

DPC300A

Reference Manual



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1. Introduction

The DPC-300A is a high accuracy portable pressure source that can accurately source pressure from internal and external pressure supplies. The product includes two pneumatic pressure sources. One source is an automated internal, -12 to 300 psi (-0.8 to 20 bar) pump and the other is connection to allow the regulation of externally supplied clean dry air (shop air up to 120psi). In addition to pressure generation and measurement, the unit has full electrical measurement capabilities from 0 to 24mA and 0 to 30VDC. It also is able to generate 4 to 20mA signals and a full-time 24 volt loop power supply is always available utilizing dedicated jacks on the front panel. Additional pressure ranges can also be supported through the use of external pressure modules. The unit can be powered by an internal, high capacity, rechargeable battery or the included AC adapter/charger.

1.1 Customer Service

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e-mail: sales@martelcorp.com

Tel: (603) 434-1433 800-821-0023 Fax: (603) 434-1653

Martel Electronics

3 Corporate Park Dr.

Derry, NH 03038















1.2 Standard Equipment

Check to see if your calibrator is complete. It should include: DPC-300A, instruction manual, test leads, calibration hose kit with fittings, 16V Universal AC charger, Nist traceable calibration certificate.

1.3 Safety information

Symbols Used

The following table lists the International Electrical Symbols. Some or all of these symbols may be used on the instrument or in this manual.

Symbol	Description
	AC (Alternating Current)
	AC-DC
	Battery
	CE Complies with European Union Directives
	DC
	Double Insulated
	Electric Shock
	Fuse
	PE Ground
	Hot Surface (Burn Hazard)
	Read the User's Manual (Important Information)
	Off
	On
	Canadian Standards Association

The following definitions apply to the terms “Warning” and “Caution”.

- “Warning” identifies conditions and actions that may pose hazards to the user.
- “Caution” identifies conditions and actions that may damage the instrument being used.

Use the calibrator only as specified in this manual, otherwise injury and damage to the calibrator may occur.



Warning

To avoid possible electric shock or personal injury:

- Do not apply more than the rated voltage. See specifications for supported ranges.
- Follow all equipment safety procedures.
- Never touch the probe to a voltage source when the test leads are plugged into the current terminals.
- Do not use the calibrator if it is damaged. Before you use the calibrator, inspect the case. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.
- Select the proper function and range for your measurement.
- Make sure the battery cover is closed and latched before you operate the calibrator.
- Remove test leads from the calibrator before you open the battery door.
- Inspect the test leads for damaged insulation or exposed metal. Check test leads continuity. Replace damaged test leads before you use the calibrator.
- When using the probes, keep your fingers away from the probe contacts. Keep your fingers behind the finger guards on the probes.
- Connect the common test lead before you connect the live test lead. When you disconnect test leads, disconnect the live test lead first.
- Do not use the calibrator if it operates abnormally. Protection may be impaired. When in doubt, have the calibrator serviced.
- Do not operate the calibrator around explosive gas, vapor, or dust.
- When measuring pressure, make sure the process pressure line is shut off and depressurized before you connect it or disconnect it from the pressure module.
- Disconnect test leads before changing to another measure or source function.

- When servicing the calibrator, use only specified replacement parts.
- To avoid false readings, which could lead to possible electric shock or personal injury, replace the battery as soon as the battery indicator appears.



To avoid possible damage to calibrator or to equipment under test:

- Use the proper jacks, function, and range for your measurement or sourcing application.

2. Calibrator Interface

Figure 1 shows the location of the pressure controls, connection port and electrical inputs.

Figure: external pressure supply

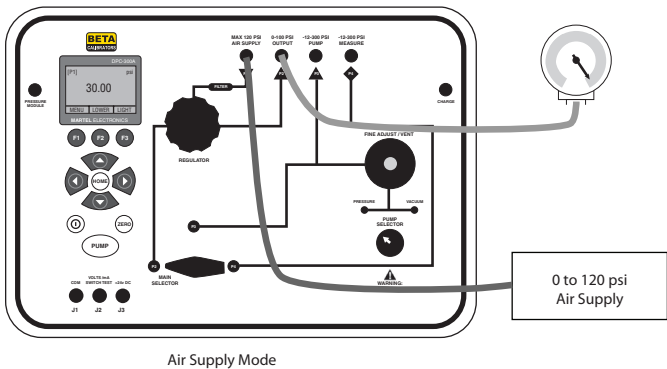


Figure: Pressure supply with integrated pump

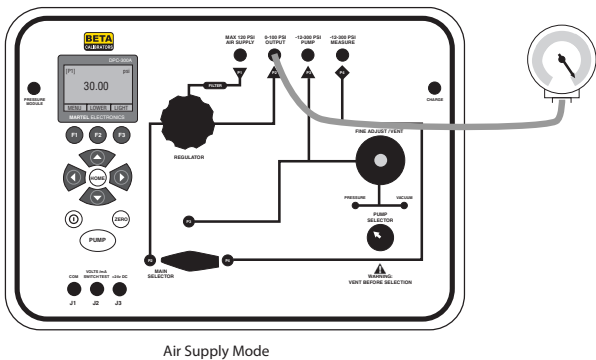
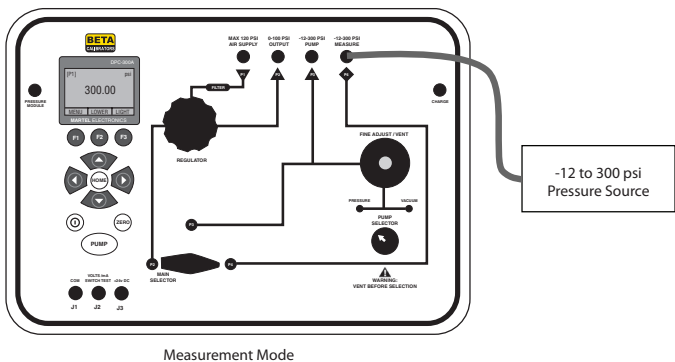


Figure: Measuring



Figures 2A and 2B show the location of the keys. Table 2 describes the function of each key.

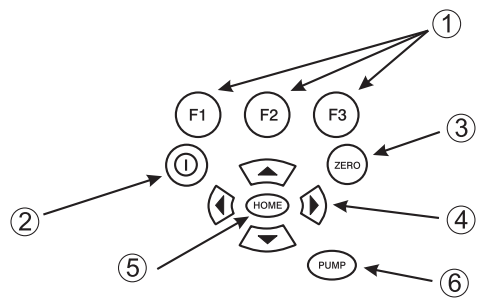


Figure 2A
Keypad

Table 2 Key Functions

No.	Name	Description
1	Function Keys	These are soft keys used to configure the calibrator
2	ON/OFF Key	This key is used to turn the calibrator on and off
3	ZERO Key	This key is used to zero pressure measurements
4	Arrow Keys	Used to control mA source/sim. and to set pump and % error limits
5	Home Key	Return to main menu screen
6	Pump Key	Push to run pump (Electric pump version)

Note: When the calibrator is turned on by pressing the ON/OFF key, it will go through a short startup self-check routine. During that routine, the display shows the current firmware revision level, auto shutdown status and the range of the internal pressure sensor. The calibrator requires a maximum of 5 minutes warm-up to rated accuracy. Large changes in ambient temperature may require a longer warm-up period. See section 2.3 for instructions on zeroing the pressure sensor displays. Pressure ranges should be zeroed each time the calibrator is started.

2.1 Calibrator Display

The Calibrator Display consists of two regions: The menu bar (located along the bottom of the screen) is used to access a menu system. The main display (the rest) consists of up to three process measurement sub-regions. These sub-regions will henceforth be referred to as the UPPER, MIDDLE and LOWER displays. Figure 3 shows the location of the different display fields while table 3 describes them.

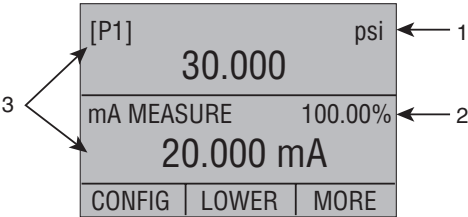


Figure 3
Display

Table 3 Display Functions

No.	Name	Description
1	Pressure units	Indication of the pressure unit (selectable from 13 pressure units)
2	Span Indicator	Indicates the percent of the 4 to 20 mA span. (For mA and mA Loop functions only)
3	Primary parameter	Indicates current measured parameter

2.1.1 Top Level Menu Functionality

There are three options for this menu: MENU, {Active Display}, and LIGHT. The Top Level Menu is home for the menu display.



2.1.1.1 Using the MENU Option

The MENU option is the gateway to the rest of the menu system.

2.1.1.2 Using the Active Display Option

The active display is indicated by the center option on the Top Level Menu. It is used to select the display to which the ZERO key will apply.

2.1.1.3 Using the LIGHT OPTION

The backlight can be toggled on and off using this key.

2.1.2 Main Menu Functionality

There are three options on the Menu, CONFIG, {Active Display} and MORE. The Main Menu is home for the menu display.



2.1.2.1 Setting the Active Display

The active display is indicated by the center option on the Main Menu, pressing the F2 key will toggle the active display.

2.1.2.2 Setting Active Display Parameters

To set the parameters of the active display use the CONFIG option to get to the Display Configuration Menu.



Here the SELECT option will toggle through the choices for each parameter. The first parameter is MODE. Since voltage, current and switch test modes all use the same jacks, two of these functions cannot be used concurrently. The ability to select certain functions is limited based on what is already selected in another display. The NEXT option is used to change to the second parameter. Only Pressure modes have a second parameter. Pressure can be read in 11 engineering units.

With a single display the following modes are available:

P[1] = Pressure internal sensor.

[EXT] = Pressure with external pressure module.

P[1] ST = Switch Test with left side sensor.

[EXT] ST = Switch Test with external pressure module.

Note: mA functions are only available on the Lower Display.

mA measure = Milliamps measure.

mA source = Milliamps source.

mA sim = Milliamps simulate using an external supply from the UUT.

VOLTS = Voltage Measure.

The following table shows which functions are available concurrently. An X in a column indicates that the mode in the active display will be available for selection if the mode in that row is in use in any other display.

Table 4 Mode Concurrency

Active Display								
Other Displays		P[1]	[EXT]	P[1] ST	[EXT] ST	mA	mA Loop	Volts
	P[1]	X	X	X	X	X	X	X
	[EXT]	X	X	X	X	X	X	X
	P[1]ST	X	X					
	[EXT]ST	X	X					
	mA	X	X			X		
	mA Loop	X	X				X	
	Volts	X	X					X

X = valid mode

2.1.1.3 Accessing Other Menus

Use the MORE option on the Main Menu to access the other menu functions.

2.2 Using the Backlight

The backlight is controlled by the LIGHT softkey on the main menu. It toggles on and off when the key is pressed; this is one of the few functions that cannot be controlled by the serial interface. There are no user configuration settings for the backlight.

2.3 Using the Zero Function

When the ZERO KEY is pressed, the calibrator will zero the **active display** if a pressure mode is selected, and the pressure is within the zero limit. The zero limits are within 10% of the full scale range of the selected sensor. If the display indicates "OL," the zero function will not operate." **Note:** The ZERO KEY is only used for pressure.

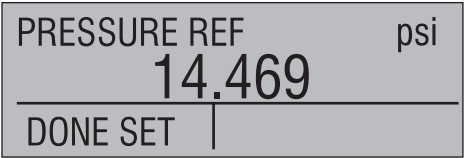
2.3.1 Internal Sensor and Pressure Module (non-absolute)

When a sensor or module is selected on the active display and the ZERO KEY is pressed the calibrator subtracts the current reading from the output. The zero limits are within 10% of the full scale range of the selected sensor. If the display indicates "OL," the zero function will not operate.

2.3.2 Absolute Pressure

When an absolute pressure range is selected on the active display and the ZERO KEY is pressed the calibrator prompts the user to enter the barometric reference pressure. This is done using the

arrow keys (F2 and F3 Keys). The sensor port should be open (vented) to atmosphere while performing this procedure.



2.4 Other Menu Controlled Functions

There are many ‘sub-main’ menus that can be accessed through the MORE option of the Main Menu. A ‘sub-main’ menu contains three options. The first option is unique to the function. The second and third options of a ‘sub-main’ menu are always the same. The NEXT option leads to the next ‘sub-main’ menu and the DONE option returns home . For the last ‘sub-main’ menu the NEXT option wraps around to home. See Figure 4 for a detailed mapping of the menu structure.

A note on naming convention:

If a ‘sub-main’ menu has subordinate menus, it will henceforth be referred to as {function} Main Menu. E.g. the display contrast sub-main menu will be called the Contrast Main Menu. If not it will be called the {function} menu.

2.4.1 Setting the Contrast

From the Contrast Main Menu choose the CONTRAST option to access the Contrast Adjustment Menu.



Use the F2, F3 keys to adjust the display contrast to the desired level and then use the CONTRAST DONE option to return home.



2.4.2 Locking and Unlocking Configurations

Use the LOCK CFG or UNLOCK CFG option of the Configuration Lock Menu to lock or unlock the display configuration.



When the LOCK CFG option is chosen the menu display returns home and the CONFIG option on the Main Menu indicates that it is locked. Also all menus are locked out with the exception of the Min

Max Menu, Contrast Adjustment menus and the Configuration Lock Menu. When the UNLOCK CFG option is chosen the configuration is unlocked and the menu display continues to the next sub-main menu.

2.4.3 Saving and Recalling Setups

The calibrator will automatically save the current set-up for recall at power-up. Additionally 5 set-ups can be accessed through the SETUPS menu. Select the SETUPS option from the Setups Main Menu.



Choose SAVE to save a set-up , RECALL to recall the set-up, or DONE to do nothing and return home.

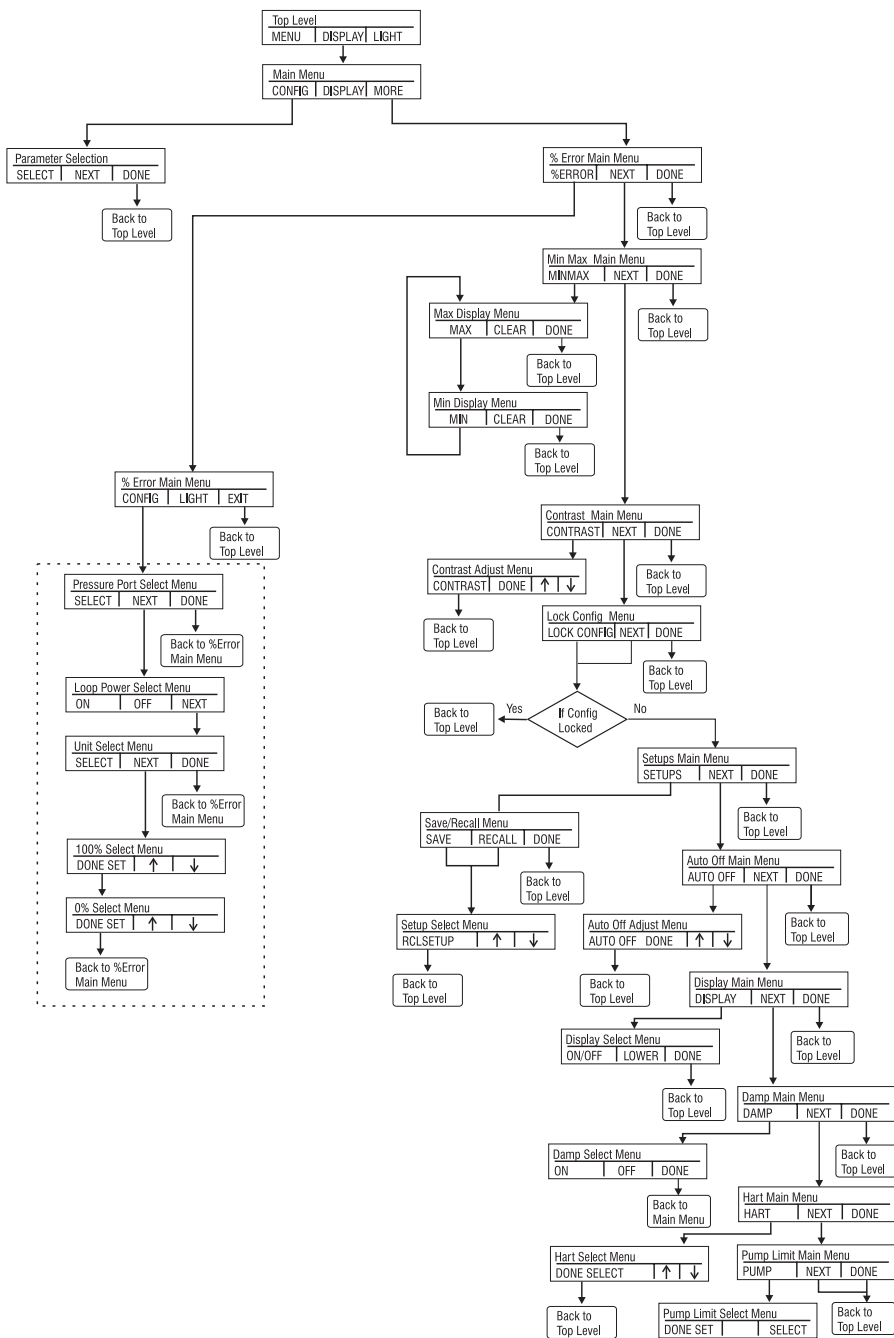


Figure 4
Menu Map

SAVE	RECALL	DONE
------	--------	------

If SAVE or RECALL is selected use the arrow keys to select the set-up location. Then use the save option to store the current set-up into the selected location or the recall option to recall the set-up stored in the selected location. The display menu will automatically go home.

SAVE SETUP 1	↑	↓
--------------	---	---

RCL SETUP 1	↑	↓
-------------	---	---

2.4.4 Setting AutoShut-off Parameters

The calibrator can be set to automatically shut-off after a selected number of minutes; this function can also be disabled. To set the auto shut off parameters select the AUTO OFF option on the Auto Shut Off Main Menu.

AUTO OFF	NEXT	DONE
----------	------	------

Use the F2, F3 keys to select the number of minutes before the calibrator turns off or disable auto shut-off by scrolling all the way down.

AUTO SHUTDOWN	15	ON
AUTO OFF DONE	↑	↓

Use the AUTO OFF DONE option to set the parameters and return home. The auto shut off time is reset whenever a key is pressed.

2.4.5 Activating and Deactivating a Display

Use the DISPLAY option on the Display Selection Main Menu to access the Display Activation Menu.

DISPLAY	NEXT	DONE
---------	------	------

The {display} option can be used to select which display to act upon. The ON/OFF option turns the selected display on or off. The selected display and current on/off state are displayed in the lower display.

MIDDLE		ON
ON/OFF	MIDDLE	DONE

Use the DONE option to save the changes and return home. When a display is deactivated its configuration is retained. When the display is activated its configuration is checked against the configurations of the other currently active displays, if the configurations are in conflict the recalled display's configuration is modified to avoid the conflict. If all three displays are deactivated the LOWER display will come on automatically

2.4.6 Damping

Damping can be turned ON or OFF using the Damping menu selection. When damping is ON, the calibrator displays an running average reading of ten measurements. The calibrator makes approximately 3 readings per second.

2.4.7 Pump Limits

To prevent overpressure of sensitive devices the maximum pressure (pump limit) can be set. When in this mode use the arrow keys to set the maximum pressure.

2.4.8 HART™ Resistor

An internal 250 ohm HART Resistor can be enabled when the BetaGauge 330 is operated in the "mA Measure-24V" mode. This allows a HART Communicator to be connected across the mA terminals and eliminates the need for adding an external resistor.

Note: When the HART resistor is on the maximum load driving capacity is 750 ohms.

3. Initial Setup and Basic Pressure Generation

1. The DPC-300A is supplied with a special low-volume calibration hose to enable faster pressure generation and quick pressure stabilisation. Included in delivery are "Quick-fit" hose connectors and various adapters. It is recommended that this hose is used in order to achieve the best results. As soon as the fittings are installed and the calibrator is connected to the test item the calibrator is ready for use.
2. The pressure calibrator must be configured for the appropriate application (see chapter 6).

3. Set the pressure/vacuum selection knob to the desired function (+ for pressure and - for vacuum).
4. Close the vent knob.
5. Press the pump key and monitor the pressure rise (or vacuum generation) until you reach the desired pressure.

Note: The motor speed will start slowly while the pressure is low (< 1 bar) to enable better control at low pressures.

6. The fine pressure adjustment enables the pressure to be set precisely.
7. To reduce or bleed off the pressure entirely slowly rotate the vent knob to the open position. The pressure reduction is best controlled if this step is carried out carefully and it makes reading the pressure easier.

4. Measuring pressure

For pressure calibration, connect the calibrator with an appropriate adapter. Select the pressure setting for the display being used. The calibrator is equipped with an internal sensor and optional external sensors are available. Choose a sensor that is suitable for the pressure range and accuracy.



Pressure sensors may be damaged and/or injuries may occur to the personnel due to improper application of pressure. For a better understanding with respect to overpressure and burst pressure, follow the specifications laid down in these operating instructions (see chapter "3. Specifications"). The calibrator display will indicate "OL" when an inappropriate pressure is applied. As soon as "OL" is observed on any pressure display, the pressure should be reduced immediately to prevent damage or possible physical injury. "OL" is displayed if the pressure exceeds the nominal range by 110 %. Use the ZERO key to zero the pressure sensor once it is vented to atmospheric pressure.

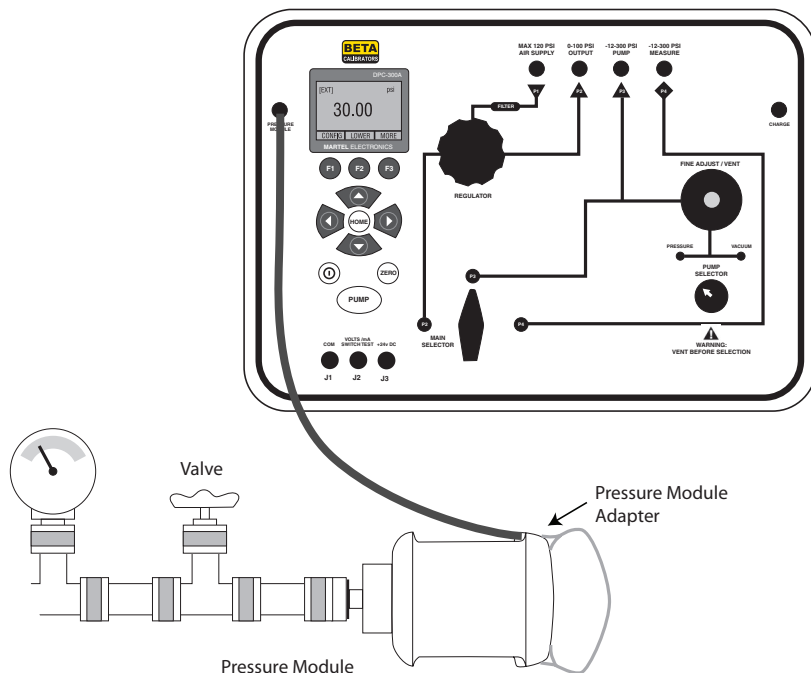
4.1 Media compatibility



The calibrator should only be used with clean, dry gases! To prevent contamination by the test pieces, the use of a dirt trap is recommended (see chapter "10. Accessories")!

4.2 Measuring pressure with external modules

The calibrator has a digital interface for external pressure modules. These modules are available for various ranges, including gauge, vacuum, differential and absolute pressure. The modules work seamlessly in conjunction with the calibrator. Simply plug them into the interface and select [EXT] (external sensor). Since the interface between the calibrator and the module is digital, the accuracy and display resolution is dependent on the module.



4.3 Measuring and sourcing current (4 ... 20 mA)

1. To measure current, use the input terminals on the front of the calibrator. Select the mA function on the lower display. Current is measured in mA and percentage of the measuring range. The measuring range on the calibrator is set to 0 % at 4 mA and 100 % at 20 mA.

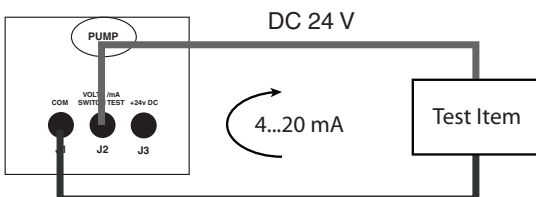
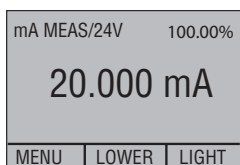
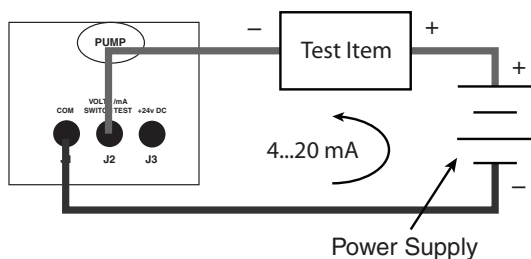
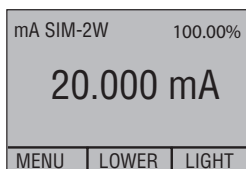
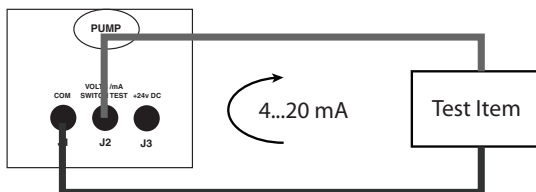
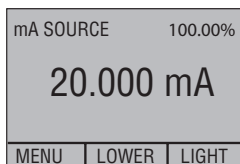
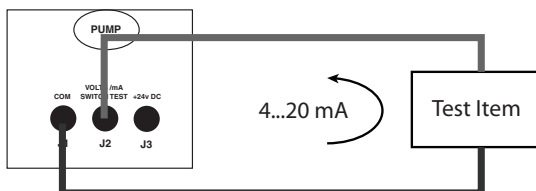
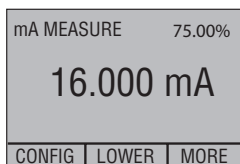
Example

If the current measured is displayed as 75 %, then the value is 16 mA.

Note: The display will indicate "OL" when the measured current exceeds the nominal range of current measurement (24 mA).

2. The same connections are used for the current source. Select mA-Source or mA Sim-2W from the configuration display.

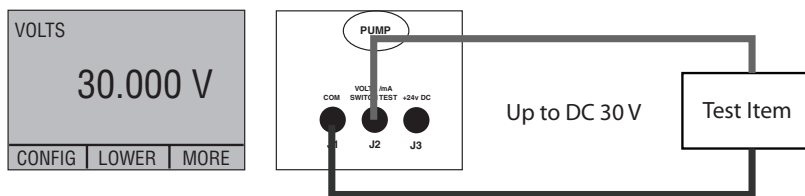
3. This selection can only be made in the lower display. Also, in source mode, the calibrator will generate 0 ... 24 mA using its own internal 24 V supply, whereas in simulation mode the calibrator acts as a 2-wire transmitter and requires an external 24 V supply.
4. Pressing any of the arrow keys will start the output mode and enable you to use the arrow keys to adjust the mA output. The function keys can also be used to progress the output in either 25 % steps (4, 8, 12, 16, 20 mA) or 0 % (4 mA) and 100 % (20 mA).
5. While in the mA output mode, if the loop is broken or the resistance burden is exceeded, the calibrator will flash "OL".



4.4 Measuring voltage

For voltage measurement, use the connections on the front of the calibrator. Select the VOLTS function on one of the displays. The calibrator can measure up to DC 30 V.

Note: The display will indicate "OL" when the measured voltage exceeds the nominal range of voltage measurement (30 V).



4.5 Performing a Pressure Switch Test

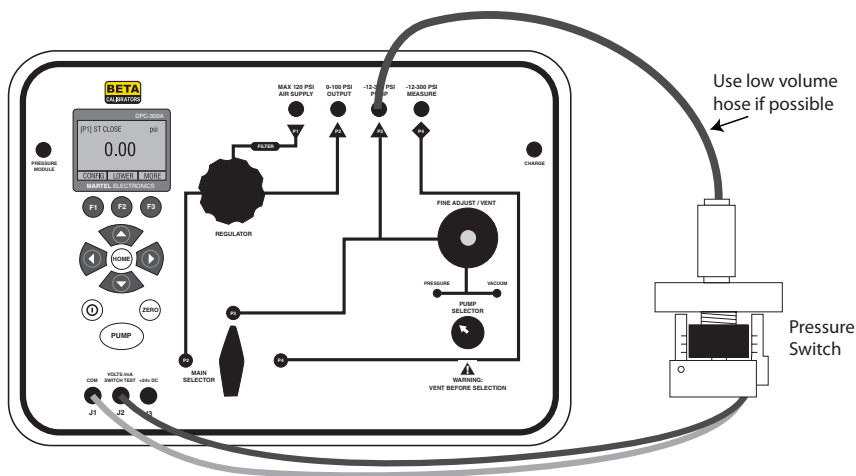


Figure 4: DPC-300A with pressure switch

To perform a switch test, the following steps must be taken:

1. The upper display is set to [P1] ST, all other displays are switched off.

Note: The pressure switch test can be performed with the following functions [P1] ST or EXT ST.

2. Connect the calibrator to the pressure switch using the switch terminals. The polarity of the terminals does not matter. Then connect the pump to the calibrator and the pressure switch.
3. Open the vent button on the pump and zero the calibrator. Then close the vent after resetting the calibrator.
4. The top of the display will indicate "CLOSE".

[P1] ST CLOSE		psi
0.000		
CONFIG	LOWER	MORE

5. Apply pressure with the pump slowly until the switch opens.

Note: In the switch test mode the display update rate is increased to help capture changing pressure inputs. Even with this enhanced sample rate the device under test should be charged slowly with pressure in order to ensure accurate readings.

6. Once the switch is open, "OPEN" will be displayed; bleed the pump slowly until the pressure switch closes.

[P1] ST OPEN		psi
30.000		
CONFIG	LOWER	MORE

7. In the top display it will now read "SW OPENED AT" and give you the pressure at which the switch opened.

SW OPENED AT		psi
30.000		
NEW TEST	NEXT	DONE

8. Select the "NEXT" option to display the pressure at which the switch closed and the hysteresis.

SW CLOSED AT psi		
29.595		
NEW TEST	NEXT	DONE

SW DEADBAND psi		
0.405		
NEW TEST	NEXT	DONE

9. Select the "NEW TEST" option to clear the data and perform another test.
10. Select the "DONE" option to end the test and return to the standard pressure setting.

Example:

[P1] ST will return to [P1].

The previous example uses a normally closed switch. The basic procedure is effectively the same for a normally open switch, the display will simply read "OPEN" instead of "CLOSE".

4.6 Calibrating transmitters

4.6.1 Using the mA measurement function

The mA function enables the user to read out the 4 ... 20 mA output from the device being calibrated. This can be done in two ways.

1. Passively – the device under test generates 4 ... 20 mA directly. This can be read on the calibrator.
2. Actively – the calibrator supplies a loop power of DC 24 V to the device under test to
3. Power the device while reading the resulting 4 ... 20 mA signal.

[P1] psi		
30.000		
mA MEASURE	100.00%	
20.000 mA		
CONFIG	LOWER	MORE

Passive

[P1] psi		
30.000		
mA MEAS/24V	100.00%	
20.000 mA		
CONFIG	LOWER	MORE

Active

4.6.2 Calibrating a pressure-to-current transmitter

To calibrate a pressure-to-current transmitter (P/I), perform the following:

1. Connect the calibrator and the pump to the transmitter.
2. Apply pressure with the pump.
3. Measure the current output of the transmitter.
4. Ensure that the read value is correct. If it isn't, the transmitter must be adjusted.

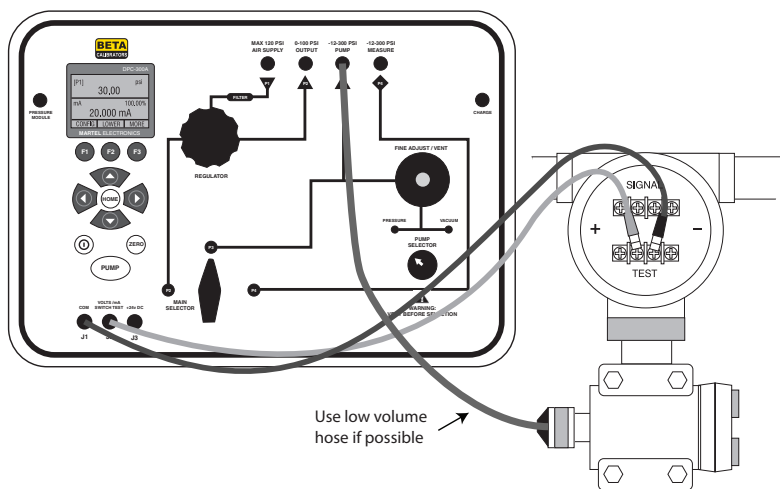


Figure 5

4.6.3 Calibrating a pressure-to-voltage transmitter

To calibrate a pressure-to-voltage transmitter (P/V), perform the following:

1. Connect the calibrator and the pump to the transmitter.
2. Apply pressure with the pump.
3. Connect the 24V to the transmitter.
3. Measure the voltage output of the transmitter.
4. Ensure that the read value is correct. If it isn't, the transmitter must be adjusted.

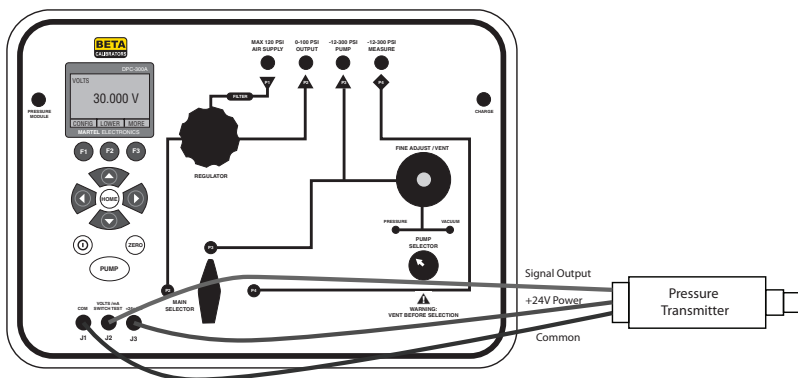


Figure 6

4.6.4 %-Error function

The calibrator features a special function which can calculate the error in the pressure value from the mA value as a percentage of the 4 ... 20 mA loop span. The %-Error mode uses all three screens and has a special menu structure. It displays pressure, mA and %-Error simultaneously.

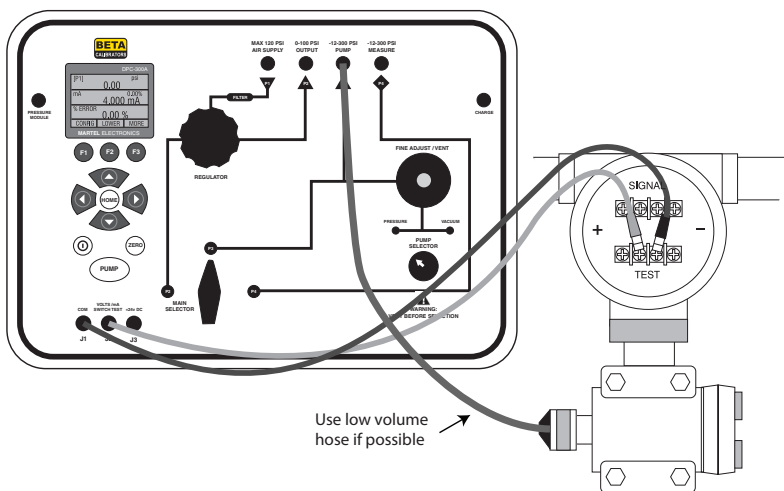


Figure 6: DPC-300A with a pressure transmitter with %-Error function

Example:

Suppose a pressure transmitter under test has a full scale range of 2 bar and gives a corresponding 4 ... 20 mA output signal. The user can programme in a 0 ... 2 bar pressure span into the calibrator and the calibrator will then calculate and display the deviation or %-Error value from the 4 ... 20 mA output. This then eliminates manual calculations.

To use the "%-ERROR" function, perform the following:

1. Once the calibrator is switched on and operating, press the F3 key to activate the "MORE" menu option. Then press the F1 key to activate the "%-ERROR" option.
2. Press the F1 key to select the "CONFIG" option.
3. The first option is the port setting. Use the "SELECT" option to scroll through the choice of ports (pressure connections). Once this is completed, select the "NEXT" option.

% ERROR PORT		[P1]
SELECT	NEXT	DONE

4. "LOOP POWER" can be toggled on or off; select "NEXT" when done.

LOOP POWER		OFF
ON	OFF	NEXT

5. Use "SELECT" to scroll through the "UNIT" options, and select "NEXT" to move on.

SET UNIT		psi
SELECT	NEXT	DONE

6. Use the arrow keys to set the upper limit of the measuring range; select "DONE SET" when finished.

SET 100% BELOW		psi
30.000		
DONE SET		

7. Use the arrow keys to set lower limit of the measuring range, and select "DONE SET" when finished. The "%-ERROR" mode will be ready to use.

SET 0% BELOW		psi
0.000		
DONE SET		

The lower and upper limit of the measuring range will be saved in non-volatile memory until they are changed again by the user for the internal sensors and the external pressure modules.

[P1]		psi
0.0000		
mA measure		-25.00%
0.000 mA		
% Error		-25.00%
CONFIG	LIGHT	EXIT

5. Minimum and Maximum Storage Capability

The 300 Series Pressure Calibrators have a min/max feature for capturing the minimum and maximum values of any displayed parameter.

The min/max function can be accessed by stepping through the menu options until “min/max” is shown on the display above the F1 key. At this time, pressing the F1 key will toggle the display through the min/max values that are stored in the min/max registers. These readings are live so that the new min/max values will be recorded while in this mode.

[P1]		psi
-0.003		
mA		-25.00%
4.000 mA		
MIN	CLEAR	DONE

[P1]		psi
30.000		
mA		-25.00%
20.001 mA		
MAX	CLEAR	DONE

To reset the min/max registers simply press the clear key. These registers are also cleared at power-up or when the configuration is changed.

6. Remote Operation

6.1 Remote Interface

The calibrator can be remotely controlled using a PC terminal, or by a computer program running the calibrator in an automated system. It uses an RS-232 serial port connection for remote operation.

NOTE: To use the remote control option a custom RS-232 cable must be purchased from Martel (LEM232). To contact Martel refer to Section 1.1 of this manual. With this connection the user can write programs on the PC, with Windows languages like Visual Basic to operate the calibrator, or use a Windows terminal, such as Hyper Terminal, to enter single commands. Typical RS-232 remote configurations are shown in Figure 13.

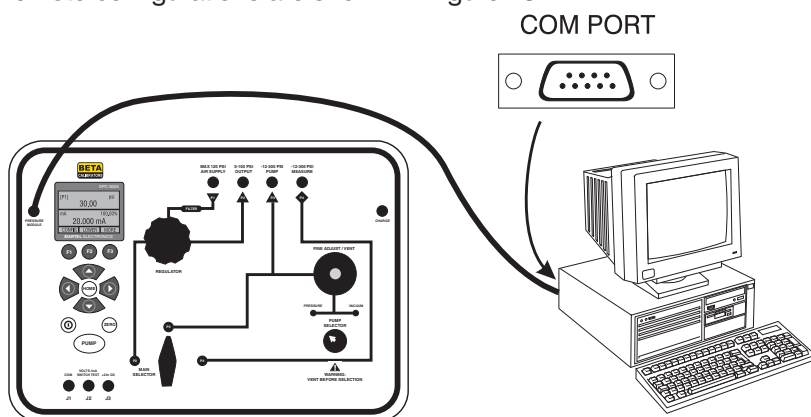


Figure 13. Calibrator-to-Computer Connection

6.2 Setting up the RS-232 Port for Remote Control

Note: The RS-232 connection cable should not exceed 15m unless the load capacitance measured at connection points is less than 2500pF.

Serial parameter values:

9600 baud

8 data bits

1 stop bit

no parity

Xon/Xoff

EOL (End of Line) character or CR (Carriage Return) or both

The LEM232 cable is used for RS-232 communications from the calibrator to a computer. If the computer only has USB type ports, a USB to RS-232 converter will be needed. These can be obtained

from most office supply and computer stores. To connect the calibrator to the computer, attach the LEMO connector end of the cable to the pressure module port on the right side of the calibrator and the DB-9 connector to the RS-232 port on the computer. The calibrator should be turned off prior to making the connection and then turned on.

To set up remote operation of the calibrator on the Windows Hyper Terminal, connected to a COM port on the PC as in Figure 23, use the following procedure:

1. Start Hyper Terminal (located in Accessories/Communications of the Windows Start menu)
2. Select New Connection.
3. For Name enter Beta 330. Select the serial port that the calibrator is connected to.
4. Enter the above information for port settings.
5. Select ASCII setup from File/Properties/Settings and mark these choices:
 - Echo typed characters locally
 - Wrap lines that exceed terminal width
6. Select Ok
7. To see if the port works enter *IDN?. This command will return information on the calibrator.

6.3 Changing Between Remote and Local Operation

There are three modes of operation of the calibrator, Local, Remote, and Remote with Lockout. Local mode is the default mode.

Commands may be entered using the keypad on the calibrator or using a computer. In Remote mode the keypad is disabled, and commands may only be entered using a computer, but choosing [GO TO LOCAL] from the menu on the calibrator display will restore keypad operation. In Remote with Lockout, the keypad can not be used at all. To switch modes proceed as follows:

1. To enable Remote mode, type in the serial command REMOTE at the computer terminal.
2. To enable Remote with Lockout, type in "REMOTE LOCKOUT" in either order.
3. To switch back to local operation enter LOCAL at the terminal. This command also turns off LOCKOUT if it was on. For more information on commands refer to the Remote Commands section.

6.4 Using Commands

6.4.1 Command types

Refer to the Section 10.5 on Remote Commands for all available commands.

The calibrator may be controlled using commands and queries. All commands may be entered using upper or lower case. The commands are divided into the following categories:

Calibrator Commands

Only the calibrator uses these commands. For example

VAL?

asks for the values displayed on the calibrator display.

Common Commands

Standard commands used by most devices. These commands always begin with an “*”. For example

*IDN?

tells the calibrator to return its identification.

Query Commands

Commands that ask for information, they always end with a “?”. For example:

FUNC?

Returns the current modes of the calibrator displays.

Compound Commands

Commands that contain more than one command on one line. For example;

PRES_UNIT LOWER, PSI;PRES_UNIT?

Sets the pressure unit to PSI on the lower display to and queries it to verify. In this case it will return the pressure units of all three displays :

BAR,BAR,PSI

6.4.2 Character Processing

The data entered into the calibrator is processed as follows:

- ASCII characters are discarded if their decimal equivalent is less than 32 (space), except 10 (LF) and 13 (CR):

- Data is taken as 7-bit ASCII
- The most significant data bit is ignored.
- Upper or lower case is acceptable.

6.4.3 Response Data Types

The data returned by the calibrator can be divided into four types:

Integer

For most computers and controllers they are decimal numbers ranging from -32768 to 32768. For example:

FAULT? could return 110

Refer to the Error Codes table (Table 8) for more information on error codes.

Floating

Floating numbers have up to 15 significant figures and exponents. For example:

VAL? returns 5.830000E01, PSI,0.000000E00, PSI,0.000000E+00,A

Character Response Data (CRD)

Data returned as keywords. For example:

PRES_UNIT? returns BAR,BAR,PSI

Indefinite ASCII (IAD)

Any ASCII characters followed by a terminator. For example:

*IDN? returns MARTEL, DPC-300A, 250, 1.00

6.4.4 Calibrator Status

Error Queue

If an error occurs due to invalid input or buffer overflow, its error code is sent to the error queue. The error code can be read from the queue with the command FAULT?. The error queue holds 15 error codes. When it is empty, FAULT? returns 0. The error queue is cleared when power is reset or when the clear command *CLS is entered.

Input Buffer

Calibrator stores all received data in the input buffer. The buffer holds 250 characters. The characters are processed on a first in, first out basis.

6.5 Remote Commands and Error Codes

The following tables list all commands, and their descriptions, that are accepted by the calibrator.

Table 5: Common Commands

Command	Description
*CLS	(Clear status.) Clears the error queue.
*IDN?	Identification query. Returns the manufacturer, model number, and firmware revision level of the Calibrator.
*RST	Resets the calibrator to the power up state.

Table 6: Calibrator Commands

Command	Description
DAMP	Turns Damp on or off.
DAMP?	Returns if DAMP is on/off
DISPLAY	Turns on/off the displays specified in the command
DISPLAY?	Returns which displays are on/off
ERROR_LOOP	Turns loop power on or off in percent error mode
ERROR_LOOP?	Returns the current state of loop power in error mode
ERROR_MODE	Turns percent error mode on or off
ERROR_MODE?	Returns whether percent error mode is on or off
ERROR_PORT	Set the pressure port for percent error mode
ERROR_PORT?	Returns the pressure port for percent error mode
FAULT?	Returns the most recent error code
FUNC	Sets the display mode as specified in the command
FUNC?	Returns the current mode of the upper, middle, and lower display
HART_ON	Turns the hart resistor on.
HART_OFF	Turns the hart resistor off.
HART?	Returns the current state of the Hart resistor.
HI_ERR	Sets the 100% of span limit for percent error mode
HI_ERR?	Returns the 100% of span limit for percent error mode
IO_STATE	Set the calibrator's mA state.
IO_STATE?	Return the calibrator's mA state.
LOCAL	Returns user to manual operation of the calibrator

LOCKOUT	Locks out the keypad of the calibrator in remote operation
LO_ERR	Sets the 0% of span limit for percent error mode
LO_ERR?	Returns the 0% of span limit for percent error mode
MOTOR_ON	Turns the motor on.
MOTOR_OFF	Turns the motor off.
MOTOR?	Returns the current state of the Hart resistor
OUT	Set the calibrator to output the requested current.
OUT?	Returns the value of the current being simulated.
PRES_UNIT	Set the pressure unit for the indicated display
PRES_UNIT?	Returns the pressure from the indicated display
PUMP_LIMIT	Sets the approximate value at which the pump will turn off.
PUMP_LIMIT?	Returns the approximate value at which the pump will turn off.
REMOTE	Puts the calibrator in remote mode
SIM	Set the calibrator to simulate the requested current.
SIM?	Returns the value of the current being simulated.
ST_CLOSE?	Returns pressure value at which the switch closed
ST_DEAD?	Returns pressure value of the deadband of the switch
ST_OPEN?	Returns pressure value at which the switch opened
ST_START	Starts a switch test
VAL?	Returns the measured values
ZERO_MEAS	Zeros the pressure module
ZERO_MEAS?	Returns the zero offset of the pressure module

Table 7: Parameter units

Units	Meaning
DCI	Current function
DCV	Voltage measure function
EXT	External pressure measurement function
LOWER	Designates Lower display
MA	Milliamps of current
MEASURE	Measure state
MEAS_LOOP	Measure with loop power state
MIDDLE	Designates Middle display
PCT_ERR	Percent Error

PERCENT	Percent
P1	P1 pressure measurement function
ST_P1	Switchtest mode with P1
ST_EXT	Switchtest mode with external module
SOURCE	Source state
SIM	Simulate state
UPPER	Designates Upper display
V	Voltage

Table 8: Error Codes

Error Number	Error Description
100	A non-numeric entry was received where it should be a numeric entry
101	Too many digits entered
102	Invalid units or parameter value received
103	Entry is above the upper limit of the allowable range
104	Entry is below the lower limit of the allowable range
105	A required command parameter was missing
106	An invalid command parameter was received
107	Pressure not selected
108	Invalid sensor type
109	Pressure module not connected
110	An unknown command was received
111	Bad Parameter received
112	The serial input buffer overflowed
113	Too many entries in the command line
114	The serial output buffer overflowed

6.6 Entering Commands

Commands for the calibrator may be entered in upper or lower case. There is at least one space required between the command and parameter, all other spaces are optional. Almost all commands for the calibrator are sequential; any overlapped commands will be indicated as such. This section will briefly explain each of the commands and describe their general use, which will include any parameters that may be entered with the command as well as what the output of the command is.

6.6.1 Common Commands

***CLS**

Clears the error queue. Also terminates all pending operations. When writing programs, use before each procedure to avoid buffer overflow.

***IDN?**

Returns the manufacturer, model number, and firmware revision of the Calibrator. For example:

*IDN? will return MARTEL, DPC300A, 0, 1.00

6.6.2 Calibrator Commands

DAMP

Turns the dampening function on or off.

For example:

If you send DAMP ON this will turn the dampening function on.

DAMP?

Returns the current state of the dampening function.

For example:

If you send DAMP? It will return ON if the dampening function is on.

DISPLAY

Turns the indicated display on or off.

For example:

If you send DISPLAY LOWER, ON this will turn the lower display on.

DISPLAY?

Returns the current state of the each of the displays.

For example:

If you send DISPLAY? It will return ON, ON, ON if the all the displays are on.

FAULT?

Returns the error code number of an error that has occurred. The command may be entered when the previous command did not do what it was meant to do.

For example, if a value for current output is entered that is bigger than the supported range (0-24mA) FAULT? Would return:

103 which is the code number for an entry over range.

Refer to the Error Codes table for more information on error code numbers.

ERROR_LOOP

Turns loop power on or off in percent error mode.

For example:

To set loop power on send ERROR_LOOP ON.

ERROR_LOOP?

Returns the current state of loop power in percent error mode.

For example:

If you send ERROR_LOOP? It will return ON if loop power is on in error mode.

ERROR_MODE

Turns percent error mode on and off.

For example:

To turn on percent error mode send ERROR_MODE ON.

ERROR_MODE?

Returns the current state of percent error mode.

For example:

If you send ERROR_MODE? It will return ON if the calibrator is in percent error mode.

ERROR_PORT

Sets the pressure port for percent error.

For example:

To set the pressure port for percent error to [P1] send ERROR_PORT P1.

ERROR _ PORT?

Returns the current pressure port for percent error mode.

For example:

If you send ERROR _PORT?, it will return P1 if the pressure port in percent error is [P1].

FUNC

Sets the display indicated in argument one to the function indicated in argument 2.

For example:

To set the lower display to pressure mode send FUNC LOWER,[P1].

FUNC?

Returns the current mode of all displays. For example if the calibrator is set to [P2] ST on the upper display, [P1] on the middle, and [P1] on the lower, FUNC? Would return:

ST_P2,P1,[P1]

HART_ON

Turns the Hart resistor on.

HART_OFF

Turns the Hart resistor off.

HART?

Returns the state of the Hart resistor.

For example:

If the Hart resistor was on HART? Would return ON.

HI_ERR

Sets the 100% point for the percent error mode calculation in the current engineering units.

For example:

To set the 100% point to 100 psi send HI_ERR 100.

HI_ERR?

Returns the 100% point for the percent error mode calculation.

For example:

If the 100% point is set to 100 psi, HI_ERR? would return 1.000000E+02, PSI .

IO_STATE

Sets the input/output/simulate state of the mA function of the calibrator. Does not put the calibrator in mA if it is not in it already.

For example:

If the calibrator is in mA simulate mode sending IO_STATE MEASURE would put it in measure mode.

IO_STATE?

Returns the input/output/simulate state of the mA function of the calibrator.

For example:

If the calibrator was in mA simulate mode IO_STATE? Would return SIM.

LOCAL

Restores the calibrator to local operation if it was in remote mode. Also clears LOCKOUT if the calibrator was in lockout mode.

LOCKOUT

Sending this command sets the lockout state, when the unit is in REMOTE or goes to remote it prohibits use of the keypad completely. The lockout state can only be cleared by sending the LOCAL command.

LO_ERR

Sets the 0% point for the percent error mode calculation in the current engineering units.

For example:

To set the 0% point to 20 psi send LO_ERR 20.

LO_ERR?

Returns the 0% point for the percent error mode calculation.

For example:

If the 0% point is set to 20 psi, LO_ERR? would return
2.000000E+01, PSI .

MOTOR_ON

Turns the motor on.

MOTOR_OFF

Turns the motor off.

MOTOR?

Returns the state of the motor.

For example:

If the motor was on MOTOR? Would return ON.

OUT

This command also switches the calibrator into mA output mode. A number and a unit must be entered after the command.

For example:

OUT 5 MA sets the current output at 5 mA

OUT?

Returns the output of the calibrator.

Using the above example, OUT? Would return: 5.000000E-03, A

PRES_UNIT

Used to set the pressure unit for the indicated display

For example:

To set the pressure unit to psi on the lower display send
PRES_UNIT LOWER, PSI.

PRES_UNIT?

Returns the pressure unit used when measuring pressure for each of the 3 displays.

PUMP_LIMIT

Sets the approximate pressure in psi at which the pump will turn off.

For example:

PUMP_LIMIT 50 sets the approximate value that the pump will shutoff at to 50 psi

PUMP_LIMIT?

Returns the pump limit. Using the above example, PUMP_LIMIT? Would return:

50.000

REMOTE

Puts the calibrator in remote mode. From the remote mode the user can still use the keypad to get back to local unless the command LOCKOUT was entered before REMOTE. Then the keypad is totally locked out, and the user has to send the LOCAL command to get back to local operation.

SIM

Sets the output for current simulation. This command also switches the calibrator into mA simulation mode. A number and a unit must be entered after the command.

For example:

SIM 5 MA sets the current simulation at 5 mA

SIM?

Returns the output of the current simulation. With the example above, the output would be: 5.000000E-03, A

ST_START

Starts a switch test.

ST_CLOSE?

Returns the pressure that the switch closed at in the current pressure units.

ST_OPEN?

Returns the pressure that the switch opened at in the current pressure units.

ST_DEAD?

Returns deadband of the switch in the current pressure units.

VAL?

Returns the value of any measurement taking place on the upper and lower display. For example, if the upper display is measuring 5mA, and the lower display is measuring 10V, then VAL? will return:

5.000000E-03, A, 1.000000E+01, V

ZERO_MEAS

Zeroes the attached pressure module. Enter the zeroing value in PSI after the command when zeroing an absolute pressure module.

ZERO_MEAS?

Returns the zero offset or the reference value for absolute pressure modules.

7. Specifications (15 °C to 35 °C unless otherwise noted.)

General

Instrument Setup Recall	5; last used on power-up
Environmental	
Operating Temperature	-10 °C to +50 °C
Storage Temperature	-20 °C to +60 °C
Battery Type	DC 16V, NiMH rechargeable battery
Battery Life (fully-charged)	Approx. 50 hours (only measurement or with external pressure supply) 125 pump cycles to 20 bar 300 pump cycles to 10 bar 1,000 pump cycles to 2 bar
Physical	
Dimensions	15.25" x 12: x 7" (387.4 x 304.8 x 177.8 mm)
Weight	15.5 lbs. (approx. 7 kg)
EMI/RFI Conformance	EN50082-1: 1992 and EN55022: 1994 Class B
Safety	EN/IEC 61010-1:2010 3rd Edition (Low Voltage Directive)
Connectors/Ports	1/8" NPT BetaPort-P pressure module adapter;
Included Accessories	manual, NIST-traceable certificate, test leads and hose kit.

Ranges

Pressure	-12 to 300.00 psi
mA	0 to 24.000 mA
Volts	0 to 30.000 VDC
Engineering Units	psi, bar, mbar, kPa, MPa, kgcm ² , mmH ₂ O @ 4°C, mmH ₂ O @ 20°C, cmH ₂ O @ 4°C, cmH ₂ O @ 20°C, inH ₂ O @ 4°C, inH ₂ O @ 20°C, inH ₂ O @ 60°F, mmHg @ 0°C, inHg @ 0°C

Accuracy

Pressure	±0.025% of rdg ±0.01% of F.S.
mA	±0.015% of rdg ±0.002mA
Volts	±0.015% of reading ±0.002V
Temperature Effect (all functions)	
No effect on accuracy on all functions from 15°C to 35°C	
Add ±0.002% F.S./°C for temps outside of 15°C to 35°C	

8. Warranty

Martel Electronics Corporation warrants all products against material defects and workmanship for a period of twelve (12) months after the date of shipment. Problems or defects that arise from misuse or abuse of the instrument are not covered. If any product is to be returned, a "Return Material Authorization" form can be obtained from our website www.martelcorp.com under customer service. You can also call 1-800-821-0023 to have a form faxed. Martel will not be responsible for damage as a result of poor return packaging. Out of warranty repairs and recalibration will be subject to specific charges. Under no circumstances will Martel Electronics be liable for any device or circumstance beyond the value of the product.

9. Maintenance

9.1 Cleaning the Unit

Warning

To avoid personal injury or damage to the calibrator, use only the specified replacement parts and do not allow water into the case.

Caution

To avoid damaging the plastic, do not use solvents or abrasive cleansers.

Clean the calibrator with a soft cloth dampened with water or water and mild soap.

9.2 Service Center Calibration or Repair

Only qualified service personnel should perform calibration, repairs, or servicing not covered in this manual. If the calibrator fails, check the batteries first, and replace them if needed.

Verify that the calibrator is being operated as explained in this manual. If the calibrator is faulty, call for an RMA number or go to www.martelcorp.com to download an RMA form to return the unit. Be sure to pack the calibrator securely, using the original shipping container if it is available.

Ranges and Resolutions

Range (PSI)		300 PSI / 20 Bar
Burst Pressure (PSI)		2000
Proof Pressure (PSI)		600
Engineering Unit	Factor	
Psi	1	300.00
bar	0.06894757	20.684
mbar	68.94757	20684
kPa	6.894757	2068.4
MPa	.00689476	2.0684
kg/cm2	0.07030697	21.092
cmH2O @ 4°C	70.3089	21093
cmH2O @ 20°C	70.4336	21130
mmH2O @ 4 °C	703.089	N/A
mmH2O @ 20°C	704.336	N/A
inH2O @ 4°C	27.68067	8304.2
inH2O @ 20°C	27.72977	8318.9
inH2O @ 60°F	27.70759	8312.3
mmHg @ 0°C	51.71508	15515
inHg @ 0°C	2.03602	610.81

- Proof pressure - maximum allowable pressure without a shift in calibration
- Burst pressure - sensor damaged or destroyed; some risk of personnel injury
- Absolute ranges - the data for the 30 PSI / 2.0 Bar, 150 PSI / 10 Bar and 300 PSI / 20 Bar ranges also applies to the absolute pressure versions of those ranges.



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