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How to Contact Us:
Thank you for choosing the XP2i Digital Test Gauge from Crystal Engineering Corporation. Your XP2i is a combination of leading edge technology and rugged industrial design.

Accuracy is 0.1 percent of reading - so any XP2i can typically replace several gauges you may have been using. The XP2i is fully temperature compensated - so there is no change in accuracy throughout the entire operating temperature range!

The case, and almost all metal components, are stainless steel. Gaskets seal out dust and water. Even the RS-232 connector (with or without the cover) is fully sealed. Circuitry is mounted in a shock absorbing elastomer, and the batteries are easily accessible by removing two screws. But you won’t need to change batteries often, since 3 AA batteries operate the XP2i for up to 1500 hours of continuous use. If you are mounting the gauge in a permanent location consider ordering the external power supply kit (PN: 2984). With the external power supply the batteries serve as an automatic backup supply, in case of power failure. Other features include:

- continuous recording of peak and valley pressure readings
- a removable filter (to keep out large particle contaminants)
- all welded 316 stainless steel sensor
- can be cleaned for oxygen service

Your XP2i can be customized through the use of ConfigXP™ software available from Crystal Engineering. Your personal computer can disable, enable or modify a variety of features of your XP2i. Look for the ConfigXP Logo for programmable features, like:

- a user defined pressure scale, and/or disable unused pressure units
- password protection to prevent unauthorized changes
- disable keypad recalibration, peak button, and/or units button
- expand or decrease allowable Zero range
- set the gauge to a different density of water factor (4°C, 60°F or 68°F)
- store a 12 digit ID or tag number in non-volatile memory
- adjust calibration values

We hope your XP2i meets your expectations, and we're interested in any comments or suggestions you may have. You can send us a note at: feedback@crystalengineering.net. Many features in this and our other products are a direct result of your comments!

Crystal Engineering is the company that designs, manufactures, markets and services the XP2i, 30 series pressure calibrators, MultiCal multimeter pressure adapters and a variety of industry specific pressure measuring equipment. Crystal Engineering pioneered features like full temperature compensation and “of reading” rated gauges and calibrators. Pressure measuring equipment is the only thing we do and that’s why we say: PRESSURE is Our BUSINESS™
The **XP2i** is shipped with batteries installed, so it’s ready to use. Press and hold the (on/off) button. The **XP2i** will first test all LCD segments. Release the button when the **XP2i** indicates pressure.

The **XP2i** always resumes operation in the mode and the units of the pressure last used, and it **does not automatically rezero when turned on**.

Connect the **XP2i** to your system. Use pipe thread tape or pipe thread sealant on the ¼” NPT fitting. **Always use a wrench (¾” or 19mm) for installation and removal of the XP2i!** There is a limit to how much rotational force can be applied to the case, so **don’t rely on, or use, the case to screw the XP2i into a fitting, and don’t use the case to remove the XP2i fitting, either.**

**WARNING:** Severe injury or damage can occur through improper use of pressure instruments! Do not exceed recommended pressure limits of tubing and fittings. Be certain all pressure connections are secured.

**CAUTION:** Never insert any object (other than the stainless steel filter) into the pressure connection! The sensor diaphragm is very thin and can be damaged or destroyed by solid or sharp objects. Cleaning of the sensor must be done with appropriate solvents only.

Most **XP2i**s are intended for gauge pressure measurement. That is, they indicate the difference between applied pressure and ambient barometric pressure. However, the **zero** button can be used to force an **XP2i** to read zero pressure at **any** applied pressure, up to the full scale rating of the gauge. The factory default setting limits the maximum zero value to 200 PSI, but this limit can be changed with **ConfigXP**.

Some **XP2i**s are rated for absolute pressure. Absolute gauges indicate the difference between applied pressure and an internal vacuum reference. Absolute pressure is always positive. For instance barometric pressure at sea level is on average about 14.7 PSI (approximately 100 kPa or 1 bar), so at sea level this is the lowest expected pressure indication. However, absolute gauges can be “zeroed” (unless prevented by **ConfigXP**). After zeroing an absolute gauge it is possible to indicate a negative pressure.

**WARNING:** This gauge can display zero pressure when connected to a source of pressure! Do not rely on the display indication before disconnecting - it may not be indicating true pressure. Never disconnect pressure instrumentation without first relieving system pressure!
Units button
Pressing this button causes the XP2i to select the next available unit of pressure measurement. See “Pressure Ranges, Display Scales & Resolution” for the list of pressure units available for your model.

CONFIGXP PROGRAMMABLE Units that you don’t need or never use can be turned off. You can also define a special unit for your XP2i with ConfigXP. That way you can use the XP2i to display directly in a unit not otherwise available, such as feet of seawater, or foot-pounds of torque. When your custom unit is selected and displayed on the XP2i, all pressure unit icons will be off.

Zero
To zero the XP2i, you must turn off peak indication, then press the zero button for at least ½ second. The display will then briefly flash all dashed lines (--- - - -), indicating that it has been re-zeroed. If you attempt to zero the gauge while more than 200 PSI is applied (or the pressure limit set with ConfigXP), the command will be ignored, and “- -HI-” will be displayed.

WARNING: This gauge can display zero pressure when connected to a source of pressure! Do not rely on the display indication before disconnecting - it may not be indicating true pressure. Never disconnect pressure instrumentation without first relieving system pressure!

You can clear the zero value: Turn off peak indication then press and hold the zero button until the display changes from (--- - - -) to (--- - -). This is especially useful for absolute gauges that have been zeroed while measuring barometric pressure.

CONFIGXP PROGRAMMABLE You can change the point at which the Zero button will display “- -HI-”. For instance, you could set the maximum zero to 3000 PSI, if you need to mix high pressure gases. You can also disable the zero button entirely, by setting the Zero value to a large negative number.

The zero button changes its function when the peak high (H) or the peak low (L) icon is displayed. While a peak icon is displayed the zero button becomes the clear button.
Peak detection and Average

Pressing the Peak button causes the display to cycle through the following:

- **HI** .......... Recorded maximum pressure
- **LO** .......... Minimum recorded pressure
- **HI** **LO** Average pressure*
- <No Icon> . Live pressure display

Peak high and low values are not saved when the gauge shuts off; they will reset to the current reading when the XP2i is turned on or reset.

* From the factory this Average Pressure is disabled. Use ConfigXP to enable.

**CONFIGXP PROGRAMMABLE** In some cases the ability to display a peak value may not be needed, or may even be dangerous. ConfigXP allows you to disable this button.

**XP2i**s can average 1 to 10 readings, recalculated every time pressure is measured (3 times per second). Enable and set the number of readings to be averaged with ConfigXP.

Resetting (clearing) recorded peak values

Peak values can only be cleared when displaying either a high or low recorded pressure. Press the **clear** button for at least ½ second. Dashed lines will then briefly appear across the display and both **HI** and **LO** icons will flash briefly, indicating that both peak values have been cleared. Both peak high and low values will then display the current applied pressure. Pressing the **clear** button while either peak hi or peak lo icon is displayed will not affect the zero value. If you need to rezero the gauge, you must turn off both peak icons by pressing the **peak** button.

Automatic Shutoff

The **XP2i** has a shutoff timer and will turn off automatically after 20 minutes of operation. Pressing any button or sending any command via the RS-232 connection resets the shutoff timer for another 20 minutes of operation.

The shutoff feature can be defeated, if desired, when turning the **XP2i** on. Pressing the **on/off** and **zero** buttons simultaneously will prevent the **XP2i** from automatically turning off. The **XP2i** will briefly display the words “No Auto Off” to indicate that it will not turn off.

This procedure is required each time the **XP2i** is turned on if you want to defeat the auto-shutoff.
Backlighting the Display

Pressing the ✡ (backlight) button instantly lights the display at maximum brightness, but to keep it on you need to hold down the button for 2 seconds. The display will flash briefly, indicating that it will stay on for 1 minute. If you press the ✡ button again, the backlight will go into a lower brightness setting to extend battery life, the display will again flash briefly, and remain on for 2 minutes. Press the ✡ button once more and the light will go out.

If you start the XP2i in the “No Auto Off” mode, you select the brightness level the same way, but the light will never time out and turn off; you will have to either turn off the XP2i or press the backlight ✡ again until the light goes out.

Measuring Vacuum

All versions of the XP2i can be used to measure moderate vacuum, though only ranges of 300 PSI (and 20 bar or 2000 kPa) and lower are actually tested and certified for vacuum operation.

When measuring pressure less than ambient barometric conditions, a minus (-) sign will appear.

Absolute gauges (models with a “B” in front of “XP2I” in the part number) will NOT indicate a negative sign when vacuum is applied, unless the zero button has been pressed while a pressure greater than full vacuum is applied to the gauge. If your absolute gauge does indicate a negative pressure, you can clear the zero value (“unzero”) by pressing the zero button until the display changes from 5 dashes (-----) to dash, space, dash, space, dash (- - -). See “Zero” for details.

CAUTION: XP2is are not recommended for continuous use at high vacuum.

Water Density (Inches of Water)

The following applies only to models where inches of water are available. As shipped from the factory, the XP2i is set to display inches of water corresponding to the density of water at 4°C (39.2°F). You may require a different water density for your application, so the XP2i can be set to use the density of water at 20°C (68°F) or 15.6°C (60°F), instead.

To check and/or change the water density setting from the keypad, turn on the XP2i by pressing the (on/off) button and the units button simultaneously. The display will indicate either “4C” or “60F” or “68F”.

Press the units button until the display cycles to the desired water density, then press the zero button to store the selection (this will not zero the gauge).

Configure > Select and set the desired density of water. If the XP2i is password protected, you will not be able to view or change the water density from the keypad.
Overpressure Conditions

The XP2i will read pressure up to approximately 110% of the rated pressure range. Above 110% percent of the range the display will start flashing and the readings will not be reliable. **The zero function does not affect the point at which the display starts flashing to indicate overpressure,** so depending on the zero value it is possible that the display can start flashing without the maximum pressure being displayed.

For instance, if a 100 PSI XP2i is zeroed when 30 PSI is being applied, it will indicate that the overpressure condition has been reached at 80 PSI (i.e., 110% x 100 PSI – 30 PSI = 80 PSI).

Overpressure can affect accuracy, but the effect is only temporary unless the sensor has been destroyed. See [specifications] for maximum overpressure.

Filter

The XP2i has a removable, stainless steel mesh filter, installed in the bottom of the pressure connection. This filter is designed to keep large particles from becoming entrapped in the sensor cavity.

If the XP2i fails to return to zero, or returns to zero or new applied pressures slowly, the filter may be obstructed. The filter can be removed and cleaned if necessary, by using internal snap ring pliers for 1/2” diameter snap rings. Clean using solvents and/or compressed air, or you can purchase a replacement filter kit, PN: 3105 (kit includes filter assembly and pliers).

Low battery indication

The battery icon (🔋) is the first indication of a low battery. The XP2i will continue to operate accurately while the icon is visible. When the batteries are exhausted, the letters “batt” will appear across the display. After “batt” appears, no pressure measurements will be possible until the batteries are replaced.

Battery replacement

The XP2i uses 3 AA batteries. **Batteries must only be changed in a non-hazardous area!** With a small flat blade screwdriver, unscrew the two rear panel screws to gain access to the battery compartment. After replacing the batteries, the XP2i will start operating immediately (without having to press the button). This indicates that a complete reset has occurred, and is normal.
**WARNING:** The XP2i is Intrinsically Safe only if powered by one of the following battery types: Rayovac Maximum Plus, Energizer® E91, or Duracell MN1500.

---

**Reset**

If for some reason the XP2i needs to be reset, remove any battery for at least one minute, then reinstall the battery. If the reset is successful, the XP2i will start operating without pressing the (on/off) button. Reset will clear the zero, peak values will be reset to the current reading, and the XP2i will be set to the default engineering unit.

---

**Troubleshooting**

The XP2i is a very high performance gauge. Due to the high resolution of this product, you may observe conditions that appear to be defects in the product, but are in fact a result of being able to resolve and measure pressure to a degree not possible with other instruments.

---

**Noisy or unstable reading when used with fluids**

When calibrating or comparing the indicated pressure from an XP2i against a hydraulic dead-weight tester or piston gauge, the reading on the XP2i may appear unstable - the least significant digit jumps up and down several counts.

**Reason:** Gas (usually air) is trapped in the line between the gauge and the deadweight tester. What is actually happening is the mass is oscillating up and down, and the combination of gas and fluid is acting like a spring. At higher pressures (above 2000 PSI, typically) this may eventually diminish, as the gas dissolves into the fluid.

**Solution:** Evacuate all tubing with a vacuum pump, before introducing fluid into the system.
Non-repeatability of pressure measurements

When checking the gauge against a hydraulic deadweight, increasing pressure measurements do not match decreasing pressure measurements.

**Reason:** As in the previous note, gas has dissolved into the hydraulic fluid. When decreasing the pressure, the dissolved gas then leaves the fluid, but at an uneven rate, so small pressure differential (due to fluid head pressure) may exist between the reference deadweight and the gauge being tested.

**Solution:** Evacuate all tubing with a vacuum pump, before introducing fluid into the system.

Slow return to zero and/or non-repeatability of pressure measurements

**Reason:** Filter is obstructed.

**Solution:** Clean filter - see “Filter” section for instructions.

Err 1 displayed

**Reason:** The XP2i checks the integrity of internal calibration coefficients every time it’s turned on. If any coefficients have been corrupted in any way, “Err 1” is displayed.

**Solution:** Contact factory for instructions on how to restore the memory to the original factory settings.

Err 2 displayed

**Reason:** The XP2i has tried to display a number too large for the display (i.e., more than 5 digits). May be due to an electrical malfunction or numerical error.

**Solution:** Contact factory for further instructions.

Display continuously flashes all segments

**Reason:** After a reset, and after replacing batteries, the XP2i checks the integrity of program memory. If for some reason it has been modified or corrupted, it flashes all segments, and prevents normal operation.

**Solution:** Contact factory for instructions on how to restore the memory to the original factory settings.

Digital Interface

The XP2i can be connected to a personal computer via RS-232, using an ordinary DB9 extension cable (male DB9 for the XP2i connection, female DB9 for the PC side). The interface lets you record displayed readings and recorded peaks. The data string always includes the pressure units.
The **XP2i** can be operated remotely, as if you were pressing the buttons. You can use a simple terminal program to send the commands, or, you can incorporate them into your own software program.

A special command, Streaming Data, initiates data transmission of displayed pressure at the rate of approximately 3 times per second.

### I/O Settings

The serial interface settings are:

<table>
<thead>
<tr>
<th>BAUD RATE</th>
<th>PARITY</th>
<th>DATA BITS</th>
<th>STOP BITS</th>
<th>FLOW CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td>9600</td>
<td>NONE</td>
<td>8</td>
<td>1</td>
<td>NONE</td>
</tr>
</tbody>
</table>

### Communication Format

Input is case-sensitive; all instructions should be sent in UPPERCASE. Instructions must be terminated with a single carriage return (CR) character followed by an optional linefeed (LF) character. Note that while the **XP2i** expects either CR or CR/LF as command termination on its input, it always appends a CR/LF pair to its output. For reference, CR is ASCII value 13 decimal, while LF is ASCII character 10 decimal.

You have 30 seconds to complete an instruction. After 30 seconds, the **XP2i** will evaluate whatever it has received and try to match it to its table of commands. Since the command is incomplete, it will fail to match and the **XP2i** will return: **N, Ø**. (Negative acknowledgment with no reception errors, so syntax is wrong.)

### Query Instructions

All queries start with a question mark (?). Any pressure values returned are split across two lines; the first contains a floating-point value, and the second contains the name of the measurement unit. Each line is right-justified in a fixed width 10 character field. (Since each line is terminated with a **CR – LF** pair, this means the total length of the response to a measurement query is 24 bytes.) A decimal point will always be included with the pressure value (for clarity) even if it is not displayed on the **XP2i**. For example, a pressure query of a 300 PSI **XP2i** on the mbar scale could return a reading like this:

```
  2478.
  mbar
```

If low batteries cause the low battery message to be displayed, then any pressure query will replace the pressure value with the letters “**BATT**”.

### Message Store

`?MSG` Retrieve the data (usually tag# or ID) from the message store.
Model

?MOD Return the model name, up to 20 characters long. For example, a 100 PSI XP2i would return the following:

100PSIXP2I

Pressure

?P,U Pressure returns the pressure value, followed by the pressure unit on the second line.

Example:

-7.89
mmH2O

Pressure (one line)

?PRE Returns data and units on one line, and separates the reading and units with a comma.

Example:

2.01,PSI

Pressure, High

?P,H Pressure, High returns the stored peak pressure value, in whatever pressure units are currently being displayed.

91.3
mmH2O

Pressure, Low

?P,L Pressure, Low returns the peak low, or “valley” measurement, in the pressure units currently being displayed.

-10.7
mmH2O

Range

?RNG Range, returns the pressure range of the gauge. It is returned in two, 10 character lines. The first line is the value, the second line is the pressure unit. For example, a 100 PSI XP2i would return.

100.00
PSI

Return Average Pressure

?P,A Using the same format as the “?P,U” command, the average pressure is returned. If averaging is disabled, “X,0” is returned. Enable averaging through Config XP.
Return the Average Window Size

?AVS The average sample size is returned. If averaging is disabled, “X,0” is returned. Enable averaging through Config XP.

Serial Number

?SN# The serial number is returned in two strings. A typical example is shown below:

```
3
12659
```

Version

?VER Version returns the XP2i’s firmware version as a 4 digit number preceded by the letter “R”.

   This number is for factory use only.
   Example version number:

```
R0101
```

Water Density

?H2O Applies only to models that include inches of water. Water density returns the current density of water in terms of temperature with one of three values possible:

```
_4C
60F
68F
```

Zero Check

?Z,U Zero Check reveals how much was subtracted from the reading to zero the gauge in the pressure units currently being displayed. When batteries are installed or the XP2i is reset, the zero is cleared and equals zero.

```
32.7
kPa
```

Commands

The following are commands. All commands start with an exclamation mark (!).

Clear Peaks

!CLR Clear high and peak low values by setting them to the current live reading (which might not be zero). For instance, if the current live reading were 253 PSI, then both high and low peak registers would contain 253.
**Disable/Enable Peak Display**

Prevent peak pressure readings from being displayed.

**INPK** Prevents peaks from being displayed.

**IPKS** Enables peak button operation (default).

**Message Store**

**!MSGx** Up to 12 characters (usually tag# or ID) can be stored in EEPROM. Set the message with “!MSGx” where “x” is the message.

**Next Pressure Unit**

**!I,P** This command is acknowledged with a simple “A, Ø”. To check which units were selected, send the command “?P, U” to return the pressure value and the current pressure units.

**No Auto Off**

**!NAO** Prevents automatic shutdown. Every time an **XP2i** is turned on, it defaults to a shutdown schedule of 20 minutes after the last button push or the last RS-232 command. This command will return:

```
NO AUTO OFF
```

To re-enable automatic shutdown, send the reset (“!RST”) command. (Read the Reset section first to be sure you understand all effects of performing a reset.)

**Reset**

**!RST** This command schedules a reset. There will be a three second pause before the **XP2i** resets; during this time, no commands or queries should be sent to the unit. When the unit resets, a product identification string, called the Boot Signature, is sent. (See the Programming Tips section for more information.) Some communications noise, including a serial framing error, is possible on reset. Resetting the **XP2i** clears the zero value, clears the peak high and peak low values, enables automatic shutdown after 20 minutes of inactivity (resetting that timer to 20 minutes on reset), and selects the first pressure unit on the **XP2i** (which can vary with product type, but will be consistent for each reset operation). After a reset, you should query and/or select appropriate measurement units using the “?P, U” and “!I, P” commands. If the reset command fails to operate properly, or appears to “lock up” the device, contact technical support.
Set the Average Window Size \textbf{(ConfigXP Programmable)}

\textbf{!AVS x} Sets the number of pressure reading to be averaged. The valid range is from 1 through 10, i.e. \texttt{!AVS 5<CR>} or \texttt{!AVS 10<CR>}. If an invalid size is entered, or averaging is disabled, \texttt{“X, 0”} is returned. Averaging is enabled with ConfigXP, only.

Streaming Data On/Off

\textbf{!SP1} Displayed pressure is sent out of the serial port after each new reading at a rate of approximately 3 readings per second, and returns data in the same format as the \texttt{?PRE} query.

\textbf{!SP0} Cancels streaming data output.

Water Density \textbf{(ConfigXP Programmable)}

\textbf{!_4C} Set the density of water to 4°C (39.2°F)

\textbf{!60F} Set the density of water to 15.6°C (60°F)

\textbf{!68F} Set the density of water to 20°C (68°F)

Zero

\textbf{!ZER} Zeroes the pressure readings by setting a zero value equal to the current applied pressure. The zero cannot be cancelled, but it can be reloaded by calling this command again. To check the zero value, send the Zero Check command ("?Z , U"). If you want to disable the zero after enabling it, send the reset ("!RST") command. (Read the Reset section first to be sure you understand all effects of performing a reset.)

Acknowledgment of a Command

The \textbf{XP2i} always returns some indication to let you know a command or query was received and acted on. For queries, the return of the measurement data is the acknowledgment. For commands, possible acknowledgments are \texttt{“A”}, \texttt{“N”} or \texttt{“X”}, followed by a comma then a single digit. The digit indicates whether there were any reception errors. The combination is left justified.

\textbf{A} The \textbf{XP2i} understood the command and acted on it.

\textbf{N} The \textbf{XP2i} did not understand the command, due to either syntax or reception errors.

\textbf{X} The command was understood, but is not implemented or supported at this time.

Following an \texttt{“A”}, \texttt{“N”} or \texttt{“X”}, the single digits mean the following:

\textbf{Ø} There were no reception errors.

\textbf{2} Buffer overflow.

\textbf{4} Framing error.

\textbf{6} There were both buffer overflow and framing errors.
Example acknowledgment:

**A,Ø**  Understood the command and acted on it. No reception errors.

**N,4**  Could not understand the command because there was a framing error.

**N,Ø**  Could not understand the command, even though it was received without errors, so syntax must have been wrong.

---

**Troubleshooting the Digital Interface**

The following section gives possible reasons for various error codes.

**N,Ø**  The “Ø” indicates there were no overrun or framing errors, so the command was properly received. However, the “N” means the **XP2i** could not match it to any allowed command. This means the syntax must have been wrong. The command is rejected and nothing is done.

**Possible reasons:**
Instruction sent without a comma between “P” and “U” of the “?P, U” query.
More than 30 seconds passed to finish a command.
Line termination is incorrect; send carriage returns (CR) only, do not send line feeds (LF).

**N,2**  **XP2i** buffer overflow, no action. In an overrun, bytes are lost, consequently the **XP2i** will not be able to match the command string. If it can’t find a match, it returns “N”.

**Possible reasons:**
Not enough time allowed between commands. Check the communication parameters.

**N,4**  Framing error: Bytes were lost. Therefore, the command could not be matched. A framing error can sometimes occur after power-on, after reset, or when the batteries are changed; see the Programming Tips section for suggestions on handling this.

**Possible reasons:**
Noise on the line either created a false start bit or obscured the stop bit.
Multiple, but infrequent, framing errors are probably due to noise on the connection.
Frequent framing errors likely mean the **XP2i** or the PC is not operating at precisely 9600 Baud.
Occasionally, plugging the RS-232 connection into the **XP2i** will create a single framing error.

**N,6**  Both buffer overrun (N, 2) and framing errors (N, 2) occurred during this command. The “6” represents the binary OR masking of the two bits used to indicate a buffer overrun (bit 1) and a framing error (bit 2).

**Possible reasons:**
Look at “Possible reasons” for troubleshooting the N, 2 and N, 4 error codes, above.
ERR 1 After sending a command or query, the XP2i returns (and displays) “ERR 1”.

**Reason:**
The XP2i has detected a CRC EEPROM error.

ERR 2 The XP2i returns (and displays) “ERR 2”.

**Possible reasons:**
The XP2i has tried to display a number too large for the display (i.e., more than 5 digits), or an electrical malfunction or numerical error has occurred.

### Effects of Password Protection on Commands

If the XP2i is password protected, the following commands will have no effect and return “X,0”:

!_4C, !60F, !68F, !NPK, !PKS, !MSG, !RAS, and !AVS.

### Programming Tips

The XP2i is a very straightforward device to communicate with, provided you follow these tips. This advice is derived from our own experiences automating systems based on the XP2i, as well as the experiences of our users; following these tips will help save you some time.

Anytime you establish (or re-establish) communications with the unit, you should use the following initialization sequence, which will help you deal with possible noise due to reset, etc.:

1. Reset the unit (unless you must preserve zero, peak values, etc.) by sending the “! RST” command.
2. Wait 15 seconds.
3. Read the Bootloader Signature, even if you ignore it, to clear it from the PC’s input buffer; see below for more details.
4. Send a carriage return to clear any noise in the XP2i’s input buffer.
5. An error code, either “N, Ø” or “N, 4” will be returned; this is normal (you have sent an empty command); read it to clear it. The buffers are now reset.
6. Use the “? P, U” and “! I, P” commands to select the pressure unit you want to use.
7. IF APPROPRIATE, zero the XP2i by sending the “! ZER” command, since the zero value will be clear.
8. IF APPROPRIATE, clear the high and low peak values to the current pressure (zero, if you followed step 6) by sending the “! CLR” command.
If you are logging data, you should log the serial number of the unit for traceability purposes by using the “?SN#” command. You should also log the product code, hardware revision and firmware version with the “?VER” command.

Disable automatic shutdown with the “!NAO” command.

A quick note about the Bootloader Signature: This string contains a 19 character, product-specific string (whose contents may vary with product revision), followed by a carriage return (CR), making the total string length 20 bytes. However, a reset turns the RS-232 interface on and off, so it may be subject to noise; a NULL may be received before the signature is sent, and the first character or so of the Bootloader Signature may be corrupted. A framing error is also possible. The procedure above will deal with this situation properly. Should you want to parse the bootloader signature, it has the following format: “=xxxxxxxxxxxxxxxxxx=” where x will vary with product revision. The bootloader signature is used by the firmware upgrade tool, but should NOT be used to identify the firmware version; use the “?VER” command for that purpose. If you have a system that may have Crystal DTG or XP2i units attached, you can use this signature to determine which device is in use.

**NOTE:** Any time you detect the Bootloader Signature, the unit has been reset, or disconnected from and reconnected to power; turning the unit on and off with the button will not send the Bootloader Signature. You can use this behavior to detect a battery change, or a problem with the XP2i.

Some commands may take up to 500 milliseconds to return a reply. You should always wait at least 50 milliseconds after each reply is received before sending the next command. After a reset command it may take up to 15 seconds before the gauge resumes normal operation.

Data transmitted from the XP2i will always be 7-bit ASCII. Any high-ASCII characters indicate a line-noise problem, or a problem with the XP2i.

The XP2i has very thorough integrity checks to catch corruption of program or calibration data memory. Should the data memory integrity check fail, the unit displays “ERR 1” on the display as the value line of the serial output. It is important to check for this, or you may mis-parse that line as “1 PSI”, depending on your program. Should the program memory integrity check fail, the unit will continuously reset, blinking the LCD on and off, and the serial output will alternate between the bootloader signature and a line reading “CRC FAIL”. This condition can be recovered from in the field by reloading the unit’s firmware; contact technical support for details.

**Calibration**

If adjustment is required, we recommend returning the unit to the factory. Factory service offers benefits you won’t find anywhere else. We have the facilities to test your gauge at a variety of temperatures utilizing NIST traceable standards, resulting in calibration certificates that provide performance data over temperature. Furthermore, upgrades may be available to add or enhance
operating features. We designed the product to last, and we support it so that you can get the most from your investment.

Under normal operating conditions, we recommend the XP2i be calibrated on an annual basis. Your quality system may require more or less frequent calibration, or your experience with the gauge or operating environment may require longer or shorter intervals.

Although we prefer that you return the XP2i to Crystal Engineering for calibration, ordinary recertification and/or adjustments may be performed by any qualified personnel with appropriate training and equipment. The following instructions are ONLY intended for such qualified personnel with appropriate test equipment. We recommend that the calibration standards used have a minimum rated accuracy of 0.025% of reading, or equivalent in terms of percent of full scale. This level of accuracy requires the use of piston (deadweight) gauges or very high performance pressure controllers, such as those manufactured by DH Instruments (www.dhinstruments.com).

There are no internal potentiometers. The XP2i contains a “span” factor, set to approximately 1 (as shipped from the factory). As components age this may need to be changed to a value slightly higher or lower, to slightly increase or decrease all readings. This adjustment can be made with or without a computer (see: ConfigXP Configuration Software).

“Zero” the XP2i, then record displayed pressure for two or more pressure points. Determine if the XP2i would benefit from an overall increase or decrease of the indicated pressures.

To change the span factor from the keypad, turn off the XP2i, then press the (on/off), units and peak buttons simultaneously. The firmware version will be briefly displayed, followed by the word “cal”, followed by the actual span factor value. The span factor may be adjusted by pressing either the units or peak button to increase or decrease the value, respectively. The value changes in 0.0001 increments. Press the zero button to store the new value in memory, or the (on/off) button to cancel the change.

For absolute XP2is, it is possible to correct for long term drift using a second calibration factor, zero value offset. When correcting for long term drift it is very important to allow thermal equilibrium of the gauge. Any momentary heating or cooling of the unit will show up in unstable or drifting readings on the display. ConfigXP and a barometric reference with accuracy of 0.1 PSI or better is required to perform the calibration. To calibrate the zero offset, clear the zero as described earlier in this manual by pressing and holding the zero button until “- - -” appears. Once cleared, subtract the displayed pressure from barometric pressure, add this difference to any existing zero value offset in ConfigXP, and update the gauge (new value = barometric – displayed + existing). For example, if the displayed value is 14.5 PSI, barometric pressure is 14.7 PSI, and the existing zero value offset in ConfigXP is 0.1 PSI, the new zero value offset would be 0.3 PSI (14.7 - 14.5 + 0.1 = 0.3).

ConfigXP PROGRAMMABLE The span factor and zero value offset can be viewed and set directly by ConfigXP. Span factor adjustment through the keypad can be disabled by ConfigXP through the disable span factor feature or by password protecting the XP2i.
**XP2i Model & Serial Numbers**

The model number and serial number of your XP2i are located behind the battery cover under a battery, as well as on the stem of the pressure fitting.

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**Serial Numbering System**

Serial Numbers consist of 6 numbers, with the left most digit representing the year of manufacture. For example: 430117 was manufactured during 2004.

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**Model Numbering System**

(prefix)(type)XP2i(options)

Prefix:  Pressure range and units - [see table on page 22](#)

Type:  (none) . . .standard gauge

   B . . . . . .(Barometric) Absolute pressure indication

   **Note:** Absolute version available only on XP2is with ranges of 2000 PSI and higher.

Options:  (none) . . .standard

   -RP. . . . . .Rear Pressure Connection

   -F4. . . . . .Panel Mount Flange for 4½” gauge cutout

   -O . . . . . .Cleaned for Oxygen Service

All Panel mounted gauges (-F4) include the rear port pressure connection. Any version may be ordered with the (-O) option (Cleaned for Oxygen Service). Shown below are the -RP and -F4 options.
Specifications

Accuracy specifications are for one year and include all effects of linearity, hysteresis, repeatability and temperature within the specified operating temperature range.

Gauges must be exercised whenever exposed to significant changes in environmental conditions to achieve these specifications, and (if not an absolute model), rezeroed. To exercise a gauge, cycle the gauge between zero (ambient barometric pressure) and the pressure of interest. A properly exercised gauge will return to a perfect zero reading (or return to the same ambient barometric reading). **Absolute versions of XP2i’s have a “B” in front of “XP2I” in the part number.**

Exposure to environmental extremes of temperature, shock and/or vibration may warrant a more frequent recertification period.

**Accuracy**

20 to 100% of Full Scale: ±0.1% of reading
0 to 20% of Full Scale: ±0.02% of Full Scale

*Vacuum*, **300 PSI and lower pressure gauges:**
0 to -14.5 PSIG: ±0.25% of Full Scale,
where F.S. = -14.5 PSI

*Not specified for 500 PSI models and higher*, although all models can be safely connected to vacuum.

**Temperature**

Operating & Compensated Range: -10°C to 50°C (14°F to 122°F)
Storage Range: -40°C to +75°C (-40°F to +167°F)

**Humidity**

<table>
<thead>
<tr>
<th>Temperature Range</th>
<th>Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10 to 10°C</td>
<td>Uncontrolled</td>
</tr>
<tr>
<td>10 to 30°C</td>
<td>0 to 95% Relative</td>
</tr>
<tr>
<td>30 to 40°C</td>
<td>0 to 75% Relative</td>
</tr>
<tr>
<td>40 to 50°C</td>
<td>0 to 45% Relative</td>
</tr>
</tbody>
</table>

**Media Compatibility**

Liquids and gases compatible with 316 Stainless Steel.
Pressure Conversions

1 PSI = 27.6806 inches of water column (water at 4°C [39.2°F])
   27.7070 inches of water column (water at 15.6°C [60°F])
   27.7292 inches of water column (water at 20°C [68°F])
   2.03602 inches of mercury (mercury at 0°C [32°F])
   6.8948 kilopascals
   51.7149 millimeters of mercury (mercury at 0°C [32°F])
   703.087 millimeters of water column (water at 4°C [39.2°F])
   0.068948 bar
   68.948 millibar
   0.070307 kilograms per square centimeter

Connection

Pressure Fitting: ¼” male NPT with integral stainless steel mesh filter.

Power

Batteries: 3 x AA, alkaline recommended

Approved batteries - The XP2i is Intrinsically Safe only if powered by one of the following battery types:

   - Rayovac® Maximum Plus™
   - Energizer® E91*
   - Energizer® EN91*
   - Duracell® MN1500.

* Energizer is manufactured by Energizer Holdings, Inc., and the Eveready Battery Company, Inc.

Many other battery types and models have been tested but failed to meet the requirements for Intrinsic Safety - do not assume other models are equivalent. The XP2i can be operated from an external power supply (AC adapter kit PN: 2984) except in hazardous locations.

Battery Life: 1500 hours continuous operation

Low Battery Indicator: Battery Icon ()

Dead Battery Indication: “batt”
Enclosure

Stainless steel, designed to meet NEMA4 and IP66.

Weight: 500g (17.6 oz.), including batteries.
Pressure Ranges, Display Scales & Resolution

<table>
<thead>
<tr>
<th>Pressure Range</th>
<th>Display Scales &amp; Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01 PSI</td>
<td>0.01, 0.1 kg/cm², 0.1 mm Hg</td>
</tr>
<tr>
<td>1</td>
<td>1.0, 10 mm Hg, 100 kPa</td>
</tr>
<tr>
<td>10</td>
<td>10, 100 bar, 1000 kPa</td>
</tr>
<tr>
<td>100</td>
<td>100, 1000 bar, 10000 kPa</td>
</tr>
<tr>
<td>300</td>
<td>300, 3000 bar, 30000 kPa</td>
</tr>
<tr>
<td>500</td>
<td>500, 5000 bar, 50000 kPa</td>
</tr>
<tr>
<td>1000</td>
<td>1000, 10000 bar, 100000 kPa</td>
</tr>
<tr>
<td>2000</td>
<td>2000, 20000 bar, 200000 kPa</td>
</tr>
<tr>
<td>3000</td>
<td>3000, 30000 bar, 300000 kPa</td>
</tr>
<tr>
<td>5000</td>
<td>5000, 50000 bar, 500000 kPa</td>
</tr>
<tr>
<td>10000</td>
<td>10000, 100000 bar, 1000000 kPa</td>
</tr>
</tbody>
</table>

1. Pressure units not desired may be disabled via RS-232, using optional ConfigXP configuration software.
2. XP2i will indicate pressure up to 10% above this number. Above 10% of this rating the XP2i display will flash, indicating that the applied pressure exceeds the calibrated pressure range, and that the displayed pressure may not be accurate.
3. Overpressure is the maximum pressure the gauge can withstand without damage. The gauge will not indicate pressure up to this value.
4. Overpressure exceeds the calibrated pressure range, and that the displayed pressure may not be accurate.
5. An Absolute version is available only on XP2i with ranges of 2000 PSI and higher.
Intrinsic Safety

**XP2i** Digital Test Gauges have been certified Intrinsically safe by the following agencies per the listed standards:

**CSA**

Intrinsically Safe and Non-incendive for Hazardous Locations: Class I, Division 1, Groups A, B, C and D, Temperature Code T4. Maximum working pressure 10,000 PSI.

**WARNINGS**

Do not use the RS-232 connector in a hazardous atmosphere.
Replace batteries in non-hazardous locations and with approved types, only.

**Certifications**

The **XP2i** has been tested and certified to comply with a variety of international standards.

**C-tick**

This **XP2i** complies with the Australian requirements for the C-tick mark. The instrument was tested against AS/NZS 3584, C-tick EMC/EMI requirements.

**Software**

**LabVIEW™ drivers**

Control and communicate with **XP2is** using National Instrument's LabVIEW. Integrate **XP2is** into your test environment!

**ConfigXP Configuration Software**

**ConfigXP** Disable unwanted pressure units, set default pressure units, change water density, adjust calibration, and more via the RS-232 interface.

**Replacement Parts**

The only user-replaceable parts are the batteries and the stainless steel mesh filter (XP2i Pressure Filter Kit with Retaining Clip, P/N: 3105).
## Accessories

### AC adapter kit

**P/N 2984:** Permits operation of an **XP2i** from an AC supply of 90 - 264 VAC and 47 - 63 Hz. Includes interchangeable international plugs (for USA, Europe, U.K., and Australia). Adapter will not charge batteries, but in the event of AC power loss, **XP2is** will automatically revert to battery operation.

### Connection Adapter

**P/N 3313:** USB B receptacle to RS232 DB9M

### Carrying Cases

**P/N 2888:** Weatherproof Hard Carry Case with die-cut foam interior.

**P/N 3009:** Plastic Carry Case with egg-shell foam interior.

### Flange Adapter Kits

**P/N 2955:** Adapts the 4½” Panel Mount (F4 option) to fit into a 6” gauge cutout.

**P/N 2956:** Adapts the 4½” Panel Mount (F4 option) to fit into an 8½” gauge cutout.

### Protective Boot

**P/N 3193:** Skydrol® compatible, elastomeric boot for increased shock resistance.

### RS-232 Cable

**P/N 2400:** DB-9 male to DB-9 female straight pass-through cable.

## Trademarks

This manual contains the following third-party trademarks, both registered and unregistered. All marks are the property of their respective companies.

Rayovac® and Maximum Plus™ . . . . Rayovac Corporation

Duracell® . . . . . . . . . . . . . . . . . . . . . . Duracell Inc. Corporation

Energizer® and Eveready . . . . . . . . Eveready Battery Company, Inc.

LabVIEW™ . . . . . . . . . . . . . . . . . . . . National Instruments

“Pressure is Our Business™” is a registered trademark of Crystal Engineering Corp.
I/We

Crystal Engineering Corporation

of

708 Fiero Lane, Suite 9
San Luis Obispo, CA, 93401
USA

declare that

Digital Pressure Gauge
XP2I Series and XP2I-DD Series
(Battery or DC Power Supply Accessory)

In accordance with the following directives

89/336/EEC The Electromagnetic Compatibility Directive
and its amending directives

has been designed and manufactured to the following specifications

<table>
<thead>
<tr>
<th>Standard</th>
<th>Specification</th>
<th>Class</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 61326-1:2002</td>
<td>Conducted Emissions</td>
<td>Class A</td>
<td>Pass</td>
</tr>
<tr>
<td>EN 61326-1:2002</td>
<td>Radiated Emissions</td>
<td>Class A</td>
<td>Pass</td>
</tr>
<tr>
<td>EN 61000-3-2:1995</td>
<td>Current Harmonic Emissions</td>
<td>Class A</td>
<td>Pass</td>
</tr>
<tr>
<td>EN 61000-3-3:1995</td>
<td>Voltage Variations &amp; Flicker</td>
<td>N/A</td>
<td>Pass</td>
</tr>
<tr>
<td>EN 61000-4-2:2002</td>
<td>Electrostatic Discharge</td>
<td></td>
<td>Exceptions (1)</td>
</tr>
<tr>
<td>EN 61000-4-3:2002</td>
<td>Radiated EM Field</td>
<td></td>
<td>Pass (2)</td>
</tr>
<tr>
<td>EN 61000-4-4:2002</td>
<td>Electrical Fast Transient/Burst</td>
<td></td>
<td>Pass</td>
</tr>
<tr>
<td>EN 61000-4-5:2002</td>
<td>Surge Immunity</td>
<td></td>
<td>Pass</td>
</tr>
<tr>
<td>EN 61000-4-6:1994</td>
<td>RF Conducted Disturbances</td>
<td></td>
<td>Pass</td>
</tr>
<tr>
<td>EN 61000-4-8:1994</td>
<td>Power Magnetic Field</td>
<td></td>
<td>Pass</td>
</tr>
<tr>
<td>EN 61000-4-11:1994</td>
<td>Voltage Dips and Interruptions</td>
<td></td>
<td>Pass</td>
</tr>
</tbody>
</table>

(1) Battery Operation: meets all performance criteria. DC Power Supply Operation: meets all performance criteria for vertical and horizontal coupling plane; air and contact modes meet criteria B when referenced to ground, criteria C when no ground reference present. This was eliminated with the use of L-Com Capacitive Filter (EMC) Adaptor, DB9 male/female, part number DGFC9MF installed on RS232 port.

(2) Battery Operation: meets all performance criteria. DC Power Supply Operation: momentary minor incorrect data observed but self recovered. Magnitude of incorrect data was 0.25psi on 300psi digital pressure gauge. Improved performance observed with the use of L-Com Capacitive Filter (EMC) Adaptor, DB9 male/female, part number DGFC9MF installed on RS232 port.

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all essential requirements of the Directives

David K. Porter, P.E.
(NAME OF AUTHORIZED PERSON)

Director of Engineering
(TITLE OF AUTHORIZED PERSON)

(SIGNATURE OF THE AUTHORIZED PERSON)  18 July 2005  (DATE OF ISSUE)
Warranty

Crystal Engineering Corporation warrants the **XP2i** Digital Test Gauge to be free from defects in material and workmanship under normal use and service for one (1) year from date of purchase to the original purchaser. It does not apply to batteries or when the product has been misused, altered or damaged by accident or abnormal conditions of operation.

Crystal Engineering will, at our option, repair or replace the defective device free of charge and the device will be returned, transportation prepaid. However, if we determine the failure was caused by misuse, alteration, accident or abnormal condition of operation, you will be billed for the repair.

CRYSTAL ENGINEERING CORPORATION MAKES NO WARRANTY OTHER THAN THE LIMITED WARRANTY STATED ABOVE. ALL WARRANTIES, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, ARE LIMITED TO A PERIOD OF ONE (1) YEAR FROM THE DATE OF PURCHASE. CRYSTAL ENGINEERING SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT OR OTHERWISE.

Note (USA only): Some states do not allow limitations of implied warranties or the exclusion of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may have other rights which vary from state to state.

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How to Contact Us:

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**Fax**  (805) 595-5466

**Email** service@crystalengineering.net

**Web**  [www.crystalengineering.net](http://www.crystalengineering.net)

If calling, have ready the model number, serial number, date of purchase and reason for return. You will receive instructions for returning the device to Crystal Engineering.

Send your comments to: feedback@crystalengineering.net