Chilled Mirror Dewpoint System model CMS2

HTi

Harmony Technology inc.

CMS2 Operators Manual v1.4

HTi warrants the reliability of its products for a period of 12 months from the date of initial shipment when operated in normal use and within the specified design limitations. Harmony Technology inc. (HTi) guarantees the solid platinum mirror used in the CMS2 for a period of 5 years of normal use from the date of initial shipment. HTi will re-polish or replace mirrors at its discretion. Mirrors which have been removed or damaged by mis-use are not covered.

HTi may at its sole discretion extend the warrantee period for up to 9 additional years, for customers who return the system to the factory for annual calibration and check. Under these Warranties, HTi will, at its discretion, repair or replace any component that upon examination by HTi or its duly authorized representatives proves to be defective during the warranty period provided the system is returned to the factory for inspection and repair shipping prepaid. Improper or unauthorized maintenance, storage, repair, or alteration of any kind by personnel other than HTi or its duly authorized representatives may void all warranties. Warranty may also be voided for misuse, neglect, accident, corrosion, improper installation, acts of nature and actions of war.

This Warranty is exclusive and in lieu of any and all other warranties of merchantability, fitness for a particular purpose, or any other warranty, expressed or implied, and all other liabilities and obligations on the part of HTi. HTi will not be liable for any other claims or damages, either direct, indirect, or consequential arising out of the use of its products.

Table of Contents

Safety

- Disconnect power before opening display enclosure
- Relieve pressure before opening sensor
- Check sensor O-rings for damage as required
- Observe voltage and current ratings on alarm relay
- Sensor may get hot during operation
- Ensure AC Line (Mains) plug connection is made in a suitable place and manner, away from wet, damp, dripping, dirty or other unsuitable or potentially dangerous situations.
- If dangerous or hazardous gases are sampled, use proper protective gear and purge sensor before opening.

Important Features

Accuracy and Stability

The CMS2 system uses chilled mirror technology to make accurate dew/frost point measurements which are stable over time. The measurement surface is solid platinum, which does not easily corrode or scratch. Optical control of the mirror temperature servo detects the dew or frost layer without touching or impacting the measurement surface. A 4 wire Kelvin connected platinum RTD measures the mirror temperature. All these features combine to provide an accurate, stable humidity measurement.

Color Touch Screen Display

The CMS2 system uses a color touch screen LCD to display data and allow user control of operations. The touch screen can configure the system, test operation and accuracy, and set-up outputs.

Built in filter

A built-in filter is supplied with the CMS2 sensor. This filter will greatly decrease the amount of dirt which reaches the mirror and cut down on required mirror cleaning maintenance. However the filter does adversely impact the speed of response of the system, especially at low frost points. If response is adversely impacted in your application, the filter is easily removed.

No cable effects

The CMS2 display communicates with the sensor using RS-485 digital communications. The sensor cable supplies power (12-24 vdc depending on sensor type) to the sensor and carries bi-directional RS-485 messages between the sensor and the display. No analog signals are carried by the cable, and so long cables do not have any effect on measurement accuracy. For very long cable runs, power "Tee's" may be added to supply local power (12-24 vdc) to the sensor.

Industrial cables and connectors

The cable used by the CMS2 system is a standard industrial cable. Connectors are rated IP-67 or better. Additional cables or long cables may be ordered from industrial supply companies or from HTi. Cables may be daisy chained, or "Tee'd" with 3 way splitters so users can add additional sensors or tap into the sensor directly.

View Port

CMS2 hygrometers incorporate a view port so the user can determine whether the condensate on the mirror is dew or frost.

NOTES on model types:

The CMS2 system supports several models of chilled mirror sensor. These are designated as CMS2a, CMS2b, CMS2n etc. Most are physically similar with height variations of a few millimeters to accommodate different power thermoelectric heatpumps. Some high power versions incorporate a cooling fan and are only suitable for clean and dry environments. Other types have special materials and software set-ups to measure humidity harsh or corrosive sample gasses. Contact Harmony Technology, inc. for any special requirements.

CMS2a: No fan. Measurement range 60°C below ambient temperature. Integral filter. Platinum mirror.

CMS2b: Cooling fan. Measurement range 80°C below ambient temperature. Integral filter. Platinum mirror.

CMS2n: Cooling fan. Measurement range 75°C below ambient temperature. No integral filter. 316 Stainless Steel mirror continuous with vapor barrier. Saphire window. FFKM O-rings.

Quick Start Guide

Unpacking
The CMS2 system consists of a sensor, sensor cable, display, power supply, cleaning kit, calibration certificate (CofC) and a manual. Please identify all components. Please retain the CofC and manual for future reference as needed.

Installing
Mount or place the sensor and display in suitable locations. Remember that the sensor will need periodic maintenance and access to the sensor will be required. Attach gas inlet and outlet tubing as required by your application. Fittings supplied with the system are ¼" swage fittings, screwed into 1/8" NPT adaptors. Most common tube fittings (both metric and imperial) are available with 1/8" NPT adaptors.

Connect the sensor to the display using the supplied cable. The cable will only attach one way.

Turn the power switch on the front of the display to off "0".

Plug the power connector into the rear of the display, and the power supply into AC power (100-240VAC 50/60Hz).

Test the system by turning the power switch on the front of the display to on "I".

The display will turn on, and display information about the system and software version for a few seconds, and then proceed to measurement.

If needed, (after start-up screen is done) access the menus by touching anywhere on the screen. Verify the output configurations before connecting the system to your data acquisition equipment.

As needed: Use the menus to set-up the system and outputs to your preferred configuration (see menu section).

Attach to the output connectors on the rear of the display.

Display

Front Panel

The front panel of the display includes a color LCD touch screen and a power switch. The touch screen is a resistive type, which means it can be actuated using fingers, pointers, gloved hands and other objects. Do not use sharp objects that may damage the screen.

In normal operation, the upper half of the screen displays the dew/frost point (or other optional data) in the user selected units.

A blinking green dot in the upper right corner of the display blinks with every data update between the sensor and the display. In case of a stable dewpoint measurement of an unchanging sample gas, the indicated dewpoint numbers will not change, so the blinking dot indicates that the system is active and updating properly.

The lower half of the screen displays sensor status and operating parameters.
These are:

- Mirror status,
    - Clean
    - Dirty
- Optical level, indication of dew/frost level on mirror
- TEC power, power applied to the thermoelectric heat pump. Indication of how much cooling is used and how much is left to measure lower dew/frost points.
- Control status,
    - Control, at or near the dew/frost point
    - Manual, user is controlling the mirror temperature
    - Heat, the user is heating the mirror
    - Cool, the user is cooling the mirror
    - Searching, the system has not locked onto the dew/frost point yet
    - ACCU, the system is performing a self clean and balance cycle
    - Normal, the system is performing start-up or maintenance functions

If optical level and/or TEC are consistently above .90 during operation then the dew/frost point is out of range or almost so. Try to find a cooler location for the sensor; or consider purchasing a more powerful model.

In the event of an error, the ERROR message will display full screen. Most menu functions will not be active in an error state.

Power off the system, correct the error, and turn the system back on.

To activate the menus, touch anywhere on the touch screen. See the MENU section of this manual for menu functions.

Rear Panel

The rear of the display contains:
- Sensor cable connector (M12 5 pin)
- Analog output connector (4 pins: output 1, gnd, output 2, gnd)
- An RS-232 field wiring connector (3 pins: TX, RX GND)
- Alarm relay terminals (3 pins: NO, COM, NC) 5A 250VAC, 5A 30VDC
- DC power input connector (jack: 5.5mm x 2.5mm center positive)

The sensor cable should be screwed into the sensor cable connector.

Note:
The sensor cable meets the NMEA 2000 standard, however 5 pin/conductor DeviceNet cables can be used for cable runs of less than 5 meters. (NMEA 2000 cables have heavier gauge power conductors)

The power connector should be inserted into the power jack. The power supply that comes with the system supplies 19V dc, which is sufficient for all sensor models. Users may supply their own dc power. 12V dc is sufficient for the CMS2a, but high power models need 15V minimum.

The various outputs can be connected to control systems or datalogging equipment as needed.

The analog outputs can be scaled to any range using the output set-up menu. They can be configured for 4-20mA, 0-20mA or 0-5 volts dc.

NOTE: to switch from mA output to voltage output requires that the output type select jumper be moved to the correct location. The jumper position and the selected outputs MUST match for accurate output of current or voltage.

The output set-up configuration as shipped is listed on the set-up sheet tucked into the pocket of the manual. It is also available from the set-up menu on the display.

The display case may be opened to more conveniently access the selection jumpers.

The RS-232 connection can be wired to external computer equipment. TX is the line the CMS2 will use to send data to the host computer, RX is the line that the CMS2 will use to listen to the external computer. (Connect RX on the computer to TX on the CMS2 and vis versa) Set-up is 9600 Baud, 8 bit, 1 stop, no parity. CMS2 does not supply local echo or loop back.

Data from the CMS2 is accessed by discrete commands such as $DP_C? which will get the response DP C = ##.## (The underscore "_" is part of the command)

A list of commands is included in the Serial Communications section of the manual.

Command response latency may be as high as 500msec if the system is busy. User menu activity will disable command responses while the user is interacting with the system using the touch screen.

The Alarm relay is rated for 250VAC 5A and 30VDC 5A. It may be configured in the menus to activate on measured values such as dew point or status values such as dirty mirror.

Sensors

The CMS2 chilled mirror sensors are comprised of a heat sink, a thermoelectric cooling module, a sample chamber with integrated filter, and an optics block. The mirrors are made of solid platinum to resist corrosion. The sample cavities are made of 316 stainless steel.

Maintenance

To access the mirror for cleaning or testing, loosen the two captive thumbscrews on the top of the optics block and pivot the block away from the sample cavity with a lifting motion.

Clean the mirror with a cotton swab wetted with cleaning solution. Dry the mirror with a clean cotton swab. The cleaning kit contains double ended swabs, wet one end for cleaning and use the dry end for drying.
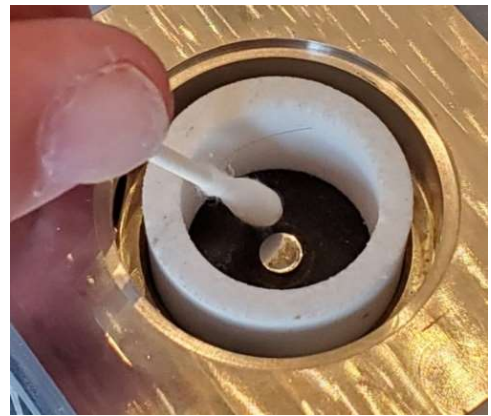

If using the internal filter, inspect it for obvious dirt. Blow clean if necessary or clean with isopropyl alcohol. If cleaning with alcohol, blow dry (wear suitable protection when blowing with compressed air) or allow alcohol to evaporate before re-installing.

Re-seat the filter by gently pressing it into the o-ring at the base of the sample cavity.

Check the optics block o-ring for damage or pinching.

Close the sensor by pivoting the optics block onto the sample cavity. It should seat into the alignment recess. Alternate tightening thumbscrews to seat the optics block evenly. Tighten both thumbscrews securely.
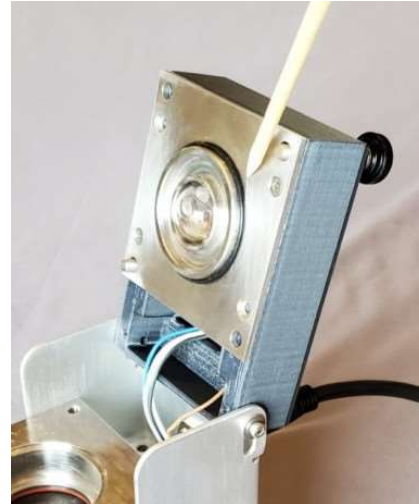
Additional Maintenance Notes:

The standard cleaning solution is a 70% isopropyl alcohol in water solution. Normal "lotion free" cotton swabs are suitable. For harsh or very dirty sample gasses, a special solution, model CS-D, is available which incorporates a mild diamond abrasive powder. CS-D will settle, and should be shaken before use.

There are O-rings that seal both the top and bottom of the sample chamber. To access the bottom O-rings, loosen the 2 M5x0.8 screws which hold the sample chamber.

Models CMS2a and CMS2b use two 2x42 mm Buna O-rings for sealing, and one -028 silicone O-ring to retain the filter.

Model CMS2n uses two -030 size FFKM O-rings for sealing.

Models using a fan for cooling also have a filter for the fan. To access and clean the filter, remove the four M3x0.5 acorn nuts and the outer fan guard. The filter may be cleaned with water or isopropyl alcohol. Allow the filter to dry before replacing. Do not over-tighten when replacing the acorn nuts.

Menus

To activate the menus from normal operation, touch the screen anywhere.

Main menu
The main menu appears when you touch the screen from normal operation.
The system will continue to operate normally while you are in this menu.

The upper half of the display will display the dew/frost point.
The lower half will display four buttons:

If you press SENSOR:
The upper half of the display will display the dew/frost point.
The lower half will display four buttons and the diagnostic and status information:

HEAT will cause the sensor to heat, dewpoint and status will continue to display. Use this to clear the mirror, or as part of a manual cleaning procedure.
- **COOL** will cause the sensor to cool, dewpoint and status will continue to display. Use this to test dew/frost growth on the mirror, or to test the lowest range of the sensor.
    - o NOTE: HEAT and COOL can be pressed to switch back and forth from heat to cool.
- **ACCU** will begin a self-clean and balance cycle. System will automatically return to operation when complete. If you have selected "HOLD" with delay minutes greater than zero, in the ACCU setup menu, "OUTPUT HOLD #.## will be displayed. The OUTPUTs will be held in their last state until #.## (in minutes) counts down to zero. **The HOLD timer begins after the system has achieved "CONTROL".** The display will continue to display the current

mirror temperature, but the Analog outputs and Alarms will be held. (see ACCU setup below)
- **BACK** returns to operation.

If you press SET-UP:

    The upper half of the display will display the dew/frost point.
    The lower half will display four buttons:

If you press **UNITS**:
The upper half of the display will display the dew/frost point.
The lower half will display four buttons:

DP C will give a preview of the dewpoint in degrees C
DP F will give a preview of the dewpoint in degrees F
SAVE will save your choice of units, this choice will be retained and continue to be used even after the system is switched off and back on.
BACK returns to the SET-UP menu.

If you press ACCU*:
    The upper half of the display will display the ACCU* settings currently stored.
    The lower half will display four buttons:
    NOTE: pressing any button except back will change the settings)

TRACK (The output will be live during an ACCU cycle)
HOLD (The outputs and ALARMS will be held during an ACCU cycle) After pressing HOLD, you will be prompted to enter a number of minutes for the HOLD to be enforced after the system has returned to control. Valid entries are 0 or any positive number of whole minutes. Zero will release the hold once the system re-establishes CONTROL. Entries such as 5.5 will be truncated to 5. Negative entries will be interpreted as zero.
INTERVAL (set the time period between automatic ACCU cycles)
BACK returns to SET-UP menu without changes

If you press OUTPUTS:

The upper half of the display will display the OUTPUT settings currently stored.

The lower half will display four buttons:

OUTPUT1   (Set the output parameters)

OUTPUT2   (Set the output parameters)

ALARM   (Set the alarm relay parameters)

BACK   returns to SET-UP menu without changes

OUTPUT1 or OUTPUT2 displays 8 buttons:

SET HI   (enter the value for 20mA or 5 volts depending on output type)

SET LO   (enter the value for 4mA, 0mA or 0 volts)

DP C   (select degrees C for output units)

DP F   (select degrees F for output units)

4-20mA, 0-20mA or 0-5v   (select output type)

BACK   returns to SET-UP menu

(NOTE: mA or voltage must match output select jumper on rear)

ALARM displays 8 buttons: These are set in a similar manner to the OUTPUT

SET ON   (enter value to energize the relay depending on type)

SET OFF   (enter value to de-energize the relay)

ACCU   (relay is controlled by ACCU status bit, ON and OFF set points can be 1 or 0)

CONTROL   (relay is controlled by CONTROL status bit, ON and OFF set points can be 1 or 0)

DP C or DP F   (units of values for relay set points)

DIRTY   (relay is controlled by DIRTY MIRROR status bit, ON and OFF set points can be 1 or 0)

BACK   returns to SET-UP menu

In all cases where numbers are entered, use the keypad.

ENTER will enter the number as displayed.

BACK remove the last digit, if there are no digits left, BACK will return to the previous menu item.

If you press TEST:
You can adjust and calibrate the analog outputs and test the accuracy of the sensor.
To calibrate the outputs you should use an accurate meter to measure voltage or current in the range of 0-20mA and/or 0-5 volts.

The upper half of the display will display the dew/frost point.
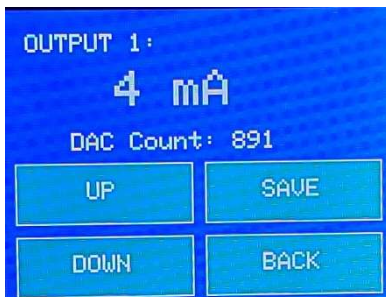The lower half will display four buttons:

If you press OUTPUT 1 or OUTPUT 2:
    If OUTPUT x is 4-20mA, the system will output 4mA on output x.
    (If OUTPUT x is 0-20mA or 0-5 volts this step will be skipped)

4 buttons will be displayed:

UP	(will increase the DAC value for 4mA)
DOWN	(will decrease the DAC value for 4mA)
SAVE	(will save the new DAC value for the selected output and continue to the NEXT STEP)
BACK	(will return to the TEST menu without saving)

Press UP or DOWN until the output is the desired 4mA.

(NOTE: mA or voltage must match output select jumper on rear)

NEXT STEP: (in the same manner as the 4mA test)
      If OUTPUT x is 4-20mA or 0-20mA, the system will output 20mA on output x.
      If OUTPUT x is 0-5 volts the system will output 5 volts on output x.

      4 buttons will be displayed:

UP   (will increase the DAC value for 20mA or 5 volts)
DOWN   (will decrease the DAC value for 20mA or 5 volts)
SAVE   (will save the new DAC value for the selected output and return to the
                  TEST menu)
BACK   (will return to the TEST menu without saving)

Press UP or DOWN until the output is the desired 20mA or 5 volts.

If you press GOTO T:
The upper half of the display will display the mirror temperature.
The lower half will display four buttons and the diagnostic and status information:

UP   raises the mirror temperature by the value
          in the INC button.
DOWN   lowers the mirror temperature by the value
          in the INC button.
INC   changes the increment value, cycling thru
          10, 1, 0.1, 0.01, and back to 10 degrees.

BACK   returns to the TEST menu

GOTO T allows you to control the temperature of the mirror manually. First it locks in
the current temperature of the mirror, then it allows you to raise or lower the mirror
temperature using the menu keys to test the system.

A useful test is an accuracy test. In this test you will freeze water on the surface of the
mirror and observe at what temperature it melts. It should melt at 0.0 C/32.0 F or very
close to that. The melting point of water is much more accurate than the freezing point.

To perform this test, while in the GOTO T menu open the sensor sample cavity so you
can observe the mirror surface. A clear plastic sheet is supplied in the manual pocket. It
is useful to avoid the influence of drafts or breath on mirror temperature.

Use the keys to cool the mirror so dew or frost forms on the surface. Cool the mirror below freezing (-20 to -30 C, -10 to 0 F, is a good choice) until the water on the mirror freezes.

Then slowly heat the mirror in increments until it is just below freezing (0 C, 32 F). Heating in increments avoids temperature overshoot that comes with large temperature change steps. One degree steps are recommended when you are within 10 degrees of melting, 0.1 degree steps when you are within 2 degrees and 0.01 degree steps when you are within 0.3 to 0.5 degrees of melting.

Observe at what temperature the water on the mirror melts. If the system is accurate it should melt at 0 C +/- 0.2 C or 32 F +/- .38 F.

If it melts well below normal temperature it is likely that the mirror needs careful cleaning of accumulated airborne salts. Clean and retry.

Serial Communications

The CMS2 has a simple field wire-able RS-232 connector on the rear of the display. The 3 pin connector has terminals for TX, RX and GND which would normally be wired to pins 2, 3 and 5 respectively on a DB-9 pc connector (some data systems will reverse pins 2 and 3 for a "NULL MODEM" connection, some systems use a 25 pin connector).

Signal	Flow	Computer DB-9	Computer DB-25
TX	>>>>>>	2	3
RX	<<<<<<	3	2
GND	<><><>	5	7

Communications set-up is 9600 BAUD, 8 bit, 1 stop bit, no parity. CMS2 does not send an echo or loopback, so if the commands that you enter do not appear on your terminal screen, set your terminal for local echo.

Command Syntax:

Commands begin with a dollar sign "$".

Commands end with a question mark "?" for a data request, or "!" for an action initiation.

All commands must be accurate with regard to capitalization, and underscores. Commands do not use spaces.

A carriage return or line feed or both (CR/LF) directs the system to process the command(s) and not wait for more input. It is good practice to only enter one command per line.

Common Commands:

The action command **$STREAM!** (CR/LF) controls whether the CMS2 will stream data on the RS-232 port or only respond to queries. The user will be prompted for an interval time.

The STREAM function may be set to 0. If it is, the system will only respond to queries on the RS-232 port. Alternately, the STREAM function may be set to the number of seconds between data streams can be set. It is not recommended to set the STREAM function to less than 2 second intervals due to latency of command processing during internal functions.

The data stream consists of:
Time from power-up (days:hours:minutes:seconds) plus the information from the $STATUS? command.

The user may request the dewpoint by sending the command **$DP_C?** (CR/LF).

    The system will return a plain text string: DP C = ##.## (CR/LF)

The user may request the dewpoint and sensor status by the command **$STATUS?** (CR/LF).

    The system will return a plain text string beginning with STATUS,   DEW C = ##.##, followed by either: NORMAL, CONTROL, SEARCH, ACCU* ON, HEAT ON, COOL ON, or MANUAL, Followed by: DIRTY, or CLEAN, Followed by: OPTICS = ### %, HP = ### %, LED = ### % (CR/LF)

    Optics and HP % are the level of dew or frost on the mirror and the power to the heatpump. LED% is the brightness of the LED; if this is near 100% send the unit in for factory service at your convenience.

The user may also request sensor information by the command **$INFO?** (CR/LF).

    The system will return a plain text string beginning with INFORM, serial number of the sensor, CAL DATE, date of calibration, BY, the name of the calibration tech (CR/LF).

    Date of calibration and name of technician are simple text strings stored exactly as the calibration technician entered the data. No error correction or formatting is applied.

    Example: CAL DATE, 04/20/20 or 20Apr20 or April 20, 2020 would all be possible.
    Example: BY, John Smith or J Smith or John S would all be possible too.

   These fields will truncate entries longer than 32 characters.

The action command **$ACCU!** (CR/LF) will initiate a self cleaning ACCU cycle.

Specific models may have additional commands which will be detailed in an addendum sheet in the manual pocket.

Mounting Dimensions, Drawings and Specifications:

The display may be used on a desktop or bench or mounted to a panel using the cutout dimensions below. To panel mount, remove all power and other connections, remove the rear panel and pass the display through the cut-out. Re-attach the rear panel and tighten the screws to capture the display in the cut-out. The screws supplied with the display accommodate a panel thickness up to 2.3mm (.093"). If thicker panels are needed, use longer screws (M5x0.80).

Panel cutout dimensions (+/- 1mm, 0.04")
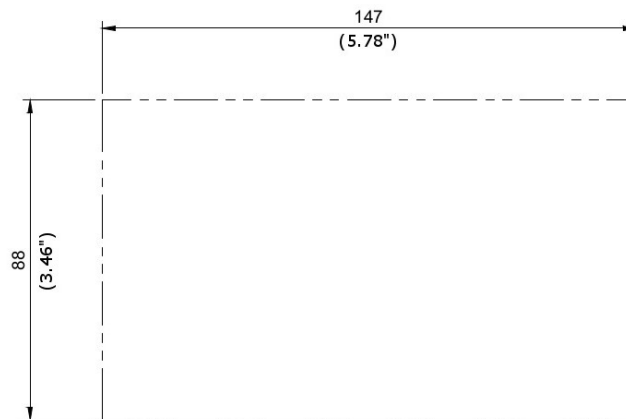
The sensor may be used on a desktop or bench or mounted using the dimensions below.
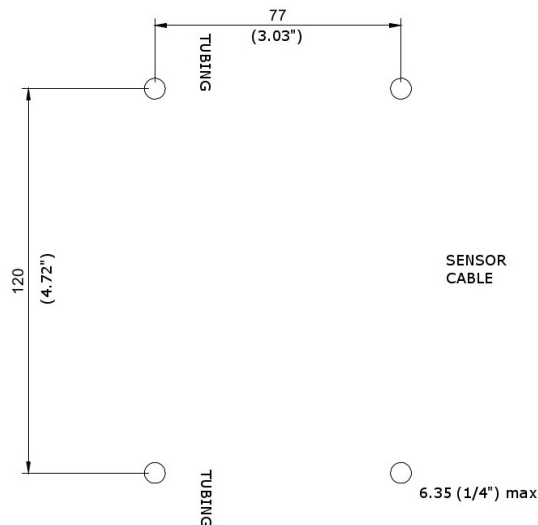
Your model's specifications, set-up, and initial factory calibration data are in the manual pocket.