BC Biomedical

A UNIT OF BC GROUP INTERNATIONAL, INC.

HIGH PRECISION / RESOLUTION DIGITAL PRESSURE METERS

Pressure 1

23.090

PSIG

MIN 23.050 MAX 23.160

BC Biomedical

POWER | SCREEN | SELECT
SETUP/RETURN | | HOLD/RESET

DPM-2300
High Precision / Resolution
Digital Pressure Meter

DPM-2300 SERIES

USER MANUAL

BC BIOMEDICAL
DPM-2300 SERIES
TABLE OF CONTENTS

WARNING - USERS

The DPM-2300 is for use by skilled technical personnel only.

WARNING - USE

The DPM-2300 is intended for testing only and should never be used in diagnostics, treatment or any other capacity where it would come in contact with a patient.

WARNING - CONNECTIONS

All connections to patients must be removed before connecting the DUT to the DPM-2300. A serious hazard may occur if the patient is connected when testing with the DPM-2300.

CAUTION - MODIFICATIONS

The DPM-2300 is intended for use within the published specifications. Any application beyond these specifications or any unauthorized user modifications may result in hazards or improper operation.

CAUTION - SERVICE

The DPM-2300 is intended to be serviced only by authorized service personnel. Troubleshooting and service procedures should only be performed by qualified technical personnel.

CAUTION - INSPECTION

The DPM-2300 Series Meters should be inspected before each use for wear and the Meter should be serviced if any parts are in question.

CAUTION - CLEANING
Do not immerse. The Meter should be cleaned by wiping gently with a damp, lint-free cloth.
A mild detergent can be used if desired.

CAUTION - LIQUIDS
Do not submerge or spill liquids on the DPM-2300. Do not operate the DPM-2300 if it may have been exposed to fluid.

CAUTION - ENVIRONMENT
Exposure to environmental conditions outside the specifications can adversely affect the performance and accuracy of the DPM-2300. If the unit is outside the Operating Specifications, allow it to acclimate to specified conditions for at least 30 minutes before attempting to operate it.

CAUTION – MEDIA COMPATIBILITY
The DPM-2300 is intended to be used with only non-corrosive, non-ionic, or otherwise pure fluids and/or gases that are compatible with sensor materials including glass, silicon, ceramic, epoxy, RTV, gold, aluminum and nickel.

NOTICE – CE

$C\varepsilon$ $C\varepsilon$

The DPM-2300 Series Meters bear the $C\varepsilon$ mark
Based on the following testing standards:

ELECTROMAGNETIC COMPATIBILITY DIRECTIVE
EMC – Directive 89/336/EEC as amended by 92/31/EEC and 93/68/EEC

EN 61326-1:1997 + A1:1998 + A2:2001 + A3:2003
**"Electrical equipment for measurement, control and
laboratory use – EMC requirements"**

This equipment has been type tested by an independent, accredited testing laboratory
and compliance was demonstrated to the above standard to the extent applicable.

EMISSIONS
Radiated and Line Conducted Emissions

EN 61000-3-2:2000	Harmonic Current Emissions
EN 61000-3-3:1995 + A1:2001	Voltage Fluctuation and Flicker

IMMUNITY– CLASS C

EN 61000-4-2:1995 + A1:1998 + A2:2001	Electrostatic Discharge
EN 61000-4-3:2002	Radiated Electric Field Immunity
EN 61000-4-4:1995 + A1:2001 + A2:2001	Electrical Fast Transients / Bursts
EN 61000-4-5:1995 + A1:2001	Surge Voltage
EN 61000-4-6:1996 + A1:2000	Conducted Disturbance
EN 61000-4-11:1994 + A1:2001	Voltage Dips and Short Interrupts

LOW VOLTAGE DIRECTIVE
EC – Directive 73/23/EC

EN 61010-1:2001
**"Safety requirements for electrical equipment for measurement, control, and
laboratory use – General requirements"**

This equipment has been type tested and compliance was demonstrated
to the above standard to the extent applicable.

NOTICE – SYMBOLS

Symbol	Description
$\oplus$—⊙	Center Negative

NOTICE – ABBREVIATIONS

ANSI	American National Standards Institute
ASCII	American Standard Code for Information Interchange
BCD	Binary Coded Decimal
C	Celsius
cmH$_2$0	centimeters of water
°	degree(s)
DUT	Device Under Test
DC	Direct Current
Euro	European
F	Fahrenheit
FS	Full Scale
inHg	inches of mercury
inH$_2$0	inches of water
kg	kilogram(s)
kg/cm^2	kilogram(s) per centimeter squared
kHz	kilohertz
kPa	kilopascal(s)
Max	Maximum
µA	microampere(s)
mA	milliampere(s)
mBar	milliBar(s)
mm	millimeter(s)
mmHg	millimeter(s) of mercury
Min	Minimum
NEDA	National Electronic Distributors Association
Lbs	pounds
PSI	pounds per square inch
Pres	Pressure
RH	Relative Humidity
RTD	Resistive Thermal Device
s	second(s)
Temp	Temperature
USA	United States of America
V	Volt(s)
VDC	Volt(s) Direct Current

NOTICE – DISCLAIMER

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NOTICE – CONTACT INFORMATION

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Rev 06

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┌─────────────────────────────────────────────────┐
│                BC BIOMEDICAL                    │
│             DPM-2300 SERIES                      │
│         DIGITAL PRESSURE METERS                  │
└─────────────────────────────────────────────────┘
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The Model DPM-2300 Series is a family of microprocessor-based, high-precision Pressure Meters, which are intended for use in the evaluation and servicing of a wide variety of medical, commercial and industrial applications. These meters measure compatible gas and liquid pressures in various engineering units. Available optional features include a RS-232 port for remote control and data collection, a DC analog output option, and an optional temperature sensor input (either YSI 700 Series or 100 Ω RTD Probe). The following are highlights of the main features:

DPM-2301 (Basic Features):
- GRAPHICAL LCD DISPLAY WITH CURSOR SELECTION OF OPTIONS AND SETUP OF PARAMETERS
- ± 0.05% FS PRESSURE ACCURACY
- DIGITAL CALIBRATION AND ZERO OFFSET ADJUSTMENT – NO POTS TO TURN
- 24 BIT MEASUREMENT
- PROGRAMMABLE DIGITAL FILTER
- 13 ENGINEERING UNITS:
    - PSI
    - inH_2O @ 4 °C
    - inH_2O @ 20 °C
    - inH_2O @ 60 °F
    - cmH_2O @ 20 °C
    - inHg @ 0 °C
    - inHg @ 20 °C
    - mmHg @ 0 °C
    - mmHg @ 20 °C
    - kg/cm^2
    - kPa
    - mBar
    - Bar
- SELECTABLE DISPLAY OPTIONS AND DIGIT SIZES
- BATTERY LIFE DISPLAY (0 to 100%)
- SOFTWARE-ADJUSTABLE DISPLAY CONTRAST
- MAX and MIN PRESSURE VALUE CAPTURE AND STORAGE

DPM-2302 MODEL ADDS:
- RS-232 SERIAL COMMUNICATIONS

SECOND PRESSURE SENSOR ADDS:
- INDEPENDENT PRESSURE CHANNEL
- SEPARATE AND COMBINED DISPLAY OPTION

ANALOG OUTPUT OPTION (OPTION DC) ADDS:
- OPTION DC - DC ANALOG OUTPUT (REFRESH RATE DEPENDENT UPON DIGITAL FILTER SETTING)
- BNC OUTPUT CONNECTOR
- ± 0.1% FS ACCURACY

<u>TEMPERATURE OPTION ADDS:</u>

- OPTION Y7 - YSI 700 TEMPERATURE PROBE INTERFACE
- OPTION R1 - 100 Ω RTD TEMPERATURE PROBE INTERFACE
- -20.0 TO 100.0 °C / -4.0 TO 212.0 °F TEMPERATURE RANGE
- ± 0.5% FS ACCURACY
- MAX and MIN TEMPERATURE VALUE CAPTURE AND STORAGE

<u>OPTIONAL ACCESSORIES:</u>

- BC20-21100   BATTERY ELIMINATOR (USA Version)
- BC20-21101   BATTERY ELIMINATOR (Euro Version)
- BC20-41337   RS-232 COMMUNICATIONS CABLE (7PIN MINI-DIN TO DB-9F)
- BC20-41339   USB COMMUNICATIONS ADAPTER (DB-9M TO USB-A) FOR USE WITH BC20-41337
- BC20-30106   SOFT-SIDED CARRYING CASE
- BC20-01005   UNIVERSAL MANOMETER (PRESSURE) ADAPTER KIT
- BC20-01006   YSI 700 TEMPERATURE PROBE
- BC20-01008   RTD (100 Ω) TEMPERATURE PROBE

MODEL INFORMATION

Use the following model configuration guide to construct or decode a DPM-230X series Digital Pressure Meter model number:

| DPM | 230X | X | X | X | X |

Options
- DC = DC (Direct Current) Analog Output
- FC = Female Quick-Disconnect
- MC = Male Quick-Disconnect
- Sxx = Special Coupler Configuration, see table

Temperature Sensor Option
- N = Not Applicable
- Y7 = YSI 700
- R1 = 100 Ω RTD

Pressure 2 Range (Left Port)
- N = Not Applicable
- 100 = Max 100 PSI (Default Quick-Disconnect)
- 75 = Max 75 PSI (Default Quick-Disconnect)
- 10 = Max 10 PSI (Default Male Luer Lock)
- 5 = Max 5 PSI (Default Male Luer Lock)
- .3 = Max 0.3 PSI (Default Male Luer Lock)

Pressure 1 Range (Right Port)
- 100 = Max 100 PSI (Default Quick-Disconnect)
- 75 = Max 75 PSI (Default Quick-Disconnect)
- 10 = Max 10 PSI (Default Male Luer Lock)
- 5 = Max 5 PSI (Default Male Luer Lock)
- .3 = Max 0.3 PSI (Default Male Luer Lock)

Model
- 2301 = Basic Model
- 2302 = Adds RS-232

Note: The FC or MC options are not applicable when the "–Sxx" option is specified.

COUPLER TYPES		
MALE LUER LOCK	FEMALE QUICK-DISCONNECT	MALE QUICK-DISCONNECT

Example model numbers:

- DPM-23017510NFC
  - Model DPM-2301 (Basic Model)
  - Two Pressure Ranges:
    - Pressure 1 Range (Right Port):
      - 75 PSI
      - Female Quick-Disconect Coupler
    - Pressure 2 Range (Left Port):
      - 10 PSI
      - Male Luer Lock Coupler
  - Not equipped with Temperature Sensor Option
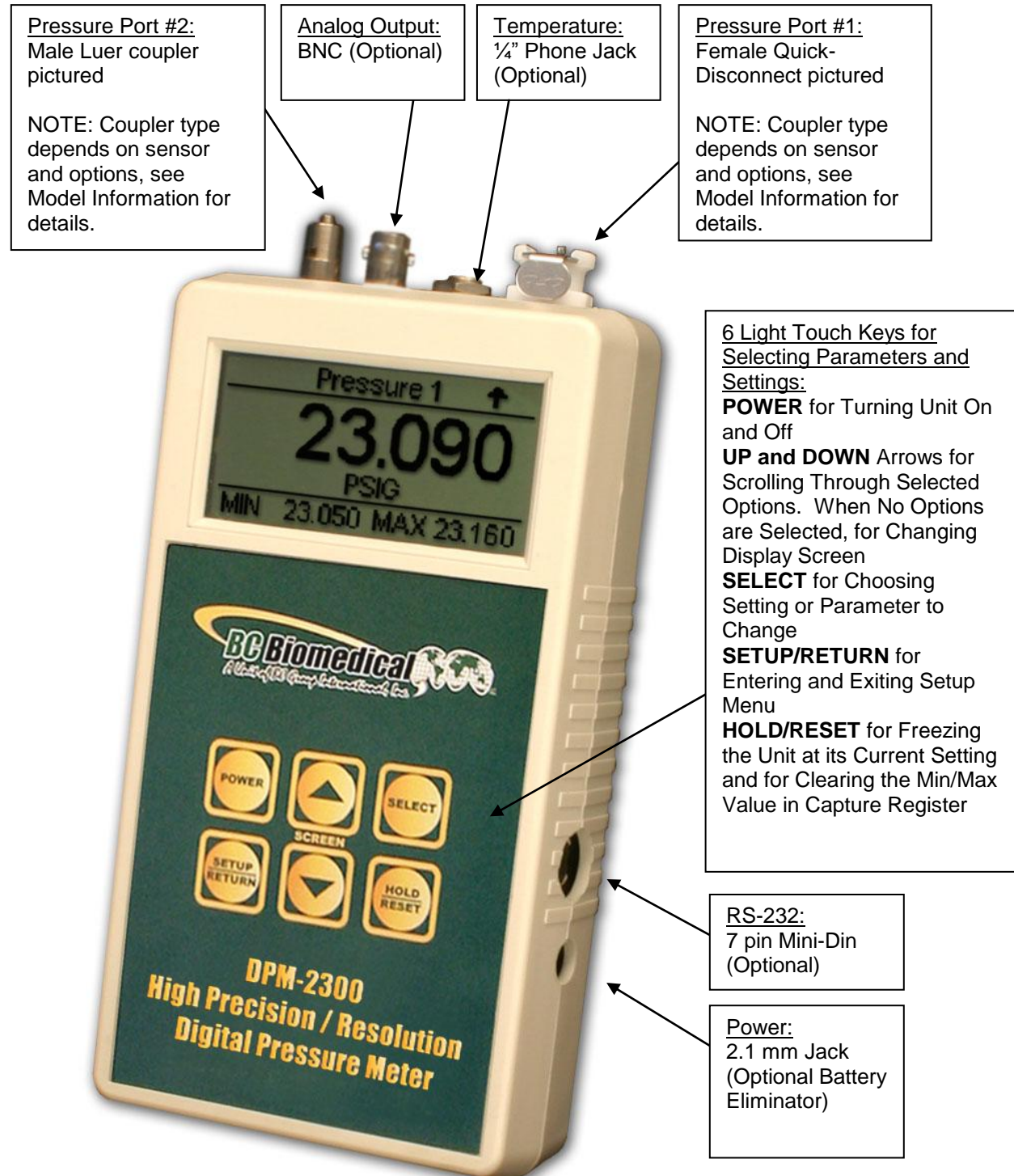 - Not equipped with Analog Output Option

- DPM-230210075Y7DCFC
  - Model DPM-2302 (Basic Model plus RS-232)
  - Two Pressure Ranges:
    - Pressure 1 Range (Right Port):
      - 100 PSI
      - Female Quick-Disconnect Coupler
    - Pressure 2 Range (Left Port):
      - 75 PSI
      - Female Quick-Disconnect Coupler
  - YSI 700 Series Temperature Sensor Option
  - DC Analog Output Option

For additional coupler options, the "-Sxx" Special Coupler Configurations option over-rides default coupler options to those listed in the following table:

SPECIAL COUPLER CONFIGURATIONS		
Option	Pressure 1 Coupler (Right Port)	Pressure 2 Coupler (Left Port)
S01	Female Quick-Disconnect	Female Quick-Disconnect
S02	Female Quick-Disconnect	Male Quick-Disconnect
S03	Female Quick-Disconnect	Male Luer Lock
S04	Female Quick-Disconnect	Not Applicable
S05	Male Quick-Disconnect	Female Quick-Disconnect
S06	Male Quick-Disconnect	Male Quick-Disconnect
S07	Male Quick-Disconnect	Male Luer Lock
S08	Male Quick-Disconnect	Not Applicable
S09	Male Luer Lock	Female Quick-Disconnect
S10	Male Luer Lock	Male Quick-Disconnect
S11	Male Luer Lock	Male Luer Lock
S12	Male Luer Lock	Not Applicable

Examples of model numbers with "-Sxx" Special Coupler Configurations option:

- DPM-2301105NS03
    - Model DPM-2301 (Basic Model)
    - Two Pressure Ranges:
        - Pressure 1 Range (Right Port):
            - 10 PSI
            - Female Quick-Disconnect Coupler
        - Pressure 2 Range (Left Port):
            - 5 PSI
            - Male Luer Lock Coupler
    - Not equipped with Temperature Sensor Option
    - Not equipped with Analog Output Option

- DPM-230210NY7DCS08
    - Model DPM-2302 (Basic Model plus RS-232)
    - One Pressure Range:
        - Pressure 1 Range (Right Port):
            - 10 PSI
            - Female Quick-Disconnect Coupler
        - Not equipped with Pressure 2 Range
    - YSI 700 Series Temperature Sensor Option
    - DC Analog Output Option

PRESSURE RANGES BY SENSOR RANGE

PRESSURE UNITS	PRESSURE SENSOR RANGE				
	100 PSI	75 PSI	10 PSI	5 PSI	0.3 PSI
PSI	-13.500 to 100.000	-13.500 to 75.000	-10.0000 to 10.0000	-5.0000 to 5.0000	-.30000 to .30000
mmHg @ 0° C	-698.2 to 5171.5	-698.2 to 3878.6	-517.15 to 517.15	-258.57 to 258.57	-15.514 to 15.514
mmHg @ 20° C	-700.6 to 5190.3	-700.6 to 3892.7	-519.00 to 519.03	-259.51 to 259.51	-15.571 to 15.571
inHg @ 0° C	-27.486 to 203.602	-27.486 to 152.702	-20.3602 to 20.3602	-10.1801 to 10.1801	-.61081 to .61081
inHg @ 20° C	-27.586 to 204.342	-27.586 to 153.256	-20.4342 to 20.4342	-10.2171 to 10.2171	-.61303 to .61303
cmH_2O @ 20° C	-951.8 to 7043.2	-951.8 to 5282.4	-704.32 to 704.32	-352.16 to 352.16	-21.129 to 21.129
inH_2O @ 4° C	-373.6 to 2768.1	-373.6 to 2076.1	-276.81 to 276.81	-138.40 to 138.40	-8.304 to 8.304
inH_2O @ 20° C	-374.3 to 2772.9	-374.3 to 2079.7	-277.29 to 277.29	-138.64 to 138.64	-8.319 to 8.319
inH_2O @ 60° F	-374.1 to 2770.8	-374.1 to 2078.1	-277.08 to 277.08	-138.54 to 138.54	-8.312 to 8.312
kg/cm^2	-.9491 to 7.0306	-.9491 to 5.2730	-.70307 to .70307	-.35153 to .35153	-.021092 to 0.21092
kPa	-93.08 to 689.48	-93.08 to 517.11	-68.948 to 68.948	-34.473 to 34.473	-2.0684 to 2.0684
mBar	-930.8 to 6894.8	-930.8 to 5171.1	-689.48 to 689.48	-344.74 to 344.74	-20.684 to 20.684
Bar	-.9308 to 6.8948	-.9308 to 5.1711	-.68948 to .68948	-.34474 to .34474	-.020684 to .020684

LAYOUT

This section looks at the layout of the DPM-2300 and gives descriptions of the elements that are present.
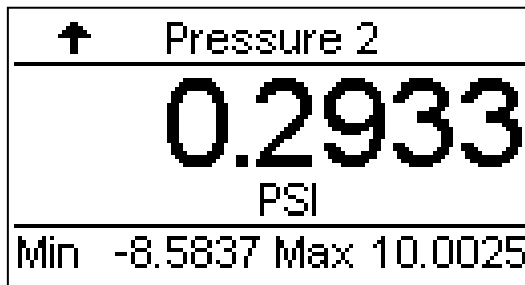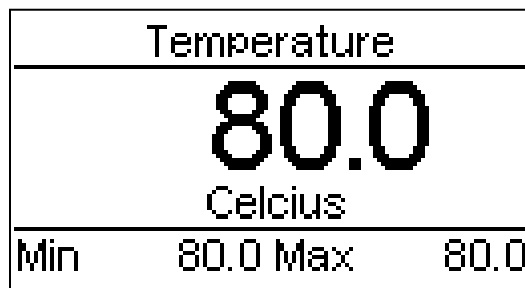
Pressure Port #2:
Male Luer coupler pictured

NOTE: Coupler type depends on sensor and options, see Model Information for details.

Analog Output:
BNC (Optional)

Temperature:
¼" Phone Jack (Optional)

Pressure Port #1:
Female Quick-Disconnect pictured

NOTE: Coupler type depends on sensor and options, see Model Information for details.

6 Light Touch Keys for Selecting Parameters and Settings:
POWER for Turning Unit On and Off
UP and DOWN Arrows for Scrolling Through Selected Options. When No Options are Selected, for Changing Display Screen
SELECT for Choosing Setting or Parameter to Change
SETUP/RETURN for Entering and Exiting Setup Menu
HOLD/RESET for Freezing the Unit at its Current Setting and for Clearing the Min/Max Value in Capture Register

RS-232:
7 pin Mini-Din (Optional)

Power:
2.1 mm Jack (Optional Battery Eliminator)

SCREENS

MAIN SCREENS – There can be up to four main screens, depending on the model. They are PRESSURE 1, PRESSURE 2, TEMPERATURE, COMBINED and INPUTS. The available screens can be toggled through using ▲ ▼ .

Pressure 1   ↑
8.198
PSI
Min   0.000 Max   8.227
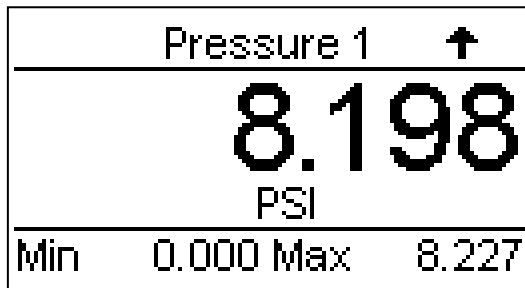
Pressure
Display with Min/Max
Option selected

↑   Pressure 2
0.2933
PSI
Min -8.5837 Max 10.0025

Pressure Port 2
Display with Min/Max
Option selected

Temperature
80.0
Celcius
Min   80.0 Max   80.0

Temperature Display with
Min/Max Option selected

8.193 PSI
0.2945 PSI
80.0 FAHRENHEIT
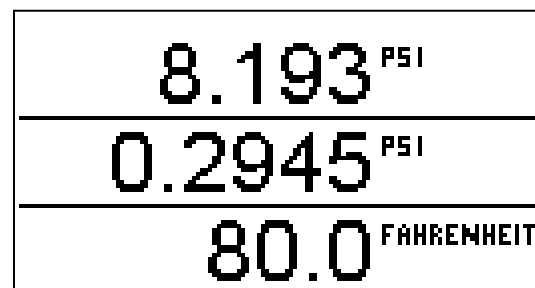
Combined Screen
showing:
Pressure Port 1
Pressure Port 2
Temperature

```
              Temperature
                100.0° C
           Analog Output
        Pressure 2      Pressure 1
        10.000 PSIG  100.00 PSIG
```
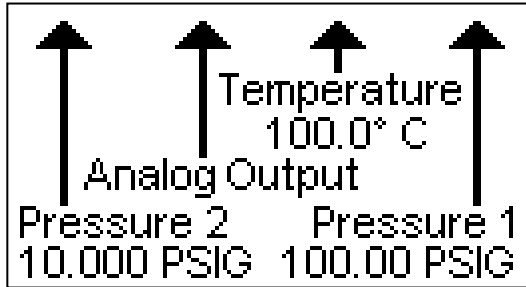
Input Identification Screen
Note: Sensor limits are displayed based on selected range.

PRESSURE SCALE – The pressure scale is indicated by the units displayed under the

reading. The scale can be changed by using `SELECT` to highlight the unit line and

⬆ ⬇ to toggle between available pressure units as listed below.

Pressure Units	
PSI	mmHg @ 0 °C
inH$_2$O @ 4 °C	mmHg @ 20 °C
inH$_2$O @ 20 °C	kg/cm^2
inH$_2$O @ 60 °F	kPa
cmH$_2$O @ 20 °C	mBar
inHg @ 0 °C	Bar
inHg @ 20 °C	

NOTE: If the measured pressure is outside of the range of the instrument, an OVER RANGE or UNDER RANGE message box will be displayed.

```
  ↑      Pressure 2

      Over Range

           PSI
  Min   4.2433 Max 10.0000
```
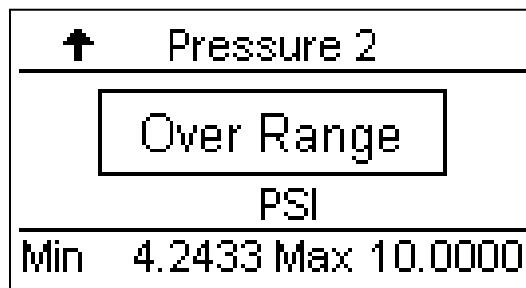
Typical display with "Over Range" message box.

TEMPERATURE SCALE – The temperature scale is indicated by the units displayed under the reading. The scale can be changed by using [SELECT] to highlight the unit line and [▲] [▼] to toggle the temperature units between Degrees Celsius (°C) and Fahrenheit (°F).

NOTE: If the measured temperature is outside of the range of the instrument, an OVER RANGE or UNDER RANGE message box will be displayed. For models with the YSI option, the NO PROBE message box will be displayed when the unit detects an open connection. For models with the RTD option, the OVER RANGE message box will also be displayed with an open connection.

```
┌─────────────────────────────┐
│         Temperature         │
│ ─────────────────────────── │
│      ┌─────────────────┐    │
│      │    No Probe      │    │
│      └─────────────────┘    │
│           Celcius           │
│ ─────────────────────────── │
│ MIN    56.9   MAX   101.6   │
└─────────────────────────────┘
```
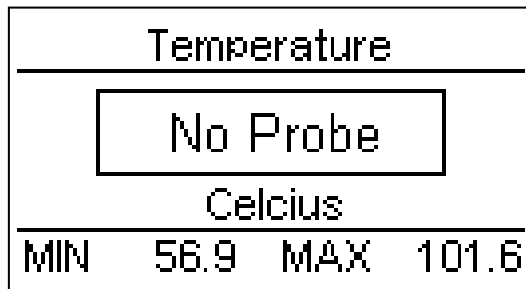
Typical display with "No Probe" message box.

NOTE: YSI option only

SYSTEM SETUP – The Setup Mode allows the user to adjust the configuration of the meter. The Setup screen can be entered using the [SETUP RETURN] key. The parameters can be changed by using [SELECT] to highlight the line and [▲] [▼] to toggle the available options. The Setup screen can be exited using the [SETUP RETURN] key.

```
┌─────────────────────────────┐
│        System Setup         │
│ 1)Display Min/Max     yes   │
│ 2)Analog Scale       1.0V   │
│ 3)Analog Source     Pres1   │
│ 4)Contrast Adjust      10   │
│ 5)Auto Off Timer (Min)  0   │
└─────────────────────────────┘
```

The following is a breakdown of the parameters available in the configuration of the unit and their available options:

| System Setup Configuration		
Parameter	**Description**	**Range**
Display Min/Max	Selects whether the Min and Max values will be displayed on the main screens (except COMBINED).	yes/no
Analog Scale	Analog Output Scaling voltage. This is the maximum analog output voltage. The output is scaled to this voltage over the positive range of the selected analog source.	1.0 to 4.0 Volts
Analog Source	Selects the source reading for the analog output	Pres1, Pres2, or Temp
Contrast Adjust	Sets the contrast of the display screen.	0 to 20
Auto Off Timer	Determines the period of inactivity before the meter is turned OFF. A timer is started when the meter is turned ON and is reset each time a key is pressed. When the timer reaches the value set in this parameter, the power is automatically turned OFF. (NOTE: Setting this parameter to 0 disables the Auto Off timer. When running from line power, the meter does not automatically shut off.)	0 to 30 Minutes
Battery Life	Displays current life of the battery. At 10%, a warning screen will appear.	0 to 100% (Read Only)
Beep Length	Sets audible beep duration.	0 to 15
Filter – Pres 1	Determines the number of samples that are averaged in the digital filter. The software has a Digital Filter that averages the readings to produce a stable display. (NOTE: Increasing this setting will cause a more stable display. However, it will also cause a slower response to small changes. The best setting is the smallest number that provides a stable display.)	0 to 10 Seconds
Filter – Pres 2		
Filter – Temp		
RTD Type (OPTION R1)	Sets the Temperature Coefficient (alpha) to match that of the RTD probe.	0.00385/°C or 0.00392/°C
Software	Displays current software program.	(Read Only)

ZEROING PRESSURE SCALES – When there is no pressure applied to either port, the display should read "0." It may be necessary to zero the pressure scales to remove any errors due to ambient conditions. This is done by pressing the [SELECT] key until the zeroing instructions are displayed, then pressing [▲] [▼] simultaneously to begin the process. The "ZEROING…" message will flash while the scale is being zeroed.

When the zeroing instructions are displayed again, the process is complete.
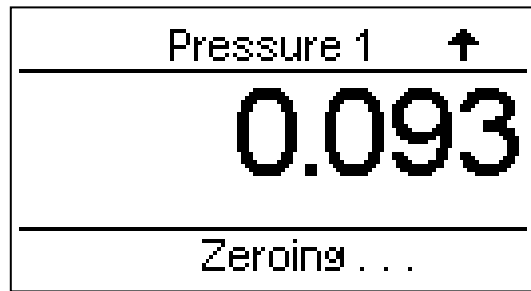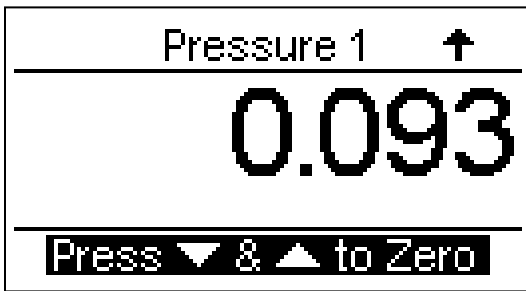
NOTE: Each sensor needs to be zeroed separately.

LOW BATTERY – When the battery life reaches 10 percent, the LOW BATTERY message box will be displayed.
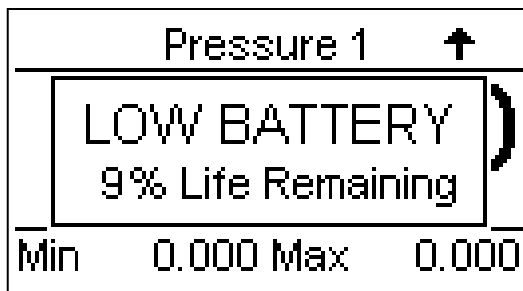
Typical display with "Low Battery" message box.

NOTE: A battery eliminator receptacle is provided so that the unit can be powered by the optional 9 VDC Battery Eliminator, enabling continuous operation.

NOTE: The unit is shipped with a Red Battery Lock-Out plug installed into the line power receptacle as shown below. Its purpose is to prevent the unit from accidentally being turned on during handling and transport, subsequently depleting the battery. This plug must be removed before any use!

KEYS

Six tactile-touch keys are provided for system operation:

POWER – This key turns the unit off and on. The unit will return to the main screen that was active when it was turned off.

▲ ▼ – In the DISPLAY MODE, these keys toggle the display through the available main screens.

In the SELECT MODE, if a parameter has been highlighted, these keys will scroll through the available settings.

SELECT – On any screen, there are a number of parameters that may be selected and changed. This key sequences the cursor (Highlight) through those parameters.

HOLD RESET – This key is used to Hold (freeze) and Reset (unfreeze) any of the input displays. Depressing this key will hold the currently displayed Pressure or Temperature reading until reset. Each input can be held independently.

When active, the word "HOLD" is in the display. Depressing this key on a screen that is held will reset that input and remove the word "HOLD" from the display.

NOTE: In the composite screen, the hold feature requires that the specific input be selected using **SELECT** before **HOLD RESET** is used.

SETUP RETURN – This key toggles the unit into and out of the Setup Mode. Depressing this key will enter the Setup screen where the configuration can be viewed and adjusted. Depressing the key again will exit the Setup Mode and return to the previously viewed main screen. This will also save any changes to the internal EEPROM memory so they will be retained even with the power turned off or battery removed.

OPTIONS

ANALOG OUTPUT – The unit may be ordered with a DC Analog Output Option. This option provides a filtered analog output that is representative of the displayed pressure or temperature, and is provided via a BNC connector on the top of the unit. The source parameter for the analog output is selectable in the Setup Menu between Pressure (Pres) or Temperature (Temp). The output is scaled to match the 0 to FS range of the selected source parameter over a variable internally generated reference voltage. This reference voltage is selectable from 1.0 to 4.0 VDC in 0.1 V increments through the Setup Menu. Filtering is dependent on the Digital Filter Setting (See System Setup section for more information).

TEMPERATURE – The unit may be ordered with the Temperature Option.   This option allows the unit to read an external temperature sensor/transducer and display temperatures between -20 to 100 °C (-4.0 to 212.0 °F). The temperature probe interface is a standard ¼" Phone Jack.

- **YSI 700 Temperature Input (Y7)** – This option allows the unit to display temperature measured by a YSI 700 series standard temperature probe.
- **RTD Temperature Input (R1)** – This option allows the unit to display temperature measured by a standard 100 Ω RTD. This option supports selectable temperature coefficients (alpha) to match that of the sensor or probe:
  - 0.00385 Ω/Ω/°C (most common)
  - 0.00392 Ω/Ω/°C

COMMUNICATIONS

Since the meter does not handle a great deal of data, the RS-232 communications link has been optimized to allow the user, through very simple instructions, to control and request data from the meter. Refer to Specifications section for RS-232 Settings (Baud, etc).

Data transmitted/received is in standard ASCII format, and all numerical values are in BCD format. All commands sent to the unit should be terminated with a "Carriage Return" character (<CR> or in hexadecimal, 0x0D). All commands and responses are echoed by the unit for confirmation of communication, and are terminated with "Carriage Return" and "Line Feed" characters (<CR><LF> or in hexadecimal, 0x0D0A). If an invalid command is received, the unit will respond with the characters "??".

The following section describes the protocol used by the meter in detail:

R - **READ**	The READ command allows the user to read system settings and data. Usage: R(Location)(CR) Where: R - READ command Location - contains two digits indicating the data location to be read CR - Carriage Return Example: <table><tr><td>**Data Sent**</td><td>**Data Returned**</td><td>**Meaning**</td></tr><tr><td>R08<CR></td><td>R08<CR><LF></td><td>Echo of Command Sent</td></tr><tr><td></td><td>10.25 mmHg<CR><LF></td><td>10.25 mmHg measured</td></tr></table>
W - **WRITE**	The WRITE command allows the user to update the system settings. Usage: W(Location – 2 digits)(Data – 5 digits)(CR) Where: W - WRITE command Location - contains two digits indicating the data location to be written Data – five-digit field containing the data to be written at the Location set above CR - Carriage Return

	Examples:
	<table><tr><td>**Data Sent**</td><td>**Data Returned**</td><td>**Meaning**</td></tr><tr><td>W064<CR></td><td>W064<CR><LF></td><td>Echo of Command Sent (Set Pressure units to "inH$_2$O")</td></tr><tr><td>W0600004<CR></td><td>W0600004<CR><LF></td><td>Echo of Command Sent (Set Pressure units to "inH$_2$O")</td></tr><tr><td>W05100<CR></td><td>W05100<CR><LF></td><td>Echo of Command Sent</td></tr><tr><td></td><td>??<CR><LF></td><td>Invalid Command Response (Location 05 is Read Only)</td></tr></table>

U - **UPLOAD**	The UPLOAD command allows the user to read all of the selected device data from locations 1 through 16 with a single command. The data returned will be formatted as a single block per location separated by a carriage return, line feed character sequence (CRLF – equivalent to hexadecimal 0x0D0A). See the table below for details on the data structure.
	
	Usage:
	
	U(CR)
	
	Where:
	    U – UPLOAD command
	    CR - Carriage Return

Q - **QUICKSEND**	QUICKSEND is a feature that allows the user to receive an automatic update of all of the meter data without any further user interaction. When the QUICKSEND command is received, the feature is turned ON and the meter will automatically send all of the device data every half second. The Quicksend feature is toggled ON and OFF with the QUICKSEND command. See the table below for details on the data structure.
	
	Usage:
	
	Q(CR)
	Where:
	    Q – QUICKSEND command
	    CR - Carriage Return

V - **VERSION**	The VERSION command allows the user to read the Software Version that the unit is currently running.
	
	Usage:
	
	V(CR)
	Where:
	    V – VERSION command
	    CR - Carriage Return

X - **CANCEL**	The CANCEL command is simply a way to re-establish proper control, should a communications error occur or an incorrect command be transmitted. For the most part, an incorrect command will simply be ignored and the meter will return to listening for future commands. However, a prior command may be cancelled midstream by transmitting the CANCEL command anytime.
	Usage:
	X
	This command does not require a carriage return, nor will it acknowledge with a carriage return. However, it will echo an 'X' character to indicate that the CANCEL command has been received.
	NOTE: The VERSION or CANCEL commands may also be utilized as an acknowledgement of the meter being on line.

**DATA LOCATIONS**			
LOCATION	ACCESS	DESCRIPTION	RANGE		
01	READ	BATTERY LIFE REMAINING	0 to 100%		
02	READ/WRITE	CONTRAST	0 to 20		
03	READ/WRITE	AUTO POWER OFF	0 to 30 (seconds)		
04	READ	MODEL	RESERVED		
05	READ	PRESSURE 1 TYPE	1	100 PSI Max	
			2	75 PSI Max	
			3	10 PSI max	
			4	5 PSI max	
			5	0.3 PSI max	
06	READ/WRITE	PRESSURE 1 UNITS	0	PSI	
			1	mmHg @ 0 °C	
			2	mmHg @ 20 °C	
			3	inHg @ 0 °C	
			4	inHg @ 20 °C	
			5	cmH_2O @ 20°C	
			6	inH_2O @ 4 °C	
			7	inH_2O @ 20 °C	
			8	inH_2O @ 60 °F	
			9	kg/cm^2	
			10	kPa	
			11	mBar	
			12	Bar	
07	READ/WRITE	PRESSURE 1 FILTER	0-60 (seconds)		
08	READ	PRESSURE 1	See Note 1		
09	READ/WRITE	PRESSURE 1 MAX	See Note 1, 3		
10	READ/WRITE	PRESSURE 1 MIN	See Note 1, 3		
11	READ	PRESSURE 2 TYPE	0	Not Applicable	
			1	100 PSI Max	
			2	75 PSI Max	
			3	10 PSI max	
			4	5 PSI max	
			5	0.3 PSI max	
12	READ/WRITE	PRESSURE 2 UNITS	0	PSI	
			1	mmHg @ 0 °C	
			2	mmHg @ 20 °C	
			3	inHg @ 0 °C	
			4	inHg @ 20 °C	
			5	cmH_2O @ 20°C	
			6	inH_2O @ 4 °C	
			7	inH_2O @ 20 °C	
			8	inH_2O @ 60 °F	
			9	kg/cm^2	
			10	kPa	
			11	mBar	
			12	Bar	
13	READ/WRITE	PRESSURE 2 FILTER	0-60		
14	READ	PRESSURE 2	See Note 1		
15	READ/WRITE	PRESSURE 2 MAX	See Note 1, 3		
16	READ/WRITE	PRESSURE 2 MIN	See Note 1, 3		

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DATA LOCATIONS (Temp option only)				
LOCATION	ACCESS	DESCRIPTION	RANGE	
17	READ	TEMPERATURE SENSOR TYPE	0	Not Applicable
			1	YSI 700
			2	RTD 100
18	READ/WRITE	TEMPERATURE UNITS	0	°C
			1	°F
19	READ/WRITE	TEMPERATURE FILTER	0-60	
20	READ	TEMPERATURE	See Note 2	
21	READ/WRITE	TEMPERATURE MAX	See Note 2, 3	
22	READ/WRITE	TEMPERATURE MIN	See Note 2, 3	

NOTES

1. Pressure readings are returned in the currently set Pressure Units parameter in Location 6. This may be changed via the WRITE command or manually via the keys.
2. Temperature readings are returned in the currently set Temperature Units parameter in Location 18. This may be changed via the WRITE command or manually via the keys.
3. MIN/MAX readings may be reset at any time via a WRITE command to either MIN/MAX location, or manually via the keys.

MANUAL REVISIONS

Revision #	Program #	Revisions Made
Rev 01	DT7321CA	Origination
Rev 02	DT7321CB	Min/Max made standard, Quick-Disconnect added
Rev 03	DT7321CB	MC and FC option for Quick-Disconnect added
Rev 04	DT7321CG	Misc. Updates
Rev 05	DT7321CH	Format Updated, Specifications Updated, Misc. Updates
Rev 06	DT7321CI	Special Coupler Configurations option added, Max Overpressure Specification added

LIMITED WARRANTY

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SPECIFICATIONS

PRESSURE MEASUREMENT (GAUGE)		
RANGE	100 PSI SENSOR	-13.5 TO 100.0 PSI
	75 PSI SENSOR	-13.5 TO 75.0 PSI
	10 PSI SENSOR	-10.0 TO 10.0 PSI
	5 PSI SENSOR	-5.0 TO 5.0 PSI
	0.3 PSI SENSOR	-0.3 TO 0.3 PSI
RESOLUTION	100 PSI SENSOR	0.001 PSI
	75 PSI SENSOR	0.001 PSI
	10 PSI SENSOR	0.0001 PSI
	5 PSI SENSOR	0.0001 PSI
	0.3 PSI SENSOR	0.00001 PSI
MAXIMUM OVERPRESSURE	100 PSI SENSOR	200 PSI
	75 PSI SENSOR	200 PSI
	10 PSI SENSOR	45 PSI
	5 PSI SENSOR	15 PSI
	0.3 PSI SENSOR	5 PSI
ACCURACY	± 0.05% FS	
DIGITAL FILTER	0 to 10 seconds, Selectable	
COMPATIBLE MEDIA	Only non-corrosive, non-ionic, or otherwise pure fluids and/or gases that are compatible with sensor materials including glass, silicon, ceramic, epoxy, RTV, gold, aluminum and nickel.	
CONNECTIONS	See Model Number Breakdown	

TEMPERATURE MEASUREMENT (OPTIONAL)		
RANGE	-20.0 to 100.0 °C (-4.0 to 212.0 °F)	
RESOLUTION	0.1 °C (0.1 °F)	
ACCURACY	± 0.5% FS	
CONNECTIONS	¼" Phone Jack for use with ¼" Phone Plug terminated temperature cables or probes.	
TRANSDUCER COMPATIBILITY	OPTION Y7	YSI 700 Transducers
	OPTION RTD	100 Ω RTD Supports 0.00385 and 0.00392 Ω/Ω/°C temperature coefficient (alpha) sensors

ANALOG OUTPUT (OPTIONAL)	
RANGE	1.0 to 4.0 VDC/FS, Selectable
ACCURACY	± 0.1% FS
RATE	Output dependent on Digital Filter setting
CONNECTIONS	Male BNC Connector

PHYSICAL & ENVIRONMENTAL		
DISPLAY	128 X 64 Pixels Non-Backlit Graphical LCD	
CONSTRUCTION	ENCLOSURE	ABS Plastic
	OVERLAY	Back-printed Lexan
SIZE	7.69 x 3.97 x 1.80 Inches (195.3 x 100.8 x 45.7 mm)	
WEIGHT	< 1 Lbs (0.45 kg)	
OPERATING RANGE	15 to 30 °C (59 to 86 °F)	
STORAGE RANGE	-40 to 60 °C (-40 to 140 °F)	

ELECTRICAL & MISC.		
BATTERY	9V Alkaline Battery (ANSI/NEDA 1604A or equivalent)	
BATTERY ELIMINATOR	9 VDC, 200 mA ⊕–◐–⊙ BC20-21100 (USA Version) BC20-21101 (Euro Version)	
POWER CONSUMPTION	ON	< 35 mA
	OFF	< 40 µA
BATTERY LIFE	CONTINUOUS	80 hours
	OFF	1 year
RS-232 COMMUNICATIONS	BAUD	115200
	DATA BITS	8
	START BITS	1
	STOP BITS	1
	PARITY	None
	HANDSHAKING	None
	CONNECTIONS	Seven (7) pin Mini-DIN Receptacle Pinout: **RS-232** RxD 4 ■ ■ ■ 3 TxD Com 2 **NOTE: As Viewed from Unit Exterior**

NOTES

NOTES

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