

Sutron Barometer Calibration Procedure Using the Omega HHP360

Procedure Number: SOP # 5.4.1.4 (A2)

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Created By: Lynn Asbeck, The Met Team

Approved By: Manoj Samant

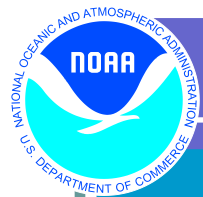
Revised: Caleb Gostnell, February 28, 2020

1. **Title** Sutron Barometer Calibration Procedure Using the Omega HHP360
2. **Purpose** The following procedure documents how to install a new Sutron field barometer in a Sutron Xpert data collection platform and how to calibrate an already-installed barometer in the field. Calibrations are performed in the field to ensure that the highest quality data is disseminated from the sensors.
3. **Background/History** NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) maintains a network of water level, oceanographic, and meteorological sensors throughout the United States and its territories. While CO-OPS's primary focus is on water levels, the network of meteorological sensors provides important ancillary information to scientists, modelers, marine users, local community managers and other NOAA partners. Annual calibration of the installed field barometers is necessary to maintain appropriate data quality.

This document supersedes the *Barometer Calibration Guidelines for Sutron Xpert DCP Systems* published November 2008 and the *Sutron Accubar Barometer Field Calibration* published February 2008.

In these previous versions, the installed barometer was compared to a handheld barometer using a local comparison at the height of the installed barometer. Data was then converted in the Sutron Xpert data collection platform to reflect atmospheric pressure at mean sea level (MSL) by applying an offset. This new procedure uses the internal conversion capability of the handheld barometer to compare the barometric pressure of both instruments at MSL. This change eliminates performing calculations in the field and takes into account local temperature when determining the calibrated atmospheric pressure at MSL.

4. **Scope/Applicability** This procedure applies to all CO-OPS personnel who service or install barometers at water level or meteorological stations, whether personnel are in-house or under a maintenance contract or task order. CO-OPS partners who maintain independent stations with barometers are strongly encouraged to adopt the guidelines in this SOP when performing barometer calibrations.



5. Main Processes

Calibration of the field barometer should be performed using a NIST-certified handheld barometer once a year during the annual inspection. Processes include:

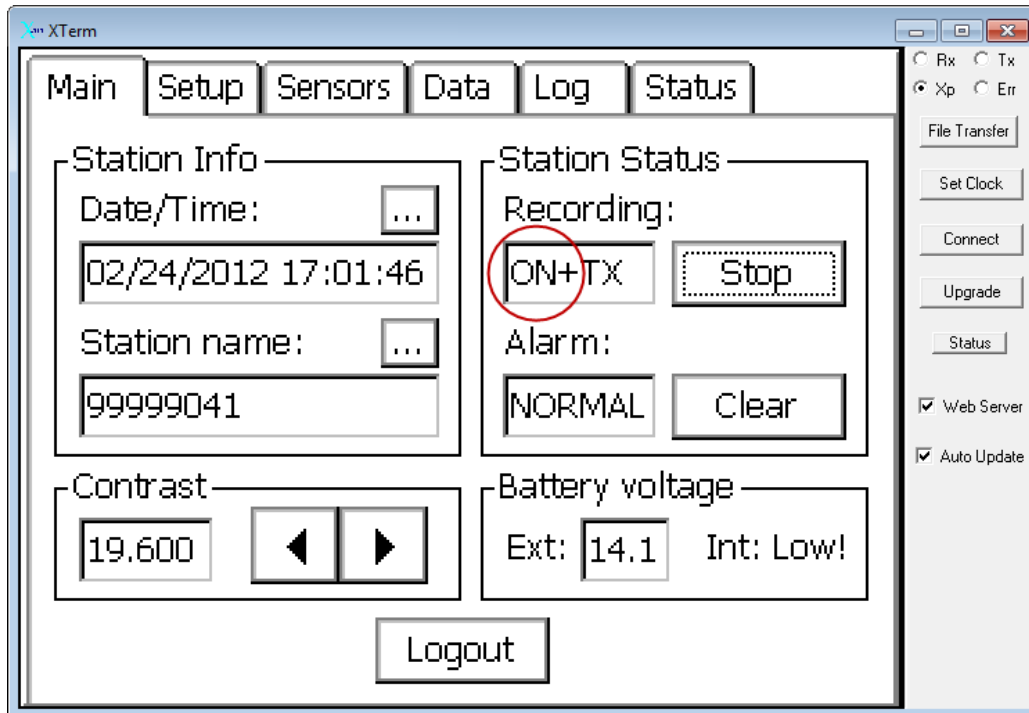
1. Install barometer and determine elevation of barometer above Mean Sea Level (or above IGLD in the Great Lakes, which is approximately equal to MSL).
2. Compare the readings of the handheld barometer and the installed barometer.
3. Enter this calibrated value into the Xpert.
4. Note the barometer offset value in the Xpert and the date and time in UTC.
5. Enter this offset value and date and time into the appropriate site report.

6. Detailed Sub-Processes/Checklists

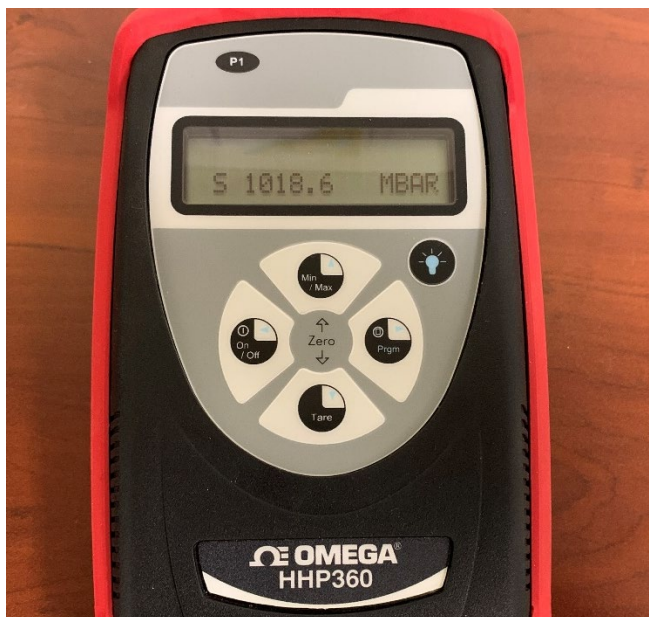
Barometer Setup For New Installations Only:

1. Install the new barometer in the Sutron Xpert data logger enclosure. Ensure that the barometer is vented to atmosphere via tubing that extends outside the data logger enclosure.
2. Tie in the barometer to the existing benchmark network via leveling and steel tape measurements. Obtain the barometer height above station datum (or above IGLD at Great Lakes stations) For more information or if this station has no nearby benchmark network, consult the *Procedure to Establish a Meteorological Sensor Reference Mark and to Measure Meteorological Sensor Heights* SOP for additional guidance.
3. For non-Great Lakes stations, convert this height above station datum to the height above mean sea level (MSL) using the conversion listed in the Project Instructions or from the Engineering Division. Great Lakes stations do not need this extra conversion since IGLD is approximately equal to MSL.

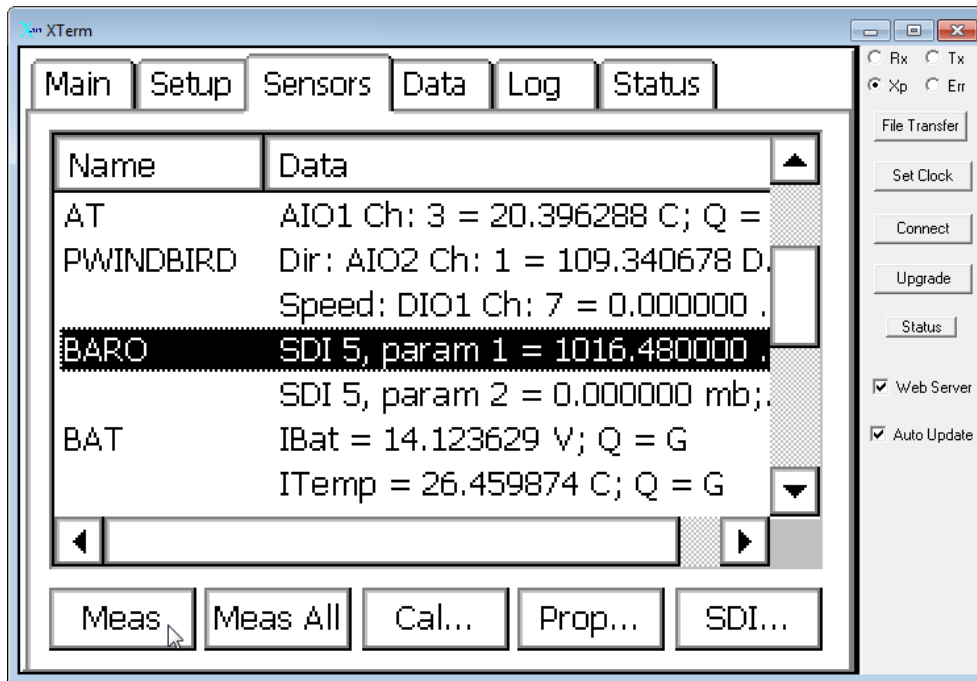
4. Make sure the Xpert is running, using the appropriate setup files, and that logging is **ON**.



5. Set the handheld barometer to **SEALEVEL** mode and confirm that the reading is in millibars (indicated by an S before the measurement and MBAR after). See Appendix A for instructions on configuring the handheld baro if needed.



- Choose the **Sensors** tab on the Xpert screen, find the **BARO** entry and choose **Meas** to update the barometer reading.

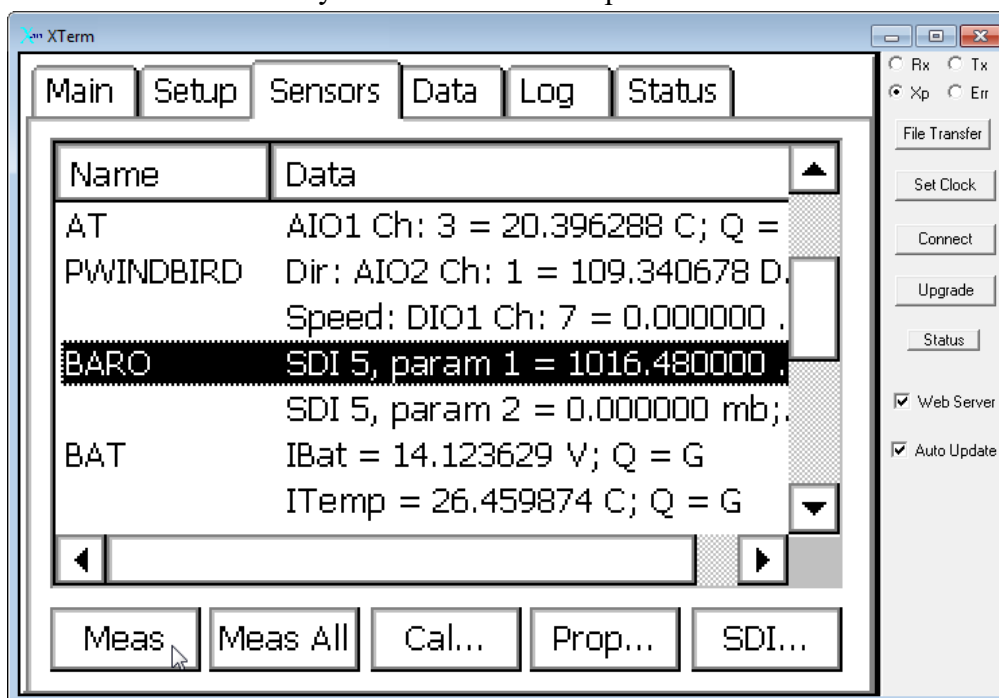


- After measuring is finished, hold the handheld barometer near the installed barometer and confirm that two are within +/- 5 mbar of each other for coastal stations, and have a difference of -5 to 30 mbar for Great Lakes stations. This is to check that the barometer has not been damaged in shipping.

Field Calibration of Barometers (New or Existing)

The barometric pressure value shown in the Xpert is adjusted by an offset to read pressure in millibars at mean sea level (MSL). Rather than using a reading from the handheld barometer at the height of the installed barometer to manually calculate the offset, this field calibration procedure uses an internal conversion in the handheld barometer to compare both barometers at MSL. This internal conversion also takes into account the effect of local air temperature, as measured by the Omega HHP360.

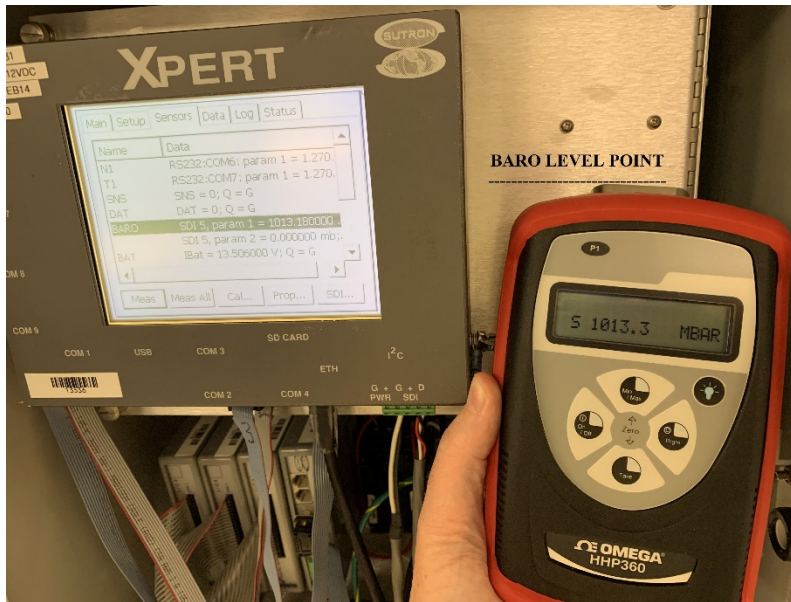
1. Ensure that the Xpert is running and logging is **ON**. Navigate to the **Sensors** tab and find the **BARO** entry. Click on **Meas** to update the barometer's value.



2. Set the elevation of the barometer above mean sea level (from the SM checklist). Temperature is internally measured and automatically applied. See Appendix A for details on configuring the handheld barometer.



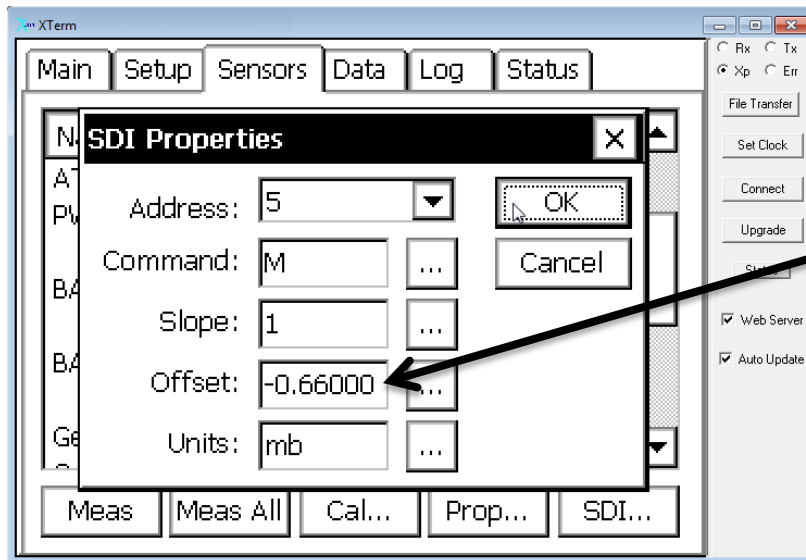
3. Hold the handheld barometer with the air pressure input port (metal fitting at the top) centered over the middle of the installed barometer. Let the readings stabilize for about 20 seconds. Note the reading on your handheld unit.



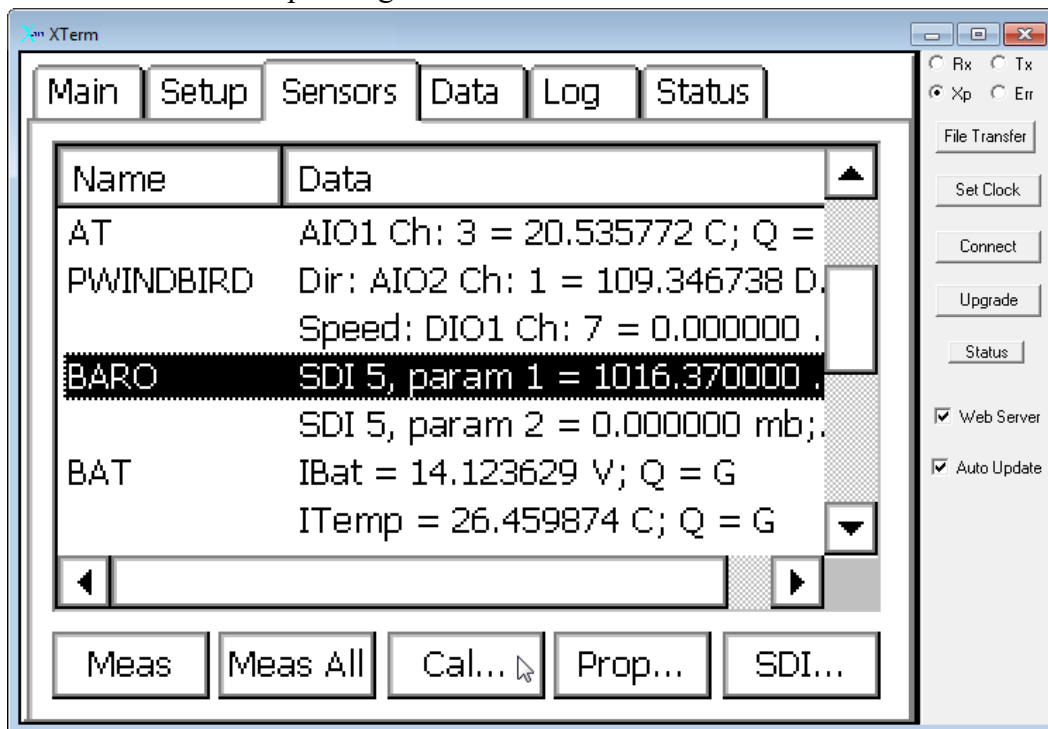
4. **[FOR EXISTING UNITS ONLY]** If the reading on the installed barometer is within **0.6 mbar** of the reading on the handheld barometer, you are finished. If the difference is between **0.6 mbar** and **1.0 mbar**, continue on with the calibration procedure below. If the difference is greater than **1.0 mbar**, replace the barometer and start the procedure from the beginning.

These adjustment criteria are based on the accuracy and precision of the handheld and installed barometers.

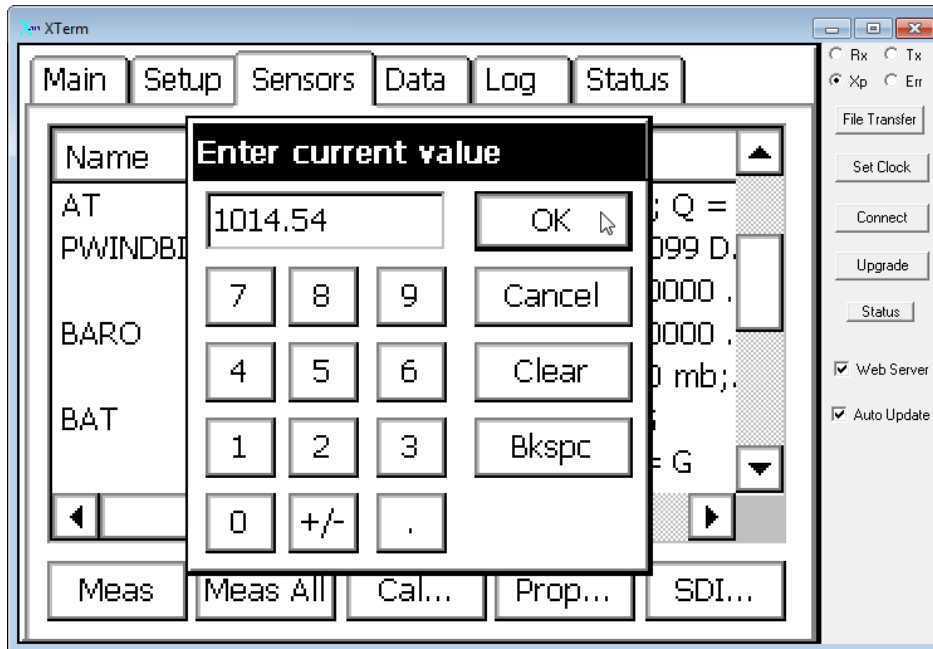
NOTE: There is no need to ‘zero out’ the barometer offset value during this calibration procedure, or make any change to the offset. Instead, the following procedure will cause the offset value to automatically update within the DCP. Crews are only required to copy over that value to the Esite report for documentation. If the offset is zeroed out, the previous year’s calibration is lost and the barometer will likely need a full recalibration (because it will fall outside of the 0.6 mbar criteria). When retaining the offset in the Xpert, the calibration procedure starts from an assumption of “some calibration from last year,” rather than starting from an assumption of “no calibration at all.” This makes it more likely that the difference between the handheld and installed barometers will fall into the less than 0.6 mbar difference level and no further action will be needed.



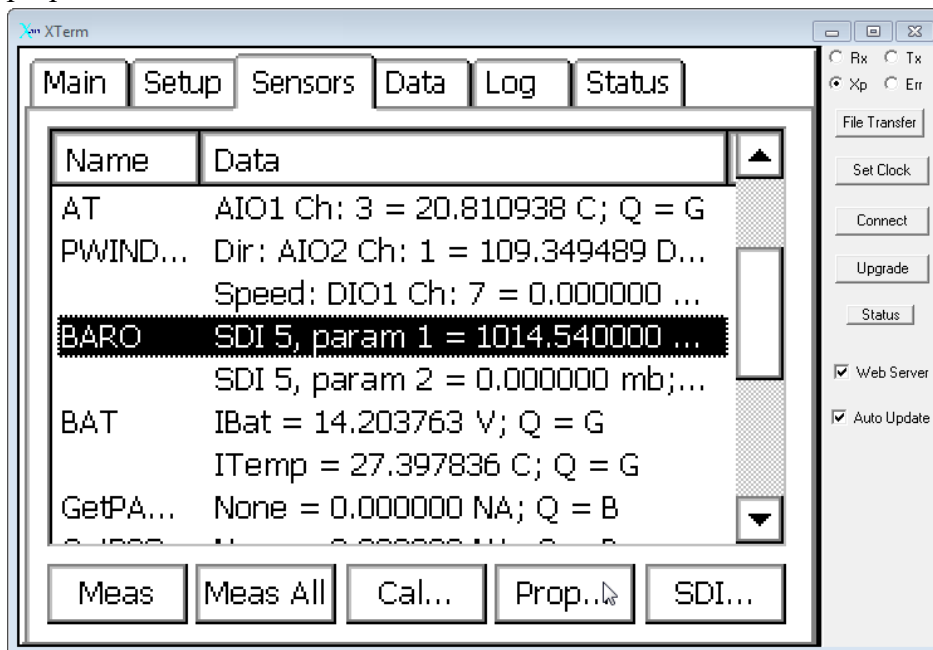
5. For new installations or to recalibrate existing installed barometers, press the **Cal...** button in the Xpert to get to the barometer calibration screen.



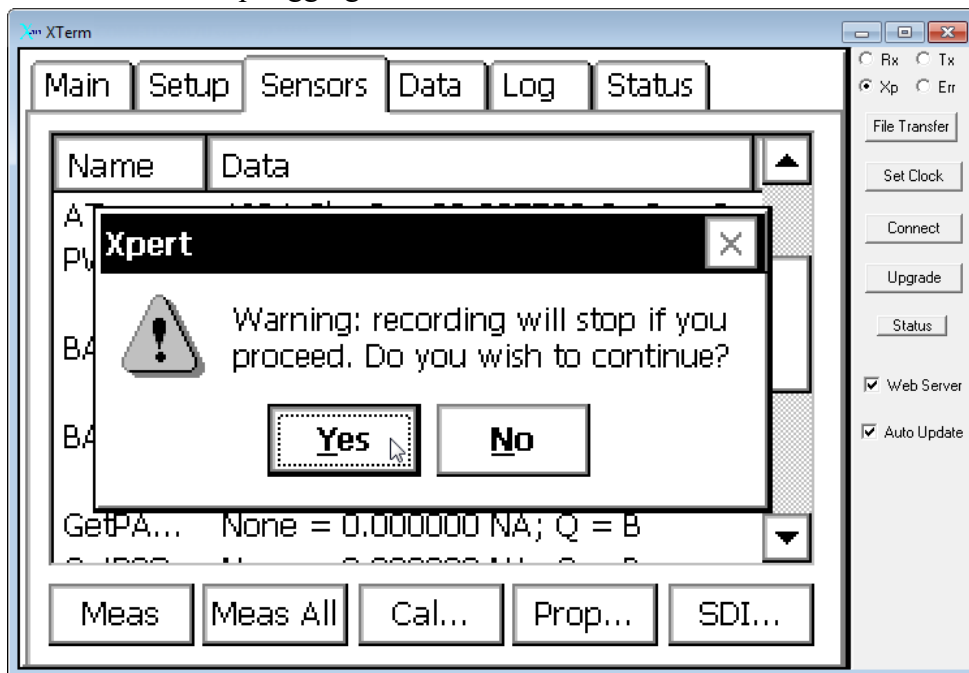
6. Enter in the real-time value of the handheld barometer and press **OK** to calibrate. The Xpert's hourglass will appear; this process may take a little while.



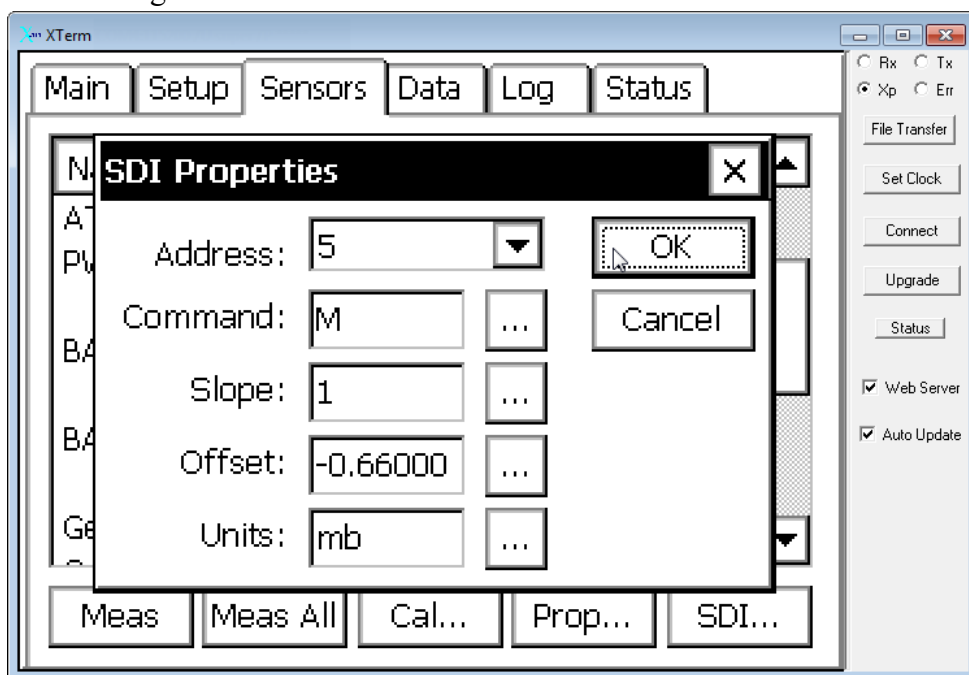
7. When back on the **Sensors** tab, choose the **Prop...** button to see the barometer properties.



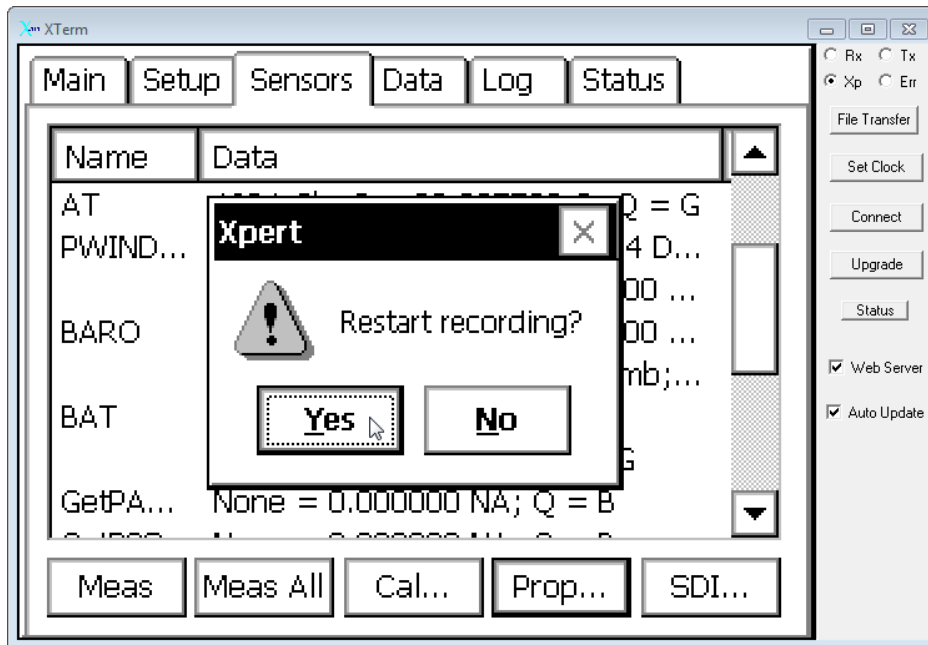
8. Choose **Yes** to stop logging.



9. **Record** the value of the barometer offset (but do not change). This should roughly be in the range of -1.0 to 1.0. Ensure the other settings on this page are correct as shown below. Contact SIL or CIL for assistance with questions about other settings on this tab.

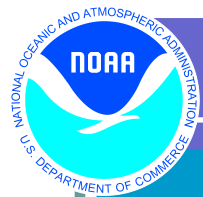


10. Choose **OK** to close the **SDI Properties** page and click **Yes** to restart recording.



11. Under the Barometric Pressure field in the “Sensors” tab of the eSite report, enter the barometer offset from the Xpert’s **SDI Properties** screen and verify the unit’s serial number in the corresponding boxes. If the unit has just been installed, note the date and time of installation in the appropriate box. In the comment box, record the UTC date and time of calibration and the barometric pressures in millibars shown on the handheld and installed units at the time of calibration. Additional details about the calibration or status of the sensor can also be included in the comment box.

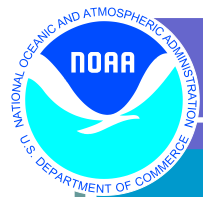
Barometer	Serial Number	Comment Box	Installation Date	Xpert Baro Offset	Swap	Remove	
DCP #:	1			Sensor ID: F1			
Type:	Sutron Cubar	Manufacturer: Sutron Corporation	Date Installed: 04/25/2009 00:00:00.0	Model:			
Serial #:	808122	Date Installed:		Date Removed:			
Cable Type:		Cable Length (m):		Barometric Offset: 0.98			
Height Above Station Datum (m):	10.931	Latitude: 58°17'55"N		Longitude: 134°24'38"W			
Sensor Comments:	2017: Unit passes cal check.						



Note: Partners or personnel working under a maintenance contract or task order should follow this procedure as closely as practicable and should use a barometer that has a NIST-certified annual calibration with accuracy of ± 0.004 inHg absolute, or better. The barometer should also be able to internally convert to read at MSL by taking into account the height of the handheld unit and local temperature.

7. **Quality Assurance/Control** The Field Crew Chief will ensure that the hand held barometer NIST-certified annual calibration date is within one year and all field and documentation requirements are met. The Data Monitoring and Assessment Team (DMAT) can identify any suspect barometric data and can validate barometer calibration against nearby stations before data is disseminated. The Operational Engineering Team will ensure the required documentation of barometer calibration is met.

8. **Management/Responsibility** The Field Operations Division Branch Chiefs who oversee field crew activities have the responsibility of ensuring that all CO-OPS field crews are properly equipped and trained to perform and/or supervise this task. Task Managers have oversight responsibilities for contractors and ensure CO-OPS requirements are met as required. The CO-OPS Meteorological Team in the Oceanography Division is responsible for establishing the barometric data acquisition requirements and updating this SOP.



APPENDIX A

WORKING WITH THE OMEGA HHP360 HANDHELD FIELD BAROMETER

Check the HHP360 baro settings before entering the installed barometer elevation:

- Set the barometer to SEA LEVEL mode
 1. After power up there should be an S to the left of the measured value indicating that the unit is in SEA LEVEL mode.
 2. If not, press the **Prgm/▶** button and then scroll down to PROGRAM MODE SEA LEVEL SELECT
 3. Press the **Prgm/▶** button again and scroll up or down until ENABLED is shown
 4. Press the **◀/On/Off** button twice to return to the measurement display screen
 5. To the left of the displayed value an S should now be shown

- Adjust the barometer to read in millibars
 1. After power up the units to the right of the measured value should read MBAR
 2. If not, press the **Prgm/▶** button and then scroll up to PROGRAM MODE UNITS SELECT
 3. Press the **Prgm/▶** button again and then scroll up or down as needed until MILLI BARS is selected.
 4. Press the **◀/On/Off** button twice to return to the measurement display screen.
 5. To the right of the displayed value the unit should now show MBAR

Enter the installed barometer elevation into the HHP360:

- Set the installed barometer elevation above **SEA LEVEL**
 1. Press the **Prgm/▶** button and then scroll down using the **▼ / ▲** buttons until PROGRAM MODE SEA LEVEL SELECT is visible.
 2. Press the **Prgm/▶** button again and ensure that SEA LEVEL SELECT is ENABLED. Press up or down as needed to get ENABLED if necessary.
 3. Press the **Prgm/▶** button again and then press **▼ / ▲** for Change: Yes
 4. Press the **Prgm/▶** button again to get to the SEA LEVEL METERS screen. Use the **▼ / ▲ / ◀ / ▶** buttons to enter the elevation of the installed barometer above sea level as shown in the SM checklist. Note that you must use the **▶** button to move to the far right of the data entry field to save the new value.
 5. Press **◀/On/Off** to return to the main screen / real time reading. The temperature is automatically applied from the internal thermistor. The handheld barometer is now set to read the pressure adjusted to mean sea level.