OPERATION MANUAL

DIGIMATIC DRO DISPLAY

Code No. 982-537A

Mitutoyo

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1. INTRODUCTION

1.1 OPERATOR'S SAFETY SUMMARY

To receive maximum service from your *Digimatic DRO Display*, read this manual.

CAUTION: This product is not designed to be used in a hazardous environment. To avoid an explosion, which may cause severe injury, do not operate this product in an environment where flammable gases or other combustible materials are present.

CAUTION: To avoid an electrical shock, use only the power adapter provided with this product.

NOTICE: The power adapter for this product operates on a power source of 108 to 132 VAC, 60 Hz, single phase.

NOTICE: Properly ground the *Digimatic DRO Display* to provide maximum protection from electrical noise. Electrical ground to the machine is accomplished by connecting the ground wire from the GND terminal on the *Digimatic DRO Display* to the machine frame. Make sure that the machine itself is grounded.

Manual Conventions
Throughout this manual, the convention for calling out a *Digimatic DRO Display* key is to place the key label in all capital letters. For example, "press PRESET" refers to the operator pressing and then releasing the key labeled "PRESET". If it is necessary to hold the key down, the instructions will so indicate.

1.2 ADVANTAGES OF THE DIGIMATIC DRO DISPLAY

The most obvious advantage of the *Digimatic DRO Display* is the increased ease with which machine tool operators can make measurements. The *Digimatic DRO Display* allows the origin to be set anywhere on the workpiece. Instead of adapting the coordinate system of the machine, the operators start at the point on the workpiece they find most convenient. This reduces the time spent transferring measurements from drawings. The *Digimatic DRO Display* also provides a display that is large, easy to read and precise - which eliminates the need to guess at measurements or rely on graduated dials.

Digimatic scales also improve machine accuracy and repeatability. Because Digimatic scales directly measure the movement of the worktable, they bypass mechanical error such as lead screw error and backlash. The *Digimatic DRO Display* can compensate for inaccuracies in the worktable with its linear error compensation feature.

1.3 FEATURES OF THE DIGIMATIC DRO DISPLAY

The *Digimatic DRO Display* provides accurate and direct linear measurements for 2-axes. Designed for simplified operation the most commonly used features include:

- Two origins for each axis (Absolute mode and Incremental mode)
- Preset - allows a reference point on the workpiece to be set as any value, not just zero.
- Resolution: .0005" (inch) and .01 mm (metric).
- Battery backup provides origin and preset backup in the case of power interruption.
- Linear error compensation.
- Choice of display units (inch or mm).
- Polarity reversal.

2. SYSTEM CONFIGURATION

2.1 STANDARD ACCESSORIES

Table 1. Standard Accessories

PART NUMBER	DESCRIPTION
50AAA297	AC/DC Power Adapter (120 Vac in, 5 Vdc out)
50AAA193	Operation Manual

2.2 SYSTEM DESCRIPTION

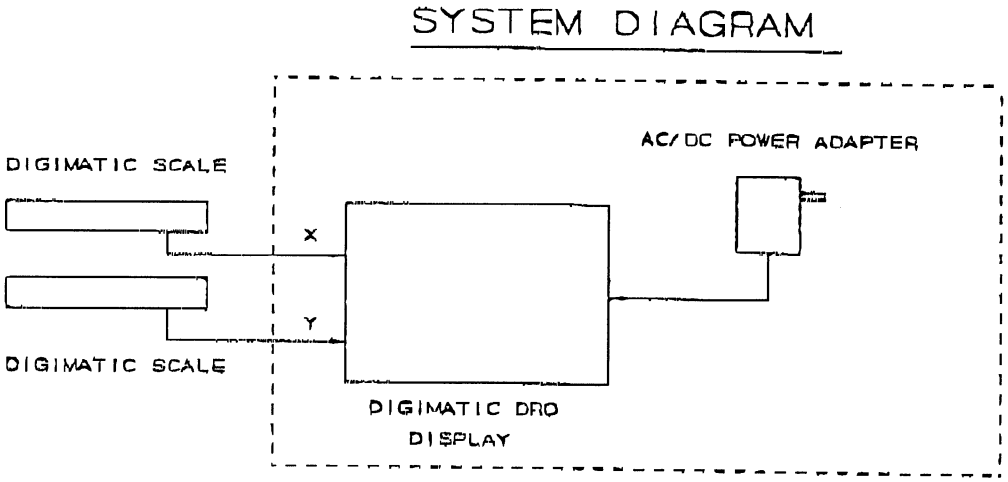

Figure 1. System Diagram

The *Digimatic DRO Display* is a two axes display intended for use with Mitutoyo Digimatic Scales. The system comprised of the *Digimatic DRO Display* and two scales provides operator feedback of tool position on manual machines.

3. NOMENCLATURE

3.1 FRONT PANEL

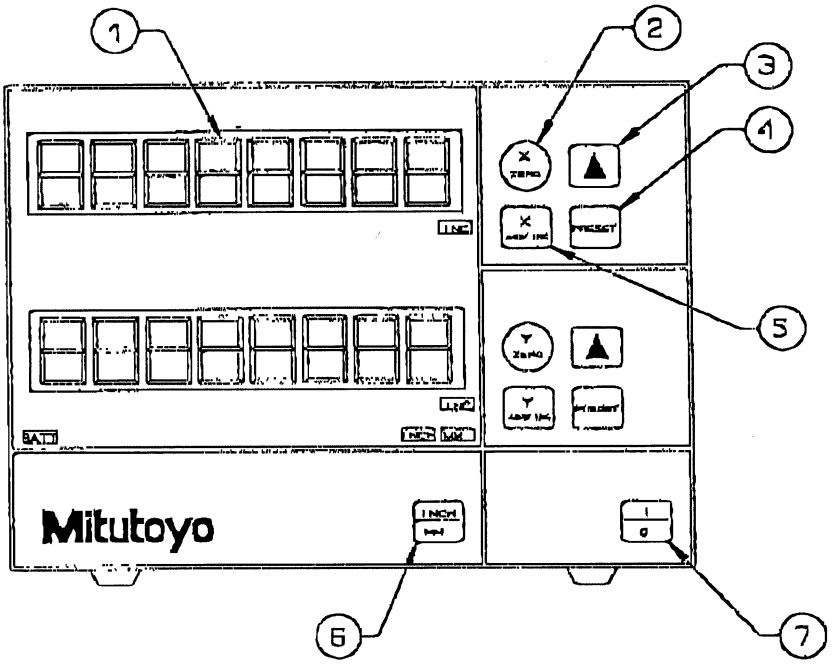

Figure 2. Front Panel

Each of the two axes has the following features:

(1) **LED Position Display**
The LED Position Display contains 8 digits including polarity digit. It displays the current position and the preset value when it is being edited.

(2) **ZERO KEY** used in both absolute and incremental modes to select the origin. Selects the current position of the scale as the origin and zeros the display. Also used to cancel preset data editing.

(3) **UP KEY** Used in Preset mode to increment the value of a digit one count at a time. Holding the key down will repeatedly increment the digit.

(4) **PRESET KEY** Used to enter and exit the Preset mode. Also used in Preset mode to select which digit will be edited by advancing right to left across the LED display.

(5) **MODE KEY** Used to select the active mode (either absolute or incremental). If the incremental mode is active, on the appropriate axis, the LED for Incremental mode, INC, will light up.

The following two keys apply to both axes:

(6) **UNIT KEY** Used to toggle between inch and mm. The same units are displayed on both axes. The LED of the active unit lights up.

(7) **POWER BUTTON** Used to turn the *Digimatic DRO Display* on and off.

There are five LED status indicators:

INCH or MM Indicates which measurement units (inch or millimeter) are currently displayed on both axes. only one unit indicator will be illuminated at any given time.

INC (X axis) When illuminated, the X axis is in Incremental mode. If this LED is not illuminated the X axis is in Absolute mode.

INC (Y axis) When illuminated, the Y axis is in Incremental mode. If this LED is not illuminated the Y axis is in Absolute mode.

BATT If illuminated, the batteries which back up the *Digimatic DRO Display* in case of a power interruption are running low and need to be replaced. Normal operation, accuracy, and zero position are not affected.

3.2 REAR PANEL

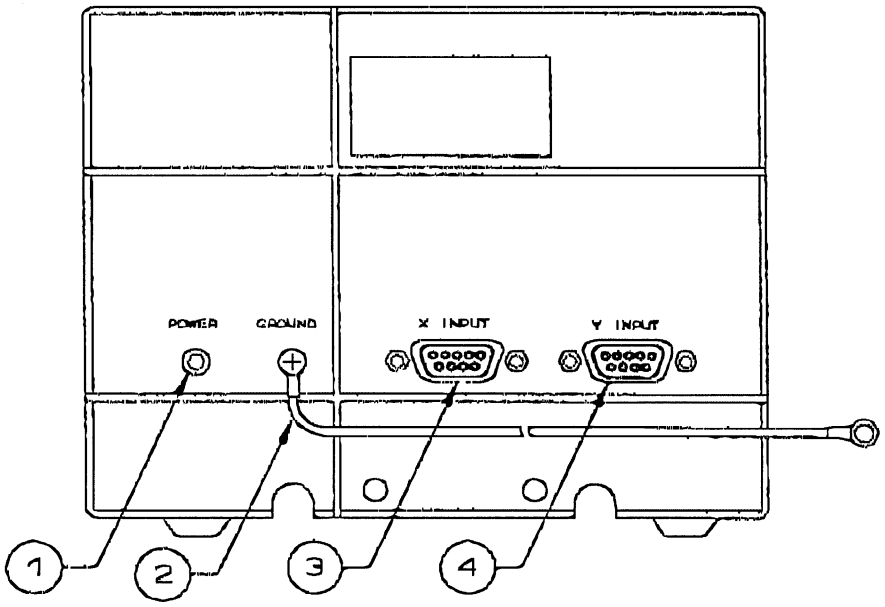

Figure 3. Rear Panel

(1) **POWER INPUT CONNECTOR**
Connects to AC/DC Power Adapter.

(2) **GROUNDING WIRE**
To provide protection from electrical noise the green/yellow wire must be grounded to the machine.

(3) **X AXIS INPUT**
Connects to the X axis Digimatic Scale.

(4) **Y AXIS INPUT**
Connects to the Y axis Digimatic Scale.

DS DRO
3.3 SIGNAL CONNECTOR on rear of DB DRO

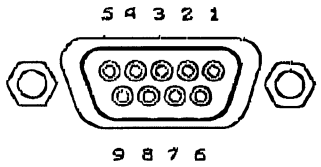

Figure 4. Signal Connector

Table 2. Signal Connector Pin Assignments

Pin Number	Signal Name
1	Data In
2	Request Out
3	Clock In
4	+1.5 Volt
5	Signal Ground
6	+5 Volt
7	Shield
8	Shield
9	No Connection

Scale

Data out
Request In
Clock out

4. OPERATION

4.1 POWERING UP

NOTICE: Make sure that the *Digimatic DRO Display* power adapter is firmly plugged into a grounded wall outlet. If possible the *Digimatic DRO Display* should have its own dedicated circuit.

Press the power button to turn the *Digimatic DRO Display* on.

When the power is turned on, the *Digimatic DRO Display* performs a self test for approximately 2 seconds as follows:

- Lamp test. All LED status indicators, LED display segments and decimal points are illuminated. The lamp test allows the user to check for a faulty LED segment or LED status indicator.
- Internal test. The *Digimatic DRO Display* shows an error code on the appropriate axis if any internal errors are detected. See "6.2 Error Codes" for the error code explanations.

After the self-test is complete, the *Digimatic DRO Display* shows the current scale position.

4.2 UNIT SELECTION

The *Digimatic DRO Display* can display the current scale position in either inch or mm. Toggling between the two units is accomplished by pressing INCH/MM (unit key). The selected units will be indicated by the status LED (INCH for inches, MM for millimeters). Selected units apply to both X and Y axes. The display resolution is .0005 inch or .01 mm.

4.3 OVERVIEW

The *Digimatic DRO Display* stores both an Absolute mode origin and an Incremental mode origin. The appropriate mode is normally selected by referring to the detail drawing of the part being machined. Figures 5 and 6 show an example of each dimensioning type.

Absolute and Incremental dimensioning can be done on the same drawing. The *Digimatic DRO Display* allows the operator to store an absolute origin, perform a series incremental measurements, and then recall the absolute origin. Changing the absolute origin will not change the incremental origin, and vice versa. With the appropriate preset, zero approach can be used in either mode.

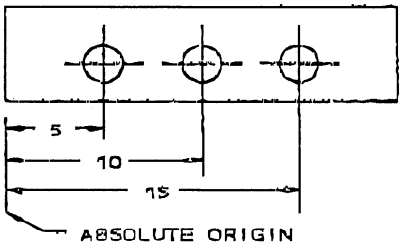

Figure 5.
Absolute Dimensioning

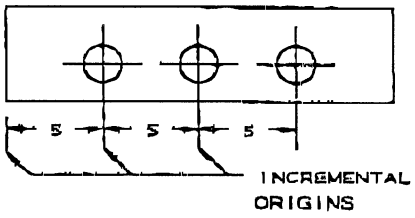

Figure 6.
Incremental Dimensioning

Absolute mode: This mode is most useful when locating a point or a series of points dimensioned from a common baseline or origin.

Incremental mode: This mode is most useful when locating a series of points that are dimensioned relative to each other.

The *Digimatic DRO Display* shows the current worktable position by adding or subtracting the distance moved from the origin or reference point entered by the user. Either location entered as a reference point (absolute or incremental) can have a "preset" value. The reference point selected doesn't have to be assigned 0, it could be 5, 5.5, 12, or any other value. See "4.5 Presetting a Reference Point" for a detailed explanation.

4.4 MEASURING DISTANCES

The following steps are performed individually for the X and Y axes. Both axes operate in the same manner.

(1) Position the worktable at the datum, origin or location selected as a reference point.

(2) Select a mode. Absolute mode is the default. The absolute mode is active if the "INC" (for incremental) LED is not illuminated. Press the ABS/INC key to switch modes, if desired.

(3) Press the ZERO key. This tells the *Digimatic DRO Display* that the current location is the origin. To preset a value for the reference point see "4.5 Presetting a Reference Point".

(4) As the worktable moves, the *Digimatic DRO Display* tracks and displays the table displacement. To make the current position the new origin for the current mode, just press zero.

4.5 PRESETTING A REFERENCE POINT

Preset mode allows the user to enter a value into the display. Preset mode can be used in both Absolute and Incremental modes. To enter a preset value for the current location of the worktable, press PRESET.

When you enter Preset mode, the *Digimatic DRO Display* shows the default preset value for the active mode (absolute or incremental). The right digit will be flashing. The flashing digit can be edited.

Absolute mode and Incremental mode have different preset defaults.

- For Absolute mode, the preset default value is the displayed location of the worktable when PRESET is depressed as measured from the last absolute origin entered by the operator.

- For Incremental mode, the preset default is the last preset value entered. This feature makes it possible to repeat an increment as many times as necessary, without re-entering the value.

- To change the value of the flashing digit, press ▲ (up key) as many times as it takes (or press and hold) until the number you want appears. The numbers recirculate like those of a digital watch. For the sign digit, pressing ▲ toggles between "-" (minus) and "P" (positive).

- To select another digit for editing, press PRESET. Each time PRESET is pressed, the next digit to the left becomes the flashing one. The 8th digit is the sign digit.

To exit Preset mode and save the entered value:

- Press PRESET while the sign digit ("-" or "P") is flashing.

  - OR -

- Press PRESET and hold for 2 seconds.

To exit Preset mode without saving the preset value: press ZERO.

After leaving Preset mode, the *Digimatic DRO Display* shows the preset value for the active mode.

4.6 ZERO APPROACH

Some machine tool operators, rather than counting up to a number as they move to a new location, prefer to count down to "0". (zero approach). Use Preset mode for zero approach. Enter the distance to your next location as a preset, but reverse the sign. See example 3 in "5. Examples of operation".

Use incremental mode to measure the same distance repeatedly. It is only necessary to enter the offset once. To recall the offset, press PRESET and hold for 2 seconds. The *Digimatic DRO Display* will enter Preset mode, recall the old (default) and save it without editing.

4.7 ERROR COMPENSATION

The *Digimatic DRO Display* is capable of performing linear error compensation to correct for error incurred by the machine. The error compensation function is an apparent multiplication of the real position by a factor close to, but not equal to 1.

To perform error compensation the user needs to provide a reference.

Procedure for machine error compensation:

(1) Move the machine to a reference point.

(2) Put the *Digimatic DRO Display* in absolute mode and press ZERO.

(3) Zero the reference.

(4) Move the machine a known distance as indicated by the reference. If the *Digimatic DRO Display* shows a position different than the reference, an error is present.

(5) To correct for the error press and hold ▲ (UP key) and then press and hold ZERO at the same time until the right-most digit starts blinking.

(6) Set the display to the correct reading as indicated by the reference by following the procedure shown in "4.5 Presetting a Reference Point". If the correction is within limits (± 2.1%) it is stored in memory. If the correction is not within limits error code E4 will be displayed. To continue after an error, press ZERO and the display is back in absolute mode with previous compensation data cleared. If ZERO is pressed while any digit is flashing in the error compensation mode the compensation data will be cleared (no error compensation).

4.8 POLARITY REVERSAL

The polarity of the *Digimatic DRO Display* can be reversed independently for each axis by means of two internal switches. The switches are marked "X DIR" and "Y DIR". Sliding one of the polarity switches will reverse the polarity for that axis. To gain access to the polarity switches the front panel needs to be opened. Refer to section "8. Battery Replacement" for instructions on opening the front panel. See "Figure 9. Battery Replacement" for location of the polarity reversal switches.

NOTE: The factory setting of the polarity switches is "-" for both axes.

4.9 BATTERY BACKUP

Battery backup eliminates the need to reposition the worktable and re-enter origins and presets after unexpected power interruptions. The battery backup saves the current origins, presets and position data. The origins and presets are also saved when the *Digimatic DRO Display* is turned off. The *Digimatic DRO Display* will not display locations while power is interrupted.

NOTE: The *Digimatic DRO Display* will operate correctly with low batteries or without batteries, as long as the power is not interrupted.

When the "BATT" LED lights up, the batteries are low on power. If the batteries are not replaced , eventually the *Digimatic DRO Display* will be unable to save the current origins and presets through a power interruption. See "8. Battery Replacement" for information on replacing the batteries.

5. EXAMPLES OF OPERATION

5.1 EXAMPLE 1

Drilling holes using absolute and incremental modes.

The following drawing is dimensioned with both absolute and relative (incremental) dimensions. The absolute origin will be set at 0,0 in the upper left hand corner. Because there are two different hole sizes, we will drill holes #1 to #4 first, then drill hole #5.

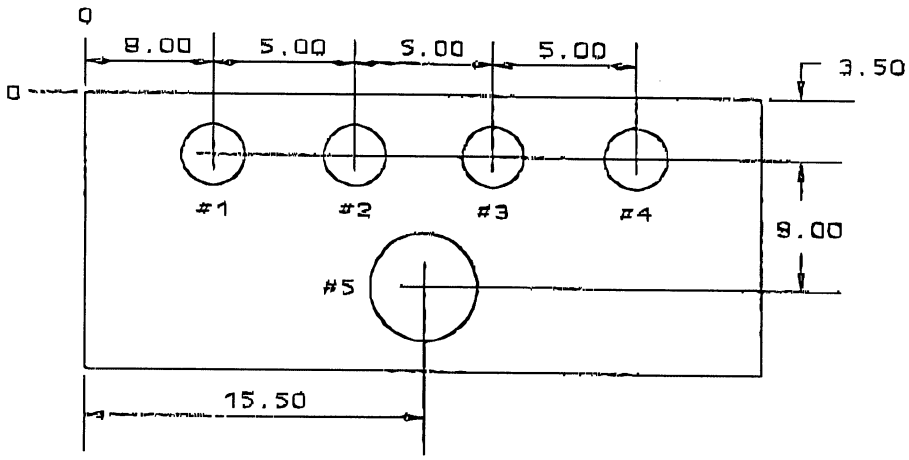

Figure 7. Absolute and Incremental dimensioning

(1) Feed the worktable and set the spindle centerline to make the upper left hand corner the origin for X and Y axes in absolute mode.

Operation	Keys	Position Display	Mode LED
Make sure the absolute origin is active for the X axis (INC LED not illuminated). Then set the origin.	X: Press ZERO	X: 0.0000 Y:	
Make sure the absolute origin is active for the Y axis (INC LED not illuminated), then set the origin.	Y: Press ZERO	X: 0.0000 Y: 0.0000	
Move the worktable and drill hole #1.		X: 8.0000 Y: -3.5000	

(2) Use Incremental mode to drill holes #2 through #4. The Y coordinate stays the same (only the X coordinate changes).

Operation	Keys	Position Display	Mode LED
For the X axis, activate the incremental origin.	X: Press ABS/INC	X: 8.0000 Y: -3.5000	X: INC
Zero the display	X: Press ZERO	X: 0.0000 Y: -3.5000	X: INC
Move the table and drill hole #1.		X: 5.0000 Y: -3.5000	X: INC
Set hole #2 as the new incremental origin.	X: Press ZERO	X: 0.0000 Y: -3.5000	X: INC
Move the table and drill hole #3.		X: 5.0000 Y: -3.5000	X: INC
Rezero hole #3 as the new incremental origin.	X: Press ZERO	X: 0.0000 Y: -3.5000	X: INC
Move the table and drill hole #4.		X: 5.0000 Y: -3.5000	X: INC

(3) For hole #5, return to absolute mode in the X axis, to allow the X axis dimension to be measured from the absolute origin. Use incremental mode for the Y axis. Drill hole #5.

Operation	Keys	Position Display	Mode LED
For the X axis, reactivate the absolute origin.	X: Press ABS/INC	X: 23.0000 Y: -3.5000	
For the Y axis set the incremental origin at hole #4 (which is the same Y location as holes #2 and #3).	Y: Press ABS/INC	X: 23.0000 Y: 0.0000	Y: INC
Move the table and drill hole #5.	X: Press ZERO	X: 15.5000 Y: -9.0000	X: INC

5.2 EXAMPLE 2

Entering a preset.

Preset mode operates in the same manner for both incremental and absolute modes. The X axis is not included in this example. For the preset location of the worktable, enter -5.00 in as an offset to the incremental origin for the Y axis. In the example below, the underlined digit will flash on the LED Position Display.

Operation	Keys	Position Display	Mode LED
The *Digimatic DRO Display* shows the current location. The Y axis is in incremental mode.		Y: 0.0000	
Enter Preset mode. The last input preset value appears with the far right digit flashing (underlined).	Y: Press PRESET	Y: 007.0000	Y: INC
Advance four digits to the left.	Y: Press PRESET four times	Y: 007.0000	Y: INC
Enter a value of "5" into the active digit.	Y: Press ▲ until "5" is displayed as the flashing digit	Y: 005.0000	Y: INC
Advance to the sign digit.	Y: Press PRESET three times	Y: P005.0000	Y: INC
Change the sign from "P" (positive) to "-" (negative).	Y: Press ▲ once	Y: -005.0000	Y: INC
Save the entered preset and return to incremental mode.	Y: Press PRESET	Y: -5.0000	Y: INC

5.3 EXAMPLE 3

Zero approach.

Before using zero approach, it is necessary to determine the direction of travel to the next point positive (increasing) or negative (decreasing). Then enter the distance as a preset, but with opposite sign.

For the workpiece illustrated below:

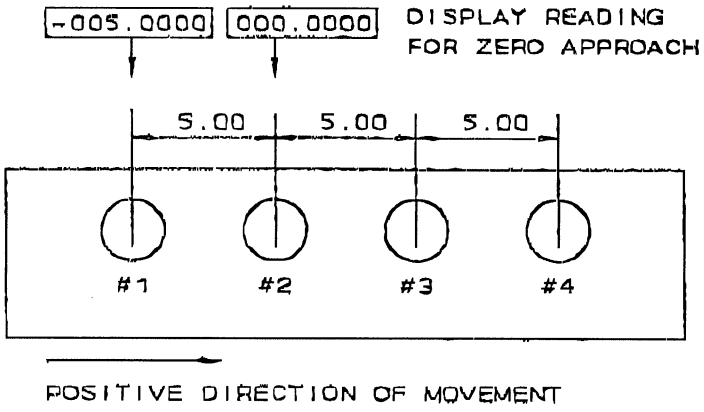

Figure 8. Zero Approach

(1) Drill hole #1.

(2) Select incremental mode for the X axis.

(3) Since The next hole is located 5 inches to the right (positive direction) preset a value of -5.0000 into the *Digimatic DRO Display.*

(4) Move the worktable until the *Digimatic DRO Display* shows zero and drill hole #2.

(5) repeat steps 2 and 3 for the next two holes. (To re-enter the preset value of -5.0000, press PRESET and hold for 2 seconds).

6. TROUBLESHOOTING

6.1 ERROR CODES

The following system status error codes may appear on the LED display.

Table 3. Error Codes

Error Code	Error Code Meaning	How to Clear	What to Do if It Keeps Recurring
All 9's	An excessively large preset value has been entered. The *Digimatic DRO Display* is unable to display this value.	Enter a smaller preset value.	
E1	Program memory check-sum failure. A fatal error. Results from a possible failure of an internal electronic component.	Press ZERO	Contact your nearest MTI Service Center.
E2	Scale data format failure. The information sent by the scale to the *Digimatic DRO Display* had the wrong format. The other axis may still be used.	Press ZERO	Test for interference due to electrical noise: Turn any nearby power equipment on and off and see if this makes a difference. If the electrical noise does not seem to be the problem, a scale may be damaged. Contact your nearest MTI Service Center.
E3	Scale data transfer time-out. The *Digimatic DRO Display* had to wait too long for a message from the scale. The other axis may still be used.	Press ZERO	Make sure scale cable is connected. Check for a bad scale cable connection and/or damaged scale cable. Test for interference as described for error code E2.
E4	Machine error correction overflow. Non-fatal. The *Digimatic DRO Display* is unable to compensate for the large amount of worktable distortion (it is larger than ± 2.1%).	Press ZERO	Operate without compensation. Repair the machine worktable.

6.2 SYMPTOMS, CAUSES AND SOLUTIONS

The following table summarizes problems that can commonly be resolved by the user.

Table 4. Symptoms, Causes and Solutions

Symptom	Cause	Solution
The display does not light.	*Digimatic DRO Display* power adapter is not plugged in.	Plug the power adapter into the wall outlet. Make sure the power adapter is firmly plugged into the back of the *Digimatic DRO Display*.
	No power at outlet.	Check for a blown fuse or circuit breaker. Check for a faulty outlet with a known working electric appliance.
	Power adapter damaged.	Check for a broken power adapter cable. Replace the power adapter if necessary. Check the DC voltage of the power adapter. If there is power at the wall outlet, but no DC power at the connector, the power adapter is probably damaged.
Part of the display or an LED does not turn on.	*Digimatic DRO Display* is in wrong mode.	Change to the correct mode.
	An LED or part of the display is burned out.	Turn the power off, and then back on. During the first 2 seconds, the *Digimatic DRO Display* will perform a self-test which will light all segments of both displays and all LED's. If an LED fails to illuminate, contact your nearest MTI Service Center.
The display doesn't change when the worktable moves.	*Digimatic DRO Display* is in preset mode.	Switch to incremental or absolute mode.

7. CARE

To clean the *Digimatic DRO Display*, wipe the outside with a soft dry cloth or a slightly damp cloth. If the surface is excessively dirty use, use a small amount of detergent. To prevent damaging the display window or plastic case, do not use organic solvents such as alcohol. To avoid damaging the internal electronics, keep any liquids from entering the *Digimatic DRO Display*. Never use compressed air to clean the *Digimatic DRO Display*.

8. BATTERY REPLACEMENT

Use two "AA" batteries. Do not use Ni-Cad batteries.

To replace the batteries:

(1) Turn the *Digimatic DRO Display* off and unplug the power adapter.

(2) Remove the two screws on the bottom front of the *Digimatic DRO Display.*

(3) Carefully rotate the bottom of the front panel out. It is held in place by two tabs at the top. Lay the panel keypad side down.

(4) Release the tie wrap and remove the old batteries. Install new batteries and make sure polarity is correct, then reattach the tie wrap.

(5) Insert the front panel tabs back in place, Rotate the panel down and reinstall the two screws.

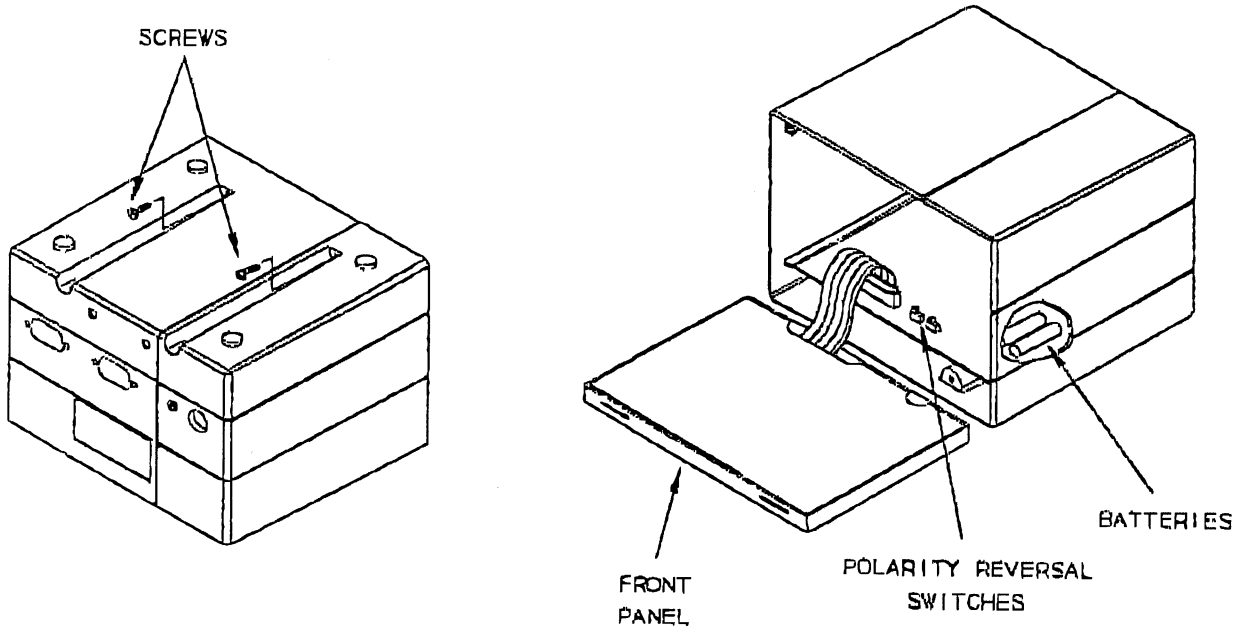

Figure 9.
Battery Installation

9. GENERAL SPECIFICATIONS

Table 5. General Specifications

Attribute	Specification
Input data format	Mitutoyo Digimatic Code
Scale resolution	.0005 in. (.01 mm)
Response speed	40" per second (1 meter per second)
Display Type: Range:	 7 segment, .56" green LED -99,999.99 to +99,999.99 mm -999.9995 to +999.9995 in. (7 digits and sign)
Input power	5 Vdc, 400 mA
Temperature Operating: Storage:	 0°C to 40°C -20°C to 70°C
Dimensions	6.7" W x 5.0" H x 6.0" D
Weight	Approx. 2 lbs.