.ch/product_T12.php

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B2: HygroGen2 / Screen Messages

On Screen Message:	Fault/Action:
HC2-S NC	HC2-S not connected or faulty. Check and replace as required. Contact service centre if message persists.
HC2-S error	Temperature or RH values are incorrect within the HygroGen2's programming. Remove Probe and check values. Replace if found to be faulty. Contact service centre if message persists.
HC null data	HC2-S communication; invalid data output. Check HC2-S and replace. Contact service centre if message persists.
Desiccant probe NC	Desiccant probe connection failure. Service centre repair only. Manual control of desiccant condition enables use to continue.
Desiccant probe null data	Desiccant probe communication; invalid data output. Service centre repair only. Manual control of desiccant condition enables work to continue.
Low Water level	Check water level, empty and refill as required, see section 2.4 . If message persists, manual control of water level allows use to continue until next service
High Water level	Water level is too high; empty completely and refill in accordance with section 2.4 . Contact service centre if message persists.
Humidification Disabled	Displays when temperature is changing. Wait for temperature to stabilise.
Desiccant wet	Desiccant condition warning. Replace desiccant (see section 8.2)
Heating Disabled	Over-temperature event. Heating shut down for safety reasons. Contact service centre.
Sample Loop error	Temperature fault (sample loop temperature sensor or heater). Operation can continue at dew points below ambient temperature.
Water Sensor error	Fault with level sensor. Manual supervision of water level allows use to continue until next service.
UV error	UV Lamp failure. Contact service centre.
Service Due	More than 3,000 hours in use since last service. Contact your service centre to arrange for the HygroGen2 to be serviced.

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B3: HygroGen2-S Specification

HygroGen2 Specification		
	Relative Humidity	Temperature
Control		
Sensor	HC2-S-S, capacitive RH sensor, Pt100 temperature sensor	
Control type	Embedded multiple PID controller, touch screen graphical user interface	
Range	5...95 %rh	0...60 °C
(with Range Extension option/s)	2...99 %rh	-5...60 °C
Stability at equilibrium	<0.1 %rh	<0.01 °C
Chamber temperature gradients	<0.05 °C (15-50 °C), <0.1 °C (5-60 °C), <0.15 °C (0-5 °C)	
Generation method	Mixed flow with desiccant dryer cell and piezoelectric humidifier	Peltier thermoelectric element with radial chamber mixing fan
Performance		
Response time	3 minutes (35 to 80 %rh change)	5 minutes (20 to 30 °C change)
Control probe specification	±0.8 %rh (23 °C ±5) ±2 %rh (0-60 °C)	±0.1K (23 °C ±5) ±0.3K (0-60 °C)
Typical calibration uncertainty	±1.5 %rh (k=2) at 23°C	±0.15 °C (k=2) 15-50 °C
Standard Features		
Water level	Low and high alarm, bar graph status indication	
Water quality	UV sterilisation, auto time cycling	
Desiccant condition	Condition monitored during control operation	
USB ports	7 front, 2 rear	
Reference connection	Temperature controlled outlet and inlet, 6mm fittings	
Programmer function	20 user program memory, up to 200 set-point changes per program	
Mechanical & Electrical		
Chamber volume	2 litres, effective working volume 1.5 litres	
Power	110-240 VAC 50/60 Hz, 3A	
Enclosure	Powder coated aluminium, IP20, 450 x 406 x 205 mm (Max)	
Operating Conditions	10-35 °C <2000 m Altitude or less.	
Weight	13 kg	
CE	Safety: EN 61010-1:2001 EMC: EN 61326-1:2006 EN 61326-1:2006 & EN 61000-6-1:2007	

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B4: HygroGen2-XL Specification

HygroGen2 Specification		
	Relative Humidity	Temperature
Control		
Sensor	HC2-S-S, capacitive RH sensor, Pt100 temperature sensor	
Control type	Embedded multiple PID controller, touch screen graphical user interface	
Range	5...95 %rh	0...60 °C
(with Range Extension option/s)	2...99 %rh	-5...60 °C
Stability at equilibrium	<0.1 %rh	<0.01 °C
Chamber temperature gradients	<0.05 °C (15-50 °C), <0.1 °C (5-60 °C), <0.15 °C (0-5 °C)	
Generation method	Mixed flow with desiccant dryer cell and piezoelectric humidifier	Peltier thermoelectric element with radial chamber mixing fan
Performance		
Response time	15 minutes (35 to 80 %rh change)	15 minutes (20 to 30 °C change)
Control probe specification	±0.8 %rh (23 °C ±5) ±2 %rh (0-60 °C)	±0.1K (23 °C ±5) ±0.3K (0-60 °C)
Typical calibration uncertainty	±1.5 %rh (k=2) at 23 °C	±0.15 °C (k=2) 15-50 °C
Standard Features		
Water level	Low and high alarm, bar graph status indication	
Water quality	UV sterilisation, auto time cycling	
Desiccant condition	Condition monitored during control operation	
USB ports	7 front, 2 rear	
Reference connection	Temperature controlled outlet and inlet, 6mm fittings	
Programmer function	20 user program memory, up to 200 set-point changes per program	
Mechanical & Electrical		
Chamber volume	20 litres, effective working volume 15 litres	
Power	110-240 VAC 50/60Hz, 3A (240 VAC) 6A (110 VAC)	
Enclosure	Powder coated aluminium, and steel, IP20, 80x62x41cm (Max)	
Operating Conditions	10-35 °C <2000m Altitude or less.	
Weight	37 kg	
CE	Safety: EN 61010-1:2001 EMC: EN 61326-1:2006 EN 61326-1:2006 & EN 61000-6-1:2007	

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B5: HygroGen2 Order Codes:

HYGROGEN2	
HG2-S	HygroGen2 with touch screen, calibrated control/reference probe, set-point control & programmer function, heated sample loop, desiccant cell, fill syringe, embedded HW4-P. <i>Order chamber door separately</i>
HG2-XL	HygroGen2-XL with touch screen, calibrated control/reference probe, set-point control & programmer function, heated sample loop, 2 x desiccant cell, fill syringe, embedded HW4-P.
Chamber doors / probe sleeves / bungs	
HG2-D-11111	HG2 door 5 x 15 mm ports (for 5 HC2-Ss) with 5 bungs, order specific B1 sleeves for smaller probe diameters
HG2-D-888888	HG2 door 6 x 30 mm ports with 6 bungs, order specific B8 sleeves to suit smaller probe diameters
HG2-D-HFW	HygroGen probe door for HF3 and HF4 wall mount transmitters, also HP21 hand held with fixed probe
HG2-DP-00000	HG2 clear acrylic door (no ports) for instruments with displays
HG2-B1	15 mm Bung for HG2-D-11111
HG2-B1-xx	B1 probe sleeves for HG2-D-11111 (15 mm external, internal probe diameter see xx diameter codes)
HG2-B8	30 mm Bung for HG2-D-888888
HG2-B8-xx	B8 probe sleeves for HG2-D-888888 (30 mm external, internal probe diameter see xx diameter codes)
HG2-D-xxxxx	HG2 fully custom door for > 30 mm ports, see xx diameter codes
HG2-Bxx	Custom bung
HG2-Bxx-xx	Custom probe adaptor sleeves (all types)
HG2-D-888888-Map	HG2-D888888 door with detachable mapping rig
Optional Enhanced Features	
HG2-AutoCal-Code	AutoCal function, activation code
HG2-ExtRef-Code	MBW/RHS External Reference - extension to enable MBW chilled mirror as external reference. NB Requires AutoCal or RemoteAPI, activation code
HG2-RemoteSS-Code	LAN Remote Control (Screen Share) – remote control access via VNC, activation code
HG2-TempExt-Code	Low Temperature Range Extension -5...60 °C, activation code
HG2-HumiExt-Code	Humidity Range Extension 2...99 %rh, activation code
HG2-RemoteAPI-Code	LAN Remote Control (API) – remote control application programming interface, activation code
HG2-EF-Bundle1	Enhanced Feature Bundle 1 [Temp/Humi/AutoCal], activation code
HG2-EF-Bundle2	Enhanced Feature Bundle 2 [AutoCal/Ext Ref/RemoteSS], activation code
HG2-EF-Bundle3	Enhanced Feature Bundle 3 [Temp/Humi/AutoCal/Ext Ref/RemoteSS], activation code
HG2-EF-Bundle4	Enhanced Feature Bundle 4 [RemoteAPI/Ext Ref/RemoteSS], activation code
HG2-EF-Bundle5	Enhanced Feature Bundle 5 [Temp/Humi/RemoteAPI/Ext Ref/RemoteSS], activation code
HG2-EF-Bundle6	Enhanced Feature Bundle 6 [Temp/Humi/AutoCal/RemoteAPI/Ext Ref/RemoteSS], activation code
Spares	
HG2-DC	Additional desiccant cell, pre-filled with molecular sieve
HG2-FILL	Fill tube and syringe
HC2-S-S	Standard control or reference probe. Order UKAS temperature and RH calibration separately
Accessories	
HG2-TB	HygroGen2-S transit bag, lightweight
HG2-TC	HygroGen2-S heavy-duty transit case
HG2-MON	DVI monitor and lead

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HG2-DVIC	DVI lead
HG2-AC3001-L/050	HC2-S calibration cable, 50 cm, USB
HG2-AC3001-L/050 (5)	HC2-S calibration cable, 50 cm, USB. Bundle of 5 pieces HG2-AC3001-L/050
HG2-PRT-ring	PRT mounting ring for permanent monitoring of HG2-S using external temperature reference
Service & Consumables	
HG2-S-SERVICE	HygroGen2 service, recommended at 12 month intervals. Warranty period then extended by 12 months
HG2-LABOUR	On-site service and training, per day, excludes 40p per mile and expenses incurred at cost
HG2-DES-3	Molecular sieve desiccant (3 kg)
xx Diameter codes for customised diameters	
0	No probe ports
1	15 mm (HC2-S)
2	20 mm
3	25 mm
4	10 mm
5	5 mm
6	12 mm
7	18 mm
8	30 mm
9	Cable gland to accept 9...17 mm diameter probes
A	6 mm
B	4 mm
C	22 mm
D	23 mm
E	13 mm
F	19 mm
G	21mm
H	18.5 mm (Vaisala HMP45AD)
I	18.2 mm (Aanderaa 3445)
J	9 mm
K	19.75 mm (no 'O' rings)
L	Cable gland to accept 3 - 7 mm diameter probes
M	12.7 mm
N	6.35 mm (1/4 inch)
O	not used
P	3 mm
Q	not used
R	13.5 mm
S	26 mm
T	34 mm
U	14 mm
V	20 mm cable gland 5 -12 mm probes
W	32 mm cable gland 11-21mm probes
X	not used
Y	15 mm angled Vaisala HMDW40/W50
Z	not used

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xx Diameter codes for customised diameters (continued)	
A1	24 mm
A2	12.5 mm
A3	24.7mm
A4	32 mm
A5	16 mm
A6	26.5 mm
A7	36 mm
A8	Cable gland to accept 22...32 mm diameter probes
A9	42 mm
C1	50 mm Optidew
C2	Cable gland to accept 32...38mm diameter probes
C3	General Eastern Chilled Mirror head (32 mm thread)
C4	47 mm
C5	Michell Optidew Chilled Mirror head (threaded)
C6	80 mm
C7	8 mm
C8	M24 x 1
C9	M20 x 1.5

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C1: HygroGen2 Warranty Statement

ROTRONIC will grant a warranty for the HygroGen2 for a period of 12 months from the date of delivery in respect of any evidenced faulty workmanship and materials. The warranty period is extended by a further 12 months when the unit is serviced at a ROTRONIC approved service centre 12 months after the date of supply. Should the instrument be proven not to meet the published specifications or to be contrary to contract upon inspection, the customer shall grant ROTRONIC the opportunity hereunder of repairing the fault by returning the unit carriage paid to ROTRONIC.

Should the supply or delivery of any improvement or replacement not prove possible, the customer may choose between having the purchase price reduced or demanding the contract of sale to be rescinded (conversion). Damage resulting from natural wear and tear, an act of God or non-compliance with the operating instructions shall be excluded from the warranty as well as mechanical interference by the customer or by third parties with plant and equipment of ROTRONIC without its written permission. No liability will be accepted for defects, damage or injury caused due to installation not carried out in accordance with the manufacturer's installation instructions.

The instrument maintains a record of its usage and this may only be reset by an authorised service centre; this will determine the warranty period granted.

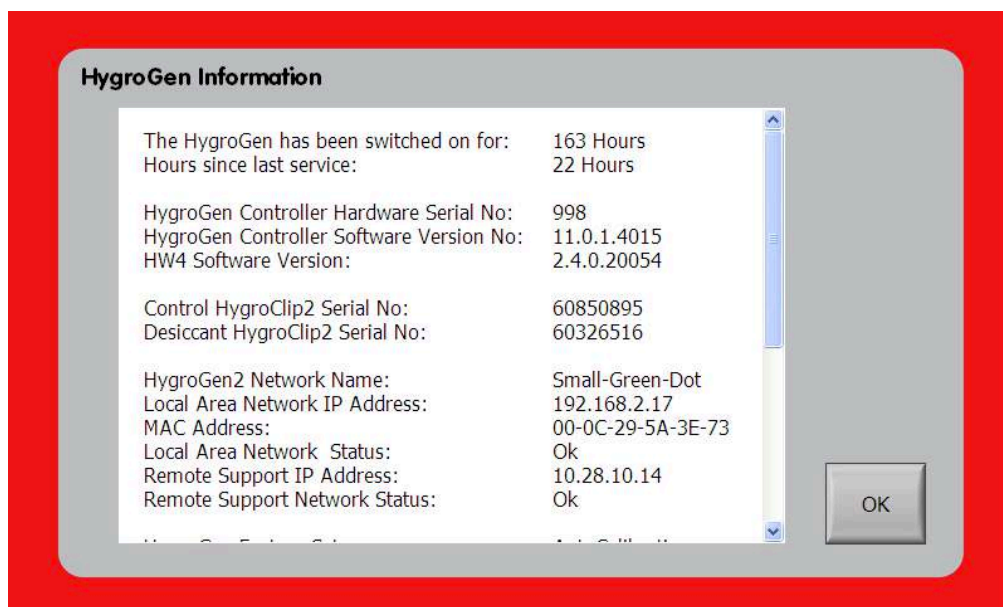


Figure 52: HygroGen Information

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C2: Manufacturer & Service Centre Contact Information

<p>Manufacturer/UK Service Centre:</p> <p>Rotronic Instruments (UK) Ltd Crompton Fields Crompton Way Crawley RH10 9EE United Kingdom</p> <p>Phone : +44(0)1293 571000 Fax : +44(0)1293 571008</p> <p>instruments@rotronic.co.uk www.rotronic.co.uk</p>	<p>Switzerland Service Centre:</p> <p>Rotronic AG Grindelstrasse 6 CH-8303 Bassersdorf Switzerland</p> <p>Phone +41 1 838 1144 Fax +41 1 837 0073</p> <p>humidity@rotronic.ch www.rotronic.ch</p>	<p>USA Service Centre:</p> <p>Rotronic Instrument Corp. Suite 150 135 Engineers Road Hauppauge, NY 11788, USA</p> <p>Phone +1 631 427 38 98 Fax +1 631 427 39 02</p> <p>sales@rotronic-sa.com www.rotronic-usa.com</p>
<p>Germany Service Centre:</p> <p>Rotronic Messgeräte GmbH Einsteinstrasse 17-23 76275 Ettlingen Germany</p> <p>info@rotronic.de www.rotronic.de</p> <p>Phone +49 7243 383 250 Fax +49 7243 383 260</p>	<p>France Service Centre:</p> <p>Rotronic s.a.r.l. 56, bd de Courcerin, F-77183 Croissy Beaubourg France</p> <p>humidite@rotronic.fr www.rotronic.fr</p> <p>Phone +33 160 95 07 10 Fax +33 160 17 12 56</p>	<p>China Service Centre:</p> <p>Rotronic Shanghai Representative Office 2B,Zao Fong Universe Building No.1800 Zhong Shan West Road, 200233 Shanghai China</p> <p>info@rotronic.cn www.rotronic.cn</p> <p>Phone +86 40 08162018 Fax +86 10 82254374</p>
<p>Italy Service Centre:</p> <p>Rotronic Italia srl Via Repubblica di San Marino, 1 I- 20157 Milano Italy</p> <p>info@rotronic.it http://www.rotronic.it/</p> <p>Phone: +39 02 39 00 71 90 Fax: +39 02 33 27 62 99</p>	<p>Singapore Service Centre:</p> <p>Rotronic Instruments PTE LTD Inno Centre, 1003 Bukit Merah Central #06-31 Singapore 159836</p> <p>sinna@rotronic.ch http://www.rotronic.sg/</p> <p>Phone:+65 63762107 Fax:+65 63764439</p>	

D1: HygroGen2 Uncertainty Framework - Internal RH Probe

Input values: 23 °C 80 % RH
 Temperature sensitivity 4.96 % RH/deg C

Reference	Uncertainty source	Distribution	Value	Units	Sensitivity	Equiv RH	Divisor	One SD	Squares
1	Uncertainty of reference probe	normal	0.900000	%rh	1.000000	0.900000	2.00	0.450	0.203
2	Repeatability of humidity	normal	0.100000	%rh	1.000000	0.100000	1.00	0.100	0.010
3	Reference drift	rectangular	1.000000	%rh	1.000000	1.000000	1.73	0.577	0.333
4	Reference resolution	rectangular	0.050000	%rh	1.000000	0.050000	1.73	0.029	0.001
5	Chamber temperature gradients	rectangular	0.020000	°C	4.960000	0.099200	1.73	0.057	0.003
6	Temperature stabilisation	rectangular	0.005000	°C	4.960000	0.024800	1.73	0.014	0.000
7	Repeatability of temperature	normal	0.050000	°C	4.960000	0.248000	1.00	0.248	0.062
8	Humidity stabilisation	rectangular	0.050000	%rh	1.000000	0.050000	1.73	0.029	0.001
9	Humidity fluctuations	rectangular	0.050000	RH %	1.000000	0.050000	1.73	0.029	0.001
10	Instrument Under Test (IUT) Resolution	rectangular	0.050000	RH	1.000000	0.050000	1.00	0.050	0.003
11	Standard deviation of Ref readings	normal	0.050000	%rh	1.000000	0.050000	1.00	0.050	0.003
12	Standard deviation of IUT readings	normal	0.100000	%rh	1.000000	0.100000	1.00	0.100	0.010

Reference		Sum of squares	One SD
			0.63
		Standard uncertainty ($\sqrt{\text{sum of squares}}$)	0.793
		Expanded uncertainty (95 % confidence)	1.59
1	From calibration certificate - check uncertainty at input values		
2	From Standard Deviation of 10 repeated calibration runs		
3	Drift between two successive calibrations of the reference instrument		
4	Resolution from manufacturer's specification		
5	Measured temperature gradients from the ROTRONIC HygroGen2 Service		
6	Measured stability from the ROTRONIC HygroGen2 Service		
7	From Standard Deviation of 10 repeated calibration runs		
8	Resolution of ROTRONIC HygroGen2 Control Clip		
9	Resolution of ROTRONIC HygroGen2 Control Clip		
10	Resolution from manufacturer's specification		
11	Standard Deviation of Ref readings during calibration		

D3: HygroGen2 Uncertainty Framework - Chilled Mirror Reference

	23	°C	50	% RH
Temperature sensitivity	3.1	% RH/deg C		

Reference	Uncertainty source	Distribution	Value	Units	Sensitivity	Equip RH	Divisor	One SD	Squares
1	Uncertainty of chilled mirror reference	normal	0.200000	°C	3.100000	0.620000	2.00	0.310	0.096
2	Repeatability of humidity	normal	0.100000	%rh	1.000000	0.100000	1.00	0.100	0.010
3	Chamber temperature gradients	rectangular	0.020000	°C	3.100000	0.062000	1.73	0.036	0.001
4	Temperature stabilisation	rectangular	0.005000	°C	3.100000	0.015500	1.73	0.009	0.000
5	Repeatability of temperature	normal	0.050000	°C	3.100000	0.155000	1.00	0.155	0.024
6	Humidity stabilisation	rectangular	0.050000	%rh	1.000000	0.050000	1.73	0.029	0.001
7	Humidity fluctuations	rectangular	0.050000	%rh	1.000000	0.050000	1.73	0.029	0.001
8	Instrument under test (IUT) resolution	rectangular	0.050000	%rh	1.000000	0.050000	1.00	0.050	0.003
9	Standard deviation of Ref readings	normal	0.050000	%rh	1.000000	0.050000	1.00	0.050	0.003
10	Standard deviation of IUT readings	normal	0.100000	%rh	1.000000	0.100000	1.00	0.100	0.010

Reference		Sum of squares	Squares
1	See sheet Dew Point UA		
2	From Standard Deviation of 10 repeated calibration runs	Standard uncertainty ($\sqrt{\text{sum of squares}}$)	0.385
3	Measured temperature gradients from the ROTRONIC HygroGen2 Service	Expanded uncertainty (95% confidence)	0.77
4	Measured stability from the ROTRONIC HygroGen2 Service		
5	From Standard Deviation of 10 repeated calibration runs		
6	Resolution of ROTRONIC HygroGen2 Control Clip		
7	Resolution of ROTRONIC HygroGen2 Control Clip		
8	Resolution from manufacturer's specification		
9	Standard Deviation of Ref readings during calibration		
10	Standard Deviation of IUT readings during calibration		

D4: Dew Point Uncertainty Analysis

Dew Point Temperature -5 to +35 °Cdp

Reference	Uncertainty source	Distribution	Value	Units	Sensitivity	Equiv °Cdp	Divisor	One SD	Squares
1	Calibration of Standard	normal	0.1	°Cdp	1	0.10	2.00	0.050	0.00250
2	Drift of Standard	rectangular	0.1	°Cdp	1	0.10	1.73	0.058	0.00333
3	Repeatability	normal	0.05	°Cdp	1	0.05	1.00	0.050	0.00250
4	Mirror Contamination	rectangular	0.05	°Cdp	1	0.05	1.73	0.029	0.00083
5	Mirror Temperature Fluctuations	rectangular	0.05	°Cdp	1	0.05	1.73	0.029	0.00083
6	Temp Gradients Across the Mirror/Condensate	rectangular	0.01	°Cdp	1	0.01	1.73	0.006	0.00003
9	Standard Deviation of Readings	normal	0.01	°Cdp	1	0.01	1.00	0.010	0.00010
Sum of squares									0.01
Standard uncertainty ($\sqrt{\text{sum of squares}}$)									0.101
Expanded uncertainty (95% confidence)									0.20