GrayWolf

Sensing Solutions

DirectSense II/XM

Version 2.3

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/XM probes, AdvancedSense™ XM and AdvancedSense™ PRO/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/XM probe. GrayWolf is the market leading manufacturer of portable Indoor Air Quality (IAQ) instrumentation with over 25 years on the market. The DirectSense II/XM 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, HCHO, 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 particulate meters (PM2.5, PM10, etc.), , air velocity probes, differential pressure sensors, and barometric pressure sensors.

The DirectSense II/XM 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/ DSXM-8	The DirectSense II/XM-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/ DSXM-5	The DirectSense II/XM-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/ DSXM-3	The DirectSense II/XM-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

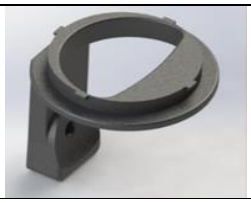
DSXM-8-KIT	The DirectSense XM-8 KIT comes with a DSXM-8 probe, SEN-SMT-TRH3 combo °C/°F and %RH sensor and has 6 sensor sockets available for additional (plug & play) smart sensors. One socket accommodates NDIR CO2, PID (TVOC) or A series electrochemical (EC) specific gas sensors. One socket accommodates 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 DSXM probe with Bluetooth low energy (for direct connection to smart devices via free iOS and Android apps), Bluetooth classic (for wireless connection to AdvancedSense XM and WIN tablets) and Wi-Fi (for remote connection utilizing GrayWolfLive). Additional sensors and 1m connection cable are NOT included.	
DSXM-5-KIT	The DirectSense XM-5 KIT comes with a DSXM-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 DSXM probe with Bluetooth low energy (for direct connection to smart devices via free iOS and Android apps), Bluetooth classic (for wireless connection to AdvancedSense XM and WIN tablets) and Wi-Fi (for remote connection utilizing GrayWolfLive). Additional sensors and 1m connection cable are NOT included.	

DSXM-3-KIT	The DirectSense XM-3 KIT comes with a DSXM-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 DSXM probe with Bluetooth low energy (for direct connection to smart devices via free iOS and Android apps), Bluetooth classic (for wireless connection to AdvancedSense XM and WIN tablets) and Wi-Fi (for remote connection utilizing GrayWolfLive). Additional sensors and 1m connection cable are NOT included.	
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 AdvancedSense XM 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 AdvancedSense XM 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 AdvancedSense XM 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/XM). 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/XM 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/XM 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/XM 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/XM 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/XM 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-XXX-XX	103/110-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/XM 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/XM probe. Single removable plug and ACC-DSII-PCCHOLD to expose sensors from 1 x DirectSense II/XM 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/XM probe. Single removable plug and ACC-DSII-PCCHOLD to expose sensors from 1 x DirectSense II/ /XM 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-22X	Hard-shell carry case for GrayWolf meter(s) and up to 2 x DirectSense II/XM probes, plus accessories. Holds AdvancedSense meter, AP-OW20 rugged Android device, MN-10RT rugged tablet (and/or some alternative tablets/smartphones). Also fits up to 2 x DSII/XM probes/cradles and other accessories. 22.5” x 16.5” x 5.75 (57cm x 42cm x 14.5cm), 6lbs (2.7kg)	
PCC-22DSII-U	Hard-shell case for AdvancedSense, MN-10 tablet or MN-10RT, 10 inch rugged tablet. Also fits DirectSense II/XM 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/XM 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/XM probes. Dual removable plugs and ACC-DSII-PCCHOLDs to expose sensors from 2 x DirectSense II/XM 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/XM probes. Dual removable plugs and ACC-DSII-PCCHOLDs to expose sensors from 2 x DirectSense II/XM 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/XM 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/XM 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; 456 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 counterclockwise 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**

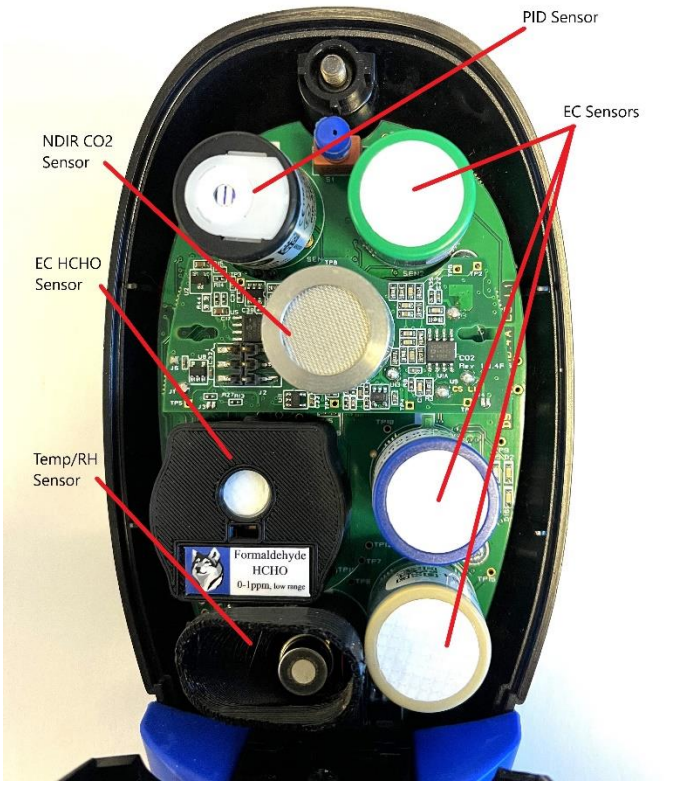
EC=Electrochemical
PID=Photoionization detector, used for TVOC.
NDIR=Nondispersive infrared, used for CO_2.
A and B denote the size of the sensor. A have a smaller diameter than B series.

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

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)	0.1	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.

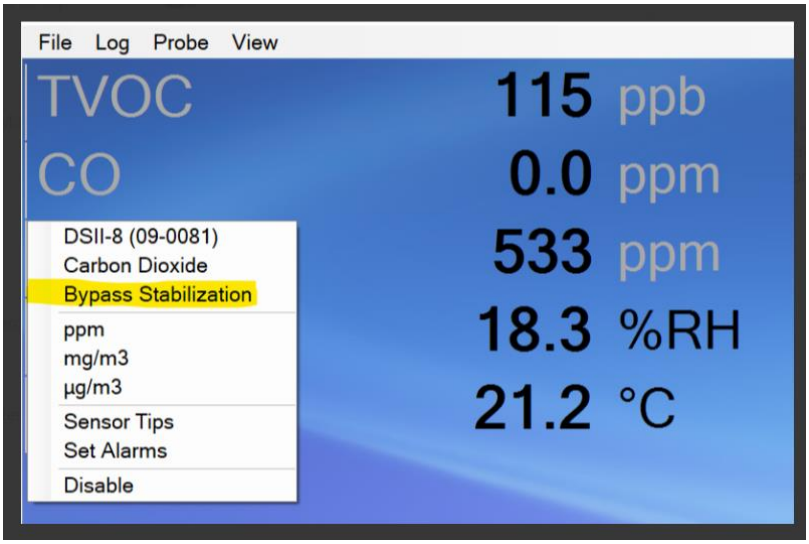
xi The 4-electrode smart NO2 sensor has significantly reduced cross-sensitivity with O3.

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/XM 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 LAP 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/XM probe must be connected to WolfSense for a User Calibration to be performed.

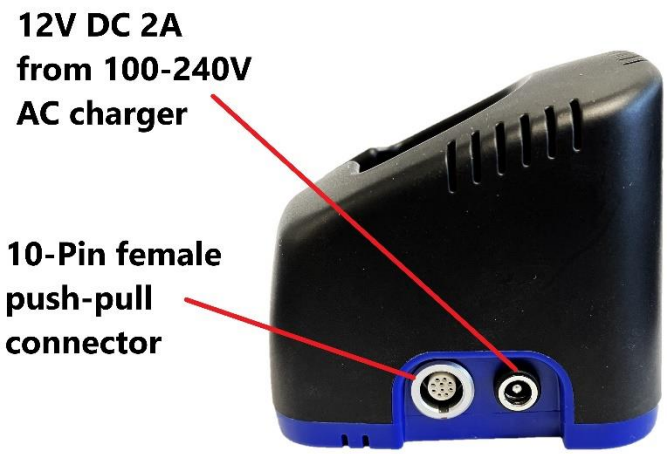
Example of Calibration Hood CA-HD4-A1

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/XM-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/XM Probe in 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/XM 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/XM 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/XM 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.

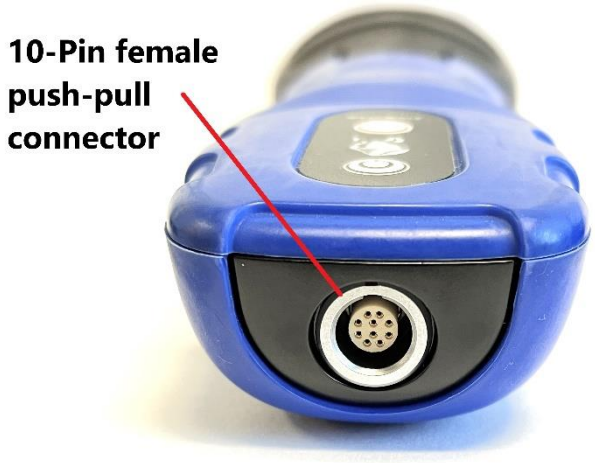
7 **Red** Flashes indicates the internal fan is stalled or jammed.

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

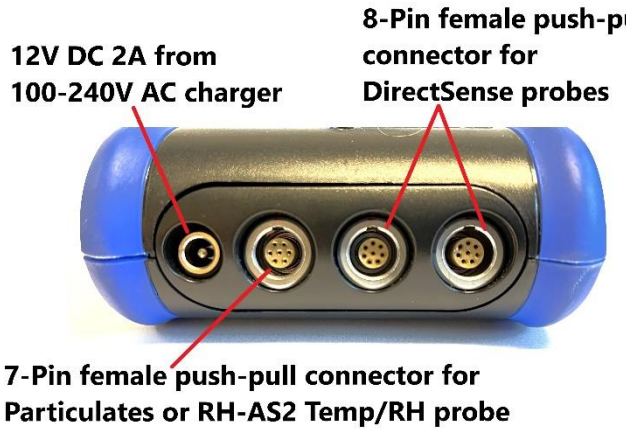
9 **Red** Flashes indicates a problem connecting to wireless.

Connecting to AdvancedSense XM/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/XM 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 XM/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 ***AdvancedSense XM 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.

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/XM probe or the right side of the cradle. The full size USB or micro USB will be attached to the tablet/PC.

Tablet with DSXM

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.

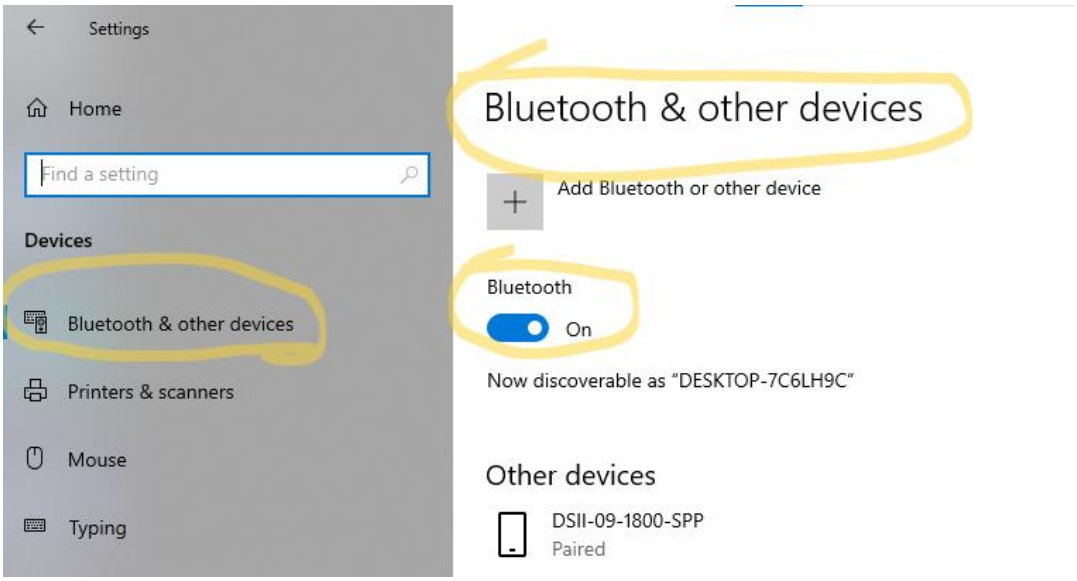
To use your DSII/XM probe via Bluetooth, you must manually turn the probe on by momentarily pressing the power button. The LED should begin flashing slowly **Blue** then **Green** to indicate that it is 'discoverable' by Bluetooth devices. If the LED is not flashing **Blue/Green**, you may need to configure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

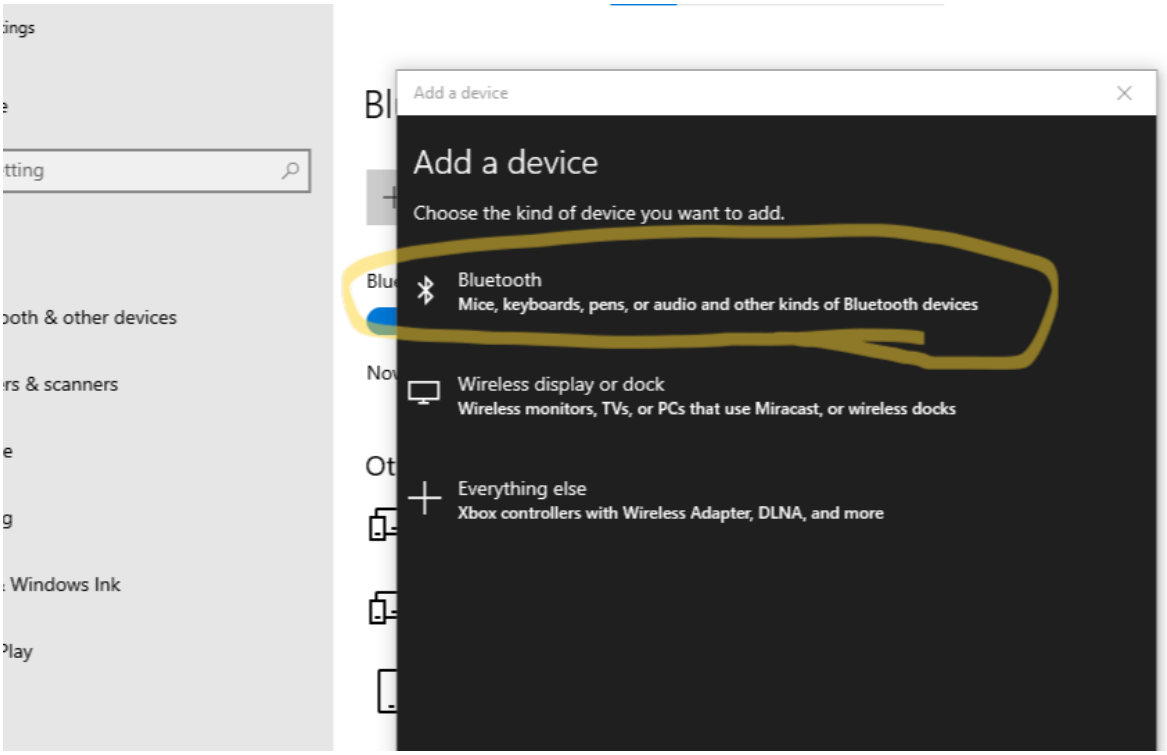
Once a Bluetooth connection is established, the LED will continue to flash **Blue** indicating the link. However, if it is plugged into a serial connection, it will disconnect Bluetooth in favor of wired and begin flashing **Green.**

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 Computer's Bluetooth is enabled.



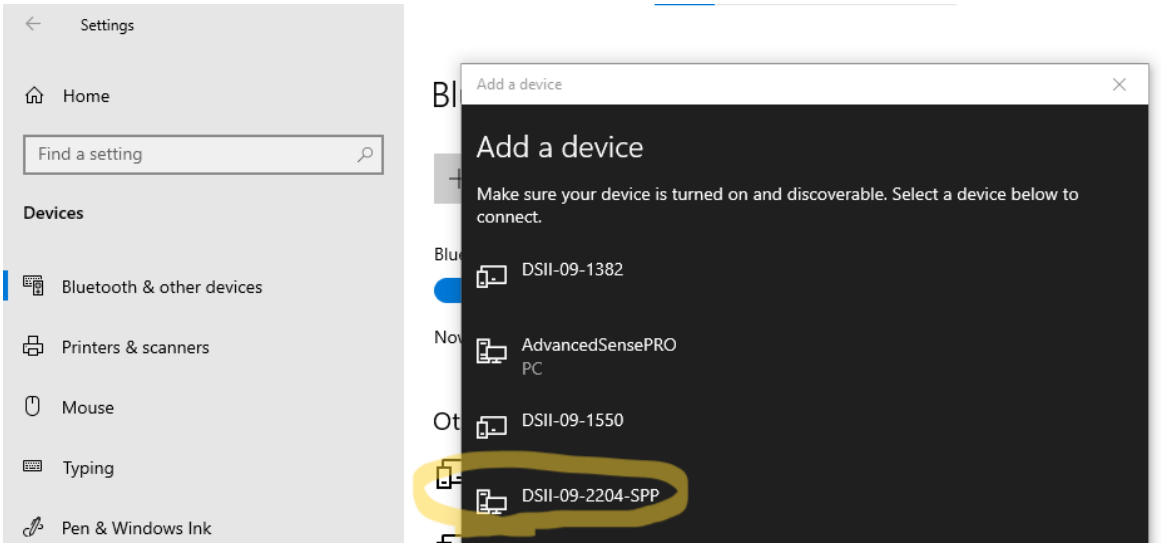
Go to **Add Bluetooth or other device** and select **Bluetooth** to connect a probe

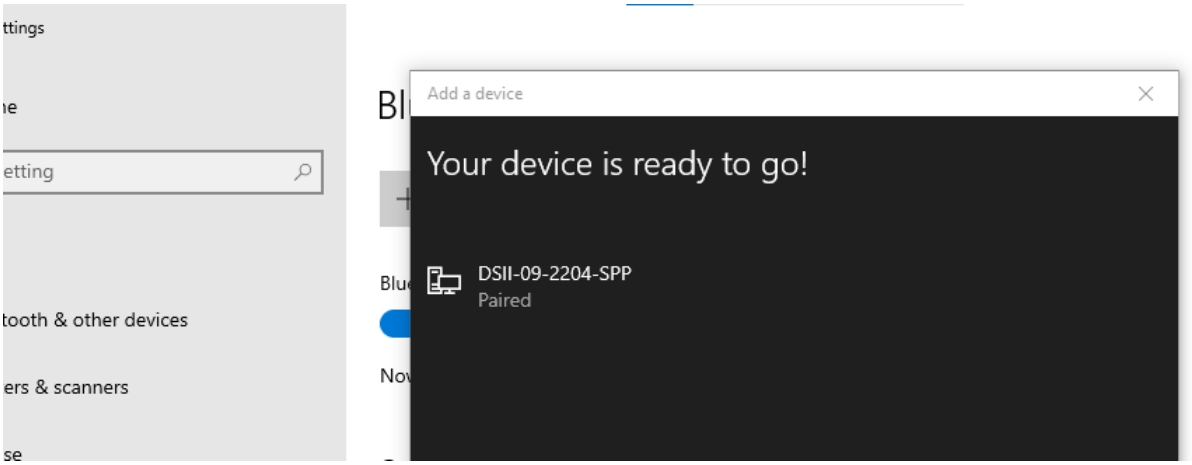


Next you will see all the available devices that you can connect to. Your DirectSense II/XM Probe will be identified by the serial number labeled on the back/bottom of the probe. For probes with WolfRadio Bluetooth connections the serial number will show up as **DSII-09-XXXX-SPP***. **SPP** signifies 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/XM 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/XM.

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.

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(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.

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Technical Support

For Drivers, Updates, Tech Notes 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/XM probe.

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