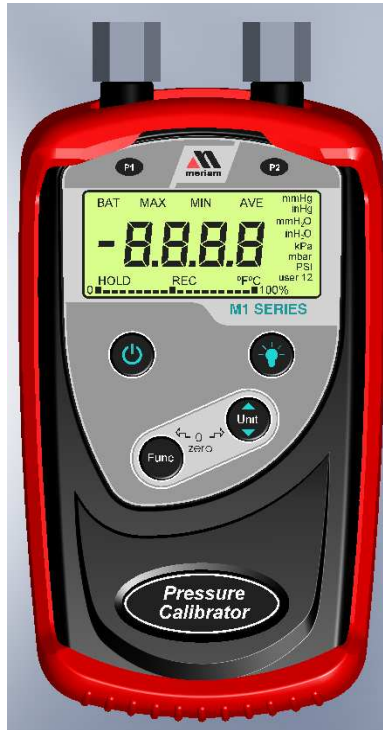


**M1 SERIES – PRESSURE CALIBRATOR
USER MANUAL**

Meriam Process Technologies' M1 Series pressure instrument is a microcontroller based pressure sensing device that can be used to directly measure pressure. Differential, Gauge and Absolute pressure sensors are supported up to 100 PSI. Pressure can be displayed in selectable engineering units of PSI, bar, mbar, kPa, mmHg, inHg, mmH2O or inH2O.

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Introduction

Thank you for purchasing this Meriam product. Meriam has been providing innovative, reliable, cost-effective measurement and calibration solutions since 1911.

The M1 has been designed using the latest technology to provide reliable accuracy throughout its entire operating temperature range, dependable operation, and exceptional battery life.

The compact design makes the unit easy to carry and the intuitive user interface makes it easy to use.

Pressure measurements are displayed on a large, easy-to-read liquid crystal display (LCD). This unit has two backlights: a green backlight which is user activated, and an automatic red backlight which indicates an error/over range condition.

Four keys provide direct access to frequently used functions (like Units, Backlight). Other, less frequently used functions (like Zero, Span, and Record) are accessible via multiple key combinations. A complete list of these functions is printed on the back of the case.

User Interface



Single Keypad Functions

ON/OFF (O) Key

The ON/OFF key, represented by the standard ON/OFF symbol, turns the M1 ON or OFF (note: the ON/OFF key must be held until the display turns on or off). Upon power on, the M1 will perform a self test, display all segments for approximately 1-2 seconds, then go into the normal pressure measure mode using the last pressure units selected.

To view the calibrated accuracy and firmware revision, press and hold the ON/OFF key for approximately 2 seconds upon power on. The display will alternate between the calibrated accuracy and firmware revision for as long as the ON/OFF key is held.

BACKLIGHT (B) Key

The BACKLIGHT key, represented by the standard light-bulb symbol, turns the green display backlight on and off. The backlight will remain on for approximately 20 seconds if not manually turned off. To temporarily override the auto shut off feature, press and hold the BACKLIGHT key for approximately 2 seconds (until the backlight turns on-off-on).

FUNC (F) Key

This key selects the functional mode of the M1. There are 5 functional modes: NORMAL (pressure measure), HOLD, MIN/MAX, AVE and TEMP. Pressing FUNC repeatedly will cycle through these modes in the order listed. Since HOLD is first in the sequence, measurements can be readily captured as needed.

UNIT (U) Key

This key selects the engineering unit of measure desired when the M1 is in NORMAL and HOLD modes. The UNIT key selects MIN or MAX in MIN/MAX mode, resets/restarts in AVE mode, and selects °C or °F in TEMP mode.

Zeroing the M1

To Zero the M1, first turn off pressure sources and vent pressure ports to atmosphere. Then simultaneously press and hold the **F and U** keys until “F.CAL” is displayed. The process is complete when the display changes from “----” to a “zero” reading.

Note: The M1 can only be zeroed if the applied pressure is within $\pm 1\%$ of the full scale range. Further details are provided under Field Recalibration.

Set Functional Mode

There are 5 possible modes: NORMAL, HOLD, MIN/MAX, AVE and TEMP ($^{\circ}\text{F}$ or $^{\circ}\text{C}$). NORMAL (pressure measure mode) is the default on power up, and is active when the latter four modes are not displayed on the LCD.

Functional Modes	
HOLD	Freezes the pressure measurement on the display, however, the bar graph is still active
MIN/MAX	Displays the MIN and MAX pressures
AVE	Displays a filtered average of the pressure measurements
TEMP	Displays the internal ambient temperature of the M1

The NORMAL mode has an additional sub mode referred to as “REC” or record mode, which is described later.

For pressure measurements:

- Selecting the HOLD mode (HOLD icon) will immediately freeze the displayed pressure measurement.
- Selecting the MIN/MAX mode (the MAX or MIN icon) will display the MAX and MIN pressures since power on or since the MAX and/or MIN value was Zeroed (see next).
 - the UNIT key will toggle between the MAX and MIN pressure measurement
 - the Zero function (**F and U**) will zero (or reset) the MAX and/or MIN values individually
- Selecting the AVE mode (AVE icon) will begin averaging the pressure measurements. While in this mode, the displayed pressure is the average of all the pressure measurements since entering AVE mode or since restarting AVE mode (see next). This mode can be used to display a stable pressure reading that may be fluctuating or noisy.
 - the UNIT key will restart (or reset) the averaging

The red backlight will illuminate when the M1 is measuring pressure values outside its calibrated range. When the red backlight is on, the accuracy of these measurements is uncharacterized.

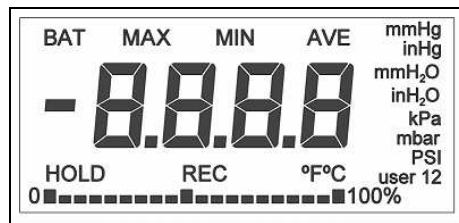
Beyond 110% of the calibrated range, “----” will be displayed. The red backlight will be illuminated in both cases.

The minimum and maximum pressure the M1 has measured is permanently recorded for factory warranty issues.

For temperature measurements:

- Selecting the TEMP mode (the °F or °C icon) will display the internal ambient temperature of the M1.
 - the UNIT key will toggle between °F and °C

The minimum and maximum temperature the M1 has measured is permanently recorded for factory warranty issues.

Liquid Crystal Display (LCD)

The LCD displays the:

- current Functional Mode via icons,
- Pressure or Temperature measurement via large digits,
- Pressure measurement via bar graph, and
- Pressure or Temperature engineering units via icons.

A low battery warning (the BAT icon) is displayed when the batteries require replacement. Approximately 2 hours of run time is available immediately following a low battery warning.

The bar graph at the bottom of the display always shows a reading of the currently applied pressure as a percent of the full scale of the M1.

The LCD incorporates two backlights:

- a green backlight which is user activated via the BACKLIGHT key, and
- **a red backlight which is automatically activated during an error/over-range condition**

During an error or over-range condition, the red backlight will “over-ride” the green backlight. However, once the error or over-range condition is corrected, the green backlight will be restored to its previous state (if the backlight auto-off timer did not expire).

The backlight should be turned off when not needed to conserve battery power. The backlight feature will be reduced when the M1 is in low battery mode.

Engineering Units Select

For pressure measurements:

mmHg (@ 0°C)
inHg (@ 0°C)
inH2O (@20°C)
mmH2O (@20°C)
kPa
mbar
bar
PSI
user 1 (optional)
user 2 (optional)

To change the pressure units, press the **UNIT** key while in NORMAL or HOLD modes.

“user 1” and “user 2” are reserved for custom user defined units of measure. Contact Meriam if this support is required.

Note: Depending upon the pressure range of the M1, some engineering units may not be available (i.e. they will be skipped).

When the M1 is turned on, it will default to the last selected pressure engineering units.

For temperature measurements:

°F
°C

To change the temperature units, press the **UNIT** key while in TEMP mode.

Notes: When the TEMP mode is selected, the M1 will default to the last selected temperature engineering units.

Record Mode

The M1 can store up to 240 pressure measurements (also called values or points) in a single record (REC) session. For maximum flexibility, a REC session can be:

- Automatic - the current value is automatically stored every 5 seconds, for up to 20 minutes
- Manual - the current value is stored every time the **U** key is pressed, up to 240 times

Both types of REC sessions can store between 1 and 240 measurements. The measurement data is preserved in non-volatile memory until another REC session is started.

REC Data:

First, set the M1 to NORMAL mode (no functional mode icons displayed). Then **enter REC Data mode** by pressing both the **B and F** keys until the **REC** icon begins flashing.

Second, choose the type of REC session.

To start an **automatic** REC session, press the **F** key. This will delete the previously stored pressure measurement and store the current pressure measurement. Then, every 5 seconds, the current pressure value will be stored.

To start a **manual** REC session, press the **U** key. This will delete the previously stored session and store the current pressure measurement. Then, every time the **U** key is pressed, the current pressure value will be stored.

For both types of REC session, the pressure value on the LCD will blank briefly every time a sample is stored, and after 240 measurements have been recorded, the following step (stop and exit REC Data mode) will happen automatically.

Third, to stop and **exit REC Data mode**, press both the **B and F** keys. All previously stored REC session data will be saved and the M1 will return to NORMAL mode (the REC icon will go off). This step can be done anytime the REC icon is flashing.

REC View:

First, set the M1 to NORMAL mode (no functional mode icons on). Then **enter REC View mode** by pressing both the **B and U** keys until the **REC** icon illuminates.

Second, press the U key to cycle through the stored values. The pressure value on the LCD will blank briefly every time a sample is displayed, and after all the recorded samples have been viewed, “----” will be displayed and the following step (stop and exit REC View mode) will happen automatically.

Third, to stop and **exit REC View mode**, press both the **B and U** keys. The M1 will return to NORMAL mode (the REC icon will go off). This step can be done anytime the REC icon is on.

Auto Shut-Off

To conserve battery life, the M1 will automatically power off after 30 minutes of keypad inactivity.

Field Recalibration

The M1 can be recalibrated in the field for zero and span. The proper primary standards must be available prior to calibrating the unit. These standards should meet the accuracy requirements for your company or industry. Meriam Process Technologies follows the guidelines established by ANSI / NCSL Z540-1-1994 which requires that the primary standard be 4 times more accurate than the unit under test.

The field recalibration is not intended to replace the original factory calibration. It is intended to trim the factory calibration curve fit to accommodate slight changes in sensor characteristics over time.

ZERO

To Zero the M1, first turn off pressure sources and vent pressure ports to atmosphere. Then simultaneously press and hold the **F and U** keys until “F.CAL” is displayed. The process is complete when the display changes from “----” to a “zero” reading.

Note: The M1 can only be zeroed if the applied pressure is within 1% of the full scale range.

The above process applies only to gauge and differential pressure instruments. To recalibrate the zero on an absolute pressure instrument, the applied pressure must be within 10 times the full scale accuracy term of the original factory calibrated zero. 200 microns is Meriam’s standard vacuum reference for all absolute pressure sensors.

Note: It should be noted that if the zero reference source used to recalibrate any pressure instrument is not accurate, the M1 zero can be recalibrated to a maximum discrepancy of 1.0% of the original factory zero. This can create a 1.0% offset in all pressure measurements after the recalibration of zero.

If this procedure generates a new value outside this limit, the red backlight will flash to indicate the procedure failed and the previous value was retained.

SPAN

First, before the M1 can be spanned, it must first be zeroed.

Second, to Span the M1, a calibration specific pressure must be applied. If this Span pressure is known (because the unit has been spanned previously), skip the next step.

To **determine the Span pressure**, make sure the pressure sources are still vented (i.e. still at zero), then press and hold the **O and B** keys until “F.CAL” is displayed. Immediately following “F.CAL” is the value of the pressure that should be applied. The red backlight will flash to indicate the M1 was not spanned (since there was no pressure applied).

Third, apply the Span pressure to the M1 and let the pressure stabilize. Then press and hold the **O and B** keys until “F.CAL” is displayed. Immediately following “F.CAL” is the value of the pressure that should be applied. The display will read “----” during the spanning process. The process is complete when the display changes from “----” to the Span pressure reading.

Note: The M1 can only be spanned if the calculated measured span is within 5 times full scale accuracy term of the original factory calibrated span pressure

For example, given:

Accuracy = 0.1% FS, FS = 100 PSI, and Span = 70 PSI the Measured Span must be within ± 0.5 PSI of 70 PSI

Note: It should be noted that if the span pressure source used to recalibrate any pressure instrument is not accurate, the M1 span can be recalibrated to a maximum discrepancy of 0.5% of the original factory span calibration pressure. This can create a 0.5% gain error in all pressure measurements after the recalibration of span.

If this procedure generates a new value outside this limit, the red backlight will flash to indicate the procedure failed and the previous value was retained.

Restore Factory Defaults

The factory calibration defaults can be restored in the M1 by simultaneously pressing the **O and F and U** keys until the display shows “----”. The process is complete when the display changes from “----” to the current pressure reading.

Specifications

<p>Type and Range:</p> <p>All sensors are non-isolated</p> <p>D – 28 inH2O (1 psi) D – 138 inH2O (5 psi) D – 416 inH2O (15 psi) D – 832 inH2O (30 psi) D – 2000 inH2O (72.3 psi)</p> <p>A – 775 mmHg (15 psia) A – 1551 mmHg (30 psia) A – 2585 mmHg (50 psia)</p> <p>G – 5 psi G – 15 psi G – 30 psi G – 50 psi G – 100 psi</p>
<p>Accuracy:</p> <p>±0.10% of FS</p> <p>Includes the combined effects of temperature, linearity, repeatability, hysteresis and resolution.</p>
<p>Temperature:</p> <p>Storage = -40°C to +60°C (-40°F to +140°F) Operating = -10°C to +50°C (14°F to +122°F) Reading = Inside product @ ±1°C</p>
<p>Media Compatibility:</p> <p>Clean, dry, non-corrosive gases only.</p>
<p>Pressure Limits:</p> <p>D – 3 × FS range on high side only or 200 PSI, whichever is less G or A – 3 × FS range or 200 PSI, whichever is less</p>
<p>Connection:</p> <p>D – 1/8" female NPT, 316SS. P1 = high side, P2 = low side G – 1/8" female NPT, P1 port only, P2 vent A – 1/8" female NPT, P1 port only, P2 vent</p> <p>See User Connection Section of this Manual</p>

<p>Battery Type: 3 x AA battery, field replaceable.</p> <p>Alkaline (A900614-00011): Duracell, PC1500, 1.5V, 2000mAh Duracell, MN1500, 1.5V, 2000mAh Varta, 4906, 1.5V, 2600mAh</p>
<p>Battery Operation: >300 hours continuous use without the backlight, 1 year shelf life, auto power off set at 30 minutes, low battery warning giving approximately 2 hours of run time.</p>
<p>Enclosure: (6.5" × 3.2" × 1.1") Polycarbonate, Permanently Static Dissipative, ESD Protection</p> <p>Enclosure with Boot: (6.8" × 3.5" × 1.3")</p>
<p>Display Resolution: Range 0-9 0-99 0-999 0-9999 Display x.yyy xx.yy xxx.y xxxx</p> <p>Some pressure units may display differently depending upon full scale range and accuracy</p>
<p>Display Warnings</p> <ul style="list-style-type: none"> ° HI = The temperature of M1 above valid calibration range/field recalibration value. ° LO = The temperature of M1 below valid calibration range/field recalibration value. P HI = Pressure applied to M1 above valid calibration range/field recalibration value. P LO = Pressure applied to M1 below valid calibration range/field recalibration value.

Certification/Safety/Warnings

The following defines the certification of the M1 Series pressure instrument.



Note the following **WARNINGS and requirements**:

- User must use bulkhead fitting hex surface when attaching user's 1/8" NPT fitting. When making mechanical connections, **DO NOT** apply torque to bulkhead fitting that causes the fitting to turn or twist with respect to plastic enclosure. To do so, will damage the product and void the warranty.

Changing the Batteries

The M1 is powered by three, 1.5 volt AA size batteries. When the output of the batteries drop below a normal level, the display will activate the "BAT" icon, indicating a low battery condition. A low battery condition may affect performance, and therefore, the unit should not be used to measure pressure. All three batteries should be replaced.

To replace the battery locate the battery compartment in the bottom rear of the M1. Remove the two screws located at the top center and bottom center of the battery cover by turning them counterclockwise until they are fully disengaged from the M1 base. Lift the cover from the back of the unit. **Do not remove the pink antistatic foam that is attached to the inside of the battery cover. This foam is necessary to properly secure the batteries under specified shock and vibration conditions!**

Remove the batteries by pulling the positive side first straight out of the battery compartment. Note the positive (+) and negative (-) battery polarity markings at the bottom of the compartment, as shown below.



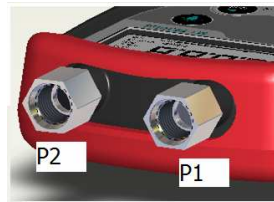
Install the three batteries by sliding them into the bottom of the battery slots, making sure the polarity markings on the batteries align with the markings shown in the battery compartment. The battery compartment has stand-offs molded into the side of the compartment. When a battery is installed with the polarity reversed, the stand-offs prevent the negative battery terminal from contacting the positive terminal in the battery compartment. The unit will not power up when a battery is installed this way. Should this happen, simply reverse the battery to correct the polarity.

With the batteries secured in the battery compartment, replace the compartment cover. The cover has only one orientation for correct alignment. The “WARNING DO NOT OPEN IN EXPLOSIVE ATMOSPHERE” statement on the battery cover must be visible and aligned in the approximate middle of the M1 case. To secure the cover, torque the screws clockwise to 1.6 in-lbs. Do not over tighten.

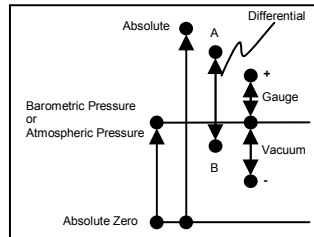
User Connections

Connection: 1/8" female NPT, 316SS. The pressure connections (P1 and P2) are marked on top of the keypad as shown on page 1.

"D" or Differential models have 2 used pressure ports. P1 is the high pressure connection and P2 is the low pressure connection (as shown below).



"G" Gauge and "A" Absolute models have one used pressure port, P1. P2 is used to vent enclosure/sensor to atmosphere (as shown above).



WARNING → Connection to the incorrect pressure port may cause damage to the pressure sensor. Once this sort of damage occurs, the unit must be returned to the factory for sensor replacement.

WARNING → User must use bulkhead fitting hex surface when attaching user's 1/8" NPT fitting. No torque can be applied to bulkhead fitting with respect to plastic enclosure.

M1 Series – PC

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Contact Information

If the M1 cannot be zeroed, spanned, or is damaged, it must be returned to the factory for servicing. In this case, contact the Meriam Process Technologies representative in your area or call the factory at the numbers listed below for a Return Material Authorization (RMA) number.

Meriam Process Technologies
10920 Madison Ave.
Cleveland, OH 44102
Ph. (216) 281-1100 FAX (216) 281-0228

All M1 Series pressure instruments recalibrated at the factory are returned with certificates of NIST traceability.