

Model 7150 Series Digital Barometer



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**User's
Manual**

Rev. D



allweatherinc

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Revision History

Revision	Date	Summary of Changes
C	2012 Jan 6	Clarified description of boot counter operation, rotated mounting diagram in Figure 4 to match photo in Figure 3, matched dimensions in specifications to those in Figure 4, corrected year of EN61326-1 :2006 report to 2005, adapted warranty to match FAA Advisory Circular 150/5220-16D Section 2.4(h) p 12.
D	2014 Apr 4	Added non-default baud rates to specifications to match options described in Chapter 3

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1. OVERVIEW

The Model 7150 Series of digital barometers is designed to provide accurate pressure measurements over a wide range of environmental temperatures and pressures. The fully compensated digital barometer is ideal for use in demanding automated weather station applications.

The barometers use pressure transducers with silicon piezoresistive absolute pressure sensors. The pressure sensors have excellent hysteresis and repeatability characteristics, low temperature dependence, and a very good long-term stability. The ruggedness of the pressure transducers is outstanding.

Three models are offered based on the number of pressure transducers in the digital barometer. Additional pressure transducers allow for operational redundancy, and can be used by a system incorporating the digital barometer as a basis to flag the digital barometer for maintenance or replacement if the difference in readings between transducers exceeds a predefined amount.

Model Number	Number of Transducers
7150	2
7150-A	3
7150-B	1

The 7150 digital barometer, which has two pressure transducers, is the standard digital barometer recommended for Automated Weather Observing Systems (AWOS).

The digital barometers communicate using full-duplex RS-232 and half-duplex RS-485 serial protocols. Both the RS-232 and the RS-485 serial ports are available on the DB9 serial interface, but only one communication protocol is normally used. Fail-safe biasing ensures that there is no interference from the unused serial port.

The 7150 Series of digital barometers is traceable to National Institute of Standards and Technology (NIST) in the United States.

1.1 DATA COLLECTION PLATFORM KIT OPTIONS

The Model 7150 Series of digital barometers is also available as part of a complete kit for installation in the All Weather Inc. Model 1190 or Model 1190-I Data Collection Platform (DCP) used in AWOS systems. These kits include the digital barometer, the M105037 Quad Plate Pressure Port, and their associated tubing and power/data cables. Three kits are offered corresponding to the digital barometer models.

Digital Barometer Model Number	DCP Kit
7150	11906
7150-A	11906-A
7150-B	11906-B

2. THEORY OF OPERATION

The 7150 Series Digital Barometer measurements are based on a peizoresistive pressure sensor and a temperature sensor, which are measured continuously. A microprocessor in the barometer calculates the pressure reading based on compensations for pressure linearity and temperature dependence.

As the pressure changes, a silicon diaphragm in the pressure sensor bends and changes the height of the vacuum gap inside the sensor. The resistivity of the sensor then changes, in turn, and this change in resistance is measured and converted into a pressure reading. The pressure sensor operates over a wide dynamic range and includes a built-in overpressure blocking mechanism.

The basic pressure and temperature compensations for the pressure transducers in the 7150 Series Digital Barometer are based on 37 calibration values that are applied to the current pressure and temperature readings. The individual pressure and temperature calibration coefficients are stored in the EEPROM of each pressure transducer. The user cannot change these calibration coefficients.

2.1 PRESSURE TRANSDUCER

The 7150 Series Digital Barometers use Honeywell integrated pressure transducers (Figure 1) to measure pressure. Each pressure transducer uses an EEPROM to store its temperature and pressure calibration coefficients.



Figure 1. Honeywell Pressure Transducer

The pressure transducers communicate with the microprocessor on the barometer motherboard over an SPI bus. The microprocessor on the 7150 motherboard can communicate with up to three pressure transducers. The raw values from the pressure transducers are converted to pressure and temperature readings.

3. OPERATION

3.1 COMMUNICATION

The 7150 Series Digital Barometer communicates over its serial port at one of four baud rates. The baud rate is selected by the SW3 DIP switches inside the enclosure. Figure 2 shows the location of the SW3 DIP switches.

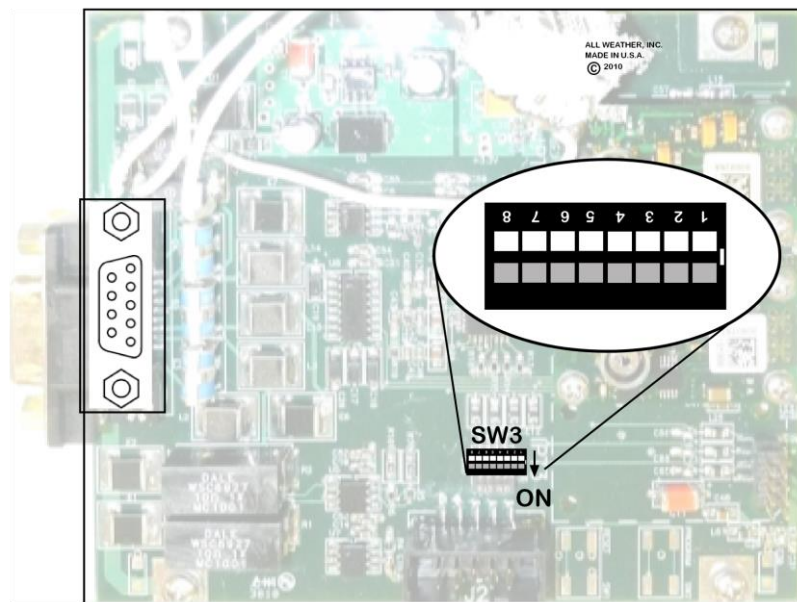


Figure 2. Location of SW3 DIP Switches

The first two DIP switches are used to select the baud rate. The default baud rate is 4800 bps.

Baud Rate (bps)	Switch							
	1	2	3	4	5	6	7	8
DEFAULT BAUD RATE 4800	OFF	OFF	x	x	x	x	ON	x
9600	ON	OFF	x	x	x	x	ON	x
19200	OFF	ON	x	x	x	x	ON	x
57600	ON	ON	x	x	x	x	ON	x
RS-232	x	x	x	x	OFF	ON	ON	x
RS-485	x	x	x	x	ON	OFF	ON	x
RS-232/RS-485	x	x	x	x	ON	ON	ON	x
PROG	x	x	x	x	x	x	OFF	x

The communication protocol uses 8 data bits, no parity, and one stop bit (8-N-1) for all baud rates, and is not selectable by the user.

All commands sent to the barometer must end in a carriage return (0x13) and line feed (0x10).

The barometer will output an identification message out of its serial port upon being powered up. This identification message will include the software version as shown in the example below.

```
7150 BP Sensor, Firmware Version 1.00
```

3.1.1 Sensor Polling

The sensor only outputs its data stream after receiving a poll command. The poll command for the barometer is **SEND 0<CR><LF>**.

The poll response with the calibration coefficients applied appears below.

```
<SP><SP>aa.aaa<SP>bb.bbb<SP>cc.ccc<SP>[-]tt <SP>xx.xxx <SP>yyy
```

<SP> = Empty space

aa.aaa = Pressure Sensor #1

bb.bbb = Pressure Sensor #2

cc.ccc = Pressure Sensor #3

xx.xxx = 3-hour pressure trend

tt = Temperature associated with Pressure Sensor #1

<-> = Empty space for positive temperature reading or
minus sign for negative temperature reading

yyy = Error code, one character for each pressure sensor

Pressure values are output in inches of mercury (inHg). Temperature is output in degrees Celsius (°C). These values are each averaged over 5 seconds. A minus sign precedes the temperature value if the temperature reading is less than 0°C.

The 3-hour pressure trend is based on 5-minute averages. This value will be reported as ****.***** until the barometer has accumulated 3 hours of data. The trend will show the increase or decrease in the 5-minute average over the previous 3 hours. All the pressure readings for the installed pressure transducers are averaged together to obtain this value.

The error code displays whether each pressure sensor has an error. There will be a one or a zero for the pressure sensor in each pressure transducer installed. If a pressure transducer is not installed, there will be an empty space for that sensor. The standard 7150 barometer (with two pressure transducers) used in AWOS systems will display two digits (one or zero), followed by an empty space. A zero represents no error. A one reports a problem with that sensor.

Asterisks (*) indicate values that are out of range or not present in the sensor. The standard 7150 barometer (with two pressure transducers) used in AWOS systems will always display **cc.ccc** as ****.***** since the third pressure transducer is not installed. All of the values will be represented initially by asterisks when polled immediately after being powered up.

Sample Poll Responses

		2	9	.	9	3	2		2	9	.	9	3	5	*	*	.	*	*	*		-	2	5	*	*	.	*	*	*		0	0	
--	--	---	---	---	---	---	---	--	---	---	---	---	---	---	---	---	---	---	---	---	--	---	---	---	---	---	---	---	---	---	--	---	---	--

7150

Pressure Sensor #1 reading 29.932 inHg
 Pressure Sensor #2 reading 29.935 inHg
 Pressure Sensor #3 reading **.*** indicates missing (this is a Model 7150 barometer)
 Temperature is -25°C
 Trend **.*** indicates barometer has been operating for less than 3 hours
 No errors in Pressure Sensor #1 or Pressure Sensor #2, Pressure Sensor #3 is missing (this is a Model 7150 barometer)

		3	0	.	4	3	2		3	0	.	4	2	5		3	0	.	4	2	9		3	7		-	0	.	0	0	7		0	0	1
--	--	---	---	---	---	---	---	--	---	---	---	---	---	---	--	---	---	---	---	---	---	--	---	---	--	---	---	---	---	---	---	--	---	---	---

7150-A

Pressure Sensor #1 reading 30.432 inHg
 Pressure Sensor #2 reading 30.425 inHg
 Pressure Sensor #3 reading 30.429 inHg (this is a Model 7150-A barometer)
 Temperature is 37°C
 Trend -0.007 inHg over past 3 hours
 No errors in Pressure Sensor #1 or Pressure Sensor #2, Pressure Sensor #3 has a problem

		2	9	.	8	3	6		*	*	.	*	*	*		*	*	.	*	*	*		2	1		0	0	.	0	0	2		0	
--	--	---	---	---	---	---	---	--	---	---	---	---	---	---	--	---	---	---	---	---	---	--	---	---	--	---	---	---	---	---	---	--	---	--

7150-B

Pressure Sensor #1 reading 29.836 inHg
 Pressure Sensor #2 reading **.*** indicates missing (this is a Model 7150-B barometer)
 Pressure Sensor #3 reading **.*** indicates missing (this is a Model 7150-B barometer)
 Temperature is 21°C
 Trend +0.002 inHg over past 3 hours
 No errors in Pressure Sensor #1, Pressure Sensor #2 and Pressure Sensor #3 are missing (this is a Model 7150-B barometer)

		*	*	.	*	*	*		3	2	.	9	2	5		3	2	.	9	5	1		-	3	8		-	0	.	0	0	1		1	0	0
--	--	---	---	---	---	---	---	--	---	---	---	---	---	---	--	---	---	---	---	---	---	--	---	---	---	--	---	---	---	---	---	---	--	---	---	---

7150-A

Pressure Sensor #1 reading **.*** indicates missing or out of range (this is a Model 7150-A barometer)
 Pressure Sensor #2 reading 32.925 inHg (this is a Model 7150-A barometer)
 Pressure Sensor #3 reading 32.951 inHg (this is a Model 7150-A barometer)
 Temperature is -38°C
 Trend -0.001 inHg over past 3 hours
 Pressure Sensor #1 has a problem, no errors in Pressure Sensor #2 and Pressure Sensor #3

4. INSTALLATION & CHECKOUT

4.1 MOUNTING

In AWOS applications, the 7150 Digital Barometer has to be installed inside a weather-resistant enclosure. The user must also pay attention to the fact that the pressure fitting supplied with the barometer is not a static pressure head. The barbed pressure fitting is not recommended for turbulent or high-speed static wind conditions — the accuracy quoted for the 7150 Series Digital Barometers does not include any wind effects. The pressure fitting must also be carefully protected from rain since water may get into the pressure connector and cause errors in the pressure measurement. These wind and rain effects can be eliminated by using the Quad Plate Pressure Port available from All Weather, Inc. as P/N M105037. (All AWOS systems supplied by All Weather, Inc. include the M105037 Quad Plate Pressure Port.)

In benign room temperature conditions, i.e., in laboratory measurements, no further environmental protection is required. In all cases, pay close attention to grounding the barometer.

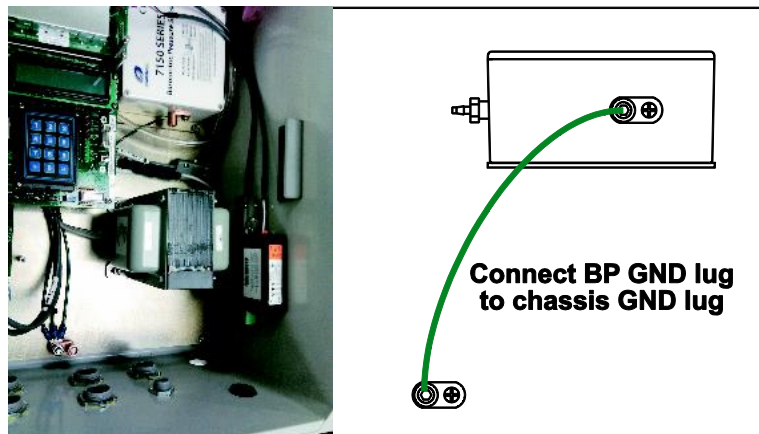


Figure 3. Connect BP Sensor Ground Lug to Chassis Ground

Figure 4 shows the mounting specifications for the 7150 Digital Barometer.

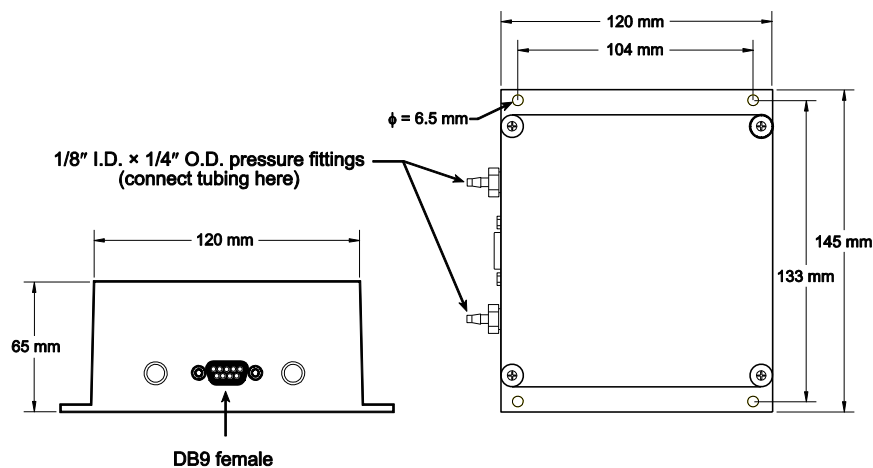


Figure 4. 7150 Digital Barometer Mounting Specifications

4.2 PRESSURE CONNECTIONS

The barometer is equipped with a barbed pressure fitting for 1/8" internal diameter tubing.

The barbed pressure fitting is not recommended for turbulent or high-speed static wind conditions — the accuracy quoted for the 7150 Series Digital Barometers does not include any wind effects. The pressure fitting must also be carefully protected from rain to keep water from getting into the pressure connector where it may cause errors in the pressure measurement.

7150 Series Digital Barometers are designed to measure the pressure of gases that are clean, non-condensing, non-conducting, and non-corrosive.

4.3 SERIAL CONNECTIONS

Figure 5 shows the wiring diagrams for the RS-232 and RS-485 serial communication options. The RS-232 option has no hardware handshaking.

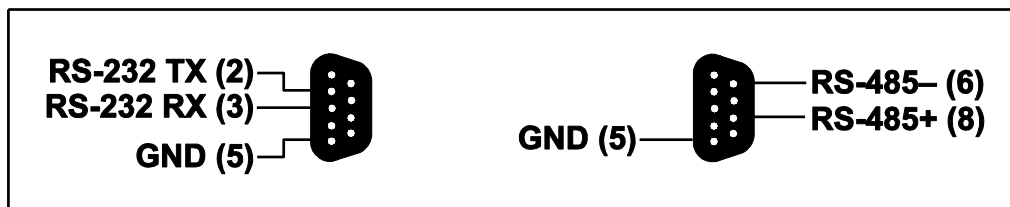


Figure 5. 7150 Digital Barometer Serial Connection Wiring Options

Both the RS-232 and the RS-485 serial ports are available on the DB9 serial interface, but only one communication protocol is normally used. Fail-safe biasing ensures that there is no interference from the unused serial port regardless of whether termination and bias resistors are used.

4.4 POWER SUPPLY CONNECTIONS

Figure 6 shows the wiring diagram for the power supply connections. The power supply is connected using the same DB9 connector that is used for serial communication.

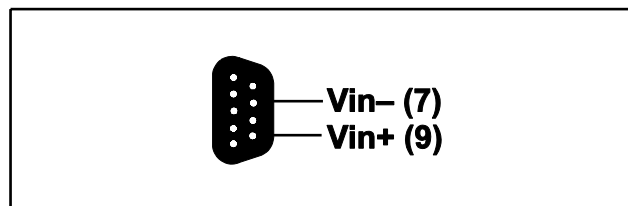


Figure 6. 7150 Digital Barometer Power Supply Wiring

4.5 CHECKOUT

Check the device the barometer is connected to verify that barometric pressure data are being output corresponding to the number of pressure transducers or model of the 7150 Series Digital Barometer. No further checks are required when the barometer is first installed. Subsequent maintenance checks must be done based on the schedule described in Chapter 5

5. MAINTENANCE

The routine maintenance described in this chapter must be performed according to the schedule presented in Section 5.1 using the maintenance procedures described in Section 5.2.

5.1 PERIODIC MAINTENANCE SCHEDULE

Periodic maintenance procedures for the 7150 Series Digital Barometers are divided into three categories within the maintenance cycle — monthly, triannual, and annual maintenance.

5.1.1 Monthly Maintenance

- Visually check the Quad Plate Pressure Port (if equipped) and clear any debris from the Pressure Port or transducer area.

5.1.2 Triannual Maintenance

- Perform the monthly maintenance visual check of the Quad Plate Pressure Port (if equipped) and clear any debris from the Quad Plate Pressure Port or transducer area.
- Clean the Quad Plate Pressure Port vents(s) if Quad Plate Pressure Ports are used.
- Perform a barometric pressure check.
- Enter the offset(s) for the barometric pressure sensors if the barometer is being used in an AWOS system.

5.1.3 Annual Maintenance

- Perform the procedures outlined for triannual maintenance.
- Perform an altimeter setting check if the barometer is being used in an AWOS system.

5.2 MAINTENANCE PROCEDURES

5.2.1 Equipment Required

The following equipment is required for the 7150 Series Digital Barometers maintenance procedures.

- Setra Model 370 pressure standard or equivalent (All Weather, Inc. P/N Z003919)

5.2.2 Debris/Obstruction Removal

Visually check the Quad Plate Pressure Port (if equipped) and clear any debris from the Pressure Port or transducer area.

5.2.3 Quad Plate Pressure Port Vent Cleaning (if equipped)

1. Remove the Quad Plate Pressure Port drain plug (the Phillips screw on the underside of the bottom plate) using a Phillips screwdriver, and drain any accumulated moisture.
2. Remove both flexible tubes from the transducer inlets and blow gently into the tubes to clear any accumulated debris.
3. Replace the tubes and the Quad Plate Pressure Port drain plug.

5.2.4 Barometric Pressure Check

Using the Z003919 pressure standard, compare the output of the pressure sensor with the standard. *If a sensor reading differs from the standard by more than 0.05 inHg, replace the sensor.*

Note that offsets are applied when the 7150 Series Digital Barometers are used with AWOS systems to keep the displayed sensor readings within ± 0.005 inHg of the standard.

5.2.5 Barometric Pressure Offset (AWOS systems only)

With AWOS systems, the readings have to be adjusted if the sensor reading drifts over time by applying an offset to keep the sensor readings within ± 0.005 inHg of the standard as explained in the AWOS user's manual for the system to which the barometer is interfaced. Note the amount of deviation of the Model 7150 from the standard; this will be used as the offset. The offset will be "negative" if the pressure sensor reading is greater than the standard.

Note that offsets of more than 0.05 inHg are not allowed—the sensor must be replaced in this case.

5.2.6 Altimeter Setting Check (AWOS systems only)

1. Use the barometric pressure value obtained with the reference pressure sensor during triannual maintenance to calculate the Altimeter Setting using the formula below.

$$\text{Alt. Setting (in Hg)} = \left(BP^\alpha + SE \cdot 1.313 \times 10^{-5} \right)^{5.25486}$$

where:

$$\alpha = 0.1903$$

SE = Sensor elevation above sea level in feet

BP = Barometric pressure in in Hg

2. Record the calculated altimeter setting and that reported by the AWOS.
3. If the difference between the calculated altimeter setting and that reported by the AWOS is more than 0.01 inHg, please advise AWI Customer Service at +1(916)928-1000.

6. SPECIFICATIONS

Parameter	Specification
Pressure Range	14.7 – 33.0 inHg (500 – 1117 hPa)
Operating Temperature	-40 to +185°F (-40 to +85°C)
Storage Temperature	-67 to +257°F (-55 to +125°C)
Humidity	noncondensing
Pressure Units	inHg
Resolution	0.001 inHg (0.03 hPa)
Accuracy ¹	±0.004 inHg (±0.1 hPa)
Baud Rate	4800, 9600, 19200, or 57600 bps
Serial Port Parameter Setting	8-N-1 (8 data bits, no parity, 1 stop bit)
Serial Connector	DB9 (female 9-pin D-sub connector)
Supply Voltage	6–40 V DC, reverse polarity protected
Current Consumption	<50 mA (continuous operation mode)
Pressure Fitting	barbed fitting for 1/8" I.D. tubing
Maximum Pressure Limit	60 inHg (absolute)
Minimum Pressure Limit	0 inHg
Enclosure	powder-coated aluminum
Dimensions	5.71" W × 4.72" H × 2.56" D (145 mm × 120 mm × 65 mm)
Weight	23 oz (0.63 kg)
Shipping Weight	34 oz (1 kg)

¹ Accuracy is the sum of worst case linearity, repeatability, hysteresis, thermal effects, and calibration errors over the operating temperature range.

7. ELECTROMAGNETIC COMPATIBILITY

The 7150 Digital Barometer is designed to comply with the CE norms for electromagnetic compatibility. The condition for this compliance is the use of braided cables and proper grounding techniques. The 7150 Digital Barometer has successfully passed the following emissions and immunity tests.

EMISSIONS	
Test	Set up according to:
Radiated Interferences	EN61326-1:2005
IMMUNITY	
Test	Set up according to:
Electrostatic Discharge	IEC 61000-4-2
RF Radiated Fields	IEC 61000-4-3
Electrical Fast Transients	IEC 61000-4-4
Surge	IEC 61000-4-5
Conducted Immunity	IEC 61000-4-6
Magnetic Immunity	IEC 61000-4-8

8. WARRANTY

Unless specified otherwise, All Weather Inc. (the Company) warrants its products to be free from defects in material and workmanship under normal use and service for one year from date of installation or a maximum of two years from date of shipment, subject to the following conditions:

- (a) The obligation of the Company under this warranty is limited to repairing or replacing items or parts which have been returned to the Company and which upon examination are disclosed, to the Company's satisfaction, to have been defective in material or workmanship at time of manufacture.
- (b) The claimant shall pay the cost of shipping any part or instrument to the Company. If the Company determines the part to be defective in material or workmanship, the Company shall prepay the cost of shipping the repaired instrument to the claimant. Under no circumstances will the Company reimburse claimant for cost incurred in removing and/or reinstalling replacement parts.
- (c) This warranty shall not apply to any Company products which have been subjected to misuse, negligence or accident.
- (d) This warranty and the Company's obligation thereunder is in lieu of all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose, consequential damages and all other obligations or liabilities.

No other person or organization is authorized to give any other warranty or to assume any additional obligation on the Company's behalf, unless made in writing and signed by an authorized officer of the Company.



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