

# Accu-Cal Plus Instruction Booklet

*The "Direct Drive Difference" in Digital*

## INTRODUCTION

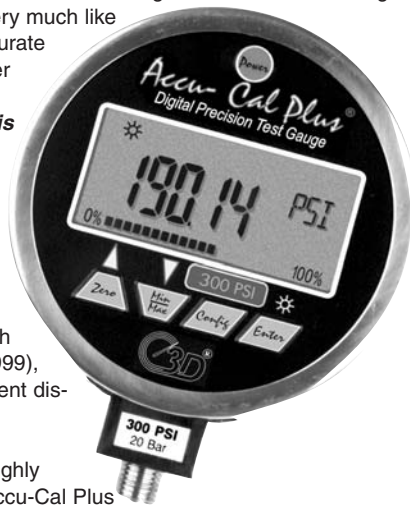
Thank you for choosing the intrinsically safe Accu-Cal Plus Digital Precision Test Gauge from 3D Instruments. The Accu-Cal Plus is very much like the 3D Direct Drive Test Gauge; Rugged, accurate and easy to use. The **Difference** is the greater accuracy possible with a digital display and, through an advanced design, **accuracy that is specified to be 0.05% full scale over the temperature range of 0 °C (32 °F) to 50 °C (122 °F).**

The large LCD was designed to be reliable and easy to read under a variety of environmental conditions. The Accu-Cal Plus display, complete with a 20 segment bar graph for visual reference, is a five digit display (99999), so auto-ranging is not required to have sufficient display resolution for the rated accuracy.

The silicon chip pressure sensors used are highly repeatable over pressure and temperature. Accu-Cal Plus sensors incorporate a permanently filled oil isolated stainless steel diaphragm in an all-welded fitting. The only wetted materials are 316 stainless steel.

Other features include the ability to select from up to 22 different pressure units (depending on pressure range), High and Low pressure reading detection, adjustable auto shutdown with 1500 hour battery life (continuous use) on 3 standard alkaline AA batteries, damping, configurable sample rate and password protection of zero and cal data. The case is polished 300 series stainless steel and is rated NEMA-4 for weather and corrosion resistance.

And finally, the Accu-Cal Plus is manufactured and serviced by the company that makes THE Premier Pressure Gauge on the market today. **Get The Direct Drive Difference in Digital Today!**



## PRODUCT INTRODUCTION

### OVERVIEW

The Accu-Cal Plus Digital Precision Test Gauge combines the high accuracy of digital electronics with the convenience and ease of use of an analog test gauge. Accurate to  $\pm 0.05\%$  FS, the Accu-Cal Plus can be used as a calibration reference, or in any application where high accuracy pressure measurement is required.

Many user configurable functions have been designed into the Accu-Cal Plus including sampling rate, TARE, damping, auto shut off, and Max/Min. Once the gauge is configured, settings can be locked and password protected to prevent unauthorized changes to configuration.

### UNPACKING

Check to see that your Accu-Cal Plus has arrived intact. Batteries are factory installed unless you have purchased the optional 24V powered version, in which case batteries are not supplied or installed. Save the packing materials at least until you have verified that there is no concealed damage.

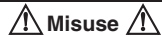
### HAZARD LOCATION INFORMATION



An ex-hazardous area as used in this manual refers to an area made hazardous by the potential presence of flammable or explosive vapors. These areas are also referred to as hazardous locations, see NFPA 70 Article 500 or CSA C22.1 Section 18.

### Certification

This product is certified by CSA with the following rating: Class I, Div. 2, Groups A-D



Should the Accu-Cal Plus be exposed to overpressure or sudden physical shock (i.e. being dropped) it should be examined for any damage that may cause a safety concern. If in doubt please return unit for evaluation to 3D Instruments. Please refer to the Warranty section on page 19 for company contact information.



**To avoid possible damage to the gauge or to equipment under test:**

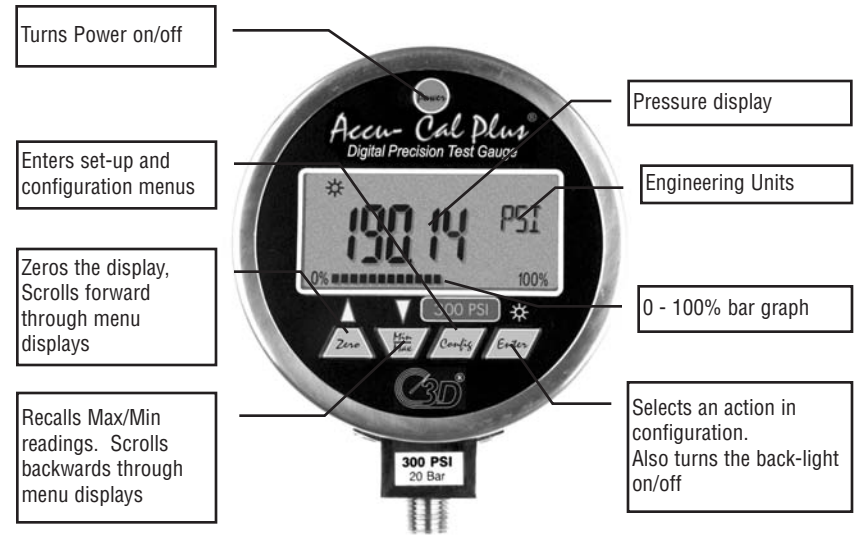
- If the LCD displays "OL", then the pressure range limit has been exceeded and the pressure source must immediately be removed from the Accu-Cal Plus to prevent damage to the pressure transducer.
- Maximum torque allowed is 13,5 Nm = 10 ftlbs. NEVER exceed the allowable torque.

### INSTALLATION

Prior to installing the gage into a process connection, please ensure all pressure is vented from the system. Ensure that you use proper fittings to mate with the gauge. Failure to utilize proper fittings will result in leaks. Never attempt to tighten the unit by turning the gauge housing by hand. **This may result in permanent damage to this gauge.**

## PRODUCT INTRODUCTION

### ACCU-CAL PLUS DISPLAYS AND CONTROLS



## OPERATING INSTRUCTIONS

### UNIT POWER-UP

The standard Accu-Cal Plus is supplied with 3 AA batteries installed. If you purchased the optional 24Volt powered version, batteries are not installed. Connect a 24V power supply to the terminal block on the rear of the gauge noting proper polarity - refer to page 6 for detailed instructions and warnings..

Push and hold down the POWER key for 2 - 3 seconds to turn the unit on. The LCD will briefly display the firmware version, test the bar graph display segments and then cycle to the "normal operation" screen. The gauge is now ready for service. To turn off the gauge, press the POWER key.

**Note:** The gauge will read to 120% of full scale. After that point, the gauge will display: OL (over limit). **The gauge is only calibrated to 100% of full scale.**

### SET-UP AND CONFIGURATION

Push the CONFIG key to access the user-settable functions on the gauge. Each time the CONFIG key is pressed, the display advances to the next function. Once a function has been set, press ENTER to exit the configuration menu, or CONFIG to continue with further configuration. In sequential order, the configuration menu and operation is as follows:

#### 1. Set Engineering Units (Default = PSI)

The unit is shipped configured to display PSI. By pressing the ▲ and ▼ (ZERO and MAX/MIN) keys you can scroll forward and backwards through the available engineering units including a custom unit. When the desired unit is displayed, press ENTER or CONFIG. Pressure will now be displayed in the chosen engineering units. Refer to pages 16 and 17 of this manual for a list of available engineering units. See the Supervisory Mode section for details on setting up custom units.

## OPERATING INSTRUCTIONS

### 2. Set Auto Off (Default = 30 minutes)

The auto shut-off can be set in 1 minute increments from 1 to 30 minutes or "off" (continuous operation). Use the ▲ and ▼ keys to set the desired interval. The "off" setting is at the low end of the choices, below 1 minute. With the auto shut-off off, it will remain on until manually switched off.

### 3. Display Battery Voltage

Displays actual voltage of battery "pack" and a "percent of life" bargraph indicating battery condition.

### 4. Display Actual Temperature

A PN junction based temperature sensor is built into the microprocessor, which is mounted on the PC board. It can accurately read the temperature inside the gauge case. The value can be set to °F or °C using the ▲ and ▼ keys. The factory default value is °C.

### 5. Set Damping (Default = OFF)

Choices are "on" and "off" set with the ▲ and ▼ keys. Turning damping on will smooth readings from pulsating pressure sources. The Damping function averages 10 successive measurements prior to updating the LCD display and MAX/MIN registers.

### 6. Set Sample Rate (Default = 10/sec)

This determines how often pressure is sampled and both the display and MAX/MIN registers are updated. Choices are 0.5, 1, 3, and 10 samples/second with 10/sec being fastest.

### 7. Set TARE

This function allows you to build in a constant offset value, which is then subtracted from the measured pressure. Example: if a TARE is set at 30 PSI and the measured pressure is 37 PSI, the displayed value will be 7 PSI. A pressure of 27 PSI would be displayed as -3 PSI. TARE is settable across the entire span of the gauge.

The TARE value is set manually with the ▲ and ▼ keys, and is based on the engineering units and resolution selected for display. TARE value can be set to the maximum range of the gauge.

**Note:** The bar graph will always display the actual pressure based on the full range of the gauge regardless of the TARE setting. This is done for safety to insure that even with a "0" reading that pressure is being applied to the gauge.

### 8. FUnC Lock

Access to each of the settable parameters above can be turned "off" once set, to prevent unauthorized changes to configuration. This is accomplished through a password protected "supervisory mode". This function is accessed through the Configuration menu - refer to the next section.

## SUPERVISORY MODE

Press the ENTER key when "FUnC LOCK" is displayed, 0 PWRD will be displayed on the gauge display. The password to enter the supervisory mode is 101, set using the ▲ and ▼ keys. Holding a key continuously will cause the display to advance quicker for faster setting. Press the ENTER key to reach the supervisory mode.

**Note:** The password is factory set and cannot be changed.

1. The Accu-Cal Plus is shipped from the factory with all accessible settings "unlocked" or available to be changed.
2. In order, the functions that can be unlocked, locked or accessed are:
  - Zero function (enable/disable)
  - Set pressure units (enable/disable)
  - Auto shutdown adjustment (enable/disable)
  - Damping settings (enable/disable)
  - Sample rate setting (enable/disable)
  - TARE setting (enable/disable)
  - Custom engr. units (set scale factor)

## OPERATING INSTRUCTIONS

3. In supervisory mode each of the parameters can be locked or unlocked individually using the ▲ and ▼ keys. Select LOC (lock) for those parameters you do not want to be accessible, and UnLOC (unlock) for those that can be accessed.

4. Use the CONFIG key to scroll through the above choices, and the ▲ and ▼ keys to lock and unlock features. Press CONFIG to continue scrolling through the parameters, pressing ENTER at any point saves your settings and returns the gauge to normal operation. When a function is "locked, it cannot be accessed or changed from its current state. To change a locked function, enter the supervisory mode, and unlock the function. Once it is changed, you may enter supervisory mode to lock access again.

5. Setting a custom engineering unit or scale: The last menu choice in supervisory mode is SET FACTR. This allows you to set a multiplier factor from 0.001 to 100, creating a custom scale. The set factor will be multiplied by the PSI measured, the result will be displayed. By setting a factor of 25, a 40 PSI pressure would display as 1000 (40 x 25). The engr. unit displayed on the Accu-Cal Plus will be "Cust".

### Backlight Operation

Press the ENTER key to enable the backlight. Press the ENTER key to turn it off.

### Zeroing the Gauge

Press and hold the ZERO key for 1 - 2 seconds until the word HOLD disappears from the LCD.

**Note:** Failure to depress the ZERO key until the word HOLD disappears will result in the gauge not being re-zeroed. **To ensure accurate measurements, the extent of unit zero adjustment is approx. ± 5% of full scale.**

**Note:** The gauge should always be re-zeroed immediately before measurements are taken. The zero will fluctuate until the temperature is stable. This will be more noticeable on low pressure ranges. If the gauge can not be zeroed, contact factory.

### MAX/MIN Function

The Accu-Cal Plus stores minimum and maximum pressure values in memory. Pressing the MAX/MIN key once will display the maximum pressure stored in memory. Pressing the MAX/MIN key again will display the minimum pressure stored in memory. Press the MAX/MIN key again to return to normal (live display) operation. To clear the MAX/MIN memory registers, press and hold the MAX/MIN key for 2 or more seconds until "CLR" is displayed. If a value of "OL" (over limit) appears in the MAX register, this indicates that the gauge experienced pressure above 120% of span.

**Note:** The rate of MAX/MIN register updates is determined by sample rate and values will be lost when the unit is shut off.

### Analog Bar Graph

The 20 segment analog bar graph located at the bottom of the LCD display indicates the applied pressure level expressed as a percentage of the full range of the gauge.

**Note:** If a TARE value has been programmed into the gauge, the numeric value indicated on the LCD display **will not** reflect the true pressure being applied to the gauge.

### Battery Life

Battery life is approximately 1500 hours (60 days) of continuous use with the backlight off and at a sample rate of 3/sec. With intermittent use, batteries could last a year or more. There is a "low battery" icon in the upper left of the display. It will appear when battery level is low at approximately 3.3 volts. The unit will shut itself off when the battery voltage drops to 3.0 volts. Replace batteries per recommendations found in the next section of this manual.

## OPERATING INSTRUCTIONS

### Changing the Batteries



#### Explosion hazard

Batteries must only be changed in an area known to be non-hazardous.

Grasp the face ring on the Accu-Cal Plus, turn it approximately ¼ turn counterclockwise and remove. The face of the gauge can now be lifted to expose the battery holder. Install three AA batteries noting proper polarity. Reassemble the case making certain that the face is properly oriented.

### RS-232 Interface (optional)

A RS-232 interface is provided standard on the Accu-Cal Plus. Serial communication can be used for configuration, calibration, and to transfer measurement data from the gauge. An optional RS-232 communication cable is required for this operation and can be obtained from the factory. For information on the optional RS-232 cable and required software communication protocol, refer to pages 9 -11.



The RS-232 interface must not be used in hazardous areas.

### 24 VDC Power Version (optional)

If you purchased the optional 24 Volt version, the terminals for power input are located on the rear of the gauge. To apply power simply connect a 24 volt source to the rear terminal block taking care to observe proper polarity. Refer to page 18.



Gauges ordered with the external power option will not come with batteries installed. Batteries **MUST NOT** be installed when operating on external power. External power option gauges are not approved for hazardous location use. The use of batteries in connection with a power adapter can cause batteries to leak or explode, thereby damaging the electronics and voiding the warranty.

If you lack a 24 VDC power source, to power the unit, one may be obtained from 3D Instruments - contact factory for details or refer to page 13 for ordering information.

The 24 volt version can be operated on 3 x AA batteries provided the unit is not already being powered by a 24 volt source. If the gauge is currently hooked to a 24 volt source, disconnect it and install the batteries per the instructions outlined in the "Changing the Batteries" section.

### Mounting (optional)

An optional front or rear 300 Series Stainless Steel mounting flange, which is welded to the case, is available for the Accu-Cal Plus. Outline drawings for both flanged versions are provided on page 12.

## ACCU-CAL PLUS CALIBRATION PROCEDURE

### Overview

Verification and calibration of the Accu-Cal Plus (ACP) is not required on newly supplied units, only when the accuracy is suspect. Unit re-calibration requires pressure and/or vacuum standards able to produce and indicate pressures from vacuum to the full-scale range of the unit under test. In order to maintain the specified accuracy of the ACP, calibration standards used to recal the ACP must have 4x better accuracy than the ACP. A vacuum standard will be required for the calibration of the following ranges: high accuracy vacuum, 100, 300, and 500 psi ranges.

Calibration adjustment of the ACP is performed electronically via internal software with the case closed. All calibration commands and adjustments are done via the keypad, using the display to prompt the user through the calibration process.

Nine or ten calibration points are used in the adjustment program, working from full scale to zero at pressures equaling 100%, 87.5%, 75%, 62.5%, 50%, 37.5%, 25%, 12.5%, and 0% of full scale plus a possible vacuum point.

**Note:** This is an ambient temperature calibration and should be performed at an ambient temperature of 23 °C ± 3 °C (72 °F ± 5 °F). Calibration outside this temperature range will invalidate the temperature compensation program.

### Calibration Interval

You should check performance of the gauge at the interval required by your calibration program. We recommend adjustment when measurement deviates by more than 75% of the specified accuracy.

### Connections

The Accu-Cal Plus has a 1/4" NPT male pressure input port. Various adapters may or may not be needed to connect to the pressure standard. Always ensure the hose, tubing, and fittings etc have a rated working pressure at or above the pressure of the unit.

### Entering Calibration Mode

After you have made your connections, turn the power on while holding the CONFIG key. Use the arrow keys to enter the password. The password is: 101. If you have entered the calibration mode correctly, the display should look as shown below. The pressure value displayed will be the full-scale value of the gauge. **Refer to important note on bottom of page 8.**

Screens shown in this manual represent the displays shown with a 500 psi gauge. The Accu-Cal Plus will prompt the technician for the appropriate pressure at each calibration point.

500.00 PSI  
CAL MODE

Use the Pressure Standard to output 500.00 psi (100%). After the output has stabilized, press the ENTER key to continue. As the unit takes readings, the screen will show ----- . When the readings are complete, the screen should look as shown below.

437.50 PSI  
CAL MODE

Use the Pressure Standard to output 437.50 psi (87.5%). After the output has stabilized, press the ENTER key to continue. As the unit takes readings, the screen will show ----- . When the readings are complete, the screen should look as shown below.

375.00 PSI  
CAL MODE

Use the Pressure Standard to output 375.00 psi (75%). After the output has stabilized, press the ENTER key to continue. As the unit takes readings, the screen will show ----- . When the readings are done, the screen should look as shown below.

## ACCU-CAL PLUS CALIBRATION PROCEDURE

312.50 PSI  
CAL MODE

Use the Pressure Standard to output 312.50 psi (62.5%). After the output has stabilized, press the ENTER key to continue. As the unit takes readings, the screen will show -----. When the readings are complete, the screen should look as shown below.

250.00 PSI  
CAL MODE

Use the Pressure Standard to output 250.00 psi (50%). After the output has stabilized, press the ENTER key to continue. As the unit takes readings, the screen will show -----. When the readings are complete, the screen should look as shown below.

187.50 PSI  
CAL MODE

Use the Pressure Standard to output 187.50 psi (37.5%). After the output has stabilized, press the ENTER key to continue. As the unit takes readings, the screen will show -----. When the readings are complete, the screen should look as shown below.

125.00 PSI  
CAL MODE

Use the Pressure Standard to output 125.00 psi (25%). After the output has stabilized, press the ENTER key to continue. As the unit takes readings, the screen will show -----. When the readings are complete, the screen should look as shown below.

62.50 PSI  
CAL MODE

Use the Pressure Standard to output 62.50 psi (12.5%). After the output has stabilized, press the ENTER key to continue. As the unit takes readings, the screen will show -----. When the readings are complete, the screen should look as shown below.

0.00 PSI  
CAL MODE

Use the Pressure Standard to output 0.00 psi. After the output has stabilized, press the ENTER key to continue. As the unit takes readings, the screen will show -----. When the readings are complete, the screen should look as shown below.

-12.00 PSI  
CAL MODE

**Note: Only some of the pressure ranges for the Accu-Cal Plus will require a vacuum point as part of the calibration routine.** If your gauge is not one of those, then this step will be automatically skipped and the calibration routine will be complete. Use the Pressure Standard to output -12.00 psi. After the output has stabilized, press the ENTER key to continue. As the unit takes readings, the screen will show -----. When the procedure is complete, the unit will update the calibration data point. The gauge will then automatically shut off and repower itself into the normal operating mode.

**Note: In the calibration routine, if an entry is misentered there is no way to correct the value - either complete the calibration step and reenter the proper value or turn the gauge off at this point and repeat the entire calibration. If the calibration routine is aborted prior to its completion, none of the newly entered cal points will be saved.**

## ACCU-CAL PLUS RS-232 COMMUNICATION

Enclosed are instructions for establishing communications between the Accu-Cal Plus Digital Test Gauge (Version 1.08/later) and a personal computer (PC) utilizing the Hyper Terminal communications software included in the Windows xP Operating System. A custom cable assembly (3D Instruments Part Number: 2025-0004) is required to complete the link-up.

To set up remote operation of the gauge via the Windows Hyper Terminal program, first connect the gauge, via the special cable, to a COM serial communications port on the PC. The following procedure details how to set up the Hyper Terminal program to allow bi-directional communication between the Accu-Cal Plus and the PC.

1. Start the Hyper Terminal program ... click on: All Programs/Accessories/Communications/Hyper Terminal.
2. In the "CONNECTION DESCRIPTION" box, enter a name for your communication routine (i.e.: Accu-Cal Plus) and then click: OK
3. In the "CONNECT TO" box, under "Connect Using", choose the appropriate serial port on the PC to which the gauge is connected (i.e.: com1) and then click: OK
4. In the "XXX PROPERTIES" box (where XXX = serial port selection in #3 above), under "port settings", enter the following serial port settings:
 

A) Bits Per Second:	9600
B) Data Bits:	8
C) Parity:	None
D) Stop Bits:	1
E) Flow Control	Xon/Xoff

 click: OK
5. At this point, the "HYPERTERMINAL" box will appear. Click on: FILE and then: PROPERTIES ... the "YYY PROPERTIES" box (where YYY=name assigned to the communications rou-

line in #2 above) appears. Click on: SETTINGS and then click on "ASCII SETUP". A box titled "ASCII SETUP" appears ... check the following items:
 

- A) In the "ASCII Sending" section: Send line ends with line feeds.
- B) In the "ASCII Sending" section: Echo typed characters locally.
- C) In the "ASCII Receiving" section: Append line feeds to incoming line ends

**Note:** In the "ASCII Receiving" section, the line "wrap lines that exceed terminal width" should already be checked.

Click: OK

6. Click: OK to exit this box.

**The gauge is sent from the factory in the "query" mode ... meaning that the information is supplied in response to a given after a query.** Refer to the List of Query Commands in Table 1 on Page 10 for information on commands. These commands can be used after you have established communication with the gauge. The Accu-Cal Plus can also be configured to transmit this information in a "streaming" mode, whereby lines of data are sent automatically to the PC. Once communication with the gauge is established, type in the command: stream\_on and press the ENTER key. The gauge is now in the "streaming" mode.

**Note:** This setting will now be saved in non-volatile memory as the default mode of RS-232 communication.

The displayed information, when the gauge is in the "streaming" mode, will appear in the form:

**A, B CC.C, D**

**Example: 0, PSI 24.4 Cel**  
 where: A = pressure reading,  
 B = Engineering Unit selected for pressure reading, CC.C = temperature reading and  
 D = unit of temperature measurement.

## ACCUCAL PLUS RS-232 COMMUNICATION

The following are general notes on RS-232 communication with the Accu-Cal Plus:

1. The rate of screen updates in the “streaming” mode is **governed by the sample rate of the Accu-Cal Plus**. Consult page 4 of the Instruction Manual for details on changing this value.

2. Data collected during a communication session can be stored and retrieved. At the end of your data collection period, type: FILE and SAVE AS. A program like EXCEL or other database programs can import and manipulate the saved ASCII information.

**Table 1 is a list of available commands to which the Accu-Cal Plus Digital Test Gauge will respond. Please note: the commands must be entered exactly as they are listed. Both upper and lower case letters and symbols are acceptable.**

Table 1	List of Query Commands
Command	Description
CAL_START	Puts the Accu-Cal Plus in calibration mode
*CLS	Clears the error queue
FAULT?	Returns an error code from the error queue
*IDN?	Identification query. (Returns 3D/Model?Firmware revision level)
TARE	Tares the offset pressure of the reading on the gauge
TARE?	Returns the current tare value
PRES_UNIT?	Returns the pressure Engr. Unit - refer to Table 2 below
PRES_UNIT	Sets the pressure unit for the display - refer to Table 2 below
ZERO_MEAS	Re-zeros the gauge (same result as pressing the “ZERO” key)
ZERO_MEAS?	Returns the current zero offset value
MINMAX_RST	Resets the minimum and maximum recorded values
MIN?	Returns the minimum recorded value
MAX?	Returns the maximum recorded value
HC_OFF	Turns unit off
TEMP?	Returns temperature in the chosen units
HC_SI_OFF	Disables SI mode
HC_SI_ON	Enables SI mode (SI enables only: kPa, MPa, Bar, mBar units)
CAL_STORE	Stores calibration data
HC_AUTO_OFF	Disables auto shutdown
HC_AUTO_ON	Enables auto shutdown
CUST_MULT?	Sets the multiplier for the custom unit type
STREAM_OFF	Disables “streaming” data
STREAM_ON	Enables “streaming” data
VAL?	Returns the measured pressure value in selected units.
HC_CMD_LIST	Prints out a command list
TEMP_UNIT	Used to set temperature unit
TEMP_UNIT?	Returns temperature unit

Command examples:

- 1) Pres\_unit bar Sets engineering unit to Bar
- 2) Temp\_unit far Sets temperature unit to fahrenheit

## ACCUCAL PLUS RS-232 COMMUNICATION

**Table 2 lists all of the potential Engineering Units available on the Accu-Cal Plus Digital Test Gauge. Please note: not all Engineering Units are available on all pressure ranges.**

Table 2	List of Engineering Units
Units	Description
PSI	Pressure in pounds per square-inch
BAR	Pressure in bars
MBAR	Pressure in millibars
KG/CM2	Pressure in kilograms per centimeter squared
INH2O4C	Pressure in inches of water measured @ 4 °C
INH2O20C	Pressure in inches of water measured @ 20 °C
INH2O60F	Pressure in inches of water measured @ 60 °F
MH2O4C	Pressure in meters of water measured @ 4 °C
MH2O20C	Pressure in meters of water measured @ 20 °C
CMH2O4C	Pressure in centimeters of water measured @ 4 °C
CMH2O20C	Pressure in centimeters of water measured @ 20 °C
MSW <sup>1</sup>	Pressure in meters of seawater
FtH2O4C	Pressure in feet of water measured @ 4 °C
FtH2O20C	Pressure in feet of water measured @ 20 °C
FtH2O60F	Pressure in feet of water measured @ 60 °F
FTSW <sup>1</sup>	Pressure in feet of seawater
INHG0C	Pressure in inches of mercury measured @ 0 °C
MMHG0C	Pressure in millimeters of mercury measured @ 0 °C
KPAL	Pressure in kilopascals
MPAL <sup>1</sup>	Pressure in megapascals
TORR	Pressure in torr
CUST	Pressure in “custom” units
FAR	Temperature in Fahrenheit
CEL	Temperature in Celsius

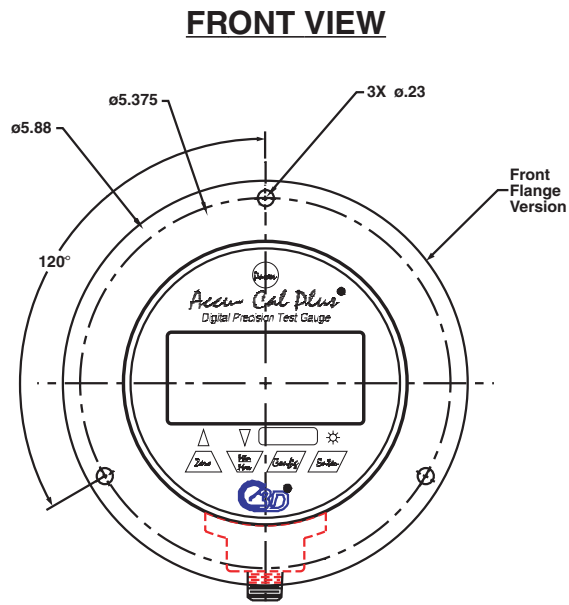
1 - Version 1.08 firmware and later

**Table 3 details a list of Error Codes that you may experience during RS-232 communication.**

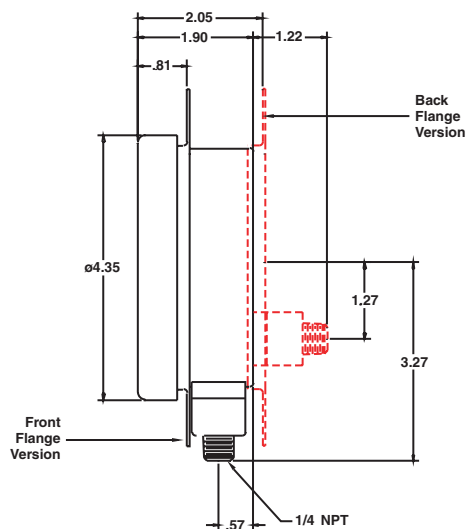
Table 3	Error Codes
Error	Description
101	A non-numeric entry was received and it should be a numeric entry
102	Too many significant digits entered
103	Invalid units or parameter value received
105	Entry is above the upper limit of the allowable range
106	Entry in below the lower limit of the allowable range
108	A required command parameter was missing
109	An invalid pressure unit was received
117	An unknown command was received
120	The serial input buffer overflowed
121	Too many entries in the command line

**Please contact our Customer Service Department should you require assistance.**

## ACCUCAL PLUS OUTLINE DRAWINGS



## SIDE VIEW



(Both front view and side view pictured with optional mounting flange)  
All dimensions in inches.

## ACCUCAL PLUS MODEL NUMBERING SYSTEM

① ② ③ ④ ⑤  
PART NUMBER: XXXXX - XX B XX XXX

Example: 75514-33B55 Battery Powered Accu-Cal Plus with 300 series SS case  
3000 psig sensor, bottom 1/4" NPT male fitting, without mounting flange

### ① Product Description:

**75514** - Accu-Cal Plus: 3 x AA battery powered version,  
**76514** - Accu-Cal Plus: 24 VDC version (**does not include 24 volt adapter**)  
**75114** - High Accuracy Vacuum Accu-Cal Plus: 3 x AA battery power version  
**76114** - High Accuracy Vacuum Accu-Cal Plus: 24 VDC version  
(**does not include 24 volt adapter**)

### ② Pressure Ranges Codes: (all pressure ranges include vacuum measurement)

**48**: -14.7-0-30 psig\*(Vac)    **26**: -14.5-0-300 psig    **33**: -14.5-0-3,000 psig  
**15**: -5-0-15 psig    **27**: -14.5-0-500 psig    **35**: -14.5-0-5,000 psig  
**21**: -5-0-30 psig    **29**: -14.5-0-1,000 psig    **38**: -14-0-10,000 psig  
**23**: -14.5-0-100 psig    **32**: -14.5-0-2,000 psig

\*Product description (Item #1) for this range to be either: **75114** or **76114**

### ③ Process Connection:

**B**: 1/4" NPT male

### ④ Connection Position and Mounting Flange Codes:

**15**: Flange front, bottom fitting    **45**: Flange back, back fitting\*  
**25**: Flange front, back fitting    **55**: Flange none, bottom fitting  
**35**: Flange back, bottom fitting\*    **65**: Flange none, back fitting  
\* Codes **35** and **45** not available on **76114** and **76514** series.

### ⑤ Option Codes: (leave blank if no options are required)

**PNO**: Accu-Cal Plus Cal Kit #1—includes an Accu-Cal Plus digital gauge,  
Model 8110-300: 0-300 psi Pneumatic Handpump, Hose Kit and  
Series-200 ABS waterproof case

**PRO**: Accu-Cal Plus Cal Kit #2—includes an Accu-Cal Plus digital gauge,  
Model 8111-300: Vac/0-300 psi Duplex Handpump, Hose Kit and  
Series-200 ABS waterproof case

**PUO**: Accu-Cal Plus Cal Kit #3—includes an Accu-Cal Plus digital gauge,  
Model 8112-3000: 0-3000 psi Hydraulic Handpump, Hose Kit and  
Series-200 ABS waterproof case

**GCO1**: Calibration Certificate Level #1 - 10 readings done in descending pressure at room temperature

**GCO2**: Calibration Certificate Level #2 - 13 readings in both ascending and descending pressures at room temperature

**GCO3**: Calibration Certificate Level #3 - 13 readings in both ascending and descending pressures done at three distinct temperatures...typically: 22°C, 5°C and 45°C.

### ⑥ Accessories:

- Custom RS-232 Cable - Part Number: 2025-0004
- 110 VAC to 24 VDC power adapter wall mount style; 6 foot cable - Part Number: 2001-0090
- Rubber boot for gauge - Part Number: 2023-0005

## SPECIFICATIONS

All specifications cover the temperature range from 0° C to +50° C, unless otherwise noted.

### Available Pressure Ranges

See pages 16 and 17 for tables of available ranges in PSI plus equivalent ranges and resolution for all Engineering Units.

### Accuracy

Positive Pressure:

±0.05% FS (full scale)

Vacuum: ±0.25% FS\* (500 PSI pressure range and below); 2% FS accuracy for ranges above 500 PSI.

\*High accuracy vacuum - series 75114 and 76114 - vacuum accuracy is: ±0.05% FS, where FS = 30 PSI

All accuracies include all effects due to hysteresis, repeatability, non-linearity and temperature.

### Temperature Compensation

0 °C to +50 °C (32 °F to +122 °F) to rated accuracy

### Over Pressure Protection

Proof Pressures for the various pressure sensors are detailed on pages 16 and 17.

Burst Pressures for the various pressure sensors are as follows:

Range	Pressure (PSI)
0-15	150
0-30*	150
0-100	500
0-300	2500
0-500	2500
0-1000	5000
0-2000	15000
0-3000	15000
0-5000	15000
0-10000	15000

\*including series 75114/76114 high accuracy vacuum gauges

### Standard Engineering Units\*

PSI, Bar, mBar, kPa, kg/cm<sup>2</sup>, inH<sub>2</sub>O (4 °C, 20 °C or 60 °F), ftH<sub>2</sub>O (4 °C, 20 °C or 60 °F), cmH<sub>2</sub>O (4 °C and 20 °C), mH<sub>2</sub>O (4 °C and 20 °C), inHg, mmHg, Torr, MPa, ftSw and mSw  
One custom unit (user programmable)  
\* Not all units available for all ranges.

### Materials of Construction

Case: 300 Series Stainless Steel  
Wetted parts: 316 Stainless Steel  
Overlay: Polycarbonate  
Sensor bracket: Nickel plated brass  
Boot (optional): Synerflex

### Sensors

All ranges other than high accuracy vacuum: piezoresistive semiconductor sensor chip in an oil isolated housing incorporating a 316 SS isolation diaphragm. Media compatibility: liquids and gases compatible with 316 SS.

High accuracy vacuum: piezoresistive silicon with wetted materials of - silicon, RTV, gold and glass. Media compatibility: non-corrosive gases.

### Environmental

Operating: -10 °C to +55 °C (14 °F - 131 °F)  
Storage: -20 °C to +70 °C (- 4 °F to +158 °F)  
Rel. Humidity: 10 to 95% non condensing

### Mechanical

Dimensions: 5.39" (height) x 4.355" (diameter) x 1.95" (depth)  
Pressure Connection: 1/8" NPT Male  
Housing: 300 Series Stainless Steel, qualifies as NEMA 4/ IP65 waterproof  
Weight: 1.09 lbs (495 gms)

### LCD Display

Digits: 5, 0.65" (16.53 mm) high  
Bar graph: 20 segment, 0 to 100% FS  
Backlight: Fiber optic

## SPECIFICATIONS

### Power

Battery: three (3) AA alkaline batteries, optional 24 VDC power  
Battery Life: 1,500 hours without backlight @ 3/sec sample rate  
2,000 hours at slow sample rate  
"Low Battery" indicator icon is displayed near the end of battery life  
Auto shutoff: adjustable from 1 - 30 mins

### Agency Approvals CE Mark

EN 55022: 1998 and  
EN 61000-4-2/3: 1995  
Meets EMI/RFI and ESD conditions outlined in above EN standards: 30 mHz to 1 GHz with a field strength of 3 v/m.

### Intrinsic Safety

The battery powered version of the Accu-Cal Plus (Series 75514 and 75114) conforms with all requirements for Class 1, Division 2, Groups A, B, C and D hazardous area locations. Specific approvals are as follows:

CSA - USA and Canada Approvals



ATEX (pending)

**PRESSURE RANGES / DISPLAY RESOLUTIONS**

Pressure Range PSI	Conversion	15	30*	100	300
Unit/Proof Pressure PSI	Factor	90	90	300	1500
psi	1.0000	15.000	30.000	100.00	300.00
bar	0.06894757	1.0342	2.0684	6.8947	20.684
mbar	68.94757	1034.2	2068.4	6894.8	20684
kPa	6.894757	103.42	206.84	689.48	2068.4
MPa	0.0068947	0.1034	0.2068	0.6895	2.0684
ftSw	2.2470	33.705	67.410	224.70	674.10
mSw	0.6849	10.274	20.547	68.490	205.47
kg/cm2	0.07030697	1.0546	2.1092	7.0307	21.092
cmH2O@4°C	70.3089	1054.6	2109.3	7030.9	21093
cmH2O@20°C	70.4336	1056.5	2113.0	7043.4	21130
mH2O@4°C	0.703089	10.546	21.093	70.309	210.93
mH2O@20°C	0.704336	10.565	21.130	70.434	211.30
inH2O@4°C	27.68067	415.21	830.42	2768.1	8304.2
inH2O@20°C	27.72977	415.95	831.89	2773.0	8318.9
inH2O@60°F	27.70759	415.61	831.23	2770.8	8312.3
mmHg@0°C	51.71508	775.73	1551.5	5171.5	15515
inHg@0°C	2.03602	30.540	61.081	203.60	610.81
ftH2O@4°C	2.306726	34.601	69.202	230.67	692.02
ftH2O@20°C	2.310814	34.662	69.324	231.08	693.24
ftH2O@60°F	2.308966	34.634	69.269	230.90	692.69
Torr	51.71508	775.73	1551.5	5171.5	15515

Proof Pressure - maximum allowable pressure without a shift in calibration.

\*including 75114/76114 series high accuracy vacuum gauges

**PRESSURE RANGES / DISPLAY RESOLUTIONS**

Pressure Range PSI	500	1000	2000	3000	5000	10000
Unit/Proof Pressure PSI	1500	3000	10000	10000	10000	15000
psi	500.00	1000.0	2000.0	3000.0	5000.0	10000
bar	34.474	68.947	137.89	206.84	344.74	689.47
mbar	34474	68948	NA	NA	NA	NA
kPa	3447.4	6894.8	13790	20684	34474	68948
MPa	3.4474	6.8948	13.790	20.684	34.474	68.948
ftSw	1123.5	2247.0	4494.0	6741.0	11235	22470
mSw	342.45	684.90	1369.8	2054.7	3424.5	6849.0
kg/cm2	35.153	70.307	140.61	210.92	351.53	703.07
cmH2O@4°C	35154	70309	NA	NA	NA	NA
cmH2O@20°C	35217	70434	NA	NA	NA	NA
mH2O@4°C	351.54	703.09	1406.2	2109.3	3515.4	7030.9
mH2O@20°C	352.17	704.34	1408.7	2113.0	3521.7	7043.4
inH2O@4°C	13840	27681	55361	83042	NA	NA
inH2O@20°C	13865	27730	55460	83189	NA	NA
inH2O@60°F	13854	27708	55415	83123	NA	NA
mmHg@0°C	25858	51715	NA	NA	NA	NA
inHg@0°C	1018.0	2036.0	4072.0	6108.1	10180	20360
ftH2O@4°C	1153.4	2306.7	4613.5	6920.2	11534	23067
ftH2O@20°C	1155.4	2310.8	4621.6	6932.4	11554	23108
ftH2O@60°F	1154.5	2309.0	4617.9	6926.9	11545	23090
Torr	25858	51715	NA	NA	NA	NA

**NA = Engineering Unit not enabled for particular pressure range**

Proof Pressure - maximum allowable pressure without a shift in calibration.

**ACCU-CAL PLUS 24VDC WIRING DETAIL**

**WARRANTY**

3D Instruments, LLC warrants the Accu-Cal Plus 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.

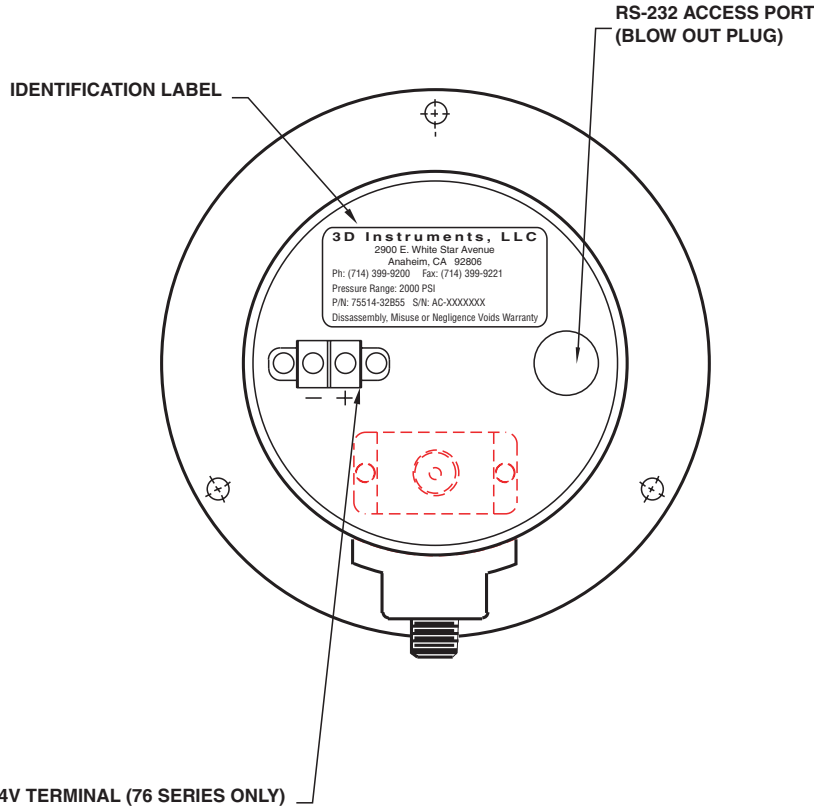
Within one (1) year from date of purchase, 3D Instruments will, at our option, repair or replace a defective device free of charge and the device will be returned, transportation prepaid. However, if we determine the failure was caused by misuse, alteration, accident or abnormal condition of operation, you will be billed for the repair.

**3D INSTRUMENTS, LLC 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. 3D INSTRUMENTS, LLC SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT OR OTHERWISE.**

For warranty or non-warranty service, we can be reached at:

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 Email .....info@3dinstruments.com  
  
 Address .....3D Instruments, LLC  
 Attn: Accu-Cal Plus Service Department  
 2900 E. White Star Avenue  
 Anaheim, CA 92806  
 U.S.A.  
  
 Web.....www.3dinstruments.com

Return Authorization numbers are not required for servicing. Please return, **freight pre-paid**, to the address above and include a Contact Name, Address, Phone and Fax Number. If you wish to be notified of the charges before any service is done, 3D Instruments will contact you after evaluating the unit. Units evaluated but not serviced are subject to an evaluation charge. Defective units need to be returned to 3D Instruments, LLC within 90 days of identification of a problem.



(Pictured with optional mounting flange)



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