GrayWolf

Sensing Solutions

DirectSense II

Version 2.2

Manual

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DISCLAIMER:

Determining the suitability for use of any equipment described in this manual remains SOLELY THE RESPONSIBILITY OF THE END USER.

PRODUCT WARNING:

GrayWolf Sensing Solutions' DirectSense II probes, AdvancedSense™ Pro and AdvancedSense™ BE kits are NOT suitable for use in flammable or potentially explosive environments. They are NOT certified intrinsically safe. They are also NOT intended for use in confined spaces where operator safety might be at risk due to exposure levels, such as reduced oxygen, during the course of the instrument survey.

Contents

Introduction

Thank you for purchasing GrayWolf's DirectSense II probe. GrayWolf is the market leading manufacturer of portable Indoor Air Quality (IAQ) instrumentation with over 20 years on the market. The DirectSense II probe takes current sensor technology to a whole new level, with the ability for:

- Plug-and-play sensors to fit your application(s), current and future.
- Smart PID sensors for low (IAQ range) or high (toxic exposure range) Total Volatile Organic Compounds (TVOCs).
- Smart NDIR sensors for low (IAQ range) or high (toxic exposure range) Carbon Dioxide (CO_2)
- Smart electrochemical sensors for CO, O_3, NO_2, NH_3, H_2S, SO_2, O_2, Cl_2, HCl, HCN, H_2 and much more.
- Smart T/%RH sensor which can also display/log pressure-corrected dewpoint, absolute humidity, specific humidity, etc.
- Handheld, tripod-mounted, case-mounted, desk-mounted, wall-mounted.
- Interface with rugged purpose-built meters, with tablet computers and/or with your own Windows Laptops or Desktops.

All calibrations are stored on the smart sensors. The probes can be combined with meters for monitoring particulate (PM2.5, PM10, etc.), low concentration (ppb) formaldehyde monitors, air velocity probes, differential pressure sensors, and barometric pressure sensors.

The DirectSense II can connect via cable, Bluetooth wireless, and/or Wi-Fi and comes standard with a rechargeable lithium ion battery.

Thank you again,

-GrayWolf Sensing Solutions

Probe Models

Model	Description	Picture
DSII-8	The DirectSense II-8 probe comes with a SEN-SMT-TRH3 combo °C/°F and %RH sensor and has 6 sensor sockets available for additional smart (plug & play) sensors. One socket accommodates NDIR CO2, PID (TVOC) or A series electrochemical (EC) specific gas sensors. One socket accommodates A or B series ECs. The remaining sockets accommodate PIDs or A series ECs. Bluetooth classic, Bluetooth low energy, and Wi-Fi WolfRadio wireless board, 10 pin rugged push-pull cable socket, a built-in fan, a smart sensor insertion tool and a combo hex/flat/Phillips screwdriver are included. Additional sensors, connection cable, REQUIRED ACC-PWR-DSII-CRDL charging cradle and 100/240V AC adapter are NOT included.	
DSII-5	The DirectSense II-5 probe comes with a SEN-SMT-TRH3 combo °C/°F and %RH sensor and has 3 sockets available for additional smart (plug & play) sensors. One socket accommodates NDIR CO2, PID (TVOC) or A series electrochemical (EC) specific gas sensors. One socket accommodates A or B series ECs. The remaining socket accommodates PIDs or A series ECs. Bluetooth classic, Bluetooth low energy, and Wi-Fi WolfRadio wireless board, 10 pin rugged push-pull cable socket, a built-in fan, a smart sensor insertion tool and a combo hex/flat/Phillips screwdriver are included. Additional sensors, connection cable, REQUIRED ACC-PWR-DSII-CRDL charging cradle and 100/240V AC adapter are NOT included.	
DSII-3	The DirectSense II-3 probe comes with a SEN-SMT-TRH3 combo °C/°F and %RH smart sensor and has 1 socket available for a smart (plug & play) NDIR CO2, PID (TVOCs) or electrochemical (EC) specific gas sensor. Bluetooth classic, Bluetooth low energy, and Wi-Fi WolfRadio wireless board, 10 pin rugged push-pull cable socket, a built-in fan, a smart sensor insertion tool and a combo hex/flat/Phillips screwdriver are included. Additional sensors, connection cable, REQUIRED ACC-PWR-DSII-CRDL charging cradle and 100/240V AC adapter are NOT included.	

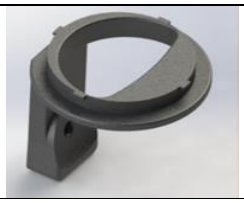
Kit Models

DSII-8-KIT	The DirectSense II-8 KIT comes with a DSII-8 probe, SEN-SMT-TRH3 combo °C/°F and %RH sensor and has 6 sensor sockets available for additional (plug & play) smart sensors. One socket accommodates NDIR CO2, PID (TVOC) or A series electrochemical (EC) specific gas sensors. One socket accommodates A or B series ECs. The remaining sockets accommodate PIDs or A series ECs. A 10 pin rugged push-pull cable socket, a built-in fan, a smart sensor insertion tool and a combo hex/flat/Phillips screwdriver are included. The KIT also includes an ACC-PWR-DSII-CRDL charging cradle (with integral wall-mount bracket and probe locking screw), the ACC-PWR-WM12V 110/240VAC wall charger (w/ US, EU, UK and AU plugs), and an ACC-TPD-M2 mini-tripod. A WolfRadio wireless board is installed in the DSII probe with Bluetooth low energy (for direct connection to smart devices via free iOS and Android apps), Bluetooth classic (for wireless connection to AdvancedSensePro and WIN tablets) and Wi-Fi (for remote connection utilizing GrayWolfLive). Additional sensors and 1m connection cable are NOT included.	
DSII-5-KIT	The DirectSense II-5 KIT comes with a DSII-5 probe,SEN-SMT-TRH3 combo °C/°F and %RH sensor and has 3 sockets available for additional smart (plug & play) sensors. One socket accommodates NDIR CO2, PID (TVOC) or A series electrochemical (EC) specific gas sensors. One socket accommodates A or B series ECs. The remaining socket accommodates PIDs or A series ECs. A 10 pin rugged push-pull cable socket, a built-in fan, a smart sensor insertion tool and a combo hex/flat/Phillips screwdriver are included. The KIT also includes an ACC-PWR-DSII-CRDL charging cradle (with integral wall-mount bracket and probe locking screw), the ACC-PWR-WM12V 110/240VAC wall charger (w/ US, EU, UK and AU plugs), and an ACC-TPD-M2 mini-tripod. A WolfRadio wireless board is installed in the DSII probe with Bluetooth low energy (for direct connection to smart devices via free iOS and Android apps), Bluetooth classic (for wireless connection to AdvancedSensePro and WIN tablets) and Wi-Fi (for remote connection utilizing GrayWolfLive). Additional sensors and 1m connection cable are NOT included.	

DSII-3-KIT	The DirectSense II-3 KIT comes with a DSII-3 probe,SEN-SMT-TRH3 combo °C/°F and %RH smart sensor and has 1 socket available for a smart (plug & play) NDIR CO2, PID (TVOC) or electrochemical (EC) specific gas sensor. A 10 pin rugged push-pull cable socket, a built-in fan, a smart sensor insertion tool and a combo hex/flat/Phillips screwdriver are included. The KIT also includes an ACC-PWR-DSII-CRDL charging cradle (with integral wall-mount bracket and probe locking screw), the ACC-PWR-WM12V 110/240VAC wall charger (w/ US, EU, UK and AU plugs), and an ACC-TPD-M2 mini-tripod. A WolfRadio wireless board is installed in the DSII probe with Bluetooth low energy (for direct connection to smart devices via free iOS and Android apps), Bluetooth classic (for wireless connection to AdvancedSensePro and WIN tablets) and Wi-Fi (for remote connection utilizing GrayWolfLive). Additional sensors and 1m connection cable are NOT included.	

Accessories

Part	Description	Picture
AD-DSIIUSBM-1M	1m cable for DSII probes to connect to Tablets/Laptops/PCs via a standard USB connector.	
AD-DSIIL8-1M	1m cable for DSII probes to connect to AdvancedSense meters.	
CA-HD4-A1	Gas Calibration Cap for A1 series smart sensors (DSII). For targeted sensor calibration (recommended for "sticky" gases). Includes 30cm tubing and 2m tubing.	
CA-HD5-B1	Gas Calibration Cap for larger diameter B1 series smart sensors (DSII). For targeted sensor calibration (recommended for "sticky" gases). Includes 30cm tubing and 2m tubing.	
ACC-PWR-DSII-CRDL	Charging Cradle for DirectSense II probes. Includes integral wall-mount bracket and probe locking screw. ACC-PWR-WM12V 110/240VAC power adapter (with US, EU, UK and AU plugs) sold separately.	
ACC-PWR-WM12V	110/240VAC to 12VDC wall adapter/charger for DirectSense II charging cradle, AdvancedSense Pro, AdvancedSense BE, or Zephyr III. Comes with US, EU, UK and AU plugs. 1m cable.	
ACC-DSII-FLANGE	Flange to secure DSII probes into ducts, environmental chambers, etc. via 2-inch diameter hole. A second, included part (not shown) attached to secure on the inside.	

ACC-DSII-PCCHOLD	Replacement bracket for PCC-20 and PCC-25 cases for holding DSII probes in place when extended out of the security case.	
ACC-SS1	Pocket clip screwdriver set with hex screw.	
CA-GS25H-DSII	VOC gas calibration Kit for GrayWolf DirectSense II probes with a high range PID sensor installed. Includes: 0.0 ppm hydrocarbon free and 8750 ppm isobutylene ref gases, CA-HD4-A1 cal cap, CA-REG1, and 2 x 103L cylinder molded case (outside of the Americas dual 110L cylinder soft case)	
CA-GS25L-DSII	VOC gas calibration Kit for GrayWolf DirectSense II probes with a low range PID sensor installed. Includes: 0.0 ppm hydrocarbon free and 7.5 ppm isobutylene ref gases,CA-HD4-A1 cal cap, CA-REG1, and 2 x 103L cylinder molded case (outside of the Americas dual 110L cylinder soft case)	
CA-GS12	Carbon dioxide and carbon monoxide gas calibration kit includes cal hood, regulator, tubing, PCC-GC4 case, 375 & 1250ppm CO2 reference gases, 0ppm hydrocarbon gas and 95ppm CO reference gases	
CA-XXX-XX	105-liter calibration gas cylinders. GrayWolf offers a broad range of calibration gases to be used for field calibration/verification of the many gas sensors that we offer. Inquire about the reference values available (and model numbers) for specific gases.	

CA-REG1	0.3 lpm standard regulator for calibration gas cylinders.	
CA-REG5	0.5 lpm standard regulator for calibration gas cylinders.	
PCC-20A	Single removable plug and ACC-DSII-PCCHOLD to expose sensors from 1 x DirectSense II probe. Room to store meter, probe, cradle, and other accessories. Also holds AS-201/202A airspeed probe and spare smart sensors. Includes Master combination lock.	
PCC-20T	Hard-shell Security case with foam cutouts for GrayWolf supplied Tablet PCs and sensor exposure for one DirectSense II probe. Single removable plug and ACC-DSII-PCCHOLD to expose sensors from 1 x DirectSense II probe. Cutouts hold MN-10 10" (or smaller) tablets. Room to store tablet, probe, cradle and other accessories. Also holds AS-201/202A airspeed probe and spare smart sensors. Includes combination lock. Front external bracket for particulate meter is optional.	
PCC-20RT	Hard-shell Security case with foam cutouts for 10" GrayWolf supplied RUGGED Tablet PC and sensor exposure for single DirectSense II probe. Single removable plug and ACC-DSII-PCCHOLD to expose sensors from 1 x DirectSense II probe. Cutouts hold MN-10RT 10" rugged tablets. Room to store	

	tablet, probe, cradle and other accessories. Also holds AS-201/202A airspeed probe and spare smart sensors. Includes combination lock. Front external bracket for particulate meter is optional.	
PCC-22DSII-2	Hard-shell case for one or 2 x DSII Probes. Also fits charging cradles and other accessories.	
PCC-22DSII-U	Hard-shell case for AdvancedSense, MN-10 tablet or MN-10RT, 10 inch rugged tablet. Also fits DirectSense II probe and AS201/202A airspeed probe and other accessories.	
PCC-25A	Dual removable plugs and ACC-DSII-PCCHOLD's to expose sensors from 2 x DirectSense II probes. Room to store meter, probes, cradles, and other accessories. Also holds AS-201/202A airspeed probe and spare smart sensors. Includes Master combination lock.	
PCC-25T	Hard-shell Security case with foam cutouts for GrayWolf supplied standard Tablet PC and sensor exposure for two DirectSense II probes. Dual removable plugs and ACC-DSII-PCCHOLDs to expose sensors from 2 x DirectSense II probes. Cutouts hold MN-10 10" (or smaller) tablets. Room to store tablet, probes, cradles and other accessories. Also holds AS-201/202A airspeed probe and spare smart sensors. Includes combination lock. Front mounted	 

	external bracket for particulate meter is optional.	
PCC-25RT	Hard-shell Security case with foam cutouts for GrayWolf supplied RUGGED Tablet PC and sensor exposure for two DirectSense II probes. Dual removable plugs and ACC-DSII-PCCHOLDs to expose sensors from 2 x DirectSense II probes. Cutouts hold MN-10RT 10" Rugged Tablets. Room to store tablet, probes, cradles and other accessories. Also holds AS-201/202A airspeed probe and spare smart sensors. Includes combination lock. Front mounted external bracket for particulate meter is optional.	 
PCC-35P	Hard-shell Security case with foam cutouts for AdvancedSense meter or tablet, sensor exposure for one DirectSense II probe plus space for storage and internal operation, with inlet exposure, for a PC-3500 particulate meter. PCC-35P-RT is also available with foam cutout for 10” RUGGED Tablet.	
PCC-36P	Hard-shell Security case with foam cutouts for AdvancedSense meter or tablet, sensor exposure for one DirectSense II probe plus space for storage and internal operation, with inlet exposure, for a PC-3016 particulate meter. PCC-36P-RT is also available with foam cutout for 10” RUGGED Tablet.	 

Specifications

General

Dimensions	Probe: 83mm (3.3in.) w. x 295mm (11.6in.) h. x 55mm (2.2in.) d. Cradle: 93mm (3.7in.) w. x 80mm (3.2in.) h. x 93mm (3.7in.) d.
Construction	Probe: Rugged polycarbonate plastic with rubberized handle grip. Cradle: Rugged polycarbonate plastic
Weight	Probe: not including sensors which are ~10 grams each; 4560 gr. (1 lb.) Cradle: not including AC adapter, 180 gr (6.4 oz.)
Wireless	Bluetooth classic / Bluetooth Low Energy (LE) and Wi-Fi for connection to AdvancedSense Pro or to Windows tablet, standard.
Mounting	1/4"-20 thread (on back) for belt clip, etc. (& for included mini tripod/stand). M4 brass thread for security screw.
Operating Range	-10 °C to 50 °C (15 °F to 122 °F), 0 to 100 %RH non-condensing. Certain specific sensors have a more limited range.

Connectors

Probe: 1 x Rugged 10 pin female socket.
Cradle: 1 x Rugged 10 pin Female and 1 x 2.5mm 12VDC power socket.

Power

Battery	6600 mAh Lithium Ion rechargeable
Battery Life	12+ hours typical with PID and NDIR sensors installed 14+ hours with EC Sensors only. Battery life of probe is highly variable and dependent on number of sensors and type of sensors.
Recharge Time	4 hours. Red/Green front cradle LED displays charging/fully charged status.
Power Supply	100/240VAC, 50-60Hz external charger.

All specifications are subject to change without further notice.

Probe Views

Opening and Closing Probe

The probe should not be powered on while opening the probe (see Power Button Operation for turning probe on/off) unless performing a User Calibration. On the back of the probe locate the hex screw near the top. Using the GrayWolf supplied hex key (ACC-SS1) unscrew counter clockwise to release. To tighten, screw the GrayWolf supplied hex key clockwise.

Sensor Placement

Slot	Sensor Type(s) Allowed
1	**A Series EC, PID**
2	**A Series EC, PID**
3	**A Series EC, PID, NDIR**
4	**A Series EC, PID**
5	**A Series EC, PID, HCHO Sensor, B Series EC**
6	**A Series EC, PID**
7	**Temperature and Relative Humidity**

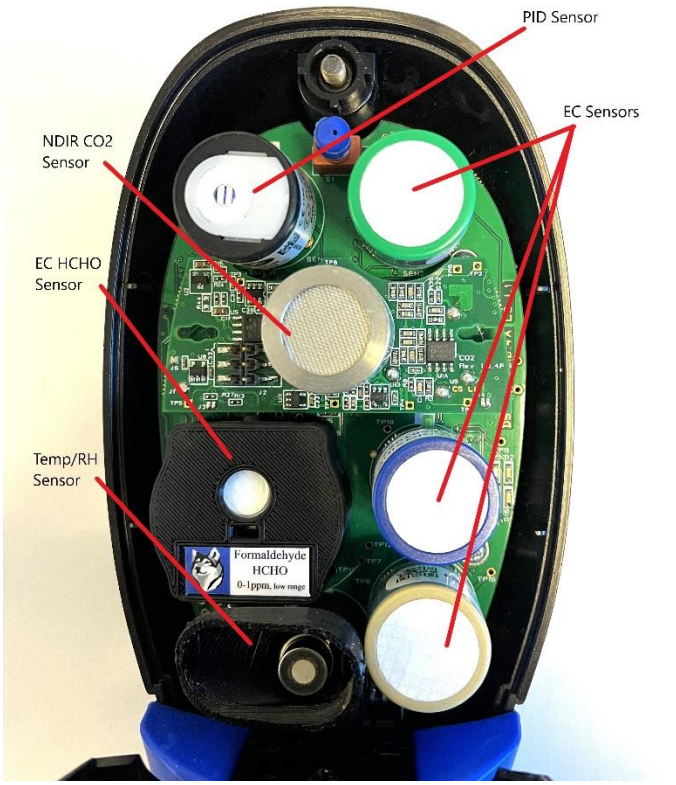
EC=Electrochemical
PID=Photoionization detector, used for TVOC.
NDIR=Nondispersive infrared, used for CO_2.
A and B denote the size of the sensor. A have a smaller diameter than B series.

When changing sensors make sure the probe is powered off.

Make sure to use the insertion tool to push any smart sensor into place. Take care not to press down on the top of any of the electrochemical, NDIR, or PID smart sensors as it could result in damage to the sensor.

Align the green tab of the smart sensor with the white mark orientation on the DirectSense II board in the desired sensor slot. Push the smart sensor firmly into place. To remove a smart sensor, pull on the sides.

If storing the probe after changing sensors power the probe on, wait a few seconds and then power it back down.



Example of tab orientation while placed in sensor slot.

Smart Sensors

GrayWolf supplied "Smart Sensors" (an assembly comprised of specific sensor plus a permanently attached "Smart Board") may be used in any DirectSense II probe and in any sensor slot (with the exceptions of NDIR which must be used in Sensor Slot 3, or the larger B series electrochemical sensors which must be used in slot 5). In addition to storing the calibration data on-board the Smart Board to allow swapping between probes and sensor slots, all signal processing electronics are also contained on the Smart Board allowing for better stability and less drift on the low end by limiting the amount of electronic noise.

DirectSense® II (DSII) / DirectSense (DSI) Gas Sensor Specs Summary (August 2022)

SENSOR	RESOLUTION (PPM)	RANGE (PPM)	SENSOR L.O.D. (PPM)	TYPICAL DRIFT	T_{90} RESPONSE	RECOMMENDED CALIBRATION FREQUENCY[i]	EXPECTED LIFE
NDIR							
Carbon Dioxide (CO_2) SEN-SMTX-CO2 (DSII)	1	0 to 10,000	<1	<80ppm /year[ii]	<20s	≤12 months[iii]	>10 years
Carbon Dioxide (CO_2) SEN-X-CO2 (DSI)	1	0 to 10,000	<1	<80ppm /year[iv]	<20s	≤12 months[iii]	>10 years
PID (TVOC)							
Low range PPB VOC Gas Sensor	0.001	0 to 40	0.001	<5 ppb / day (at zero), <50 ppb / day (at span)	<8s	<2 weeks User[v],12 months Factory	>5 years[vi]
Mid-Low Range VOC Gas Sensor	0.01	0 to >200	0.02		<8s	<2 weeks User, 12 months Factory	>5 years[vi]
Mid-High PPM VOC Gas Sensor	0.1	0 to 4,000	0.1		<3s	<2 weeks User, 12 months Factory	>5 years[vi]
High Range PPM VOC Gas Sensor	0.1	0 to >10,000	0.5		<3s	<2 weeks User, 12 months Factory	>5 years[vi]
ELECTROCHEMICAL							
Ammonia (NH_3)	1	0 to 100	<1	<20% / year	<75s	≤12 months	>24 months
Ammonia (NH_3) TOX Range	1	0 to 1,000	<5	<20% / year	<75s	≤12 months	>24 months
Arsine (AsH_3)	0.01	0 to 1	<0.02	<5% / month	<60s	<12 months[vii]	18-24 months
Carbon Monoxide (CO) 4-electrode (DSII)	0.1	0 to 500	<0.1	<10% / year	<30s	≤12 months	36-60 months[ix]
Carbon Monoxide (CO) 3-electrode (DSI)	0.1	0 to 500	<0.1	<10% / year	<30s	≤12 months	36-60 months[ix]

Chlorine (Cl_2)	0.01	0 to 20	<0.02	<10% / year	<60s	≤12 months[vii]	>24 months
Chlorine Dioxide (ClO_2)	0.01	0 to 1	<0.03	<10% / 6 months	<90s	≤6 months[vii]	>24 months
Diborane (B_2H_6)	0.01	0 to 1	<0.02	<10% / 6 months	<30s	≤6 months[vii]	>18 months
Ethylene Oxide (EtO)	0.1	0 to 100	<0.1		<150s	≤12 months	>24 months
Fluorine (F_2)	0.01	0 to 1	<0.01	<10% / 6 months	<60s	≤4 months[vii]	>18 months
Formaldehyde (HCHO) DSII mfg ≥ 09/2021[xii]	0.001	0 to 1	<0.01		<80s	≤12 months	>36 months
Hydrogen (H_2)	1	0 to 1000	<2	<2% / month	<35s	≤6 months	>24 months
Hydrogen Chloride (HCl)	0.1	0 to 20	<0.2	<2% / month	<60s	≤6 months	24 months
Hydrogen Cyanide (HCN)	0.01	0 to 100	<0.05		<70s	≤4 months	>12 months
Hydrogen Fluoride (HF)	0.1	0 to 10	<0.1	<5% / month	<90s	≤6 months[vii]	>18 months
Hydrogen Sulfide (H_2S)	0.01	0 to 50	<0.03	<2% / year	<30s	≤12 months	24-48 months[ix]
Nitric Oxide (NO)	0.1	0 to 250	<0.2	<5% / year	<45s	≤12 months	24-48 months[ix]
Nitrogen Dioxide (NO_2) 4-electrode (DSII)[xi]	0.01	0 to 20	<0.02	<20ppb / year (at zero)	<80s	≤12 months	24-48 months[ix]
Nitrogen Dioxide (NO_2) 3-electrode (DSI)	0.01	0 to 20	<0.02	<20ppb / year (at zero)	<50s	≤12 months	24-48 months[ix]
Ozone (O_3)	0.01	0 to 1	<0.02	<10% / 6 months	<60s	≤12 months[viii]	12-18 months[x]
Phosgene ($COCl_2$)	0.01	0 to 1	<0.02	<10% / 6 months	<150s	<12 months[vii]	>15 months
Phosphine (PH_3)	0.1	0 to 10	<0.1	<10% / year	<25s	≤12 months	>24 months
Silane (SiH_4)	0.1	0 to 50	<0.1	<2% / month	<60s	≤12 months	>24 months
Sulfur Dioxide (SO_2)	0.1	0 to 50	<0.1	±15% / year	<20s	≤12 months	24-48 months[ix]
	RES %	**RANGE%**	**LOD %**	**TYPICAL DRIFT**	**T_{90} RESPONSE**	**CAL FREQUENCY**	**EXPECTED LIFE**
Oxygen (O_2)	0.1	0 to 25	<0.2	<1% / 3 months	<15s	≤12 months	24 - 36 months[x]

All specifications are subject to change without further notice.

Any sensor(s) used for safety critical situations, such as OSHA TWAs or STELs, must be User calibrated or, at minimum, exposed to a target gas (bump tested) to assure sensor response each day of use with a reference gas close to the critical level. Failure to carry out such tests may jeopardize the safety of people and property.

For optimum accuracy, it is advised to perform more frequent User calibrations of zero and/or span (dependent on application). GrayWolf makes the User calibration procedure simple and reliable. The software walks users through the calibration process. Calibration kits and appropriate reference gasses are available for shipment to most locations.

i Calibration may be User Cal or Factory/Lab Cal. However, annual Factory/Lab calibration is recommended even if User calibrations are being performed more often.
ii Over the "IAQ critical range" (350ppm to 2000ppm), based on GrayWolf data and long-term experience.

iii Exceptional accuracy of +/-35ppm over the "IAQ critical range" range, assuming quarterly calibration. GrayWolf offers User calibration kits to help maintain optimum accuracy between annual Factory/Lab calibrations.

iv Over the “IAQ critical range” (350ppm to 2000ppm), based on GrayWolf data and long-term experience. Accuracy of +/-50ppm, +/-3% of reading.

v While GrayWolf recommends <2 week User cal intervals, years of customer feedback has indicated that User calibrations at 4 to 8 week intervals is satisfactory for most IAQ applications.

vi PIDs carry a 1 year warranty. Their lamps and electrode stacks are rated 10,000 hours lit and usually perform far better. Unless clients are running probes 24/7, GrayWolf’s experience is that it is rare to replace lamps or detector stacks <4 years.

vii For User calibrations, a surrogate reference gas is recommended. Contact GrayWolf for details.

viii For User calibrations, NO2 surrogate ref. gas is recommended as it is easier to work with than O3 gas.

ix This specification is enhanced vs. the sensor mfg. spec based on GrayWolf data & long-term experience.

x This specification is reduced vs. the sensor mfg. lifetime spec based on GrayWolf data & long-term experience.

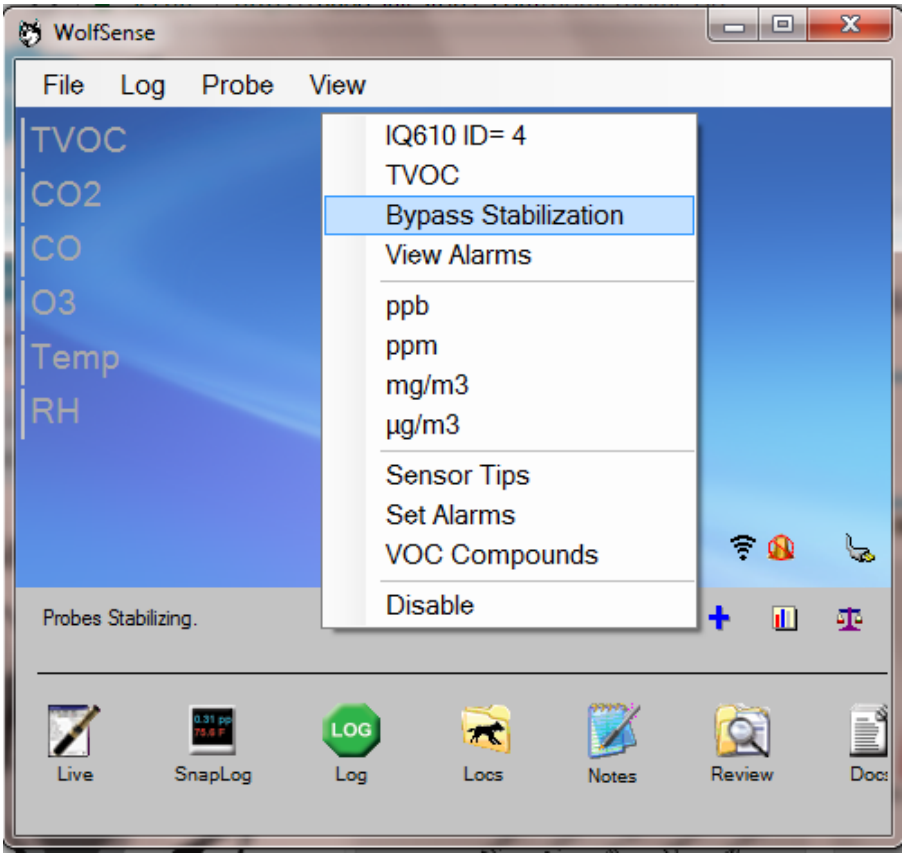
xi The 4-electrode smart NO2 sensor has significantly reduced cross-sensitivity with O3.

xii DirectSense II probes manufactured after September 2021 may require a firmware update to accept the Formaldehyde sensor. Probes manufactured after June 2022 are fully compatible. Probes manufactured prior to Sept 2021 are NOT compatible with the Formaldehyde sensor.

Smart Sensor Warm Up

Each Smart Sensor keeps track of the DirectSense II probe it is installed in, the last time it was stabilized and the duration it has been powered off. Using this information, sensor stabilization time is adjusted accordingly. In the WolfSense software, you can view the Smart Sensor information by selecting Smart Sensor Info from the Probe Menu. The color of the parameter in WolfSense will either be gray for stabilizing, or black for stable. Each sensor placed in a probe you will see information about when the sensor expires, approximately how long it has been powered off (within hours, days, weeks, or months) and the status and condition of the power off. The power off status can be "OK" meaning it was shut down normally, "Moved" which means the sensor was moved from probe to probe or sent from GrayWolf or a distributor not in a probe, or "Dead Battery" meaning the DSII probe shut down because it lost power. The system uses this information to determine how long to require stabilization for a sensor as some sensors require more stabilization when not used for a while and some sensors require a trickle of current when not in use to remain stable.

Alternatively, there is the ability to bypass the stabilization by clicking on any sensor in WolfSense and a dropdown will appear. From the dropdown menu there is a choice for Bypass Stabilization.



In addition, each smart sensor maintains a separate Factory Calibration due date and Sensor Expiration date (see Smart Sensors for information about specific life expectancies). Many sensors have a limited life and must be replaced rather than just factory calibrated. When initiating a log, WolfSense software will remind you of expired sensors and sensors in need of calibration.

Calibration Hood

When the probe is open (refer to Opening and Closing Probe) the CA-HD4-A1/CA-HD5-B1 can be placed on the individual sensor. One end of the tubing is connected to the inlet and the other end is connected to the regulator and gas. The DirectSense II probe must be connected to WolfSense for a User Calibration to be performed. Instructions for User Calibrations in WolfSense can be found in the DirectSense/WolfPack/AdvancedSense manuals.

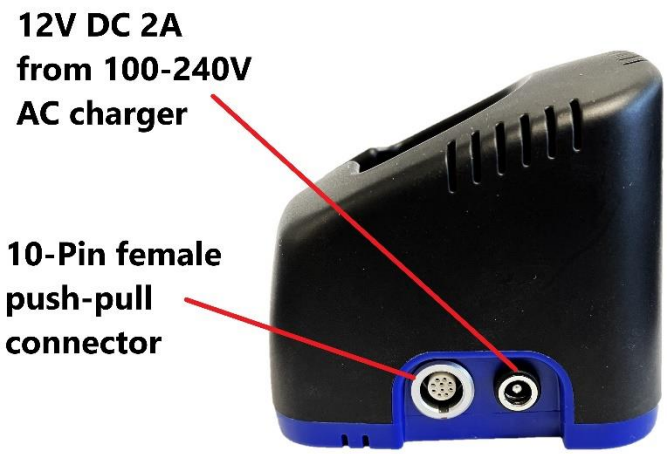
Example of Calibration Hood CA-HD4-A1

Charging Cradle

When a probe is initially shipped it will be less than 30% charged and should be placed on the charging cradle (ACC-PWR-DSII-CRDL). On the right side of the cradle there are two inputs. The one on the left is a female 10 pin Lemo that can be used to connect to an AdvancedSense/WolfPack/Tablet/PC with a cable. The port to the right is for the AC power. Only the supplied power adapter should be used for the charging cradle. While charging or powering the DSII, the DSII Cradle LED will flash **Green** periodically. The Cradle LED will turn **Solid Green** when fully charged. **Solid Blue** indicates the cradle is powered but no probe is attached. If the LEDs are **Flashing Red** there is a fault.

> NOTE: On earlier editions of the cradle, while charging the LEDs will be solid **Red** and when fully charged, solid **Green**.

The probe can be powered with its internal battery or alternatively through an AdvancedSense/WolfPack/Tablet/PC. When powered through AdvancedSense/WolfPack/Tablet/PC, the probe will not be charged. In order to charge the probe, it must be placed on the charging cradle. To choose powering options for the probe while connected to AdvancedSense/WolfPack/Tablet/PC in WolfSense go to Probe>Probe Options. Here there is the ability to Always Power, Never Power, or Power on Low.



Charging Cradle

DirectSense II Probe in Charging Cradle

The charging cradle can be used to lock the probe into place for security. Remove the wall mounting bracket from the back of the probe. The wall mount can be released by pulling on the tab and pulling the bracket down. After the probe has been placed in the cradle, turn the screw clockwise to tighten into place.

Cradle with wall mount and probe

Cradle with wall mount removed

The wall mount has three holes that can be used to screw the mount into the wall. The screws should be placed in the three inlets in the mount. Once the wall mount bracket is securely screwed on the wall, the cradle can be placed on the mount. Make sure that when installing the wall mount that the tab is facing the ground.

DSII probe in Wall Mounted Cradle

Power Button Operation

Depress the power button momentarily to turn on the probe. When the probe first boots up, the LED will cycle **Red**, **Green**, **Blue** to indicate start up.

While the probe is operating the LED will flash color sequences to indicate status. See LED Status Messages for additional detail.

To turn the probe OFF, depress the power button for >3 seconds. The LED will turn solid **Red** for 2 seconds and then will power down indicating an orderly shutdown has occurred. If the probe is not responding, holding the power button down for >12 seconds will force the probe to power off immediately.

Auto Power Off – If the probe does not receive any communications from WolfSense or WolfSense Mobile software on Tablet/PC/AdvancedSense/WolfPack/Phone AND the probe is not connected to GrayWolfLive via Wi-Fi, the probe will automatically turn off to conserve battery power after approximately 8 minutes.

Other Automatic Shutdown Procedures

The DSII probe will automatically shut down under the following conditions after warning the operator by updating the LED status (see LED Status Messages section):

-If the internal temperature of the probe exceeds 60 °C (140 °F).

-If the internal battery discharges to a critical level and probe is not receiving external power.

-If the internal battery temperature is excessive.

The probe can be powered with its internal battery or alternatively through an AdvancedSense/WolfPack/Tablet/PC. When powered through AdvancedSense/WolfPack/Tablet/PC, the probe will not be charged. In order to charge the probe, it must be placed on the charging cradle. To choose powering options for the probe while connected to AdvancedSense/WolfPack/Tablet/PC in WolfSense go to Probe>Probe Options. Here there is the ability to Always Power, Never Power, or Power on Low.

Initiate Log from Probe

When WolfSense is running on your AdvancedSense/WolfPack/Tablet or Laptop you may initiate a snap-shot log by pressing the LOG button on the probe. If a Location file is selected and can be logged to without user interaction (prompts on screen), the snap shot log will be recorded, and a quick series of green flashes will be shown on the probe's LED to indicate data was stored. If the LED does not indicate success, you will need to respond to a prompt in WolfSense before the data is stored.

LED Status Messages

The LED on the front of the DSII probe will flash at fixed internals to indicate status.

Steady **Green** flashes indicate normal probe operation.

Steady **Blue** flashes indicate normal operation with Bluetooth active (discoverable or linked).

Steady **Green** without flashing indicates Calibration Mode and Probe Cover may be opened to expose sensors.

Alternating **Blue** / **Green** flashes indicates OEM operation mode.

Alternating **Green** / **Red** indicates low battery.

Alternating **Blue** / **Red** indicates low battery (while Bluetooth is active).

One **Green** flash every 30 seconds indicates probe powered on via Wi-Fi.

Flashing **Red** indicates an error or warning. The LED will flash red a number of times and then pause. The number of times the LED flashes indicates the error message.

2 **Red** Flashes indicates critical battery and probe shutdown is imminent.

3 **Red** Flashes indicates the RH/ Temperature probe is missing or inoperable.

4 **Red** Flashes indicates the internal Real Time Clock is not set or is malfunctioning.

5 **Red** Flashes indicates there are no sensors installed or all sensors are malfunctioning.

6 **Red** Flashes indicates an internal power fault.

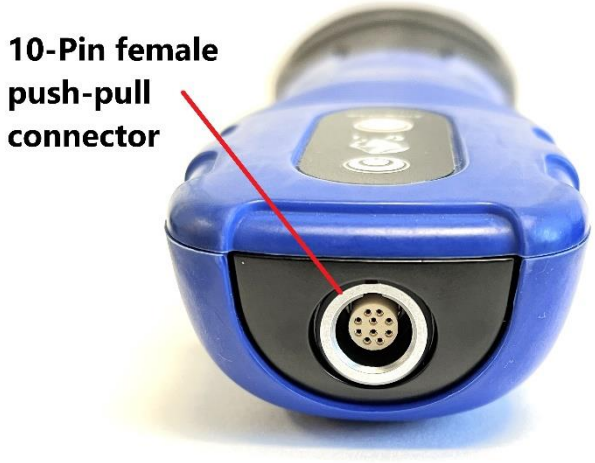
7 **Red** Flashes indicates the internal fan is stalled or jammed.

8 **Red** Flashes indicates the internal temperature of the probe is too high and shutdown is imminent.

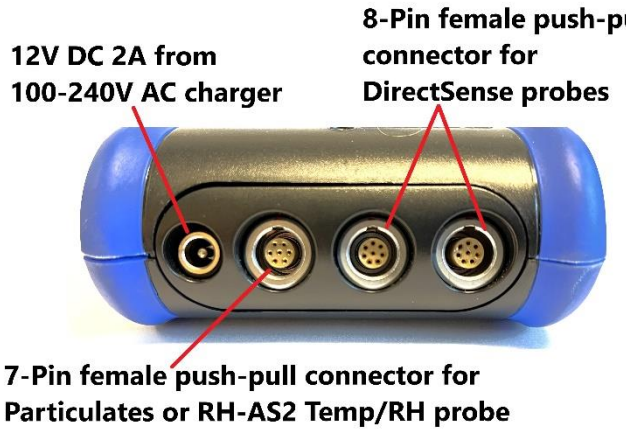
9 **Red** Flashes indicates a problem connecting to wireless.

Connecting to AdvancedSense Pro/BE/Standard with Cable

Using the AD-DSIIL8-1M cable, connect the male 10 pin Plug (with blue strain) relief side to either the base of the DirectSense II probe or the right side of the cradle. The male 8 pin rugged (black strain relief) connector will be attached to one of the ports in the AdvancedSense Pro/BE/Standard.



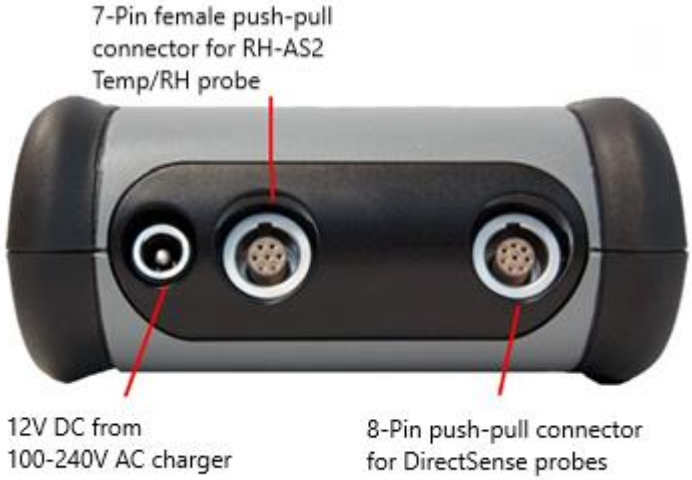
For the AdvancedSense Pro/Standard the male 8 pin end of the cable can be attached to either one of the two female 8 pin Lemo connectors on the bottom right:



Bottom of AdvancedSense Pro

AdvancedSense Pro with DSII

For the AdvancedSense BE the male 8 pin end of the cable can be attached to the female 8 pin connector on the bottom right:



Bottom of AdvancedSense BE

AdvancedSense BE with DSII

Connecting to Tablet/PC with Cable

Using the AD-DSIIUSBM-1M (full size USB) or AD-DSIIUSB-1M (micro size USB) connect the male 10 pin side to either the base of the DirectSense II probe or the right side of the cradle. The full size USB or micro USB will be attached to the tablet/PC.

Tablet with DSII

Bluetooth Connection

Specific directions for configuring your Tablet or AdvancedSense PRO to support Bluetooth connection can be found in the Pairing with Windows or Pairing with WolfSense OS sections.

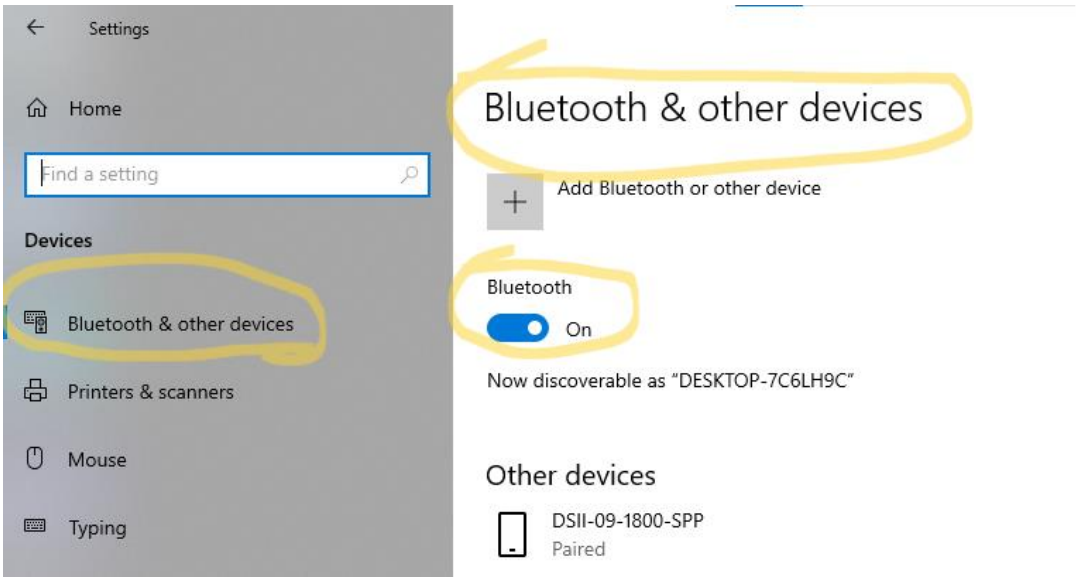
To use your DSII probe via Bluetooth, you must manually turn the probe on by momentarily pressing the power button. The LED should begin flashing slowly **Blue** then **Green** to indicate that it is 'discoverable' by Bluetooth devices. If the LED is not flashing **Blue/Green**, you may need to configure the probe by connecting it via the serial cable to WolfSense and using PROBE OPTIONS / DSII under the PROBE MENU.

The probe will stay in discoverable mode for 5 minutes and then will shut down the Bluetooth radio to save power. Additionally, if the system detects wired communications, it will automatically disable Bluetooth. The LED will change from flashing **Blue** to flashing green to indicate that Bluetooth is no longer functioning.

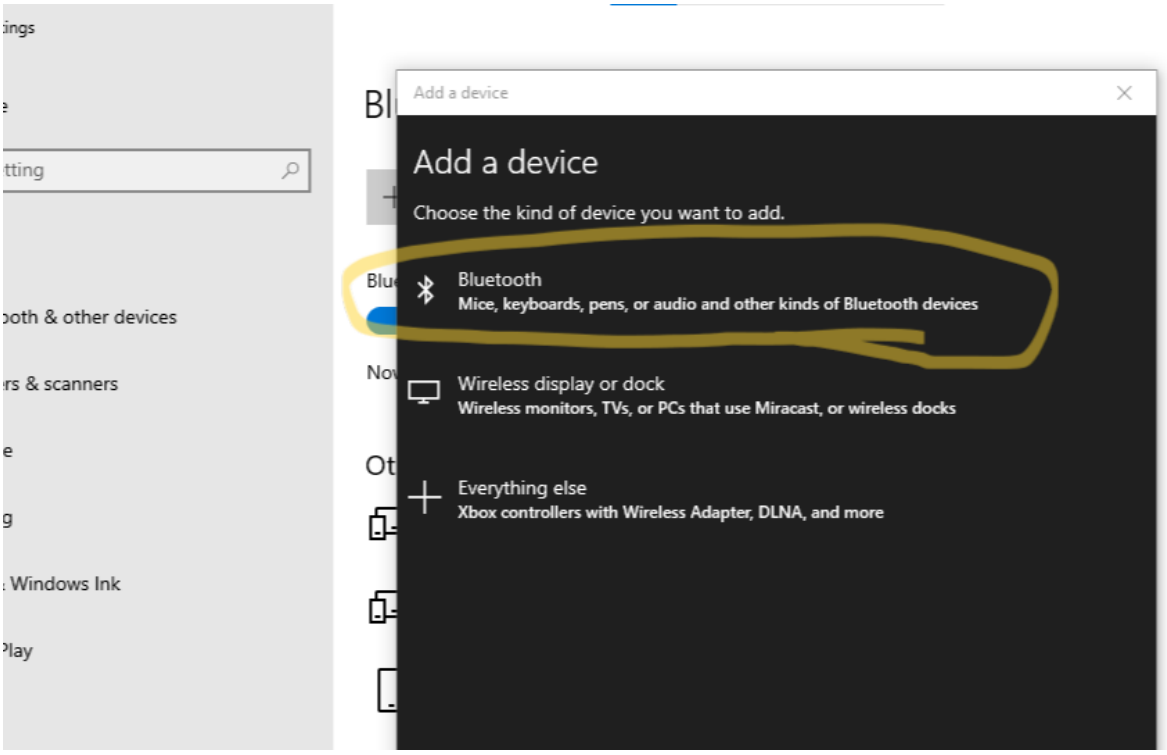
Once a Bluetooth connection is established, the LED will continue to flash **Blue** indicating the link. However, if it is plugged into a serial connection, it will disconnect Bluetooth in favor of wired and begin flashing **Green.**

Bluetooth Pairing with Windows

Go to the Settings of your Windows 8+ computer. And find the Device settings. Then navigate to the BlueTooth device settings. Make sure your Computers Bluetooth is enabled.

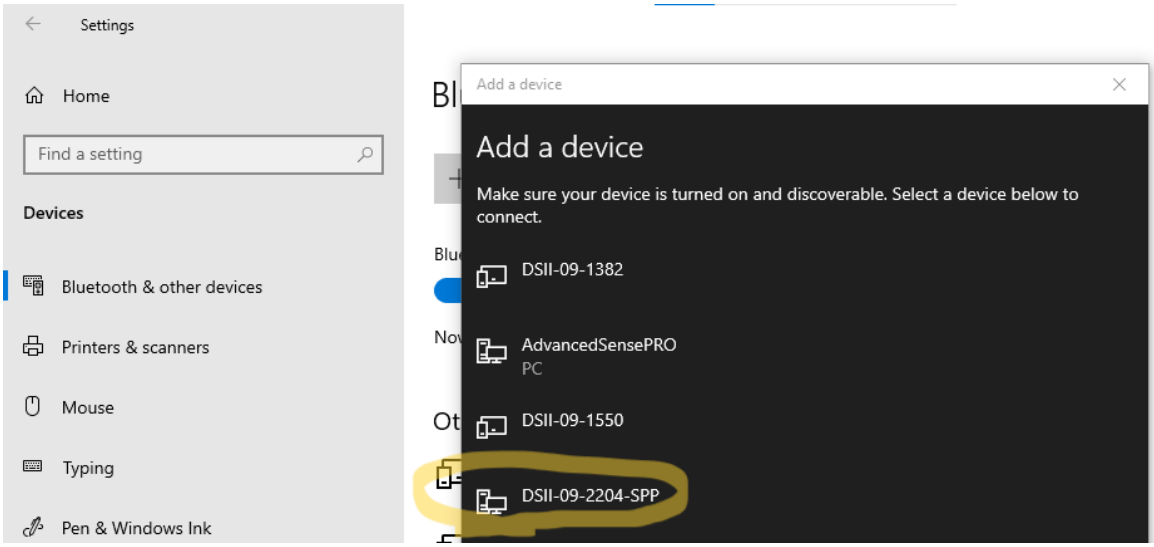


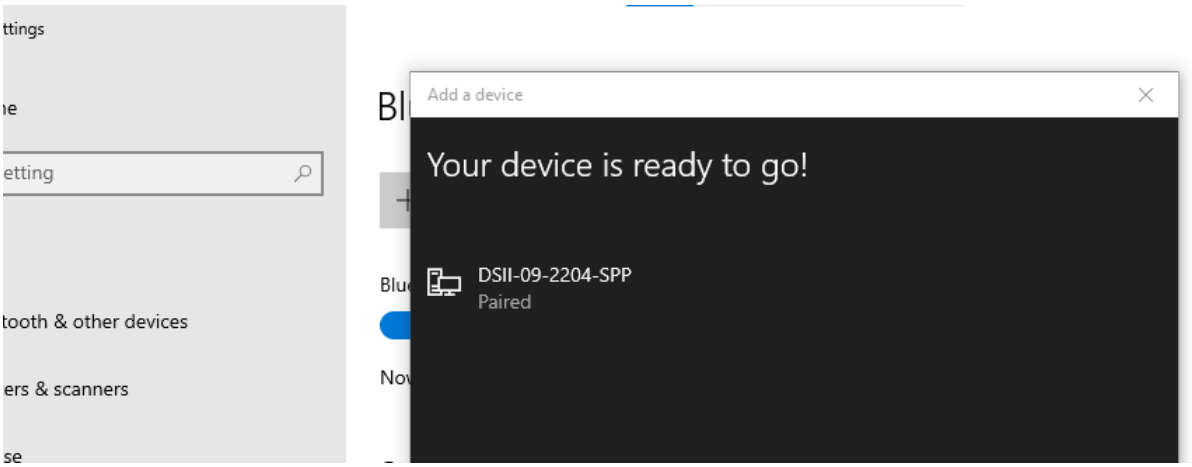
Go to **Add Bluetooth or other device** and select **Bluetooth** to connect a probe



Next you will see all the available devices that you can connect to. Your DirectSense II Probe will be identified by the serial number labeled on the back/bottom of the probe. For probes with WolfRadio Bluetooth connections the serial number will show up as **DSII-09-XXXX-SPP***. **SPP** signifies that the probe is set to Bluetooth classic- what is necessary for connection to a Windows PC/laptop/tablet. If the **SPP** is not present and your probe is showing up as **DSII-09-XXXX**, then it is set to BLE (Bluetooth Low Energy)- which is used for connection to the WolfSense Mobile app. Refer to the beginning of this section on how to change the probes settings.

*Probes that do not have WolfRadio (manufactured before September 2021) will show up as **DSII-09-XXXX** as they only have Bluetooth classic.





Select your probe and it should automatically pair to your computer. Older probes may ask for a PIN to pair your device. The Pin is **7997**.

Proceed to opening WolfSense LAP and allow the software to search for probes to connect to the DirectSense II probe. Once the initial pairing process is performed it should not have to be performed again on subsequent connections.

Attaching Tripod and Belt Clip

Tripods and the belt clip can be attached in the same upper ¼“ - 20 tpi brass insert on the back of the DirectSense II.

Attaching Flange

Slide the probe through the ACC-DSII-PCCHOLD or ACC-DSII-FLANGE and screw in the bottom M4 locking thumb.

Warranty

GrayWolf Sensing Solutions LTD and its subsidiary GrayWolf Sensing Solutions LLC (hereafter collectively referred to as "GrayWolf") will warranty parts and labor for any manufactured defects in its products for 12 months. The warranty does not cover abuse (e.g., products crushed, dropped, electrically shocked, heat-stressed, or water-saturated), hazard, accident, transportation or causes beyond ordinary use. All service, including repair, maintenance, and sensor replacements, must be performed by GrayWolf or one of its authorized service centers. Defects on finished goods manufactured by others, such as computer systems, are excluded and are covered by the original manufacturer's warranty (usually one year).

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(a) Except as otherwise agreed in writing, GrayWolf warrants, under normal conditions of operation, each product sold (except for finished products not of its manufacture) against defects of material and workmanship, provided that such product has been properly utilized. This warranty applies to the original purchaser only and shall commence to run from the date of shipment and shall continue for a period of twelve (12) months. In any event, GrayWolf's liability for any such defects of material and workmanship shall not exceed the cost of replacement of defective parts upon timely notification of such defect in writing delivered to GrayWolf's North American home office. GrayWolf shall not be liable for damage or destruction caused during delivery or caused other than by employees of GrayWolf.

(b) GrayWolf shall, at its option, repair such defects or replace the parts or products found defective. All defective parts are to be returned immediately, freight prepaid, to GrayWolf. GrayWolf will make no allowance for repairs or alterations made by the purchaser unless made with the advance written consent of GrayWolf. GrayWolf assumes no liability for costs of disassembly of defective parts and equipment. Shipment by purchaser of all repairs and replacements under this warranty are F.O.B. GrayWolf's factory, North American service facility or authorized service representative, and method of shipment will be determined by GrayWolf. The purchaser will pay shipping costs and insurance in both directions of products, parts, or components shipped for warranty service hereunder. The purchaser will be responsible for risk of loss in both directions. Replaced parts or components will become the property of GrayWolf. Replacement parts or components may contain recycled, refurbished, or remanufactured parts equivalent to new parts and shall be warranted for the remainder of the original warranty period for the products.

(c) Products that are not covered by warranty, such as products that have been subjected to physical misuse or are beyond the warranty period, will have an estimate submitted before the repair work commences. All out-of-warranty repairs carry a 90-day warranty from the date of return shipment.

(d) GrayWolf shall not be liable for delays, deprivation of use, or any other damages, direct or indirect, which may result to the purchaser because of defects in the product or because of the purchaser's inability to operate it or use it to his satisfaction. GrayWolf will not be liable to anyone for special or consequential damages of any kind. GrayWolf neither assumes nor authorizes any person to assume for it any other obligation or liability with respect to GrayWolf products. GrayWolf does not warranty that the equipment is fit for any purpose unless notice of the purpose is specifically submitted to GrayWolf in writing and is specifically confirmed by an officer of GrayWolf to you.

(e) Finished goods manufactured by others, including computers, batteries, carrying cases and bar coding wands are not warranted by GrayWolf, but are covered by the original manufacturer's warranty.

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Technical Support

For Drivers, Updates, TechNotes visit:

http://graywolfsensing.com/support/

Software e-mail: support@graywolfsensing.com

Phone: 1-203-402-0477 (in Europe 353-61 358044)

GrayWolf on the Web: http://graywolfsensing.com/

For videos on Probe Calibration, changing sensors, etc. visit:

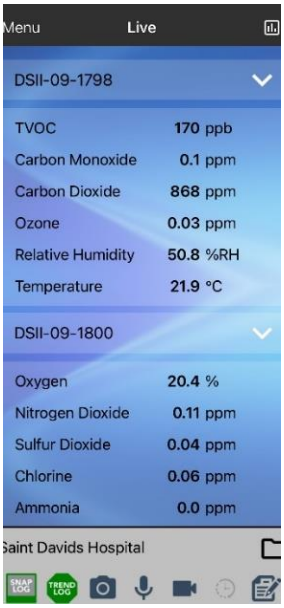
http://graywolfsensing.com/graywolf-videos/

Appendix

The following documents have been appended to provide additional support for specific uses and applications of the DirectSense II probe.

- DSII BLE QuickStart
- DSII Wi-Fi QuickStart
- User Calibrations with DirectSense II Configuration Tool or WolfSense LAP
- PID TVOC Sensor Guide

DirectSense II And Mobile App Quick Start Guide



Download the FREE App

Search for WolfSense Mobile on the Google Play and Apple App store or visit https://graywolfsensing.com/wolfsensemobile/ for links to the app store.

The WolfSense Mobile App Quick Start is available in the Help/About Menu or by visiting: https://graywolfsensing.com/wolfsense-mobile-app-quick-start/

Powering Probe

Depress the power button momentarily to turn on the probe. When the probe first boots up, the LED will cycle **Red**, **Green**, **Blue** to indicate start up. While the probe is operating the LED will flash color sequences to indicate status. To turn the probe OFF, depress the power button for >3 seconds. The LED will turn solid **Red** for 2 seconds and then will power down indicating an orderly shutdown has occurred. If the probe is not responding, holding the power button down for >12 seconds will force the probe to power off immediately.

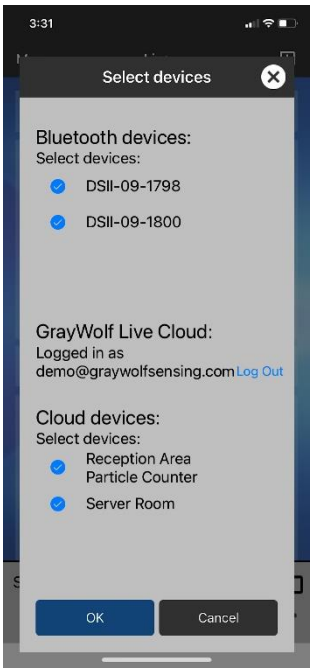
Charging Probe

Place the probe in the charging cradle to charge. The LED on the charging cradle will pulse **Green** intermittently until the probe is fully charged, and then will become solid **Green**. Flashing **Red** indicates a fault and solid **Blue** indicates the cradle is powered but the probe is not inserted correctly.

Connecting Probe

Power on your probe, then open the WolfSense Mobile App on your phone or tablet. Tap the main menu, select READINGS and SELECT DEVICES. Within a few seconds any BLE-enabled probes will appear. Make sure probes are selected and press OK. The readings may take up to 30 seconds to first appear.

If you have a GrayWolf Live account, you may also view live readings of any probe registered to your account. In the SELECT DEVICES menu, log in to your GrayWolf Live account and select Cloud devices you would like to display and press OK. They will now appear on the Live reading screen.



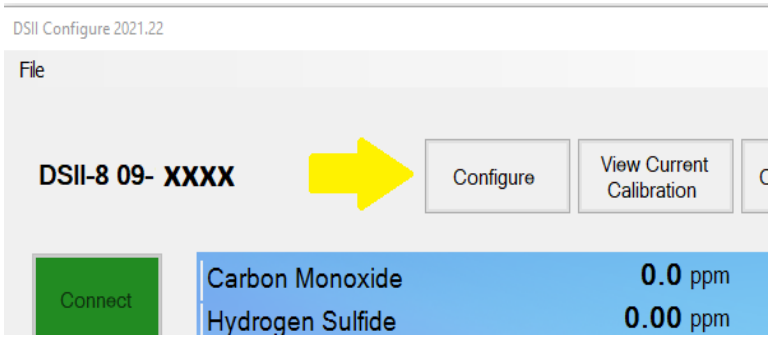
Troubleshooting

Your DSII probe should have Bluetooth Low Energy (BLE) enabled by default. However, it is possible to disable BLE. Make sure the LED on the front of the DSII is either blinking **blue** or alternating between **green** and **blue**. If not, the Bluetooth may be disabled, follow directions below to enable BLE.

Configure Probe

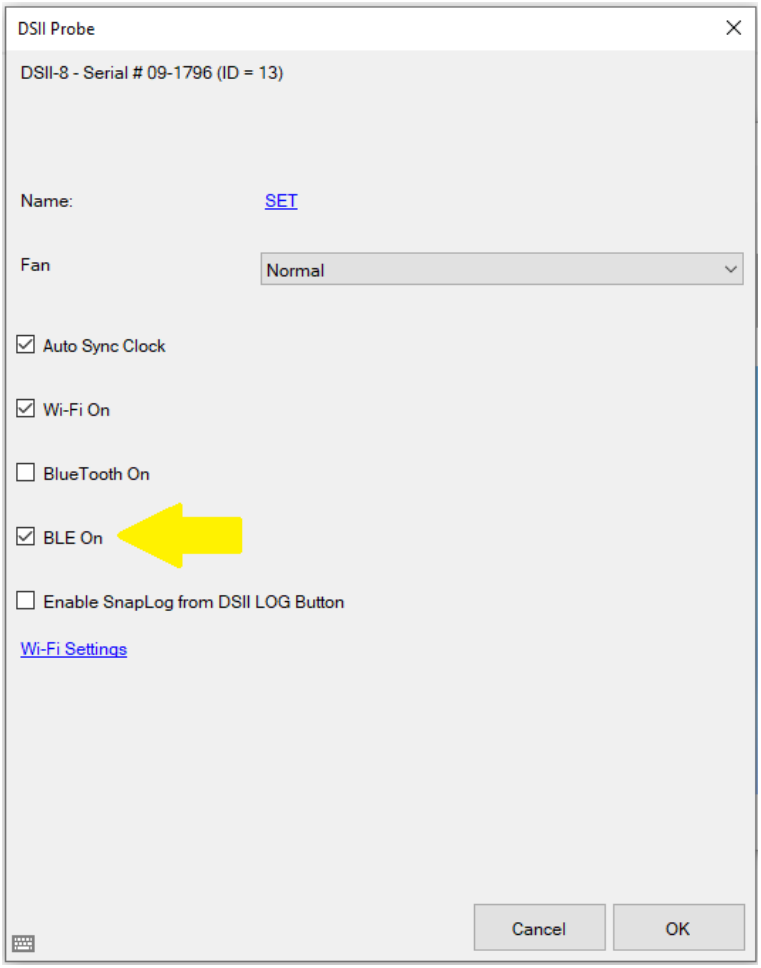
Your DirectSense II Probe should be pre-configured for Bluetooth LE (BLE) by default. You can change the Bluetooth and Wi-Fi settings by using the DirectSense II Configuration Tool.

Connect your DirectSense II Probe using the supplied USB cable and run the configuration tool on a Windows PC/Laptop from: https://graywolfsensing.com/downloads/dsii/dsii.exe



Use the CONNECT button to search for your DirectSense II Probe and then use the CONFIGURE BUTTON.

Make sure **BLE On** is checked (and **Bluetooth On** is NOT checked). Press OK and reboot probe if you make changes.



For additional troubleshooting and tech support, please contact:
TechSupport@GrayWolfSensing.com

GrayWolf

Sensing Solutions

DirectSense II Wi-Fi + GrayWolfLive

QuickStart Guide

October 2022 v1.1

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Table of Contents

Overview

DSII probes equipped with WolfRadio can utilize GrayWolfLive to log data directly to the cloud where readings can be viewed online.

To turn on the DSII Probe, use the Power Button on the probe. The probe will show a sequence of 3 lights: **Green**, **Blue**, **Red** and then it will begin flashing periodically.

To turn off the probe, hold the Power Button down for 3 seconds until the LED shows **Solid Red** and then turns off. If the probe will not turn off, hold the Power Button down for 12 seconds to force a reset.

Charging Cradle

On the right side of the cradle there are two inputs (see figure above). The input on the left is a female 10-pin Lemo for connection to an AdvancedSense/WolfPack/Tablet/PC with the appropriate GrayWolf interface cable. The input on the right is for AC power. Only the GrayWolf-supplied power adapter should be used for the charging cradle.

Charger LED Status

Flashing Green = DSII is charging or being powered (LED will pulse once every 5 seconds)

Solid Green = DSII is fully charged*

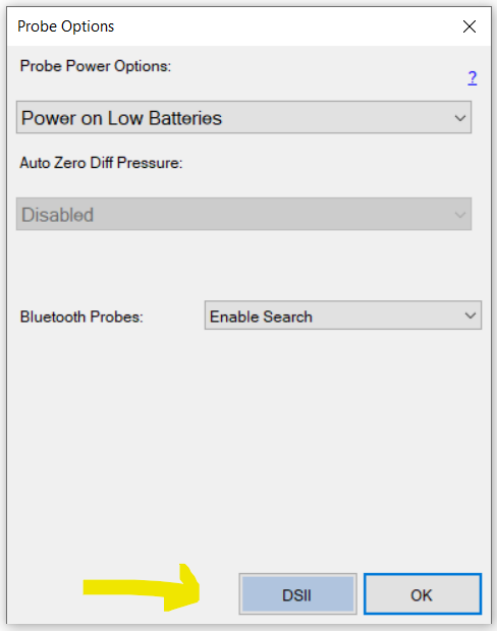
Solid Blue = Charging cradle is powered but no probe is attached

Flashing Red = A fault is indicated

* *If DSII is powered ON and connected to Wi-Fi, the charging cradle LED may never change to **Solid Green**.*

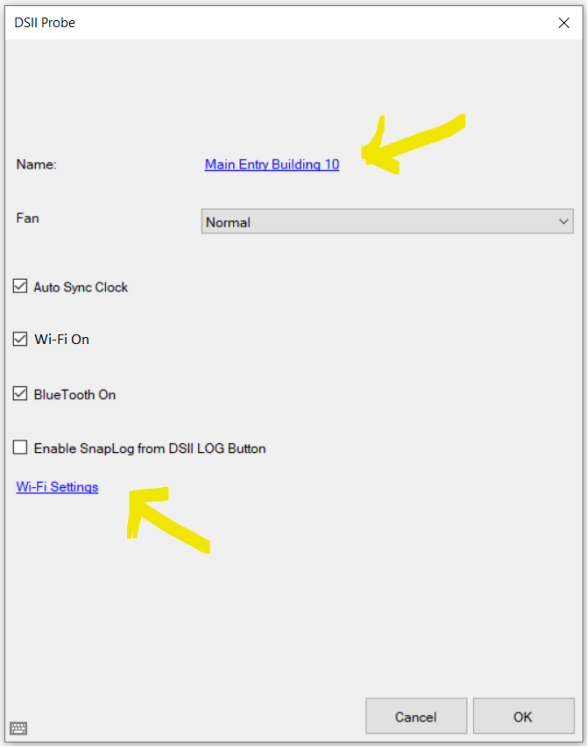
Configure DSII Wi-Fi

Configure the Wi-Fi on your DSII probe using the supplied USB to Serial Cable and WolfSense LAP 2020.51 (or higher) or the serial cable with an AdvancedSense PRO 2020.40 (or higher). Navigate to the PROBE menu and select PROBE OPTIONS. If a DSII probe is connected, the **DSII Button** will appear. Press the DSII button to begin configuration.



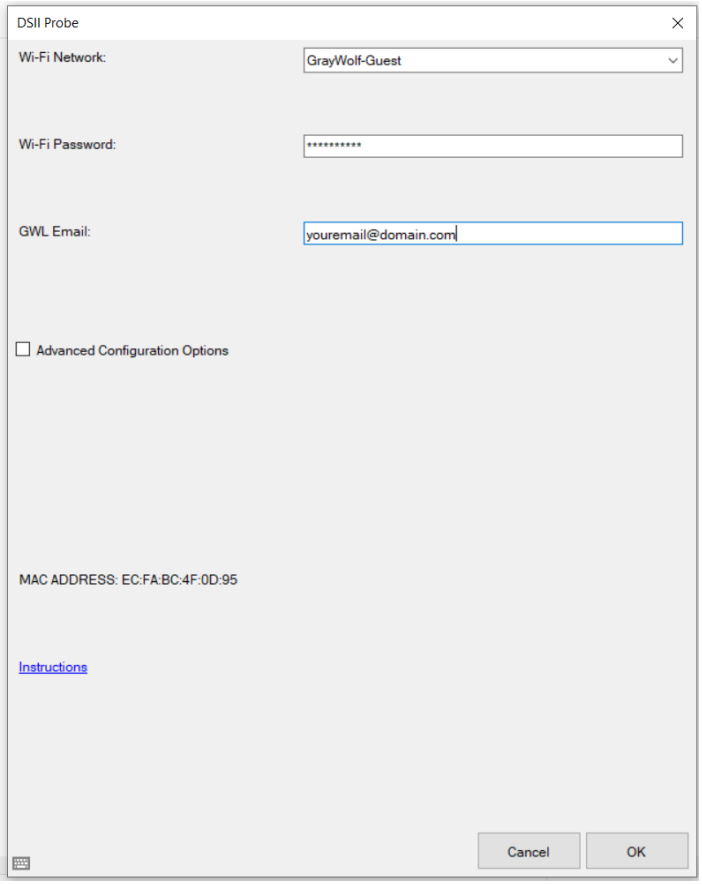
You may also utilize a web-based tool to configure your DSII probe which can be run on any Windows PC/ Laptop by clicking: https://graywolfsensing.com/downloads/dsii/dsii.exe
You will need to connect the DSII probe to the PC using the supplied USB to DSII cable.

USB Drivers are generally built-in or auto-installed by Windows. If you need to manually install the probe drivers, they are available from GrayWolf's website: https://graywolfsensing.com/software-drivers/



The **NAME field** can be used to label the DSII probe or the location of the DSII probe. When the probe first connects to GrayWolfLive, this name will be used to identify the probe but the name can be changed at any time through the GrayWolfLive interface. **Wi-Fi On** must be checked for the probe to connect to a network.

Use the Wi-Fi Settings link to open the Wi-Fi Settings box.



Use the Wi-Fi Settings dialog box to configure your probe to connect to your Wi-Fi network.

Wi-Fi Network – If the Notebook or Tablet PC is connected to a network, the name of the network will appear in the drop-down menu. Alternately, you can type in the network name. The Wi-Fi network name is also known as the SSID or Service Set Identification.

Wi-Fi Password – Enter the password for the Wi-Fi network.

GWL Email – Enter the full email address used to establish your GrayWolfLive account. This email address must match exactly, or the system will not be able to route data to the proper account. This field is not case-sensitive.

MAC ADDRESS: Once the DSII probe has connected to your network, the MAC Address of the Wi-Fi card will be displayed here. This information may be needed by your IT Department if MAC address security or filtering is being utilized.

Use the ADVANCED CONFIGURATIONS OPTIONS to setup additional security options like RADIUS SERVER login credentials and CERTIFICATES or to change the default server address to a custom URL to receive data.
To return to sending data to GrayWolfLive, the **Server** address is www.graywolflivesync.com/v1/ and the **Port** is 80.

Press OK to commit the data to the DSII probe. The probe will need to be re-booted for the changes to take effect.

WolfRadio Technical Information

The DSII "WolfRadio" module can connect to 802.11 b/g (2.4GHz) wireless networks.

The DSII is compatible with the following Wi-Fi security Standards:
WPA/WPA2-Personal with a Pre-Shared Key (PSK) a password that is distributed to all users of the network, or Open networks not requiring a password.

WPA/WPA2-Enterprise (PEAP-MSCHAPv2, TTLS-MSCHAPv2) also commonly known as RADIUS server authentication.

Secondary Log-ins or Captive Portals:

For open-networks that require a Secondary Log-In or Captive Portal to log onto the network, the DSII does not have a web-browser or user-interface so it is not possible to respond to prompts or enter additional log-on information.

The simplest solution is to "white-list" the DSII probe's MAC address by entering in your router's safe-device or white-list table. Devices that are white-listed will generally bypass the secondary prompt. The MAC address can be obtained through the Configuration Menus as described in Step 1 above.

You may need to consult with your IT department to see if white-listing the device's MAC address will bypass the captive portal.

Alternatively, a secondary network or hotspot could be utilized. GrayWolf Sales can assist with hotspot selection.

DSII Wi-Fi Connection Status

The DSII probe can take up to 2 minutes to initially connect to the Wi-Fi Network. Once connection is established, the probe LED will **Flash Green** once every 10 seconds and will remain OFF otherwise. This LED operation is different than the normal steady green or blue flashing when the probe is connected to WolfSense software via cable or Bluetooth. Note that the probe can be connected to Wi-Fi and WolfSense software simultaneously, but the once per 10 second green LED flash indicating Wi-Fi connection will take precedence over the standard LED behavior.

If the DSII is operating on battery power, the LED will flash RED to indicate low battery level.

If the DSII is able to connect to your Wi-Fi network but unable to send data, it will flash the LED **RED** 9x then pause. This usually indicates that the email address entered for GrayWolfLive is incorrect or that a firewall or router configuration issue is preventing connection. It may also indicate that your router is not currently connected to the internet.

The DSII will attempt to reconnect to the network if the Wi-Fi signal or internet connection is lost. The DSII will only quit these attempts after approximately 10 minutes initially. Once a successful connection is made, should it be subsequently lost, the DSII will attempt to re-establish connection indefinitely on AC power or on battery (until the DSII probe battery level is insufficient to continue).

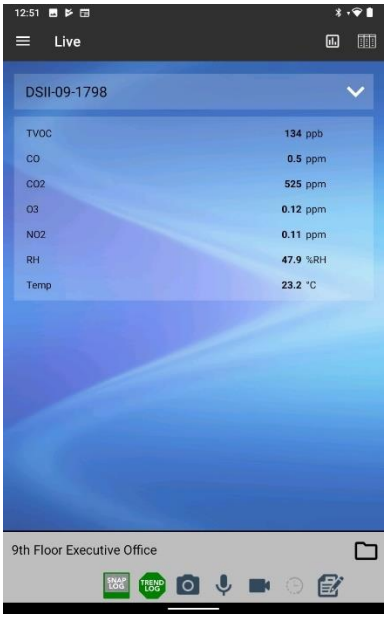
Fixed and Long-term Monitoring

The DSII charging cradle may be wall-mounted and used as a security stand for long-term monitoring. The cradle should be plugged in to the GrayWolf-supplied AC Charger for continuous use.

The charging cradle mount contains a security tab insert which will prevent unwanted removal of the probe from the wall. Consult GrayWolf's training videos or contact GrayWolf Tech Support for more info.

When the DSII is used as a fixed or long-term monitor, activate the POWER BUTTON IGNORE feature to prevent building occupants from accidentally turning off the probe. To activate this feature: Power on the DirectSense II probe and watch for the initial **GREEN**, **BLUE**, **RED** Startup LED sequence. Once that is complete, press and hold the LOG BUTTON until you see the LED turn solid **RED** with quick flashes of **GREEN**. You must perform this operation within the first 30 seconds of the probe being on. In this mode, the normal Power Button function is ignored; to turn off the probe you must press and hold the power button for more than 12 seconds.

WolfSenseMobile App



GrayWolf offers a FREE app for reviewing and logging live readings collected by your Wi-Fi-equipped DSII probe (as well as Bluetooth connected devices). The app may be downloaded from GOOGLE PLAY and APPLE APP STORE by searching "WolfSense Mobile" or by using the links below. To use the app, you must sign-in to your GrayWolfLive account using the READINGS MENU / SELECT DEVICES and select LOG-IN to GRAYWOLFLIVE CLOUD.

A quick start guide to using the app can be found here:
https://graywolfsensing.com/wolfsense-mobile-app-quick-start/

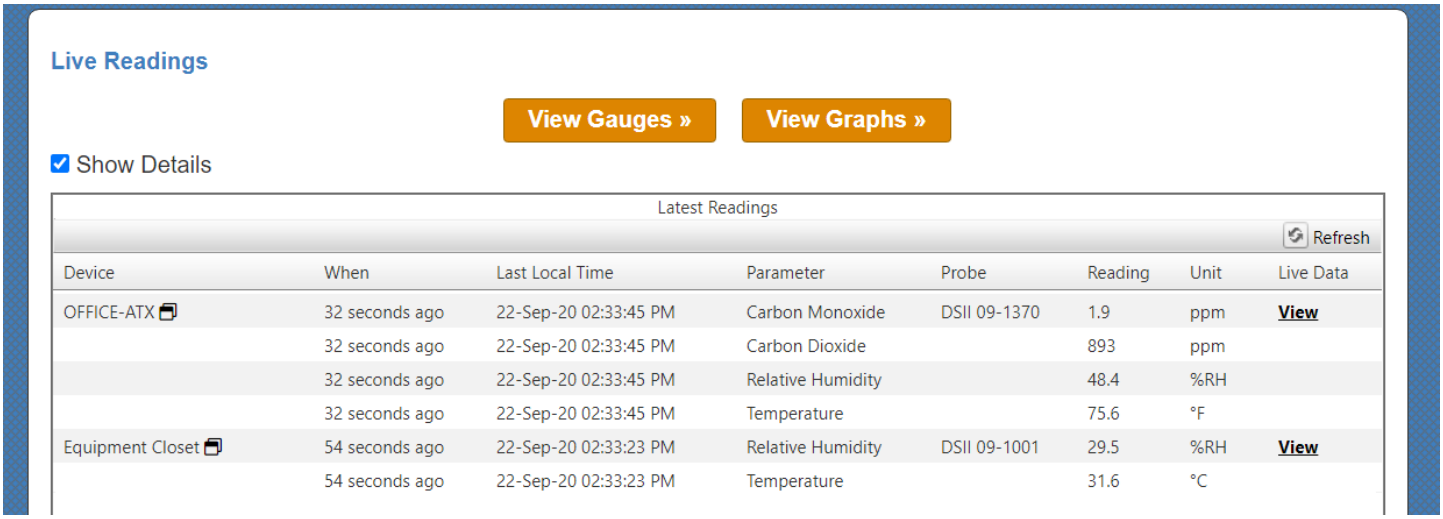
Apple Store Link:
https://apps.apple.com/us/app/wolfsense-mobile/id1522804523

Android Store Link.
https://play.google.com/store/apps/details?id=com.graywolfsensing.wolfsensemobile

Using GrayWolfLive

If you do not have a GrayWolfLive account, please contact GrayWolf Sales to setup an account.

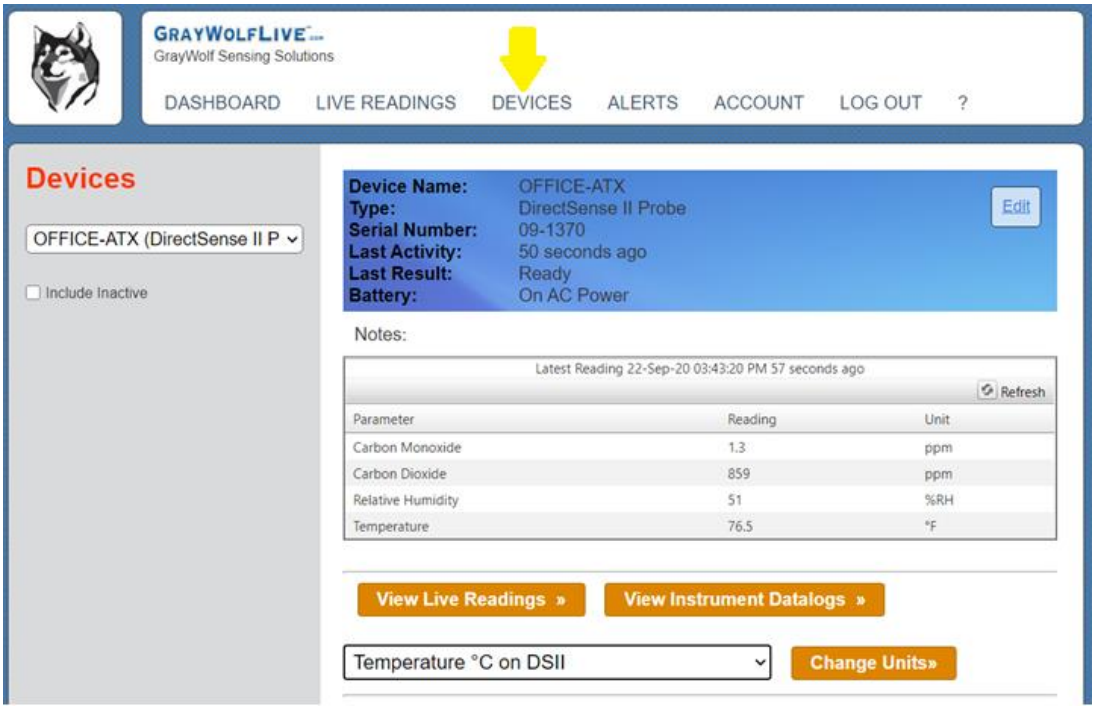
Enter https://us.GrayWolfLive.com into any web-browser to access GrayWolfLive. All devices which are registered with the email address you signed up with, will be displayed in the Live Readings view.



For information on using the features of GrayWolfLive, refer to the GrayWolfLive Quick Start guide or contact GrayWolf Sales for training.

NOTE: Device data is automatically stored in GrayWolfLive for 1 year and thereafter erased. To permanently retain data you must EXPORT or STORE using one of the methods described in *Saving and Reviewing Data Recorded in GrayWolfLive* below.

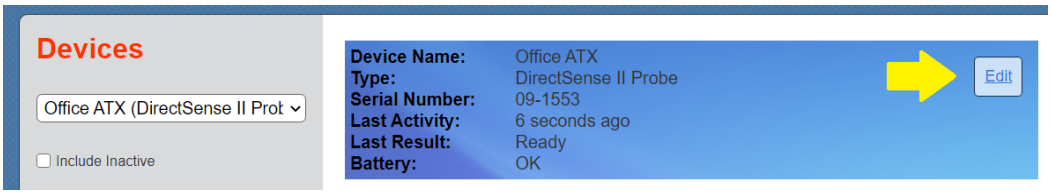
Changing Units Displayed by your DSII Probe



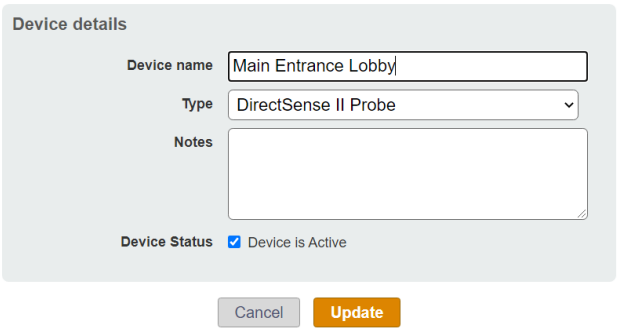
From the main **DEVICES** menu, choose the Device from the drop-down list on the left side of the screen. The most current set of readings will be displayed. Choose the desired unit for each parameter from the drop-down list and click the **Change Units** button. The changes will take effect once the next data set is synced to GrayWolfLive.

Renaming your DSII Probe

From the main **DEVICES** menu, choose the Device from the drop-down list on the left side of the screen.
The Device Summary window will be shown which will display the DSII Probe Serial number as well as its last connection, status, battery status. Choose the EDIT button in the upper right corner of the summary window.



Enter the new name in the Device Name field and click on UPDATE. The new name will be shown on Live Readings, Gauges, Graphs and Logged Data.

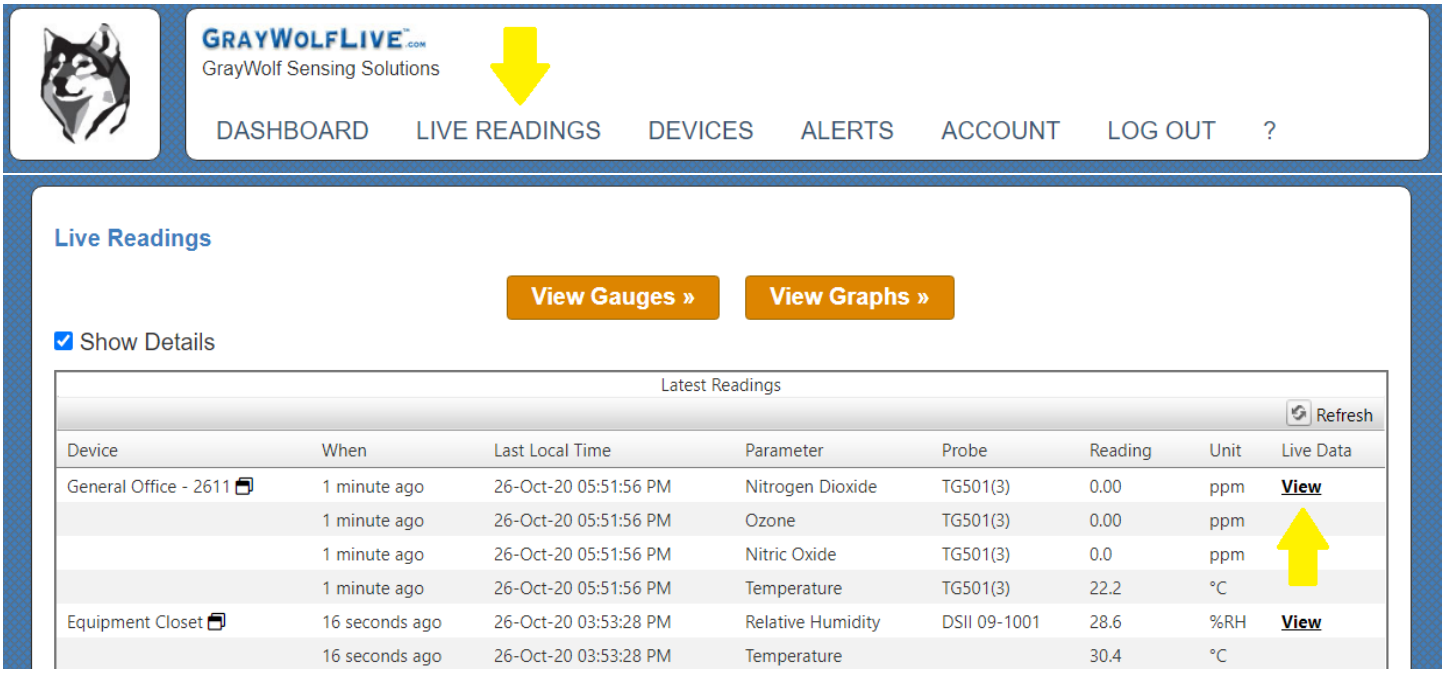


You may also mark devices as ACTIVE/ INACTIVE. INACTIVE devices will not be shown in your LIVE READINGS view.

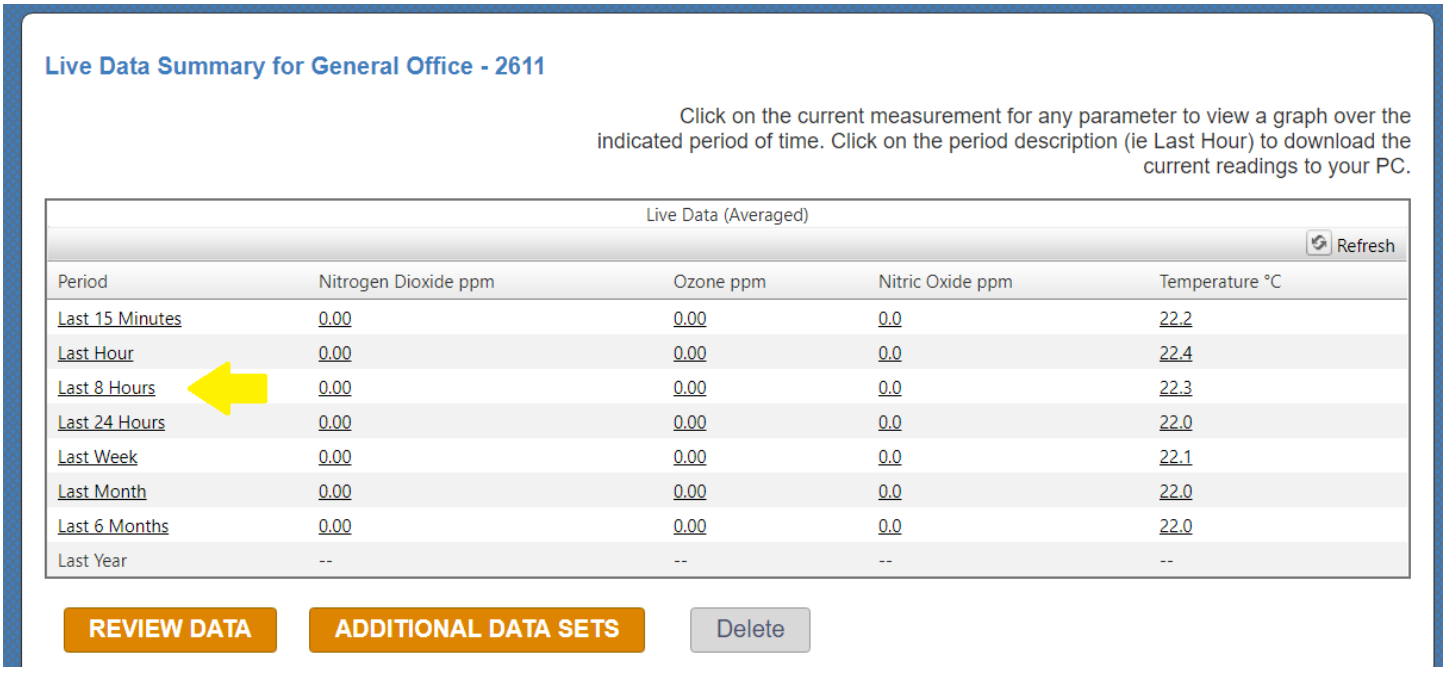
Saving and Reviewing Data Recorded in GrayWolfLive

Method 1: Quick Download Links

Use this method to permanently store data in .csv format on your PC or other storage device. From the main **LIVE READINGS** screen, select the **View** link in the Live Data column for the Device you are interested in retrieving data from.



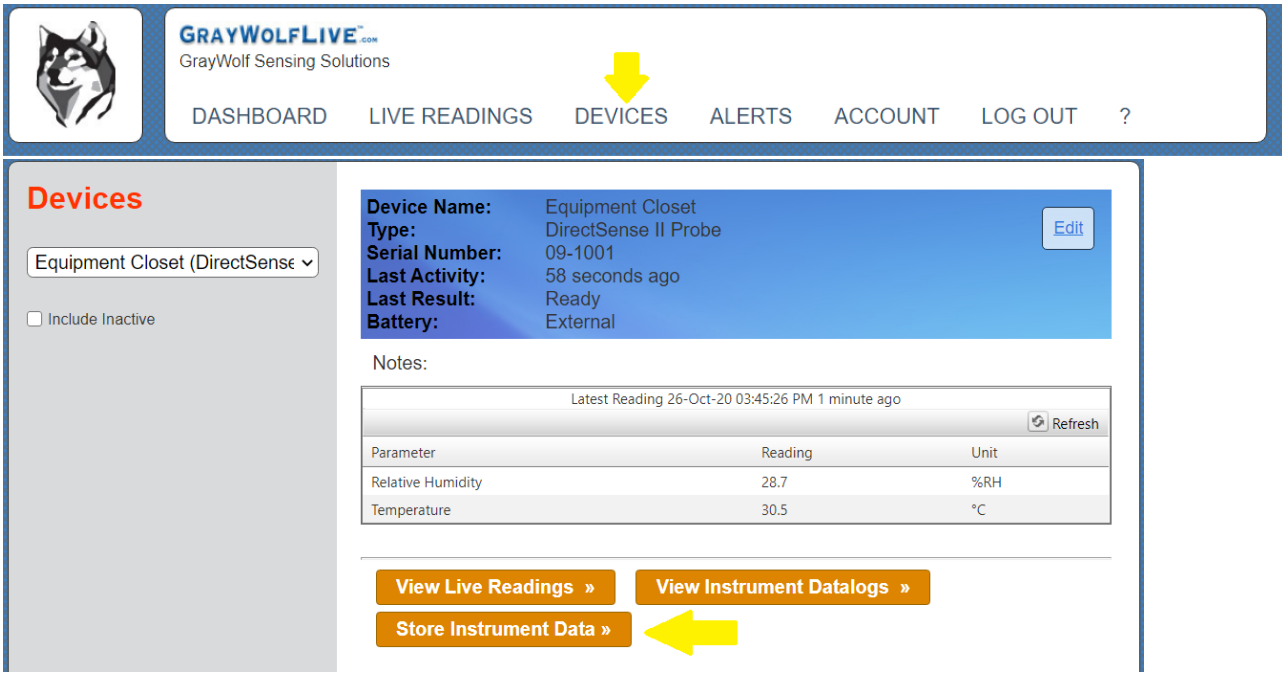
From the Period column, select the link for the time period you would like to download. The data download will start automatically and provide a .csv file containing all the logged parameters for the selected

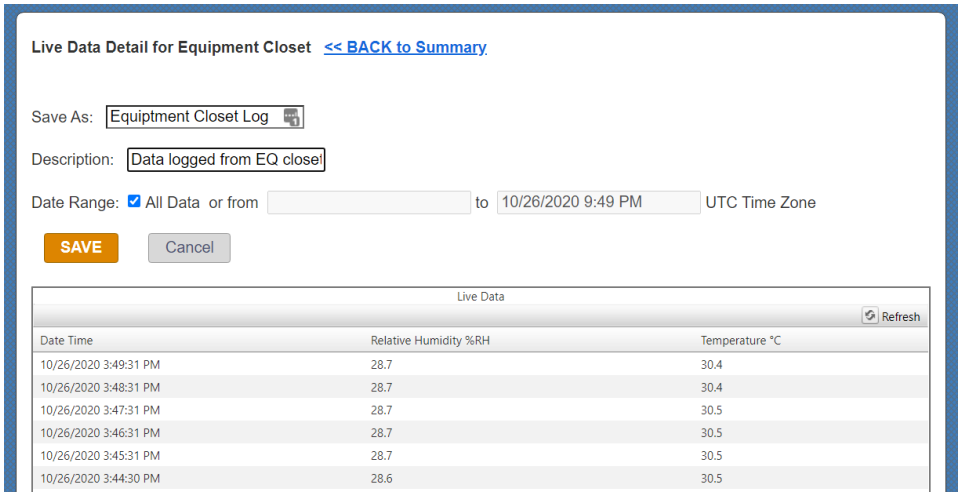


Method 2: STORE DATA in GRAYWOLFLIVE

Use this method to permanently store logged data in GrayWolfLive. Live data is normally erased after 1 year. If you store data in GrayWolfLive is it available indefinitely.

From the main **DEVICES** menu, select a device from the drop down list on the left side of the screen and select the **Store Instrument Data** button.

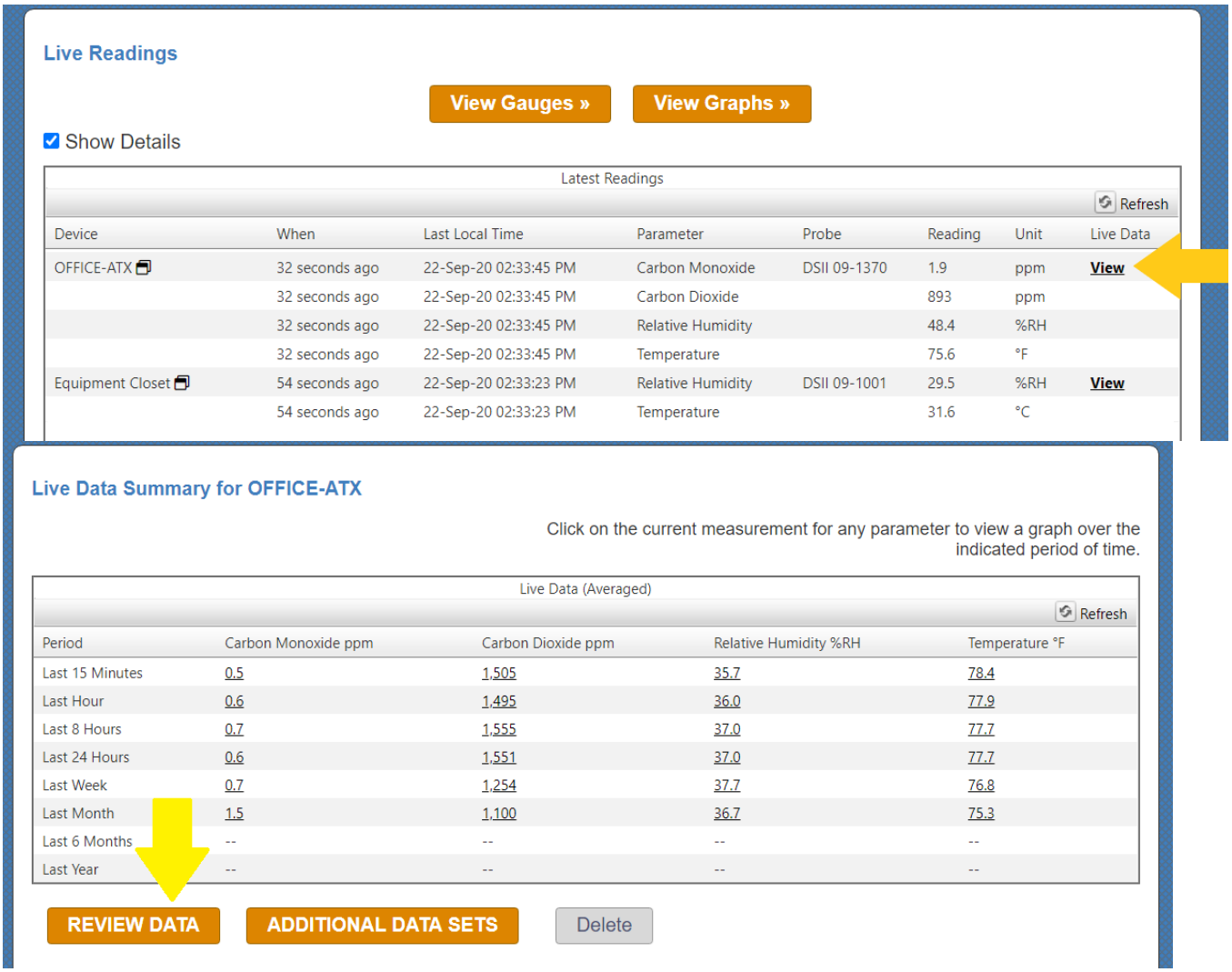




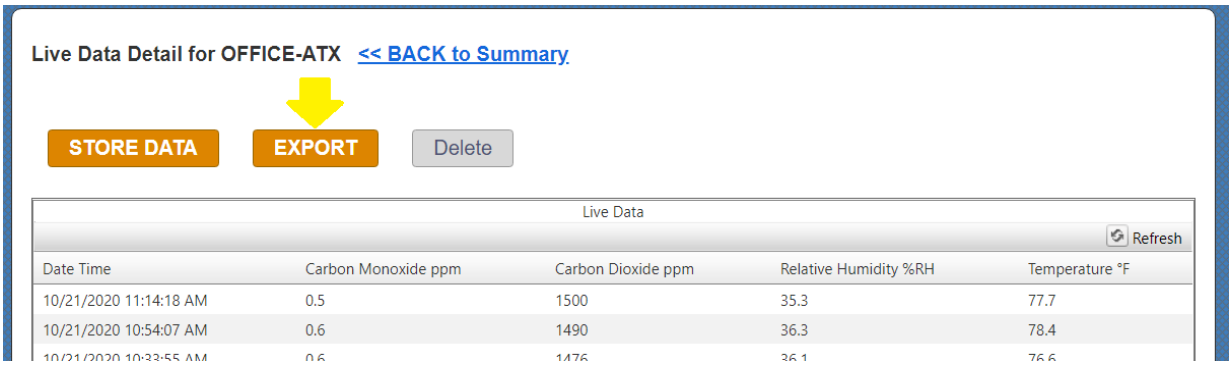
Enter a name for the data in the **Save As** field and optionally input a description. You may store all data or a specific time range of data. Saved data will permanently remain on the GrayWolfLive platform (as opposed to Live Data which is erased after 1 year). Saved data can be accessed in GrayWolfLive by double-clicking the file name from the Locations panel on the left side of the screen. This data may be emailed directly from GrayWolfLive or be accessed from within WolfSense PC (version 4.0 or higher) by clicking the GWL button. Once data is opened in WolfSense PC, it may be used in Advanced Report Generator reports.

Method 3: EXPORT DATA

Use this method to export data in .csv format. From the main **LIVE READINGS** menu, select the **View** Select the **REVIEW DATA** button.



Select the **EXPORT** button to save the data in .csv format.



Use the **STORE DATA** button to save the data in GrayWolfLive as described in method #2 so it may be opened in WolfSense PC, included in an ARG (Advanced Report Generator) Report or emailed to a customer directly from the GrayWolfLive website**.**

DirectSense II User Calibration

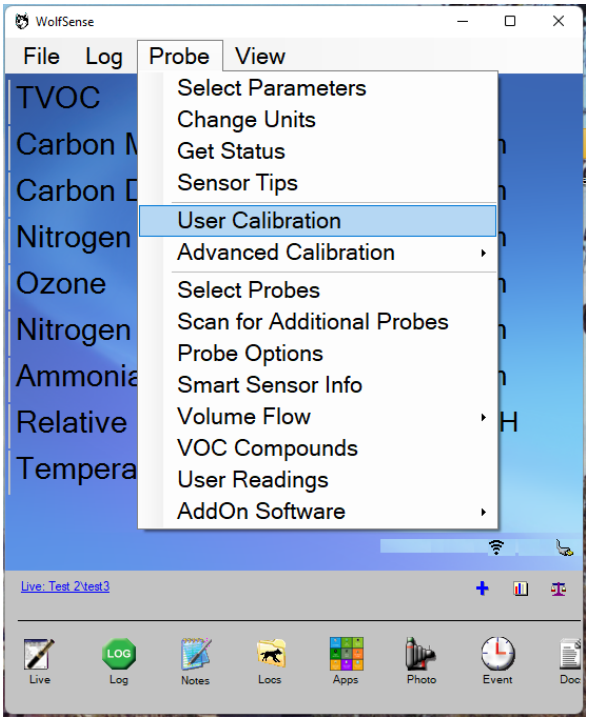
Performed with WolfSense LAP or DSII Configuration Tool

September 2022

With the appropriate calibration kit / equipment, a User Calibration can be performed on most gas sensors. Standard GrayWolf calibration kits include a regulator, calibration hood with tubing & reference gas to calibrate VOC's, CO2, CO and other gases. Interim User calibrations can help to maintain accuracy and reliability following a Factory calibration. The frequency of User calibrations recommended to maintain sensor accuracy will vary by sensor. Specific applications, protocols or S.O.P.s may require more frequent User (or Factory) calibrations.

Accessing the User Calibration Procedure

User calibration can be performed two ways using a Windows-based tablet, laptop or computer. For users with WolfSense LAP, access the procedure from the main menu, **Probe → User Calibration. Proceed to the Calibration Procedure on page 2.**

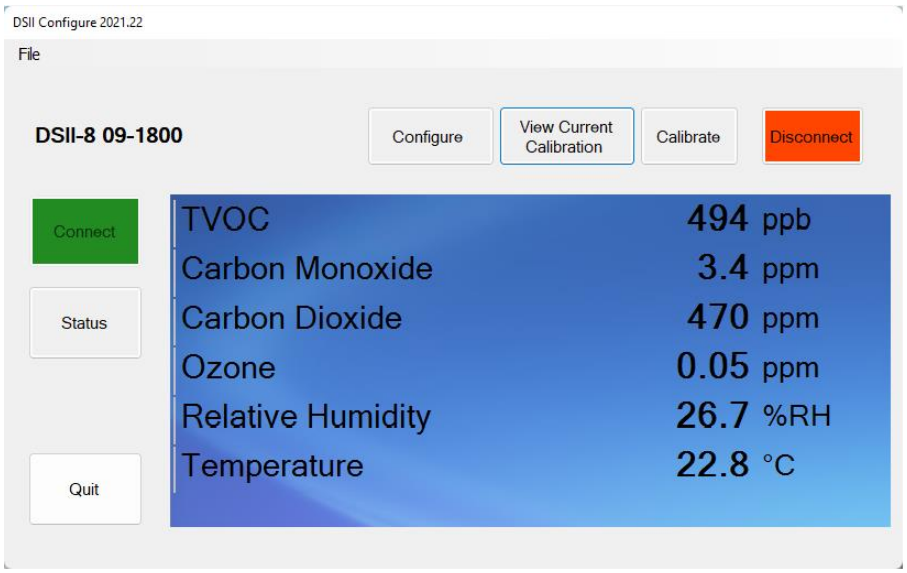


For users without WolfSense LAP, the web based DSII Configuration Tool can be used to configure settings and User calibrate the DirectSense II probe. This tool can be found at: https://graywolfsensing.com/downloads/dsii/dsii.exe

Once the link is opened, the free tool will be downloaded and run on your computer or tablet. If the file does not automatically run, locate your Downloads folder and open **dsii.exe.** (You may also create a desktop shortcut to this tool for easy access.)

Connect the DirectSense II probe to a USB port on your computer using the AD-DSIIUSB-1M probe cable (or wirelessly via Bluetooth). Click the **CONNECT** button.

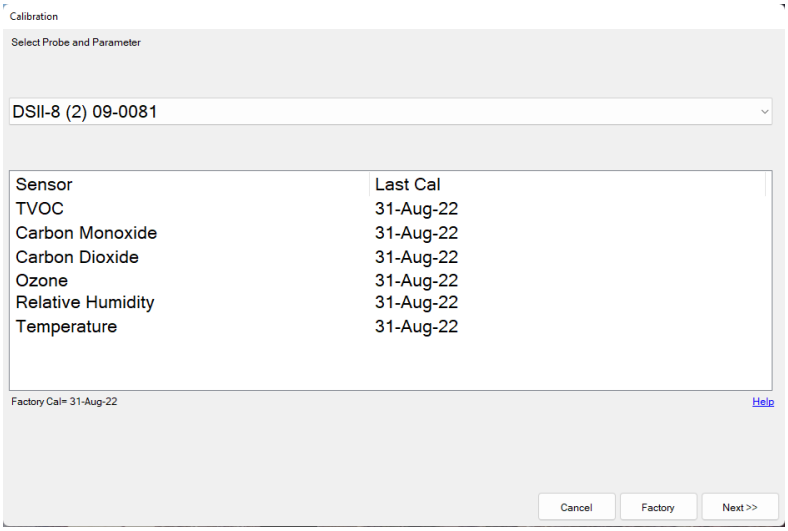
Once the parameters appear on screen, access User calibration by clicking **CALIBRATE**.

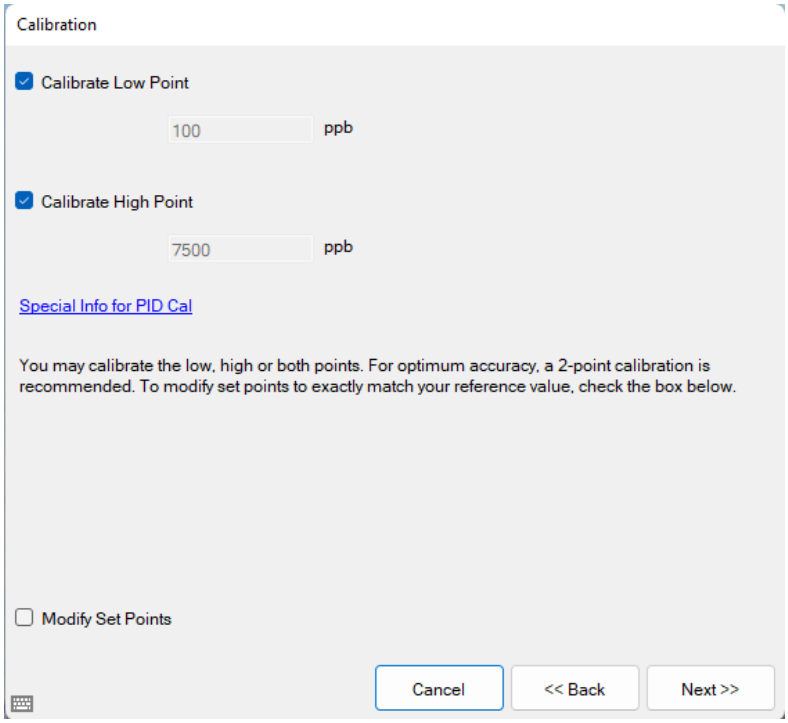


Calibration Procedure:

Prior to attempting calibration, the DirectSense II probe should be powered on for a minimum of 30 minutes to fully stabilize for optimum results.

1. Select the parameter you wish to calibrate from the list of available sensors.
2. Click **NEXT** to continue.
3. Choose to calibrate the high point, the low point or both points. For best accuracy, GrayWolf always recommends that you calibrate both points.
4. For the low and high calibration points, default calibration values are displayed. If the concentration of the reference gases you are using differs from these points, check the **Modify Set Points** checkbox. Refer to your Calibration Reference Gas labels for the proper values, then enter the new values into the Low and High Point fields and press **Next**.





Note: For TVOC calibration on the low-range PID sensor the recommended reference gases are **hydrocarbon-free zero air** (0.0 ppm gas) for the low point and **Isobutylene** between 5.0 ppm and 10.0 ppm for the high point. (GrayWolf typically supplies 7.5 ppm or 8.0 ppm gas.) For calibration on the high-range PID sensor, GrayWolf typically supplies a 3500 ppm Isobutylene gas for the high point. **See chart on the last page for more details.**

5. Open the sensor hatch on the DirectSense II probe to expose the individual sensors. This is done by using a 2.5mm Hex driver to unscrew the screw on the top-back of the probe. (This tool is provided in every kit with a DirectSense II probe.)

6. Screw the 0.3 LPM flow rate regulator snuggly onto the tank.

7. To start the flow of reference gas, turn the regulator dial counterclockwise. (On older regulators, push the dial in and turn a quarter turn.) To verify gas is flowing, put calibration hood to ear and listen for a slight hiss (although this is not recommended if using Cl2, HCl or other reactive reference gases).

8. Identify the sensor you have selected to calibrate and place the CA-HD4-A1 Calibration cap over the sensor. (Most sensors have a label identifying what they are. Call GrayWolf Tech Support at (203) 402-0477 for help identifying a sensor.)

9. Follow the prompts of the User calibration tool and then click **Start Calibration Procedure.**

10. While the reference gas is flowing over the sensor, follow the recommended stabilization time stated in the User calibration tool prompts.

11. Confirm that the readings have stabilized by the color of the displayed reading in the bottom left corner of the window. **Green** means the readings are stabilized, **Orange** means they are still stabilizing, and **Red** means they are not yet stable.

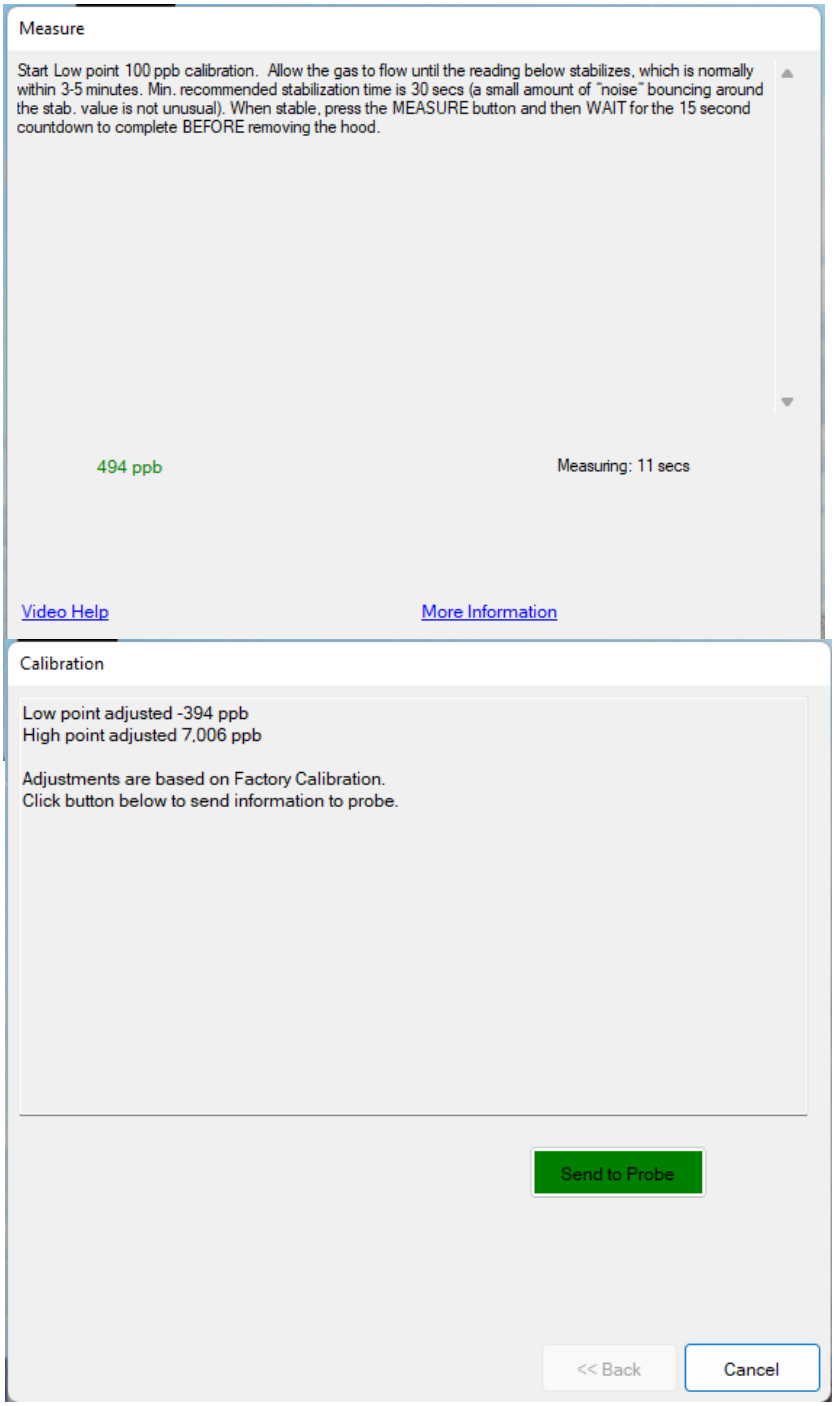
12. Once the readings are stable, press the **Measure** button. The calibration tool will take a 15-second average reading and will indicate “Complete” when the measurement is done. Press **Next** and follow the prompts to turn off the regulator (turn clockwise).

13. Repeat procedure steps 6-11 to perform a high point calibration.

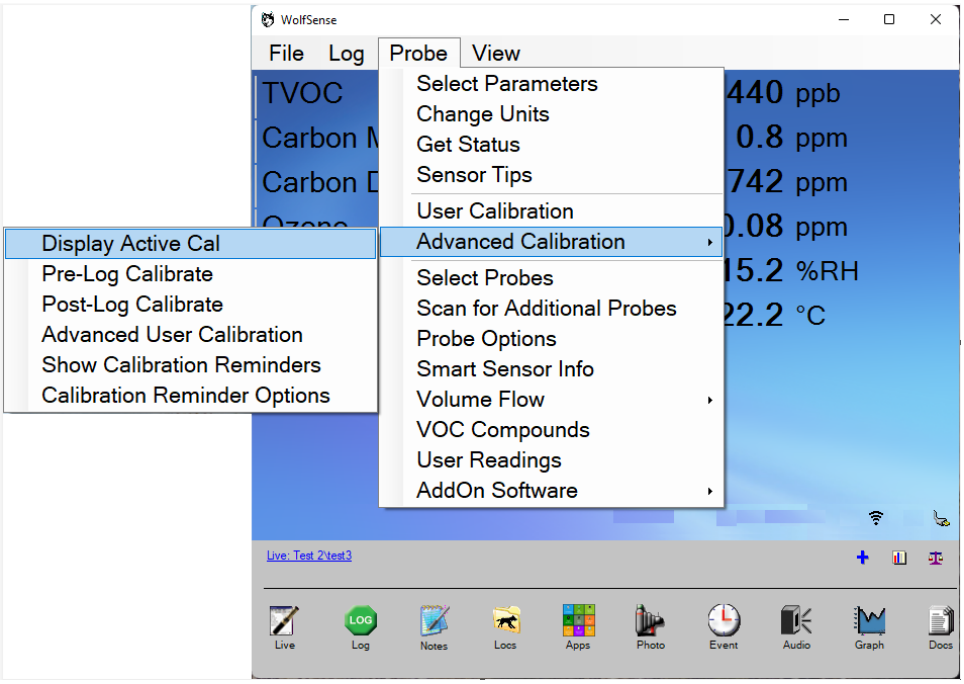
14. When the calibration procedure is complete, the tool will display a message indicating the offsets that will be applied on top of the current Factory calibration. To save these offsets, press **Send To Probe.**

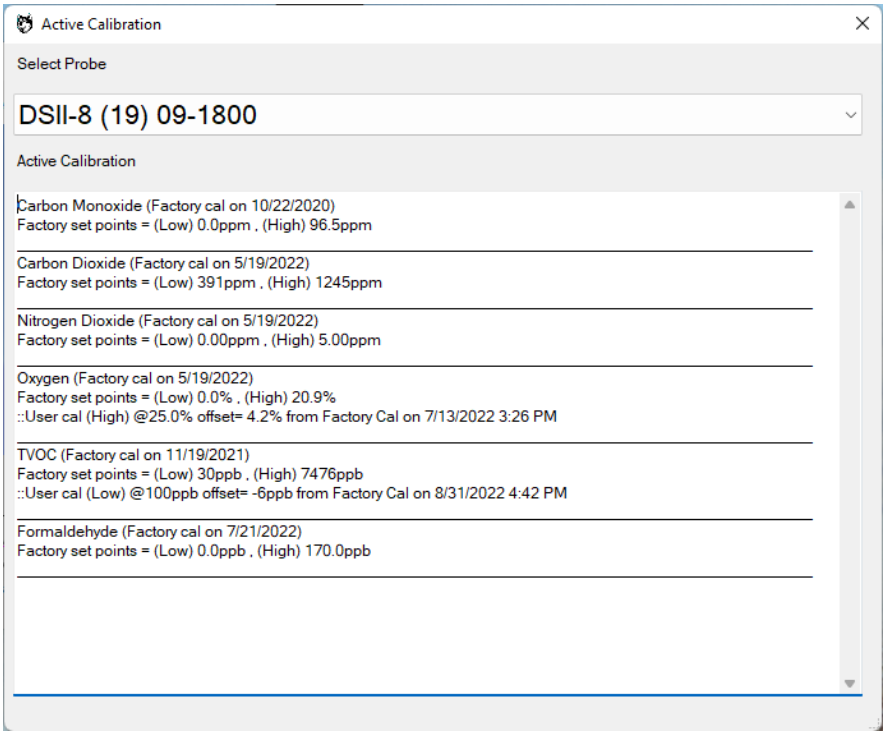
15. Allow 1-2 minutes for the calibration data to be saved to the smart sensors. Once complete, you may exit the User calibration tool or calibrate additional sensors.

Note: User Calibrations will be immediately reflected in the readings of the DirectSense II probe when connected via cable or Bluetooth classic. The probe must be rebooted for the changes to take effect on readings sent over BLE (to the WolfSense Mobile app), Wi-Fi or OEM mode.



After the calibration is complete, you can view the current settings in WolfSense LAP by selecting **Probe Menu / Advanced Calibration / Display Active Cal.** In the DSII Configuration Tool, select the **VIEW CURRENT CALIBRATION** button.





Restoring Factory Default Settings:

It may be necessary to restore the current Factory calibration if the User calibration does not appear to be reading as expected. To restore factory settings in WolfSense LAP, Select **Probe** menu, **User Calibration**, select the parameter to reset and press the **FACTORY** button. If you do not select a specific parameter all sensors will be reset to factory defaults. When using the DSII Configuration Tool, select the **CALIBRATE** button, then the parameter to rest and press the **FACTORY** button.

Typical Calibration Set Points and Gas Ranges

To properly calibrate your DirectSense II probe, Gray Wolf recommends that the following gas and concentrations be used:

Gas	Range	Typical Set Point
CO	Low	0.5 ppm
CO	High	95 ppm
CO_2	Low	375 ppm
CO_2	High	1250 ppm
VOC	Low	0 HC Air*
VOC	High PPB range	7500 ppb or 8000 ppb
VOC	High PPM range	3500 ppm or 5000 ppm

Note: Hydrocarbon-free Zero Air cylinders may contain a mixture of CO and CO2 (typically specified on the label) and may be used for the low-point calibration of those gases, but with reduced accuracy. For optimum accuracy, it is recommended that reference gases closer to the CO Low and CO2 Low calibration values referenced above be utilized to calibrate the CO & CO2 sensors.

For additional questions or troubleshooting regarding User Calibration, please email TechSupport@GrayWolfSensing.com.

For information regarding the purchase of calibration gas and equipment, please contact your sales representative or authorized GrayWolf Distributor, or email SalesTeam@GrayWolfSensing.com.

PID (TVOC) Sensor Guide

PID Sensor (for measuring Total Volatile Organic Compounds) Usage and Troubleshooting Guide

Relevant Products: DSII, IQ610, TG502, TG503, VOC-103 Probes

Date Updated: October 2022

PID Theory of Operation

Total Volatile Organic Compounds (TVOC) can be measured using a Photo Ionization Detector (PID). The PID sensor is comprised of filter membrane, a ultra-violet lamp and a detector electrode. Gas passes through the filter membrane to exclude particles and liquids, and is exposed to high energy ultra violet (UV) radiation which ionizes some percentage of the molecules. Some of the molecules are converted into either positively or negatively charged ions. These ions are measured by a collection electrode and converted into a current corresponding to a concentration. This relationship can be seen below:

$$M + \gamma \rightarrow M^{+} + e^{-}$$

Where:
M=Target molecule
γ=Photon

In order for a molecule to be ionized by the UV lamp, the ionization potential (IP) must be lower than the energy of the UV lamp. GrayWolf utilizes a 10.6 electron volt (eV) lamp, so anything that has a higher ionization potential will not be detected. Major components of air such as nitrogen, oxygen, methane and carbon dioxide have a higher ionization potential then the UV lamp so they are not detected by a PID sensor, as can be seen in table below. Because PIDs are not affected by the ambient air, they are used for total volatile organic compounds (TVOC)

Compound	IP (eV)
Nitrogen	14.54
Oxygen	13.61
Carbon Dioxide	13.79
Methane	12.98

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PID (TVOC) Sensor Guide

Getting Accurate Readings with your GrayWolf VOC Probe

The PID sensor is a very sensitive device. Proper care, storage, use and calibration of the PID sensor is required to yield optimal results for this product; whether your application is for low range applications, such as IAQ testing, or for high range toxic exposure screening.

Warm-up

A 20-minute warm-up and stabilization time should be sufficient for most applications. If the sensor readings are pinned at zero or are continuing to rise (or to fall) while in a stable environment, the probe may require additional warm-up time, calibration or an overnight burn-in (see Troubleshooting, Burn-In sections below).

Storage

The probe should ideally be stored in a closed plastic bag (one that doesn't emit VOCs) with one or two small desiccant packs.

For long term storage (> 2 weeks) remove the batteries. Note that probes fitted with Nitric Oxide or Ethylene Oxide sensors will require 12 hours, once probe batteries are reconnected, before use.

Storage in humid conditions greater than 60%RH may cause sensor drift, and cause long stabilization times. However, the standard 20 minute warm-up, prior to recalibration and use, should minimize high %RH storage bias.

If the sensor has been stored for a significant amount of time, it may become contaminated. This in turn may cause excessive drift of the background signal. Therefore, it is highly recommended (for ppb range sensors in particular) to run the sensor for an extended period of time before operating it after prolonged storage. Refer to the section on **Contamination** and **Burn-In** for more information.

Use

Don't blow directly on the sensor. Do not use the probe in high humidity (>90%RH) environments as condensation moisture that may result could degrade performance. At humidity's above 80%, sensor response becomes sluggish longer stabilization times are required.

Allow the probe to equilibrate to the ambient room temperature before using. Do not use the probe if you observe condensation or moisture on any part of it.

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PID (TVOC) Sensor Guide

Calibration

As a rule, a daily User calibration (or check) of the sensor is recommended for excellent accuracy. However, if the sensor is used in a clean environment, calibration/check frequency can be reduced to just once per week for very good results. For generally adequate results, calibrations can be performed once a month. **Note: any sensor(s) used for life safety critical situations, such as OSHA TWAs or STELs of specific volatile organic compounds, must be User calibrated (or checked) *each day of use* with a span reference gas close to the critical level.**

A typical User calibration, for the low point, is performed utilizing a hydrocarbon-free air (nitrogen is not recommended as there could be trace amounts of VOCs present). Hydrocarbon-free reference gas supplied in portable (e.g. 110L) cylinders, generally have an uncertainty up to 100 ppb, although check with the specific manufacturer for clarification. Due to the uncertainty in the gas, GrayWolf recommends a positive set point of 100 ppb to account for the uncertainty of the gas. It should be noted that larger gas cylinders (e.g. 3993L which GrayWolf employs for Factory calibrations) can have uncertainty down to 10 ppb. In such cases a positive set point of 10 ppb can be used, but verify with the gas supplier.

For User calibrations for IAQ, green building or IVF applications, the high point typically utilizes isobutylene ranging between 7-10 ppm, depending on local access to reference gas, although lower concentrations (>2 ppm) can be implemented for specific applications. For toxic exposure applications, the span gas utilized for the application should be closer to the high range of the specific PID installed, or near the exposure level (e.g. TWA or STEL) of concern.

If the sensor is being exposed to dirty samples (containing substantial compound concentrations and/or particles), the lamp window may get contaminated. The rate of the window contamination is a function of the sample gas condition, i.e. how badly it is contaminated with chemicals and particles. Contamination of the lamp window can cause partial UV light blocking, which in turn will rapidly reduce the detector's sensitivity. In this case, more frequent calibration is needed, and an overnight "burn-in" of the sensor, leaving it turned on for 12+ hours, is advised.

Storage (sensor "off") in high humidity conditions >60 %RH may cause sensor drift, which takes time to re-stabilize after power-up. A 20-minute warm-up, prior to recalibration and use, should minimize high %RH storage bias. Utilize desiccant to maintain lower %RH during storage.

If the sensor has been stored for a significant amount of time, it may become contaminated with VOCs or other compounds. This in turn may cause excessive drift of the background signal. Therefore, it is highly recommended to run the sensor for an extended period of time before

operating it after prolonged storage, especially if it is going to be used for low-range applications. An overnight burn-in period should be sufficient in most cases. During this time, the detector will clean itself and the baseline signal will drop and stabilize. If the sensor is used on a frequent basis, the user should still let it stabilize for 20 minutes before use. If high accuracy is not important (for example, in a blood-hounding application) or in the case of measuring relatively high concentrations (> 10 ppm), this stabilization procedure can be bypassed after a few minutes (click on the TVOC reading, then click "Bypass Stabilization"). However, NEVER bypass the 20 minute stabilization period ahead of performing a calibration. Ideally, power the probe overnight ahead of calibration.

Another way to improve the accuracy of measurement of a known specific compound is to calibrate the sensor span at a concentration of the specific target gas, within the expected application range, rather than with isobutylene.

Bump Test

You can perform a bump-test of the sensor to verify its calibration by exposing the sensor to a known concentration of test gas**.** Using the regulator and hood supplied with the GrayWolf Calibration Kit, attach a cylinder of gas and start gas flow. After 5-10 minutes, the readings should stabilize. If the reading is within an acceptable tolerance range of the actual concentration as shown on the gas cylinder label, then its calibration is verified. If the bump test results are not within the acceptable range, a full user calibration must be performed.

For ppb range PID sensors, zero readings should be within +/- 100 ppb, span readings within +/- 10% of the cal gas value (i.e. for 7.5 ppm isobutylene; +/- 750 ppb).

For ppm range PID sensors, zero readings should be within +/- 1 ppm, span readings within +/- 10% of the cal gas value (i.e. for 3500 ppm isobutylene; +/- 350 ppm).

Note: These ranges are provided as a guideline.

PID (TVOC) Sensor Guide

User Cal (recommended over Bump Test)

Essentially the same procedure as a Bump Test, except that you follow the User Calibration instructions on WolfSense, to not only check, but also adjust the readings to match the calibration gas. As long as you are already expending the known reference gas, and as GrayWolf makes User Cal so simple, you might as well adjust the reading!

Factory Cal

Annual calibration at a GrayWolf facility or at a GrayWolf *authorized* calibration lab for the PID (and all other sensors) is recommended for optimal performance.

Using for Specific Compound

Under certain conditions a TVOC meter is able to be utilized for a specific compound. The compound of interest must be the only gas present that can elicit a response from the 10.6 eV lamp. If other compounds are present that have an ionization potential (IP) less than 10.6 eV then the sensor will still detect those compounds.

The linearity of the sensor may vary somewhat depending on the specific target compound. As a rule, the greater the sensor's response to some compounds the narrower the linear range, and vice versa. If the target gas is the only compound present then there are two ways that you can measure for that compound:

-The PID must have a known correction factor for the gas of interest. GrayWolf meters have a list of some VOCs with their correction factors listed onboard under Sensor Tips. In the cases of a known correction factor the compound can be displayed on the device. This will have an accuracy of +/-25% when just using the correction factor and does not take into consideration %RH and temperature effects, nor linearity over the full range of the sensor response.

- If an application requires high accuracy, linearity characteristics of the sensor should be experimentally measured for the target compound. If access to a span gas, within the application range, of the target compound is available it can be used to perform a User Calibration with. This would eliminate the need to use the correction factor for a specific gas as the PID would be calibrated to that gas and have a 1:1 response. GrayWolf uses a calibration gas of 7500 ppb isobutylene for the high point calibration as standard.

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PID (TVOC) Sensor Guide

Background Readings

Ambient air, absent unusual pollutants, will typically read 50 to 400 ppb due to the "typical" background levels of VOCs and other ionizing compounds, although higher levels are not uncommon in indoor air.

Contamination

In polluted environments, excessive lamp window contamination can substantially degrade the sensor's performance, especially the low range ppb sensor.

If the sensor is being exposed to dirty samples (containing heavy compounds and/or particles), the lamp window will get contaminated. The rate of the window contamination is a function of the sample gas condition, i.e. how badly it is contaminated with chemicals and particles. Contamination of the lamp window can cause partial UV light blocking, which in turn will rapidly reduce the detector's sensitivity. In this case, more frequent calibration is needed.

If the sensor has been stored for a significant amount of time, it may have become contaminated. This in turn may cause excessive drift of the background signal.

Burn-In

To correct most contamination and high humidity exposure problems, an overnight burn-in should be sufficient. During this time, the detector will clean itself and the baseline signal will drop and stabilize.

To perform a burn-in, the probe must be powered on. Hook the probe up to the AdvancedSense, Tablet PC or LapTop PC that is running WolfSense software. Power the device display device via its AC adapter.

Note: Excessive contamination may required longer burn-in times (up to 48 hours), or lamp replacement. If you suspect your sensor is significantly contaminated, contact GrayWolf for additional assistance.

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PID (TVOC) Sensor Guide

Troubleshooting

Symptom:	Solution:
Readings are pinned at zero, sensor appears non-responsive -or- Zero reading, Check Cal icon is present on-screen.	Perform a quick "Sensor Response Test" (see section at end of this document) to verify sensor is responding. If sensor is responding but the reading then returns to zero, the sensor should be recalibrated. Note that it is normal that PID sensors will drift over time, and calibration each day that you utilize the equipment is recommended (although you may find from experience that weekly or even broader calibration intervals are sufficient for your specific application). Take care that calibration is not rushed, before probe stabilizes, as this could yield readings below zero (WolfSense will lock at zero and will not display negative numbers). Conservatively, allow the probe to warm up for an extended time period, and then recalibrate. It may be necessary to restore the factory default settings to erase any user calibration values that are causing unusual readings before another calibration is performed. Position the gas outlet from the cal hood directly at the PID sensor and make sure the reading on gas has stabilized before accepting the calibration (may take up to 10 minutes). If the TVOC readings respond to the Sensor Response Test but continue to lock on zero *after* the calibration, it may be necessary to adjust the low calibration edit point to 50-100ppb. The specification for the Scott® Gas HC Free Air supplied by GrayWolf guarantees less than 100ppb THC, and may not be precisely at zero. If the ambient conditions have very low TVOC concentrations, then it is possible that the ambient conditions are lower than the HC Free Air which will force a negative value, causing WolfSense to display zero. If there is no response during the Sensor Response Test (and you are certain you haven't used a water based product, rather than an appropriate alcohol based product or VOC containing product for your test), it is likely that the lamp in your PID sensor has failed. Contact GrayWolf or a GrayWolf authorized distributor for a Return Authorization Number to initiate PID lamp replacement.

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PID (TVOC) Sensor Guide

Symptom:	Solution:
Readings will not stabilize.	Be patient, especially with the PID sensor which is a very sensitive sensor. Try to avoid sudden temperature or %RH changes which will result in longer stabilization time. Each time the sensor is powered on, tiny amounts of contamination, which accumulate on the lens and lamp while the probe is powered down, are burned off. The stabilization time will vary depending on contaminant and moisture exposure during storage conditions. If possible, store the probe in a clean, low RH environment with desiccant to minimize the stabilization time.
Sensor readings are not as expected.	It may be necessary to restore the factory default settings to erase any user calibration values that may be causing unusual readings before another calibration is performed. Perform a quick "Sensor Response Test" (see section at end of this document). If sensor is responding, but the reading then returns to zero, the sensor should be recalibrated.

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Sensor Response Test

You can use readily available retail/commercial products to perform a simple response test of the PID sensor. This will verify the basic operation of the sensor but will not verify that it is properly calibrated.

Suitable commercially available substances for Sensor Response Tests:

Product	Contains	Suggested Use
Sharpie® Permanent Markers	Alcohols. May also contain ethylene glycol monobutyl ether	Wave the marker near the slotted openings in the probe. Do not insert marker inside the probe.
Windex® Glass and Multi-Surface Cleaners	detergents, solvents, fragrance, Ammonia and alcohol	Spray some Windex on a paper towel (or use pre-treated wipes) and wave probe several inches above the towel or wipe.
Purell® Hand Sanitizer	Ethyl Alcohol Also: Glycerin, Isopropyl Myristate, Propylene Glycol, Tocopheryl Acetate, Aminomethyl Propanol	Place a drop on a paper towel and wave probe several inches above towel.
PaperMate® Liquid Paper	Naptha	Wave the (wetted) dabber near the slotted openings in the probe.
Kensington® Surface Guardian Computer Screen Cleaner	Isopropanol and ethanol	Wave probe several inches above moist towel/wipe.
Rubbing Alcohol (any brand)	Alcohol	Dip a cotton swab in the alcohol and position it close to the probe slit closest to the PID sensor.

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Important: Do not spray or apply the product directly onto the sensor; do not immerse the probe in a container of the product; and do not insert anything inside the probe housing as you may contaminate or permanently damage the sensor or electronics.

Accuracy

There are no accuracy values listed for any of the GrayWolf supplied photoionization detector sensors. This is due to a number of reasons. All of the sensors are calibrated in the laboratory at set temperature and relative humidity values. After a factory calibration all sensors are checked to ensure that they are within a certain percentage within the set point for verification. This ultimately ensures that the values are accurate within one or two percent of the set point. When using the unit in an environment different than the calibration environment the accuracy will diminish. The sensitivity of photoionization detectors drift over a short time scale (day) so the accuracy is optimized by operating a calibration at a regular interval. The drift for the low range PID, 0-40 ppm, is 6-10 ppb/day. Other factors are small response to humidity transient (when humidity changes abruptly) and small responses to large temperature changes. Long exposure to a very dry atmosphere can also result in a small reduction in output.

All GrayWolf total volatile organic compounds (TVOC) sensors are calibrated to isobutylene in the factory, so all readings must be compared against isobutylene. The GrayWolf PID utilizes a 10.6 eV lamp which means that it will illicit a response from any compound with an ionization potential (IP) below 10.6 eV. Comparing the accuracy for a specific compound, except the gas the sensor was calibrated against, will not provide accurate readings. Because a PID has a different response from each gas below 10.6 eV the only way to see the accuracy is to compare it against the gas it was calibrated against.

In addition the quality and accuracy of the calibration gas plays as important a role as sensor accuracy in the overall uncertainty of the readings. Each gas cylinder has an associated uncertainty, for example isobutylene at 7.5 ppm +/-10%. This means that the gas could really be anywhere between 6.75.5-8.25 ppm. The sensor accuracy is based off how close to the set point of the gas being used. This means if the sensor is calibrated to 7.5 ppm, the readings that would be expected would be +/- a very small percentage from 7.5 ppm after a calibration. The actual concentration of gas, anywhere between 6.75 ppm to 8.25 ppm, will not change which is why the accuracy is compared against the set point value of 7.5 ppm even though the uncertainty of gas is +/-10%. Therefore to calculate the total error in a reading you need to consider multiple factors most notable the uncertainty of the gas, the accuracy of the sensor, the precision of the measuring process, the operator's skill, and the stability of the environment.

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