

DIGITAL TEST GAUGE



OPERATION MANUAL

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Introduction

Thank you for choosing the **XP2** Digital Test Gauge from Crystal Engineering Corporation. Your **XP2** is a combination of leading edge technology and rugged industrial design.

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 **XP2** for up to 1500 hours of continuous use. If you are mounting the gauge in a permanent location you might consider ordering the optional 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 particles contaminants)
- all welded 316 stainless steel sensor
- can be cleaned for oxygen service

Accuracy is 0.1 percent **of reading** - so any **XP2** can typically replace several of the range rated gauges you may have been using. And the **XP2** is **fully temperature compensated** - so there is **no change in accuracy throughout the entire operating temperature range!**

*We hope your **XP2** 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 **XP2**, 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![™]

Operating Instructions



The **XP2** is shipped with batteries installed, so it's ready to use. Press the  (on/off) button and the **XP2** will test all LCD segments. Continue pressing the  button for at least one second and the **XP2** will start normal operation. (The one second delay avoids turning on **XP2** by mistake.)

The **XP2** always resumes operation in the mode and the units of the pressure last used, and it **does not automatically rezero when turned on.**

All **XP2**s are intended for gauge pressure measurement. That is, they indicate the difference between applied pressure and ambient barometric pressure. The  button can also be used as a tare function, meaning it can be set to read zero pressure at for any pressure up to the full scale of the gauge, or 200 PSI, whichever is lower.

Connect the **XP2** to your system. Use pipe thread tape or pipe thread sealant on the 1/4" NPT fitting. **Always use a wrench (3/4" or 19mm) for installation and removal of XP2s!** 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 XP2 into a fitting, and don't use the case to remove the XP2 fitting, either.**

To ensure safe and accurate operation, please read the following warnings:

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.

This gauge can display zero pressure with up to 200 PSI applied! 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.**

CAUTION:

Never insert any object (other than the 1/16" NPT metal 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.

Zero/Tare



To make sure that the **XP2** is performing to its rated accuracy, the **XP2** should be exercised and re-zeroed whenever exposed to changes in temperature (see **Specifications**). It's also good practice to check zero as your final reading too, as the **XP2** should return to a perfect zero reading. (If it does not return to zero, check the filter - it may be blocked).

The XP2 can zero (or "tare") any applied pressure up to 200 PSI (or equivalent). This means that even if zero pressure is displayed, the actual gas or fluid pressure connected to the **XP2** may be high enough to be dangerous if you were to disconnect the **XP2** without relieving the pressure first. **Always check that the pressure has been equalized with ambient pressure before disconnecting the XP2!**

To zero or tare the XP2, you must turn off peak indication, then press the zero button for at least 1/2 second before it responds. The delay avoids unintentional changes to the zero/tare setting. The display will briefly flash all dashed lines, indicating that it has been re-zeroed. If you attempt to tare or zero the gauge when more than 200 PSI is being applied, the command will be ignored, and "--HI--" will be displayed.

The zero button changes its function when the peak high (HI) or the peak low (LO) icon is displayed. While a peak icon is displayed the zero button becomes the clear button.

Units button



Pressing this button causes the **XP2** to select the next unit of pressure measurement. There are up to 9 units available. See "**Pressure Ranges, Display Scales & Resolution**" for the list of pressure units available for your model.

Peak detection



The **XP2** continuously records maximum and minimum applied pressure. To see the recorded values, press the **peak** button, and the **HI** icon will appear, along with the recorded peak pressure. Press the **peak** button again and the **LO** icon will appear instead, along with the minimum recorded pressure. Pressing the **peak** button once more and the display resumes normal operation, with only the current applied pressure reading displayed.

Peak high and low values are not preserved when the unit shuts off; they will reset to the current reading when the **XP2** is turned on or reset.

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 or tare value. If you need to rezero the gauge, you must turn off both peak icons by pressing the **peak** button.

Disable Peak display

In some cases it may be critical that the indicated pressure always be the true applied pressure - not a stored peak high or peak low reading. For these cases the peak button can be disabled, eliminating any possible indication of a stored reading. This feature can only be enabled or disabled via the RS-232 interface. Refer to the [Digital Interface](#) section of the manual for general instructions and the “Disable/Enable Peak Display” commands.

Automatic shut-off

The **XP2** 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 **XP2** on. Pressing the **⏻** (on/off) and **zero** buttons simultaneously will prevent the **XP2** from automatically turning off. The **XP2** will briefly display the words “**No Auto Off**” to indicate that it will not turn off.

This procedure is required each time the **XP2** is turned on, if you want to defeat the auto-shutoff.



Measuring Vacuum



All versions of the **XP2** 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. **XP2s** are not recommended for continuous use at high vacuum (pressures less than -14.5 PSI, at sea level). If the pressure applied is less than -14.5 PSI or equivalent, regardless of zero or tare, the gauge will indicate overpressure (see “[Overpressure Conditions](#)”).

Water Density (Inches of Water)

The following applies *only* to models where inches of water are available. As shipped from the factory, the **XP2** 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 **XP2** can be set to use the density of water at 20°C (68°F) or 15.6°C (60°F), instead. Changing the setting can be accomplished via the keypad, or via the RS-232 interface (see: [WinXP2 Configuration Software](#) or refer to the [Digital Interface](#) section for instructions to change the water density via RS-232).

To check and or change the water density setting from the keypad, turn on the **XP2** by pressing the  (on/off) button and the  button simultaneously. The display will indicate either “4C” or “60F” or “68F”.

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

Overpressure Conditions

The **XP2** 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/tare function does not affect the point at which the display starts flashing to indicate overpressure**, so depending on the tare value it is possible that the display can start flashing without the maximum pressure being displayed.

For instance, if a 100 PSI **XP2** 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 **XP2** 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 **XP2** 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 unscrewing it with a $\frac{5}{32}$ " (4 mm) hex key, and using solvents and/or compressed air to clean it out. Or, you can purchase a replacement filter, PN:3002.




Low battery indication

The battery icon () is the first indication of a low battery. The **XP2** 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 **XP2** 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 **XP2** will start operating immediately (without having to press the  button). This indicates that a complete reset has occurred, and is normal.



Reset

If for some reason the **XP2** needs to be reset, remove any battery for at least one minute, then reinstall the battery. If the reset is successful, the **XP2** will start operating without pressing the  (on/off) button. Reset will clear the tare, peak values will be reset to the current reading, and the **XP2** will be set to the default engineering units.

Troubleshooting

The **XP2** 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 **XP2** against a hydraulic deadweight tester or piston gauge, the reading on the **XP2** 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 **XP2** 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 **XP2** 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 **XP2** 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 **XP2** can be connected to a personal computer via RS-232, using an ordinary DB9 extension cable (male DB9 for the **XP2** 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. And the **XP2** 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.

Turn off the **XP2** before connecting the RS-232 cable - if the gauge is on while connecting it may reset, and clear the zero/tare and the recorded peak values.

I/O Settings

The serial interface settings are:

<u>Baud Rate</u>	<u>Parity</u>	<u>Data Bits</u>	<u>Stop Bits</u>	<u>Flow Control</u>
9600	None	8	1	Hardware (CTS/RTS)

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 **XP2** 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 **XP2** 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 **XP2** 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 **XP2**. For example, a pressure query of a 300 PSI **XP2** on the mbar scale could return a reading like this:

```
2478.  
mbar
```

If the batteries are low enough to trip the low battery message, then any pressure query will replace the pressure value with the letters **"BATT"**.

Pressure

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

```
-7.89  
mmH2O
```

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

Water Density

?H2O Applies only to models with 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

Tare Check

?Z,U Tare 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 **XP2** is reset, the tare is cleared, and equals zero.

32.7
kPa

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 engineering unit. For example, a 100 PSI **XP2** would return

100.00
PSI

Model

?MOD Return the model name, up to 20 characters long. For example, a 100 PSI **XP2**, dual display would return the following:

100PSIXP2

Version

?VER Version returns the **XP2**'s firmware version as a 4 digit number preceded by the letter “R”. This number is for factory use, only. This command also causes the version to be displayed on the unit's LCD.

Example Version Number:

R0101

Serial Number

?SN# The serial number is returned in two strings, which are also shown sequentially on the display. A typical example is shown below:

3
12659

Commands

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

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.

Zero

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

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.

Water Density

- !_4C Set the density of water to 4°C (39.2°F)
- !60F Set the density of water to 15.6°C (60°F)
- !68F Set the density of water to 20°C (68°F)

No Auto Off

!NAO Prevents automatic shutdown. Every time an XP2 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

This message will also appear sequentially on the display.

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 **XP2** 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 **XP2** clears the tare (**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 **XP2** (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.

Disable/Enable Peak Display

Prevent peak pressure readings from being displayed.

- !NPK** Prevents peaks from being displayed.
- !PKS** Enables peak button operation (default).

Acknowledgment of a Command

The **XP2** 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 “**A**”, “**N**” or “**X**”, followed by a comma then a single digit. The digit indicates whether there were any reception errors. The combination is left justified.

- A** The **XP2** understood the command and acted on it.
- N** The **XP2** did not understand the command, due to either syntax or reception errors.
- X** The command was understood, but is not implemented at this time.

Following an “**A**”, “**N**” or “**X**”, the single digits mean the following:

- Ø** There were no reception errors.
- 2** Buffer overflow.
- 4** Framing error.
- 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, 0** The “0” indicates there were no overrun or framing errors, so the command was properly received. However, the “N” means the **XP2** 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** **XP2** buffer overflow, no action. In an overrun, bytes are lost, consequently the **XP2** 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. This error should not occur if the communication flow control is set to hardware. Check the communication parameters. If hardware flow control is not available, wait 50 milliseconds between receiving a complete response to a command and sending the next command.

- 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 more likely mean the **XP2** or the PC is not operating at precisely 9600 Baud.

Occasionally, plugging the RS-232 connection into the **XP2** will create a single framing error.

- N, 6** Both buffer overrun (**N, 2**) and framing errors (**N, 4**) 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.

Programming Tips

The **XP2** 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 **XP2**, as well as the experiences of our users; following it will probably 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 tare, 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 **XP2**’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 **XP2** by sending the “**!ZER**” command, since the tare 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.
9. 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.
10. Disable automatic shutdown with the “**!NAO**” command.

A quick note about the Bootloader Signature: This string contains a ten-character, product-specific string (whose contents may vary with product revision), followed by a carriage return and line feed (**CR-LF**), making the total string length 12 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: “=**XP2 BLxy**=” where **x** and **y** 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 **XP2** 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 **XP2**.

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 if you are not using hardware flow control. After a reset command it may take up to 15 seconds before the gauge resumes normal operation.

The **XP2** uses RTS/CTS hardware flow control, but only the CTS line is used; since the **XP2** only produces output when requested to do so, this is unlikely to cause a problem.

Data transmitted from the **XP2** will always be 7-bit ASCII. Any high-ASCII characters indicate a line-noise problem, or a problem with the **XP2** or PC.

The **XP2** 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 **XP2** 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 suggest longer or shorter intervals.

Although we prefer that you return the **XP2** 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.dhstruments.com).

There are no internal potentiometers. The **XP2** contains a “span” factor: “Userspan”, 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: [WinXP2 Configuration Software](#)).

“Zero” the **XP2**, then record displayed pressure for two or more pressure points. Determine if the **XP2** would benefit from an overall increase or decrease of the indicated pressures.

To change the userspan factor from the keypad, turn off the **XP2**, then press the  (on/off),  and  buttons simultaneously. The firmware version will be briefly displayed, followed by the word “cal”, followed by the actual userspan value. The userspan factor may be adjusted by pressing either the  or  button to increase or decrease the value, respectively. The value changes in 0.0001 increments. Press the  button to store the new value in memory, or the  (on/off) button to cancel the change.

Note: Changing the userspan value causes the **XP2** to reset. After the reset, the **XP2** will have to be re-zeroed. Remove any applied pressure and zero the gauge. Then check to see if the adjustment was correct and achieved the desired effect.

XP2 Model & Serial Numbers

The model number and serial number of your **XP2** are located behind the battery cover under a battery.



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.

Model Numbering System

(prefix)**XP2**(options)

Prefix: Pressure range and units - see table on next page

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.

-RP



Rear Pressure Fitting

-F4



Panel Mount Flange

Pressure Ranges, Display Scales & Resolution

PSI			Bar			kPa ⁽⁴⁾			inch	inch	mm	mm	kPa ⁽⁴⁾	Bar ⁽⁴⁾	mBar ⁽⁴⁾		
Part # Prefix	Range PSI ⁽²⁾	max PSI ⁽³⁾	Part # Prefix	Range bar ⁽²⁾	max bar ⁽³⁾	Part # Prefix	Range kPa ⁽²⁾	max kPa ⁽³⁾	PSI	kg/cm ²	Hg	H ₂ O	Hg	H ₂ O	kPa ⁽⁴⁾	Bar ⁽⁴⁾	mBar ⁽⁴⁾
15PSI	15	100	1BAR	1	7	100KPA	100	700	0.001	0.0001	0.001	0.01	0.01	1	0.01	0.0001	0.1
30PSI	30	100	2BAR	2	7	200KPA	200	700	0.001	0.0001	0.001	0.01	0.1	1	0.01	0.0001	0.1
100PSI	100	200	7BAR	7	14	700KPA	700	1400	0.01	0.0001	0.01	0.1	0.1	1	0.01	0.0001	0.1
300PSI	300	600	20BAR	20	42	2KKPA	2000	4200	0.01	0.001	0.01	0.1	1		0.1	0.001	1
500PSI	500	1000	30BAR	30	70	3KKPA	3000	7000	0.01	0.001	0.1	1	1		0.1	0.001	1
1KPSI	1000	2000	70BAR	70	140	7KKPA	7000	14000	0.1	0.001	0.1				0.1	0.001	
2KPSI	2000	4500	140BAR	140	350	14KKPA	14000	35000	0.1	0.01	0.1				1	0.01	
3KPSI	3000	4500	200BAR	200	350	20KKPA	20000	35000	0.1	0.01	0.1	0.1			1	0.01	
5KPSI	5000	7500	300BAR	300	450	30KKPA	30000	45000	0.1	0.01	1				1	0.01	
10KPSI	10000	15000	700BAR	700	1000	70KKPA	70000	100000	1	0.01					1	0.01	

⁽¹⁾ Pressure units not desired may be disabled via RS-232, using optional WinXP2 configuration software.

⁽²⁾ **XP2s** will indicate pressure up to 10% above this number. Above 110% of this rating the **XP2** display will flash, indicating that the applied pressure exceeds the calibrated pressure range, and that the displayed pressure may not be accurate.

⁽³⁾ Max PSI, max Bar and max kPa are the maximum pressures the gauge can withstand without damage. The gauge *will not* indicate pressure up to this number.

⁽⁴⁾ kPa models can display pressure in kPa and Bar (or mBar), only. PSI and bar models have all available units.

Specifications

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

The gauge must be exercised and re-zeroed whenever exposed to significant changes in environmental conditions to achieve these specifications. To exercise the gauge, cycle the gauge between zero and the pressure of interest. A properly exercised gauge will return to a perfect zero reading.

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

Accuracy

20 to 100% of Full Scale: $\pm 0.1\%$ of reading

0 to 20% of Full Scale: $\pm 0.02\%$ of Full Scale

*Vacuum**, for 2000 kPa (300 PSI) and lower pressure gauges:

0 to -14.5 PSIG (0 to -99.9 kPa): $\pm 0.25\%$ of Full Scale,
where F.S. = -14.5 PSI (-99.9 kPa)

***Not specified for 500 PSI/ 30 bar/ 3000 kpa 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: -20°C to $+70^{\circ}\text{C}$ (-4°F to $+158^{\circ}\text{F}$)

Humidity

<u>Temperature Range</u>	<u>Humidity</u>
-10 to 10°C	Uncontrolled
10 to 30°C	0 to 95% Relative
30 to 40°C	0 to 75% Relative
40 to 50°C	0 to 45% Relative

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

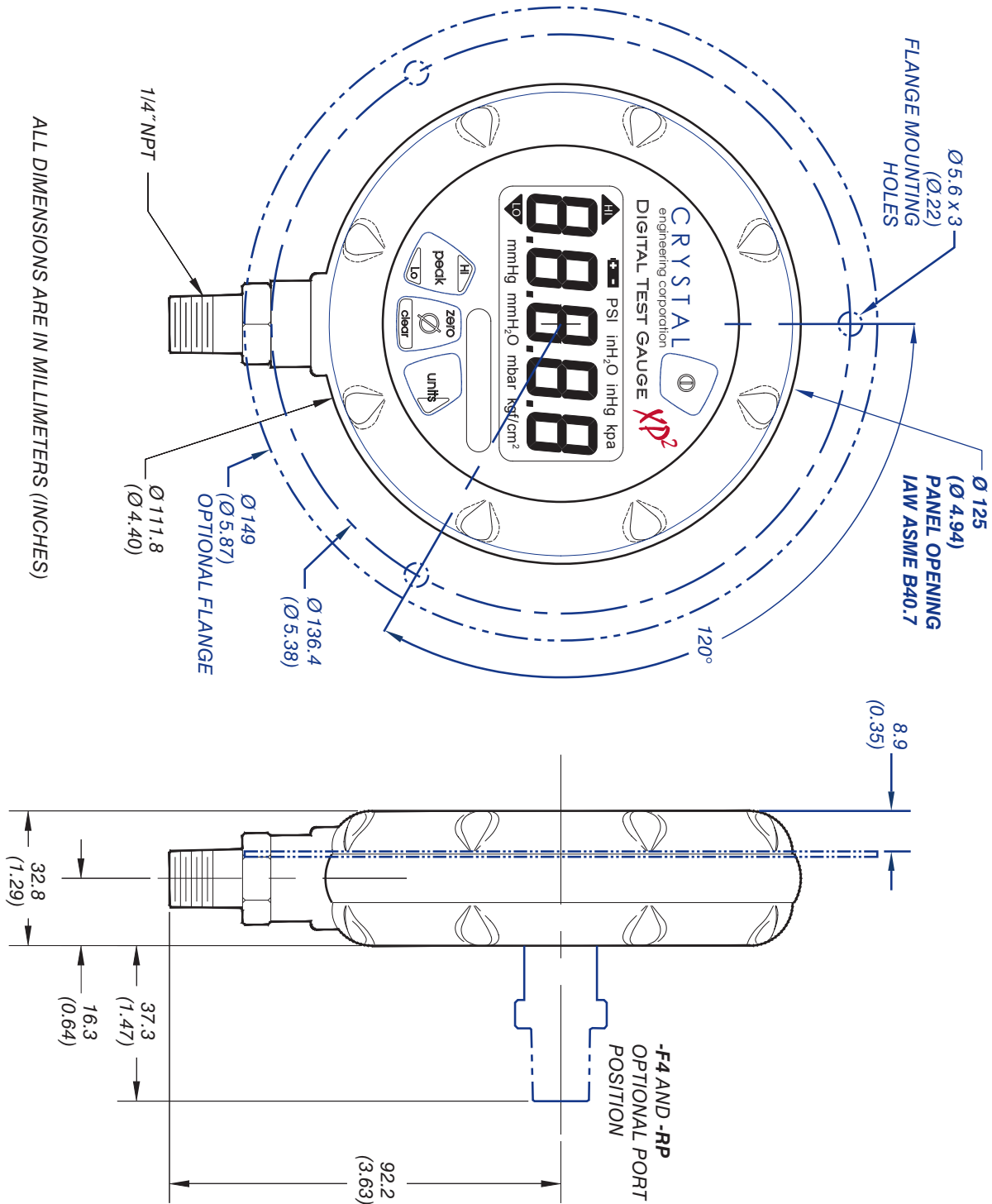
Connection

Pressure Fitting: 1/4" male NPT with integral 1/16" NPT stainless steel filter.

Enclosure

Stainless steel, designed to meet NEMA4 and IP66.

Weight: 500g (17.6 oz.), including batteries.




Power

Batteries: 3 x AA, alkaline recommended

The **XP2** can be operated from an external power supply (AC adapter kit PN: 2984).

Battery Life: 1500 hours continuous operation

Low Battery Indicator: Battery Icon ()

Dead Battery Indication: "batt"

Certifications

The **XP2** has been tested and certified to comply with a variety of international standards.

C-tick



This **XP2** complies with the Australian requirements for the C-tick mark. The instrument was tested against AS/NZS 3584, C-tick EMC/EMI requirements.

EC Declaration of Conformity



I/We

Crystal Engineering Corporation

of

720 Aerovista Place, Suite B
San Luis Obispo, CA, 93401
USA

declare that

**Digital Pressure Gauge
XP2 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

EN 61326-1:2002	Conducted Emissions	Class A	Pass
EN 61326-1:2002	Radiated Emissions	Class A	Pass
EN 61000-3-2:1995	Current Harmonic Emissions	Class A	Pass
EN 61000-3-3:1995	Voltage Variations & Flicker	N/A	Pass
EN 61000-4-2:2002	Electrostatic Discharge		Exceptions (1)
EN 61000-4-3:2002	Radiated EM Field		Pass (2)
EN 61000-4-4:2002	Electrical Fast Transient/Burst		Pass
EN 61000-4-5:2002	Surge Immunity		Pass
EN 61000-4-6:1994	RF Conducted Disturbances		Pass
EN 61000-4-8:1994	Power Magnetic Field		Pass
EN 61000-4-11:1994	Voltage Dips and Interruptions		Pass

(1) System meets requirements for Vertical Coupling Plane and Horizontal Coupling Plane; Air and Contact meets performance criteria B when referenced to ground, criteria C when no ground reference present.

(2) Unit performs as advertised for standard battery configuration. Unit when attached to RS232 cable performs to performance criteria B. Improved performance observed using L-Com Capacitive Filter (EMC) Adaptor, DB9 male/female, part number DGFC9MF.

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)

16 July 2003
(DATE OF ISSUE)

Accessories

AC adapter kit

P/N 2984: Permits operation of an **XP2** 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, **XP2s** will automatically revert to battery operation.

Plastic Carrying Case

P/N 3009, 35.6 cm (14")L x 27.9 cm (11")W x 8.3 cm (3¼")H with egg-shell foam interior.

6" Gauge Adapter Kit

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

8½" Gauge Adapter Kit

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



Software

LabVIEW™ drivers

Control and communicate with **XP2s** using National Instrument's LabVIEW. Integrate **XP2s** into your test environment!

WinXP2 Configuration Software

WinXP2: Disable unwanted pressure units, set default pressure units, change water density, disable Peak button and adjust calibration, via the RS-232 interface.

Replacement Parts

The only user-replaceable parts are the batteries and the 1/16" NPT stainless steel filter (Filter Replacement Kit P/N: 3002).

Trademarks

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

LabVIEW™ National Instruments

"Pressure is Our Business™" is a registered trademark of Crystal Engineering Corp.

Warranty

Crystal Engineering Corporation warrants the **XP2** 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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Web 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

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