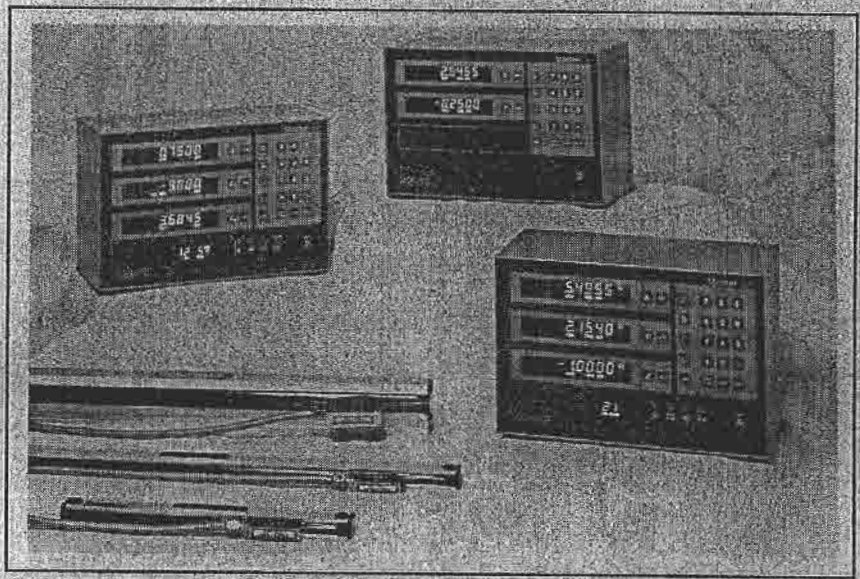


Stant S.N.

9603-1335

# Master-TP

Digital Readout System



## REFERENCE MANUAL

**ACU-RITE®**

Note: Since the ZERO key is decoded as the axis key, it effectively selects and deselects the axis for numeric entry as well.

### Tool Direction (Edge) Annunciators

The operation of the tool direction annunciators have be modified such that only axis related information is displayed. Only the X axis direction annunciators are displayed on the X axis, and only the Y axis direction on the Y axis. The Z axis tool direction annunciators are not used.

### Multiple Scale Coupling with Axis Encoders

By enabling a special coupling mode in the personality mode, it is possible to couple any of the scale inputs to one of the displays. The only exception is that a scale may not be coupled to itself (i.e. X coupled to X). The feature is available on both Mill and Turn specific units.

In the personality mode, the special coupling mode is enabled by selecting the number of axes parameter and pressing the 2nd key followed by the X Zero key. The display will show a two digit number with the first digit indicating the number of axis displays and the second digit indicating the number of axis scale inputs (option board not included).

22 - 2 axis displays/2 scale inputs  
23 - 2 axis displays/3 scale inputs  
33 - 3 axis displays/3 scale inputs

Coupling is enabled from the setup mode. The MSC axis parameter is selected. Instead of having the option of enabling/disabling coupling (COUPLE 1/COUPLE 0), the axis input to be coupled with the display axis is selected. Only available coupling axes are presented:

COUPLE 0 - Disabled (No Coupling)  
COUPLE 1 - X axis  
COUPLE 2 - Y axis  
COUPLE 3 - Z axis  
COUPLE 4 - MSC Option Board encoder

If the coupled source axis has a display (i.e. coupling Y to X), the source axis display will be blanked (i.e. Y is blanked).

Changing coupling status will reset both the source and destination axis displays.

## Master readout parameter access code

An access code must be entered before axis and system parameters can be set or changed. This prevents inadvertently resetting parameters.

### IMPORTANT

The access code is 8891

Refer to Section 1. Master measuring system setup operations. Begin the parameter setup mode from the DRO mode by pressing the 2<sup>ND</sup> and SET SYS keys; a "Code \_\_\_\_" message is displayed. Press the 8, 8, 9, and 1 keys. The "code" message is replaced with "Set sys", indicating that the Master readout is ready for parameter setting operations. Set parameters as described in Section 2.

### IMPORTANT

Supervisors may wish to remove this page from the Master manual after initially setting up the readout system. Keep it in a safe place for future use.

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## ***Installation***

### ***Introduction***

The family of Master readouts are application-specific full-featured readouts that provide the measuring features required to obtain the most productivity from your manual machine tool.

- Master-MP® is a two- or three-axis application-specific readout designed especially for milling operations. It includes features to support common milling requirements such as creating hole patterns, and can be programmed to assist with producing multiple parts.
- Master-TP® is a two- or three-axis application-specific readout designed especially for turning operations. It includes features to support common turning requirements such as tool offsets, and can also be programmed to assist with producing multiple parts.
- Master-G® is a one-, two-, or three-axis general-purpose readout that provides the features required for most common machine tool operations. Programming features are not provided.

All Master readouts can be provided with options to allow coupling of two encoders onto one measurement axis, provide bi-directional RS232-C serial communications with a computer or output to a printer, provide connections to a parallel printer, provide a Control Function Interface (CFI) for simple machine control functions, and to provide a battery backup.

### • **Accessories**

Accessories are available to enhance your Master measuring system. They include:

- A Master Foot Switch for remote zeroing of selected axis displays
- An Edge Finder Probe to speed workpiece setup and measuring

These accessories provide additional functions and capabilities to create a customized solution to your measuring system needs. To order these accessories, contact your ACU-RITE Distributor or Original Equipment Manufacturer/Importer (OEM/OEI), or call the ACU-RITE Sales and Service Center at (800) 344-2311.

## Installing the Master Measuring System

### IMPORTANT

Before installing the Master readout, record the serial number on the Warranty card. The serial number label is located on the bottom of the Master readout.

#### • Selecting Location

Selecting a location for the Master readout is an important consideration for proper installation. Keep the following points in mind when selecting a safe and convenient location:

- The Master readout should be within easy reach of the operator for access to the keypad and other controls.
- The Master readout should be at approximate eye level and tilted towards the operator.
- Avoid moving components or tools, and minimize coolant splash or spray.
- The operating environment must be within the range of 0° to 40° C (32° to 104°F), with a non-condensing relative humidity of 25% to 95%.

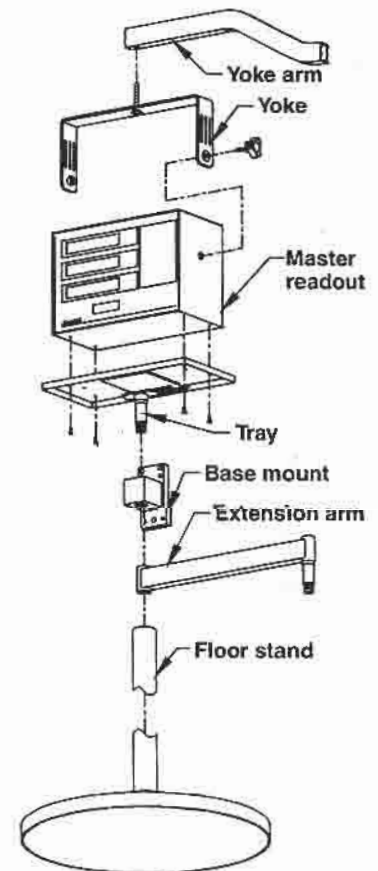
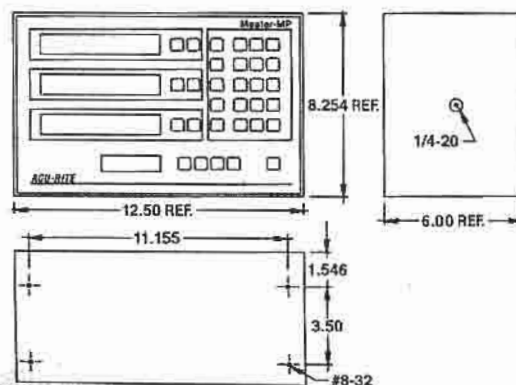
#### • Proper Mounting

ACU-RITE has developed special mounting kits for the Master readout which address the most common mounting requirements. Mounting kits include:

- Column and base machine mountings and floor stands
- Tray and yoke readout mounts
- Hardware and mounting instructions

These kits are available from your ACU-RITE Distributor, OEM/OEI, or the ACU-RITE Sales and Service Center at (800) 344-2311.

If fabricating a support device for the Master readout, it should be large and strong enough to accommodate the readout and any other devices that may be placed on top (printer, etc). It must also be stiff enough to minimize any vibration induced by machinery on the shop floor; vibration will make the displays difficult to read.



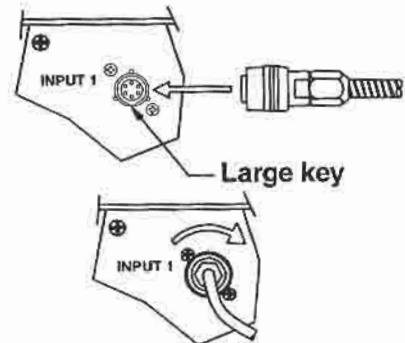


- **Connecting Encoders**

Encoder input receptacles :

|         |         |
|---------|---------|
| INPUT 1 | X Axis  |
| INPUT 2 | Z1 Axis |
| INPUT 3 | Z2 Axis |

Insert the male connector from each encoder, with the large spline down, into mating receptacle on the back of the Master readout. Lock it in place with a 1/4-turn of the outer shell. If using encoders other than ACU-RITE's, refer to the connector requirements in Appendix C of Section 4. Appendices. Obtain the correct connectors and install it on the encoder cables.



Provide enough slack in the encoder cables to allow for full travel of all machine axes. Assure that cables will not be pinched by table movements. Use the cable tie-down hardware kits supplied with the encoders to fasten the cables neatly to the machine.

- **Connecting Accessories**

Connect all accessories to the Master readout. Refer to Appendix D in Section 4. Appendices for a description of the ACU-RITE Foot Switch and Edge Finder Probe accessories and hookup information.

Each accessory should be mounted so that:

- Vibration, normal material handling, traffic near the installation site, and operation of the machine will not damage the accessory or cause it to fall.
- Power and signal cords are out of the way so they will not be damaged by machining operations or normal traffic, and are not a tripping hazard to the operator.
- Cords provide enough length to allow normal movements of the machine tables, the Master readout and its mountings, and other machine or mounting components.
- The accessories are within the view and easy reach of the operator.

- **Connecting Ground, Checking Voltage, Connecting Power**

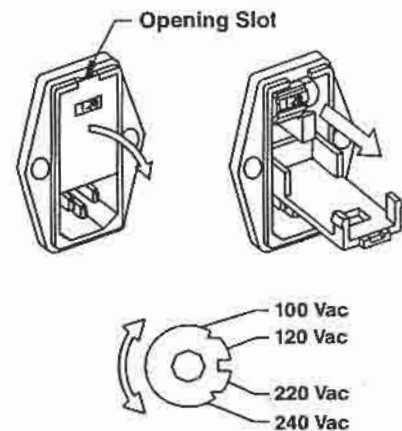
Connect a ground wire from the terminal on the back of the Master readout to the machine. The machine should also be connected to a solid earth ground.

Confirm the voltage available at the power source for connecting to the Master readout. Refer to Appendix B in Section 4. Appendices for a listing of the acceptable voltage ratings for use with the Master readout.

### CAUTION

Connecting the Master readout to a power source outside of the acceptable range, or making an inappropriate setting with the voltage selector may damage the Master readout or the encoders.

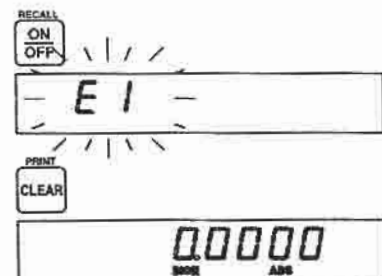
The voltage selector is set for 120VAC operation. If required, set the voltage selector to match the line voltage. Remove the caution label from the input module, and use a thin-bladed screwdriver in the slot at the top of the power input module to open the module cover. Pull the selection drum out, rotate it to the correct setting, and push it back into place. Close and snap the cover shut. The voltage setting will show through the window in the cover. Connect the Master readout to the power source using the power cord supplied.



### Initial System Power-up

Press the **ON/OFF** key on the front of the Master readout. The X-axis display flashes "E1", indicating that power to the readout has been interrupted. Press the **CLEAR** key. The Master readout commences digital readout (DRO) mode operations, with all displays zeroed.

Proceed to Section 2. System Set-Up for instructions on entering setup parameters.



## SYSTEM SET-UP

### Set System Mode

Requires Access Code. Set when the readout is initially set-up and infrequently changed. Used to set all Axis Parameters.

- **Setting Parameters**

- **Entering Set System Mode:**

- Press   keys to start Setup
    - Enter Access Code #\_ \_ \_ \_ found at the front of this manual. (This page may have been removed for safekeeping.)
    - At  display, Press axis key you wish to change. Ex:

The following parameters can be set for each axis:

|                                      |                                  |
|--------------------------------------|----------------------------------|
| <input type="text" value="Enc RES"/> | Encoder Resolution               |
| <input type="text" value="RAD-DIA"/> | Radius/Diameter Switching Enable |
| <input type="text" value="LEc"/>     | Linear Error Compensation        |
| <input type="text" value="Enc dir"/> | Encoder Count Direction          |
| <input type="text" value="FACTOR"/>  | Multiplier Factor *              |
| <input type="text" value="nEAR 0"/>  | Near-Zero Warning *              |

\* Parameter may be set without entering code through Quick Access Setup

- **Quick Access Parameter Setting** - can be used for Scaling Factor Multiplier, Near-Zero Warning and CFI option. These parameters may be changed often during machining. Quick Access does not require access code entry and locks system parameters out to prevent accidental changes.

- **To Enter Quick Access Mode:** Press   and Axis Key. Ex:

## • Setting Axis Parameters

- Press **ZERO** to display current parameter setting.
- Pressing **ZERO** repeatedly toggles through parameter choices.
- Pressing Axis key moves to the next parameter. Ex: **X**
- To set, or display, parameters on a new axis, Press desired axis key.  
Ex: **Y** or **Z**
- **Save Changes:** Press **ON/OFF** to save settings and return to DRO mode.
- **Abandon Changes:** Press **2nd** **SET SYS** **ENTER** to return to DRO mode without changing setups.

### Entering Numeric Information:

- Use minus key as required.
- If needed, clear incorrect entries by pressing **CLEAR**
- Last entry may be recalled by pressing **2nd** and axis key. Ex. **X**
- An axis may be de-selected by pressing the axis key again.
- More than one axis can be selected at a time for common numeric entry.

## **ENCRES**

Encoder Resolution

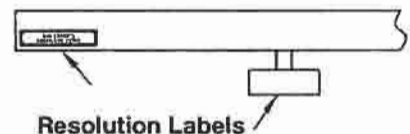
Can be entered by choosing a table value or with a numeric entry.

- **Choosing the correct resolution** - from the list of available settings:

Note: Current ACU-RITE encoders are metric scales.

- *Use the following table to choose the correct metric encoder setting from the internal list in the readout:*

| Setting (mm) | Resolution label |
|--------------|------------------|
| .01          | = 10um (.0005")  |
| .005         | = 5um (.0002")   |
| .002         | = 2um (.0001")   |
| .001         | = 1um (.00005")  |



- Press **ZERO** for current setting
- Press **ZERO** again to toggle through available settings
- **To make a numeric entry for ACU-RITE English scales or non-ACU-RITE encoders:**
- Press **CLEAR** to zero out display
- If needed, Press **2nd** **INMM** **SET ABS** to set required measuring units. Enter numeric value.

NOTE: To clear an incorrect entry, Press **CLEAR**

## **RAD-DIA**

### Radius/Diameter Switching Enable

When an axis is set to enable the feature, the axis display will change between radius and diameter measurements when the RAD/DIA key is pressed.

Factory Default = 1 or Active

#### • **Setting Radius/Diameter Switching**

- Press **ZERO** for current setting.
- Press **ZERO** again to toggle through available options:
  - 1 = Enabled
  - 0 = Disabled

## **LEC**

### Linear Error Compensation

Can be entered with a numeric entry or by using the automatic routine.

#### • **Setting LEC with a Numeric Entry:**

- Press **ZERO** for current setting.
- Enter PPM (Parts Per Million) with numeric keypad.
- Press **ENTER** to record setting.

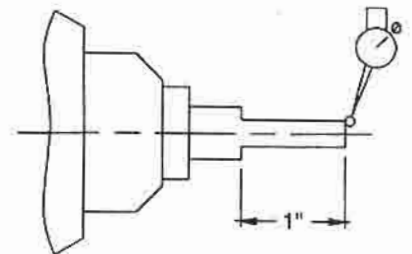
Note: The sign is important; use the **-** key to change the sign of the compensation factor. Direct entry requires that the LEC factor be determined manually.

#### • **Setting LEC using Automatic Routine**

Requires either a manual or electronic Edge Finder Probe.

##### • **Manual Edgefinder, same side surfaces (ex: dial indicator)**

1. Install a measurement standard of known length on the table, aligned with table movement.
2. Install edgefinder securely in the tool holder or at another fixed reference position.
3. Press **ZERO** to display current setting.
4. Locate first edge of the standard,  
Press **ZERO** again to zero the display.



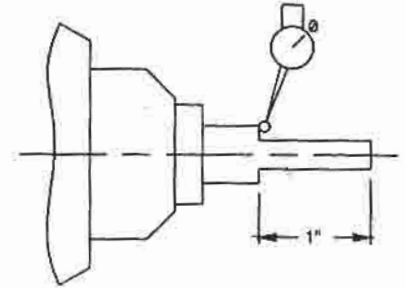
5. Move to the opposite end of the standard. As the example illustrates, use a firm, flat surface to create a marker at the end of the standard. Touch the end marker with the same side of the edge finder used to touch off the first edge. The axis display will show the distance moved (usually this value will be slightly different from the length of the standard).

Press

6. At  Press

7. At  Enter the length of the measuring standard,

Press  - axis display will indicate calculated LEC factor in PPM.



• **Manual Indicator, opposite side surfaces**

1. Install a measurement standard of known length on the table, aligned with table movement.

2. Install edgefinder securely in the tool holder or at another fixed reference position.

3. Press  to display current setting.

4. Locate first edge of the standard,

Press  again to zero the display.

5. Move to the opposite end of the standard.

Locate the second edge of the standard (usually the value will be slightly different from the length of the standard).

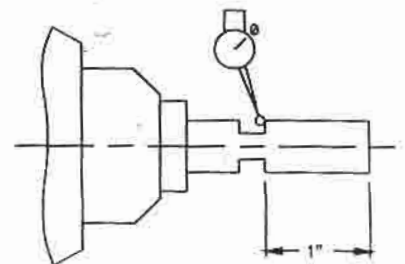
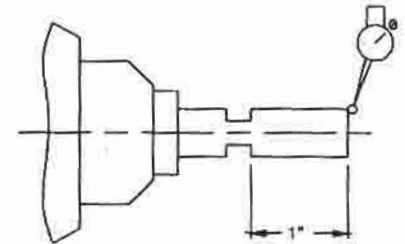
Press

6. At  Enter the diameter of the edgefinder probe tip,

Press

7. At  Enter the length of the measuring standard,

Press  - axis display will indicate calculated LEC factor in PPM.



**NOTE: E4 Error**

E4 error indicates the calculated LEC factor is outside acceptable range of -9999 to +9999. Typically the result of incorrect entry during automatic routine.

Press **ZERO** to re-start automatic routine at step 3.

- OR -

Press **CLEAR** to return to manual entry.

**Factor** Multiplier Factor

Can be set either in Axis Parameter Setup or Quick Access Setup.

Factory Default = 1.000000 or No Multiplier Factor

• **Setting Multiplier Factor**

- Press **ZERO** to view existing factor.
- Enter new value with numeric keypad.

**Value > 1 ENLARGES** features. Ex: setting scaling factor to 2 will double the size of the part as compared to the engineering drawing.

**Value < 1 SHRINKS** features. Ex: setting scaling factor to .5 will decrease the size of the part by 1/2, as compared to the engineering drawing.



**NOTE:** accommodating for material shrinkage. For a scaling factor that reflects 3% part shrinkage, determine the scaling factor as follows:

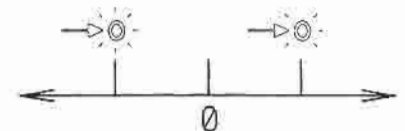
$$\begin{aligned}
 \text{Scaling Factor} &= 1/(1-\text{shrinkage factor}) \\
 &= 1/(100\% - 3\%) \\
 &= 1/(0.970) \\
 &= 1.0309
 \end{aligned}$$

**Mirror Imaging:** A scaling factor of -1.0 directly mirrors the dimensions entered. The scaling factor may be set to other negative values to both mirror and scale the features.

**nEAR 0** Near Zero Warning

Can be set either in Axis Parameter Setup or Quick Access Setup.

Indicates that the tool is nearing zero. When the value of the axis display is within the near zero range set by the operator, the Near 0 annunciator (→0) on that axis will flash.



- **Quick Access Setup**

In Quick Access Setup Mode:

- Press **ZERO** for the current Near 0 value.
- Enter new range with numeric keypad.

**Encoder** Encoder Counting Direction

Sets positive and negative count direction.

Factory Default = DIR 1

- **Setting Count Direction**

- Press **ZERO** for current setting.
- Press **ZERO** again to change direction.

## OPTION PARAMETERS

For RS-232, Multiple Scale Coupling (MSC) and Control Function Interface (CFI), refer to the Master Options manual.

- **Option Parameter Setting** - refer to Master Options Manual.

**SLEEP** Sleep Mode Operation

Installed on all Master Readouts. Will turn displays "off" after 30 minutes of no activity (indicated by a moving dot advancing across the X-axis display). Displays are "awakened" by pressing any key or moving an encoder.

- **Setting**

- Press **2nd** **CLEAR**<sup>OPTION</sup>
- Press **ZERO** for current setting.
- Press **ZERO** again to toggle through available options:
  - 1 = Active
  - 0 = Not Active

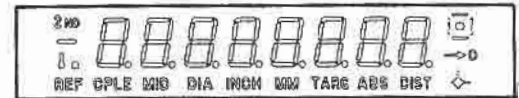


## MASTER READOUT OPERATIONS

### DRO Operations

- **Axis Display Settings**

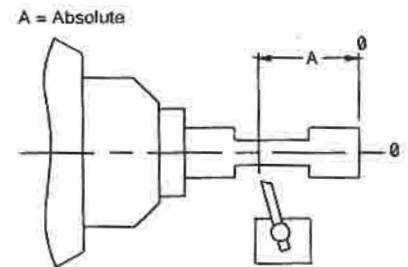
Lighted annunciators on each axis indicate the current settings.




- **Display Modes**

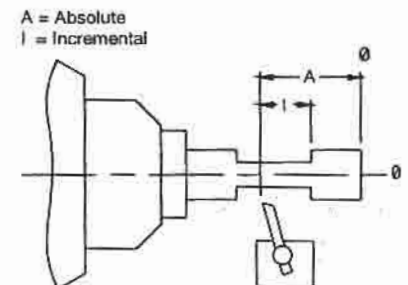
- **Absolute and Incremental**

Absolute display shows the distance from your current position to Absolute Zero (current Datum/workpiece Zero).




Incremental display shows the distance from your current position to your last incremental zero.

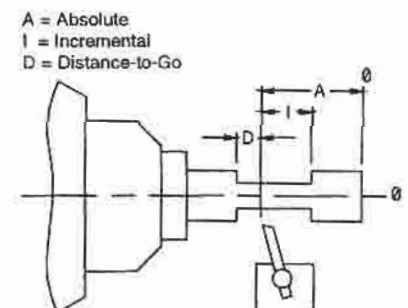
- Press  to toggle through available choices.





- **Distance-to-Go**

Dist-to-Go shows the distance from your current position to your next preset dimension (target position).

- Press  from any mode.



- **Inch/Millimeter Measuring Units**

- Press   to change current setting.

- **Display Resolution**

Sets the display resolution as seen when the table is in motion. Resolution is available as High, Medium and Low. Refer to Appendix E in Section 4. Appendices, for a complete table of display options.

- Press    to change the current setting.

Ex: A 10um (.0005") resolution linear encoder may be displayed as follows: .0005" / .001" / .002".

- **Zeroing Displays**

- **Absolute display**

New absolute zero points, or Datums, are created only with Datum Setting Procedures.  
(see Datum Operations section below)

- **Incremental display**

- Press   on the appropriate axis, if needed, to be in Incremental Mode.

- **Distance-to-Go display**

- Press   on the appropriate axis, if needed, to be in Incremental Mode.

## Datum Operations

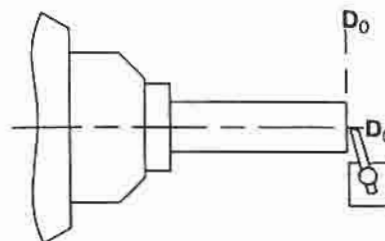
Datums are used to establish reference points for the workpiece. The Master-TP allows up to 10 Datum points, numbered 0 to 9. Datum 0 is normally set to coincide with workpiece zero, from which all features on the workpiece are referenced. When in the absolute display mode, display axes will show the tool distance from the current Datum. If no Datums have been set or selected, the readout defaults to Datum 0.

In the event of a Loss of Power, the Home Reference Point may be used to reestablish the position of Datum 0 without reindicating the workpiece (see Power Loss Restoration Features).

- **Setting Datum 0**

- Locate edge of your workpiece.
  - Press   for each axis.








This sets the tools current position to zero. To establish the centerline of your part as zero, follow the hold feature directions following.



- **HOLD**






The hold feature is used to establish workpiece zero and Datum 0 more accurately and quickly.

- **Establishing Datum 0 on the X axis**

- Load material for first part.
- Press  to enter Datum mode .
- Make skim cut on the diameter of the part.
- During skim cut, press  then .
- Back tool out and measure part diameter.
- Enter diameter measured. Ex:    

*The readout will now display your current tool position (after backing out) and the part centerline has been set to zero, taking into consideration tool and post deflections.*

- **Establishing Datum 0 on the Z axis**




- Enter Datum mode 
- Make a face cut.
- During face cut, press  
- Back tool out, press  
- Face of part is now Workpiece zero, Datum 0

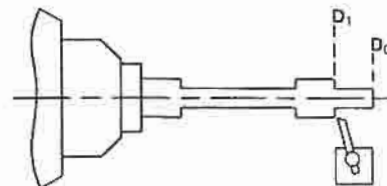
- **Multiple Datums**

Master-TP allows for the placement of up to 10 Datums, numbered 0 to 9. Datums may be set to a specific location from Datum 0, or can be referenced from one another. When changing Datums, the last Datum selected becomes the reference Datum. However, circular referencing (1 referenced to 2 and 2 referenced to 1) is not allowed, and Datum 0 cannot be referenced to another Datum. In the event of circular referencing, no offset distance entry will be allowed by the DRO.



- **Setting a Datum**

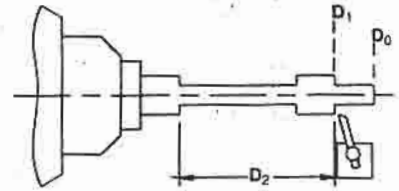
- **Setting Datums from the Current Location:**

- Move table to the position of the desired Datum. Press 
- Select a Datum number using the numeric keypad. Ex: Press 
- Press  for each axis. (Datum number is shown in the auxiliary display.)



- **Setting Datums from Print Dimensions:**

- Press  **0** **ENTER** to reference Datum 0.
- Press 
- Select a Datum number using numeric keypad. Ex: **2**
- Press an axis key to select an axis. Ex. **X**
- Enter the offset. Ex: **5**
- Set other axes as needed.
- Press **ENTER** to create the Datum and return to DRO operations. Absolute displays will indicate the distance of the tool to the new Datum point.



- **Selecting a Datum**



- Press  **0** **ENTER** to select Datum 0 as the reference Datum.

Note: If the position of Datum 0 is changed, the position of all Datums change accordingly. All Datum offsets are maintained. The same is true for all Datums referenced from other Datums. For example: if Datum 3 is referenced from the position of Datum 2, and Datum 2 is moved 1/2" in the positive direction, Datum 3 will also move 1/2" in the positive direction.

## Presetting Operations

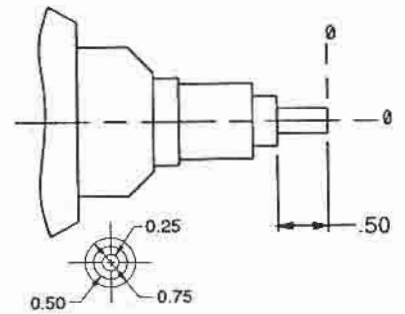
Distance-to-Go can be preset to indicate the distance to a targeted location. Target locations can be referenced from the current position (an incremental preset) or the current DATUM (an absolute preset).

- **Entering Preset Mode**

Press either  or . Pushing either key will display the last preset values, and whether they were incremental or absolute, as shown by the display annunciators. Preset mode is indicated with a flashing "TARG" indicator.

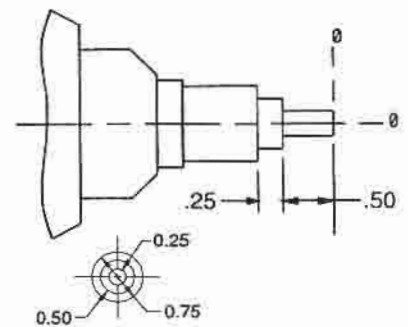
## • Setting Absolute Preset Referencing the Current Datum

- Press **SET ABS** **X**
- Enter numeric value. Ex: [0.25"] = **•** **2** **5**
- Press **Z**
- Enter numeric value. Ex: [0.500"] = **•** **5**
- Press **ENTER** Display shows the Distance-to-Go from your current position to the target position.
- Move table until display shows zero.



## • Setting Incremental Preset from Current Position (Distance-to-Go)

- Press **SET INCR** **X**
- Enter numeric value. Ex: **•** **5**
- Press **Z**
- Enter numeric Value. Ex: **•** **2** **5**
- Press **ENTER** Display will show the Distance to Go to the targeted position.
- Move table until display shows zero.



## • Presetting Options

- To Re-use the previous preset entries for all axes, Press **DIST TO GO** in Preset Mode.
- To Select a DATUM prior to selecting an axis, Press **DATUM** **NUMERIC ENTRY** **ENTER**. Display will return to Preset Mode after selecting a DATUM.
- To Select another axis to preset, press the desired axis key. The previous axis is deselected.
- To Deselect an axis, press the axis key again. Display reverts to last preset value.

- **Tool Offsetting**

A tool catalog of up to 9 tools can be stored. Catalog data includes tool number and tool offset dimensions. Once tool settings are entered, displays will be modified to account for tool point offsets on X and Z. Tool offset compensation can only be used if you have repeatable tooling.

- **Creating Tool Offset Table**

Before the readout can compensate for the dimensional differences between each tool, those differences have to be measured. This is done by qualifying each tool using the hold feature and making skim cuts on a piece of scrap material. Repeat this process for each tool to be qualified.

Set X axis offset

- Press **TOOL** Current tool number is indicated in the auxiliary display.
- Press tool number. Ex: **1**
- Make a skim cut on the part diameter
- During skim cut, press **HOLD X**
- Back tool out and measure part diameter.
- Enter measured diameter. Ex: **1 • 8 9 5 ENTER**

Set Z axis offset

- Press **TOOL** to re-enter tool mode.
- Make an edge cut.
- At end of cut, press **HOLD Z**
- Back tool out and measure depth of cut from the faced end.
- Enter measured depth. Ex: **4 • 1 3 4 ENTER**

NOTE: To clear an incorrect entry, press **CLEAR**

- **Selecting a Tool**

- Press **TOOL** Current tool number is indicated in the auxiliary display.
- To Select an existing tool, press the desired number key.
- Press **ENTER** Tool number appears in auxiliary display.

- **Turn Tool Offsetting Off:** Select Tool 0 by pressing **TOOL 0 ENTER**.

## Programming Operations

The Master-TP can hold programs up to 99 steps in length. Program steps consist of preset positions up to 3 axes, DATUM selection, and tool selection. DATUM and tool offset settings must be made separately (see Datum Operations). Programming operations are shown in the auxiliary display, which shows the "PROG" annunciator, a step number, and may indicate a DATUM, a tool, and indicates if a program is running.

Programs must be written in consecutive steps. While each step can have various characteristics, a program CANNOT have a blank step (a step without program information) between other steps.

- **Entering or Exiting Programming Mode:** Press

- **Entering a new program:**

- Press  to enter Programming Mode. Display shows the current step number.

(Blank steps show a "PROG END" message.)

- Select a Step number (Programs may start at any step number.)

- Either press  until desired step is reached,

- Or press      to move to specific step.

- **STEP 1: Entering an Absolute Preset**

- If you are not there, go to the first step number.

Ex:

This step will cut the major OD.

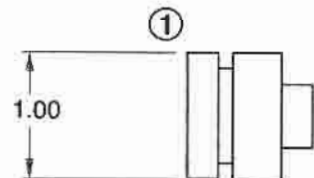
- Press   to set the X dimension.

- Enter numeric value for X. Ex:

- Press

- Select tool by pressing

Your readout will display the preset dimension on the X axis. The auxiliary display will read: STEP 1, TOOL 1, DATUM 0, PROG.

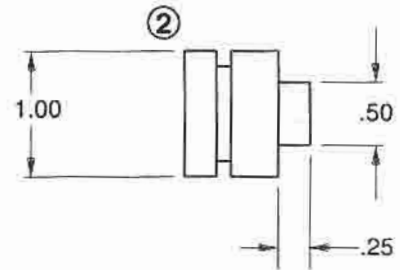


■ Press **NEXT** to go on to Step 2.

• **STEP 2: Entering Second Absolute Preset**

This step will cut the minor OD.

- Press **SET ABS** **X** to set the X dimension.
- Enter numeric value for X. Ex: **•** **2** **5**
- Press **Z** to set Z dimension.
- Enter dimension for Z. Ex: **•** **5**
- Press **ENTER**



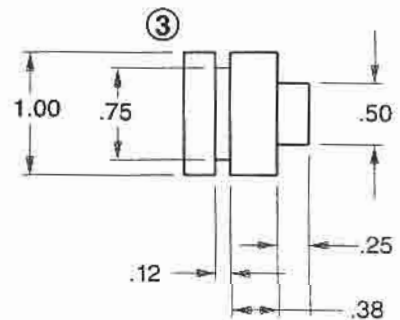
Your readout will display the preset dimension on the X and Z axes. The auxiliary display will read:  
STEP 2, TOOL 1, DATUM 0, PROG.

■ Press **NEXT** to go on to Step 3.

• **STEP 3. Entering an Incremental Preset and Selecting a Tool**

This step will cut the groove.

- Press **SET INCR** **X** to set the X dimension.
- Enter numeric value for X. Ex: **•** **7** **5**
- Press **Z** to set the Z dimension.
- Enter numeric value for Z. Ex: **•** **3** **8**
- Press **ENTER**
- Press **TOOL** to select tool from library.
- Select Tool Number. Ex: **2**
- Press **ENTER**



Your readout will display the preset dimension on the X and Z axes. The auxiliary display will read:  
STEP 3, TOOL 2, DATUM 0, PROG.

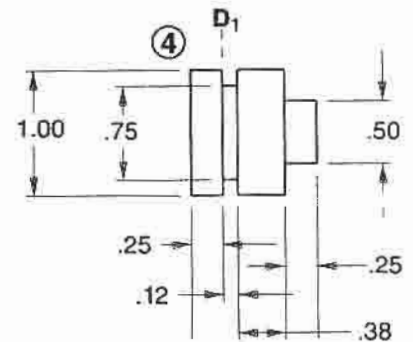


■ Press **NEXT** to go on to

• **STEP 4. Setting an Absolute Preset from Another DATUM**

This step will cut the part off.

- Press **SET ABS** **X** to set the X dimension.
- Enter numeric value for X. Ex: **0**
- Press **Z** to set Z dimension.
- Enter dimension for Z. Ex: **• 2 5**
- Press **ENTER**
- Press **D1** to select new Datum.
- Enter Datum number. Ex: **1** **ENTER**



Your readout will display the preset dimension on the X and Z axes. The auxiliary display shows: **STEP 4, TOOL 2, DATUM 1, PROG.**

• **Running a Program**

- Press **PROG** if not in Program Mode.
- Press **2nd** **SELECT STEP** **NEXT**, number of first program step, **ENTER** to go to first step of program.
- Press **DIST TO GO**
- Press **NEXT** to go through program.

**Note:** While running a program, you can do any of the following operations:

- Jump to a specific step number by pressing the SELECT STEP key sequence.
- Select Tools
- Set X and Y axis tool edge indicators by pressing the tool edge keys.
- Enable CFI, it will be active until another step is chosen.

- **Viewing or Editing a Program:**

- ***Review/Edit an existing program***

- Press **PROG** to enter program mode.
- Go to the beginning of the program
  - Either press **NEXT**
  - Or **2nd** **NEXT**, step number, **ENTER**
- Examine the tool, DATUM and tool edge indicator settings.
- For preset positions, examine the axis presets and the settings for absolute or incremental displays.
- Existing step characteristics can be changed to desired settings, or steps can be added or deleted.

- ***Inserting a program step***

- Press **2nd** **HOLD** to insert a blank step at the current step number. (Current and all following steps will be pushed ahead one step number.)
- At "PROG End", enter your step information.

- ***Deleting a program step***

- Press **2nd** **DELETE STEP TOOL** to delete the current step. (All following steps will be moved back one step number.)

- ***Creating Multiple Programs***

- Repeat the steps to create a single program.
- Leave at least one BLANK STEP between programs to indicate end-of-program, and begin next program on the second blank step. Ex: Program 1 uses steps 1 through 4, Step 5 is blank and indicates the end of Program 1, Program 2 uses steps 6 through 11, Step 12 is blank, Program 3 begins on step 13.

- ***Stopping the program at any point***

- Press **PROG** to return to DRO mode.

- ***Clearing the program memory***

- If needed, press **PROG** to enter Program Mode.

- Press  . **ALL programs will be cleared by this key, Not just the current one.**

Confirmation is required before programs are cleared. The X and Y axis will display "YES" and "NO" respectively. Press the axis key for the desired action.

## Power Loss Restoration Features

- **Continu-Trac** - AC power is not lost, Press
- **Recall** - AC power is lost, no table movements have been made, Press
- **Home Reference Point (HRP) Find Routine**

The home reference point is a fixed reference mark along the machine table. It is found by sensing a reference signal on the encoder (the Fiducial Trigger Output signal, or FTO). FTOs are found every 8 inches (200 mm) on Mini-Scale and AR-5 Scales, and every 4 inches (100 mm) on MicroScales. Refer to your encoder manual for more information. Establishing a HRP creates the basis for referencing the position of Datum 0. After a loss of power, finding the HRP will allow you to return to your Datum 0 and restore all displays, DATUM locations and tool settings.

**NOTE:** The HRP should be established each time a/c power is turned off. This must be done prior to setting Datums. If Datums are established without first setting the HRP, the readout system cannot be returned to Datum 0 after power loss. it is very important to locate the same reference point each time.

- **Setting HRP**
- Determine workpiece location.
- Find closest encoder reference mark.
  - Press   "REF" indicator will flash on all axes.
  - Select an axis by pressing the axis key. Ex:

- Move table for the selected axis in a positive direction until you move across the closest FTO. This is indicated when the "REF" indicator disappears.
- Mark FTO position on the scale case with a permanent marker.

*At this point, the incremental displays will be zeroed, and the previous offset for the absolute display for DATUM 0 will be restored. A Home Reference Point offset will remain effective as long as AC power is not lost, regardless of whether or not the readout displays are ON or OFF.*

**NOTE:** For coupled encoders, see the Master Options Manual.

## Using an Electronic EdgeFinder Probe

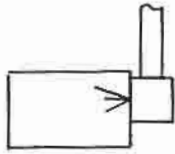
An edgefinder is used to locate workpiece edges and features, and can be used to measure workpiece features. The Electronic Edgefinder probe must be installed in the tool holder, with a cable connecting the Edgefinder to the Master-TP readout.

### • Electronic Edgefinder Probe Tool Settings

- Press The tool annunciator in the auxiliary display will read "E".
- *Prompt "DIA"*. Press any axis key and the numeric value of the diameter of the probe tip.  
Ex:
- Press to save values and return to DRO Mode.

### • Zeroing at an Edge

#### • *Setting Workpiece 0 with an Electronic Edgefinder Probe*

- Press 
- Press an axis key, Ex: to select an axis to zero.
- Locate the edge of your workpiece with the Edgefinder. The display will zero out at the point of contact.

#### • *Setting Incremental Zero with an Electronic Edgefinder Probe*

- Press to select Incremental displays.
- Press to activate Edgefinder Probe. "Edgefinder" symbol will flash on all axes.
- Press the axis key of the axis to be zeroed. Ex: The "edgefinder" symbol for this axis lights, but all other axes extinguish.
- Move the machine table to make contact with the workpiece. The Incremental display for this axis changes with table movement, and tool edge indicators change automatically to accommodate the direction of movement. When the Edgefinder contacts the workpiece, the display resets to zero, the "edgefinder" symbol light extinguishes and the tool edge indicator shows contact. (The indicator will no longer change as the table moves.) Further movements are shown on the axis display.

- **Finding Linear Error Compensation using an Electronic Edgefinder Probe**

1. Install a measurement standard of known length on the table, aligned with table movement.
2. Install Edgefinder securely in the tool holder.

3. Press

4. Enter the Access Code Number found at the front of this manual.

5. Prompt  Press axis key you wish to change. Ex:

6. Press axis key until you receive Prompt

7. Press   to activate edge finder.

Locate first edge of the measuring standard, axis display zeros at point of contact.

8. Move to the opposite end of the standard.

Press

Touch the end of the standard.

9. Prompt  Enter the diameter of the Edgefinder. Ex:

10. Prompt

Enter the length of the measuring standard Ex:

Axis display will indicate calculated LEC factor in PPM.

## Section 4. Appendices

### Appendix A. Troubleshooting

This appendix covers some problems encountered with readout systems. Simple troubleshooting procedures are listed to assist service personnel with determining the extent of problems. If contacting your ACU-RITE Distributor, OEM/OEI, or the ACU-RITE Sales and Service Center for assistance, the service technician will need to know the results of these procedures.

- **No operation**

If the Master readout display will not operate, check the following conditions:

- **Check outlet** If the Master readout cannot be turned on, confirm that line voltage is present at the outlet.
- **Check power at cord** Remove the power cord at the electrical input module on the back of the Master readout. Determine if line voltage is present at this end of the cord.
- **Check fuse** With the power cord removed, use a thin straight-blade screwdriver to remove the cover of the electrical input module. Slide out the fuse holder and check the fuse. If necessary, replace it.



#### CAUTION

Replace fuses only with the specified type. Using incorrect fuses can present a safety hazard. The Master readout may also be permanently damaged.

Use a 1.0A, 250V, 3AG, slow-blow style fuse (1-1/4" x 1/4" dia.) for 100/120VAC operation; or a 0.5A, 250V, 3AG, slow-blow fuse for 220/240VAC operation. Replace the fuse in the fuse holder, and slide it back into the input module. Replace the input module cover by snapping it back into place, and reconnect the power cord.

- **Internal testing**

Several internal tests may be run to assure that the Master readout is functioning properly. Tests are available for the internal memory, the keypad, and the display. In addition, the testing procedure reports the version of the software programs built into the Master readout.

- **Begin the internal testing** from the OFF state by holding down the  key while pressing the  key. The software version is shown in the X-axis display.

- **Begin the memory test** by pressing the **X** key. After a short testing period, results are indicated in the X-axis display, as either "PASS" or "FAIL".
- **Begin keypad testing** by pressing the **X** key. Press each key (except the **X** key) in turn to verify that it is functioning properly. The X-axis display reports each key press by incrementing one digit starting with 0 and increasing to 9, then repeating.
- **Terminate keypad testing** and begin the display test by pressing the **X** key. All indicators in all displays are lit (including the auxiliary display for Master-MP and -TP readouts). Visually check each portion of each display to assure that they are functioning properly.
- **Return to the software version display** by pressing the **X** key. Repeat the tests as required.
- **Terminate the testing** at any time by pressing the **ON/OFF** key. The Master readout returns to the OFF state.

- **Resetting factory defaults**

Master readouts can be reset to the factory defaults to allow more in-depth troubleshooting or to install the readout on another machine.

### IMPORTANT

Resetting the Master readout to factory defaults will clear all current settings. This includes the current position, ongoing operations, operator settings, and all parameters.

- **Reset the Master readout** by turning the displays OFF with the **ON/OFF** key. Hold down the **X** <sup>INMM</sup>**SET ABS** **3** and **●** keys simultaneously. The X-axis display momentarily shows a "CLR MEM" message, confirming the reset.

- **Error reports**

The Master readout includes built-in test and error-checking circuitry. This circuitry identifies errors that occur, and reports the problem to the operator.

System errors are reported to the operator with flashing error codes on the X-axis display, while axis errors are reported by flashing error codes in individual axis displays. Errors that are reported include loss of power, "E1"; counting (encoder signal miscount) errors, "E2"; display overflow (measurements too large to be displayed), "E4"; power-on memory error "E5"; programming error, "E6"; and memory test failure, "FAIL". Refer to Master Readout Operations for further details on resetting measurements to continue with machining operations following an error.

- **Loss of power** is indicated by a flashing "E1" error code in the X-axis display; all other displays are blank. Loss of power means that power to the Master readout has been interrupted. Since power to the encoders has also been interrupted, measuring information may no longer be accurate. Press the  key to clear the error message. All display measurements are zeroed.
- **Counting errors** are indicated by a flashing "E2" error code in an axis display. Counting errors result from distorted electrical signals from an axis' encoder. These signals can be a result of an encoder malfunction, alignment or mounting problems, or electrical interference. Press the  key to clear the error message. The axis display (for both absolute and incremental measurements) is zeroed.
- **Display overflow errors** are indicated by a flashing "E4" error code in an axis display. A numeric overflow occurs when the intended measurement is too large for the eight-digit display. Clear the error by returning the machine table into an area where measurements can again be displayed, selecting a lower display resolution, setting a new target preset, or zeroing the display with the  key.

This error may also occur when using the automatic compensation routine while setting the LEC parameter. An error indicates that the calculated compensation factor was outside the acceptable range of -9999 to +9999, and usually is the result of incorrectly entering data. Clear the error and return to the beginning of the automatic error compensation routine by pressing the  key.

- **Power-on memory errors** are indicated by a flashing "E5" error message in the X-axis display when the Master readout is turned on following a loss-of-power. An "E5" error denotes a serious internal failure, and indicates that some of the working settings are no longer valid. Working settings include current operating settings such as inches or millimeters; as well as programs, DATUMs, tool settings, current position information, and setup parameters.



Although all working settings can be checked and reset as required, they will likely be lost again when the power is interrupted. The Master readout should be serviced as soon as possible. Contact your ACU-RITE Distributor, OEM/OEI, or the ACU-RITE Sales and Service Center at (800) 344-2311.

Press the  key to clear the error; an "E1" error will be displayed next, since power to the Master readout was interrupted. Press the  key again to return to DRO operations.

### CAUTION

Some working settings are not valid. Proceed with caution.

Check all working settings before proceeding, and reset as required. Once reset, settings will be maintained until power to the Master readout is interrupted.

- **Program errors** are indicated by a flashing "E6" error code in the auxiliary display (Master-MP and -TP only). Error "E6" flags two related programming errors, either of which would result in a program or programs longer than 99 steps.

An "E6" error can occur when attempting to insert another step into a long program. With the INSERT STEP feature, all following program steps are pushed ahead by one step. The 99th step would be pushed ahead to become the 100th step, causing the error.

An "E6" error can also occur if the  key is pressed when the current step is step 99. Since step 99 is the last available program step, attempting to move to the next step results in an error.

Press the  key to clear the error and return to the current program step.

- **Memory failures** are indicated by a flashing "FAIL" error message in the X-axis display. A memory test failure indicates a serious malfunction with the Master readout.

### CAUTION

The Master readout cannot be relied on for correct operation if a "Fail" message is shown during this test. The Master readout should be serviced immediately. Contact your ACU-RITE Distributor, OEM/OEI, or the ACU-RITE Sales and Service Center at (800) 344-2311.

The error message can be cleared with the  key, and further testing or operations can be resumed.

## Appendix B. Master Readout Specifications

**Table 4-1. Master Readout Specifications**

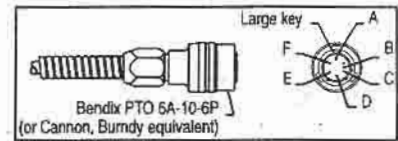
| Characteristic                | Specification  |
|-------------------------------|--|
| Operating conditions          | 0 to 40°C (32 to 104°F)<br>25 to 85% relative humidity (non-condensing)  |
| Storage conditions            | -40 to 60°C (-40 to 140°F)<br>25 to 95% relative humidity (non-condensing)   |
| Input requirements            |  |
| Voltage:                      | 100/120/220/240VAC (+/- 20%), single phase   |
| Frequency:                    | 50-60 Hz   |
| Current:                      | 0.75 A maximum   |
| Fuse                          | 110/120VAC operation: 1.0A,<br>250V, 3AG, Slo-blo<br>220/240VAC operation: 0.5A,   |
| Electronics                   | Microprocessor-based circuitry   |
| Number of axes                | 1, 2, or 3   |
| Display                       | 8-digit vacuum fluorescent display. MP and TP models also include a 4-digit display  |
| Display resolution            | Operator configurable. Refer to Table 4-6  |
| Encoder resolution            | 10µm, 5µm, 2µm, 1µm<br><br>0.0005", 0.00025", 0.0001"<br><br>Manual entry  |
| Encoder input characteristics | Position signals: channel A & B TTL square wave signal in quadrature (90° nominal phase relationship). Maximum input rate: 50 KHz<br><br>Reference signals: TTL square wave Fiducial Trigger Output signal (when provided) |
| Size                          | 12.5" W x 6.0" D x 8.7" H  |
| Weight                        | Approximately 15 lbs. (basic unit; options add additional weight)  |
| Mounting                      | Bottom: four #8-32 threaded inserts<br><br>Sides: two 1/4-20 threaded inserts (for ACU-RITE yoke mounts)   |
| Recognition/ approval         | UL, CSA pending  |
| FCC compliance                | Class A  |

## Appendix C. Encoder Requirements

**Table 4-2. Master encoder receptacle pin-out**

| Pin | Signal   |
|-----|--|
| A   | Channel A square wave counting signal  |
| B   | Channel B square wave counting signal in quadrature (90° nominal phase relationship) with channel A signal |
| C   | Vcc, +5.1 +/-0.1 VDC @ 140 mA (supplied by Master readout)   |
| D   | Common (power supply and signal return)  |
| E   | Shield, reading head casting ground  |
| F   | Fiducial Trigger Output (FTO) signal   |

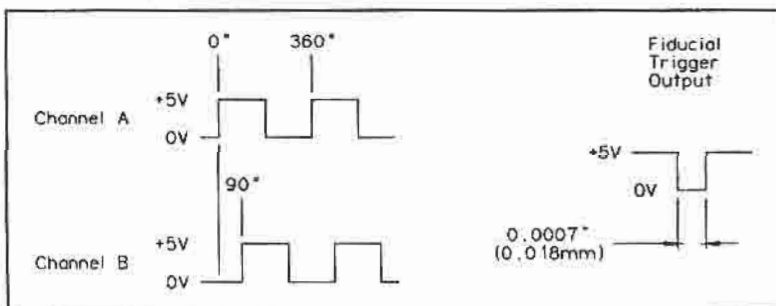
If installing a non- ACU-RITE encoder, a connector kit may be obtained to adapt the encoder cable for use with the Master readout. Contact your ACU-RITE Distributor or OEM/OEI, or the ACU-RITE Sales and Service Center at (800) 344-2311, and order part number 382214-000.



**Figure 4-1. Required encoder connector**

**Table 4-3. Master encoder receptacle pin-out**

| Characteristic                         | Requirement   |
|--|---|
| Output signals<br>Incremental          | Two square-wave signals, channels A and B, in quadrature (90° nominal phase relationship) |
| FTO                                    | One square-wave signal  |
| Signal levels                          | Low: 0 to 0.8 VDC<br>High: 3.5 to 5.1 VDC   |
| Maximum current draw                   | 140 mA  |
| Minimum A to B channel edge separation | 5 us  |



**Figure 4-2. Typical encoder waveforms**

## ***Appendix D. Accessory Connectors and Output Specifications***

All Master readouts are equipped with receptacles for the ACU-RITE VISION/Master Edgefinder Probe and ACU-RITE Master Foot Switch accessories

- **EdgeFinder**

The EDGEFINDER receptacle is provided for use with the ACU-RITE VISION/Master Edge Finder Probe accessory. The accessory is equipped with a cable that provides a mating connector.

Other manufacturer's edge finder probes may be used, if they perform the same functions as the ACU-RITE unit, and can be provided with a comparable connector. The connector from the edge finder must be a two-conductor, 1/8" (3.5mm) Mini-size Phone plug, such as Radio Shack part number 274-288. The ball or contact edge must be electrically isolated from the tool holder and the machine base. The conductor from the edge finder must be wired to the central contact on the plug, and the other conductor from the workpiece or machine base must be wired to the side contact on the plug.

- **Remote Zero**

The REMOTE ZERO receptacle is provided for use with the ACU-RITE Master Foot Switch Assembly accessory. The Foot Switch can be used in place of the ZERO key to zero a selected Master axis display.

Prior to installing the accessory, the connector supplied with the Foot Switch must be installed on the cable and wired to zero the desired axis. Refer to Table 4-5. for wiring information. For example, if the Foot Switch is to be used to zero the X-axis display, connect one wire on the Foot Switch cable assembly to pin 5, and the other wire to pin 1, 2, or 7.

**Table 4-5. Remote zero receptacle pin-out**

| Pin | Signal                     |
|-----|----------------------------|
| 1   | Ground                     |
| 2   | Ground                     |
| 3   | N.C.                       |
| 4   | Remote zero, Y- (Z1-) axis |
| 5   | Remote zero, X-axis        |
| 6   | Remote zero, Z- (Z2-) axis |
| 7   | Ground                     |
| 8   | N.C.                       |

Other switch arrangements may be used, if they perform the same functions as the ACU-RITE Foot Switch Assembly. Up to three switches may be provided for this assembly, one for each axis that is to be zeroed remotely. Each external switch must be a normally-open, momentary-closed, SPST switch. One side of each switch must be wired to one of the remote axis-zeroing connector pins (4, 5, or 6), and the other side wired to one of the ground pins (1, 2, or 7). The connector from the switch(es) must be an eight-conductor DIN plug, such as Switch Craft part #15BL7M.

## Appendix E. Measurement displays

### • Display increments with standard encoder resolution selections

The DISP RES feature allows setting display resolution to high resolution, medium, or low resolution. Table 4-6. shows the least-significant digit and number of decimal digits displayed, with each selection of encoder resolution provided by the Master readout. The table shows these characteristics for all combinations of inches vs. millimeter and radius vs. diameter (Master-G only) settings.

**Table 4-6. Master display increments with various settings**

| Encoder Resolution | INCH, RAD |        |        | INCH, DIA |        |        | MM, RAD |        |       | MM, DIA |        |      |
|--------------------|-----------|--------|--------|-----------|--------|--------|---------|--------|-------|---------|--------|------|
|                    | High      | Medium | Low    | High      | Medium | Low    | High    | Medium | Low   | High    | Medium | Low  |
| 10 $\mu$ m         | 0.0005    | 0.001  | 0.002  | 0.001     | 0.002  | 0.005  | 0.01    | 0.02   | 0.05  | 0.02    | 0.05   | 0.1  |
| 5 $\mu$ m          | 0.0002    | 0.0005 | 0.001  | 0.0005    | 0.001  | 0.002  | 0.005   | 0.01   | 0.02  | 0.01    | 0.02   | 0.05 |
| 2 $\mu$ m          | 0.0001    | 0.0002 | 0.0005 | 0.0002    | 0.0005 | 0.001  | 0.002   | 0.005  | 0.01  | 0.005   | 0.01   | 0.02 |
| 1 $\mu$ m          | 0.0005    | 0.0001 | 0.0002 | 0.0001    | 0.0002 | 0.0005 | 0.001   | 0.002  | 0.005 | 0.002   | 0.005  | 0.01 |
| 0.0005"            | 0.0005    | 0.001  | 0.002  | 0.001     | 0.002  | 0.005  | 0.02    | 0.05   | 0.1   | 0.05    | 0.1    | 0.2  |
| 0.00025"           | 0.0005    | 0.0005 | 0.001  | 0.0005    | 0.001  | 0.002  | 0.01    | 0.02   | 0.05  | 0.02    | 0.05   | 0.1  |
| 0.0001"            | 0.0001    | 0.0002 | 0.0005 | 0.0002    | 0.0005 | 0.001  | 0.002   | 0.005  | 0.01  | 0.005   | 0.01   | 0.02 |

1. The table illustrates Master display increments with various combinations of INCH/MM and RAD/DIA key settings.
2. The display increments corresponding to a diameter setting are valid only if diameter displays are enabled on that axis.

## ***Appendix H. Warranty***

- **FCC compliance statement**

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions in this manual, may cause interference to radio communications. It has been tested and found to comply with the limits in effect at the time of manufacture for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

- **The ACU-RITE warranty**

ACU-RITE products and accessories are warranted against defects in material and workmanship for a period of three years from the date of purchase. ACU-RITE will, at its option and expense, repair or replace any part of the ACU-RITE product which fails to meet this warranty. This warranty covers both materials and factory service labor. In addition, ACU-RITE Distributors and OEM/OEI service representatives will provide service labor (field service) for a one-year period at no charge. Notice of the claimed defect must be received by ACU-RITE within the warranty period.

This warranty applies only to products and accessories installed and operated in accordance with this reference manual. ACU-RITE shall have no obligation, with respect to any defect or other condition caused in whole or in part by the customer's incorrect use, improper maintenance, modification of the equipment, or by the repair or maintenance of the product by any person except persons deemed by ACU-RITE to be qualified.

Responsibility for loss in operation performance due to environmental condition, such as humidity, dust, corrosive chemicals, depositions of oil or other foreign matter, spillage, or other conditions beyond ACU-RITE's control cannot be accepted by ACU-RITE.

There are no other warranties expressed or implied, and ACU-RITE INCORPORATED shall not be liable under any circumstances for consequential damages.