VRO 300M™

REFERENCE MANUAL

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Readout Parameter Access Code

An access code must be entered before machine-related parameters can be set or changed. This prevents inadvertent adjustments to the setup parameters.

IMPORTANT
The access code is 8891

Refer to the <u>Setup</u> section. Begin by pressing the [SETUP] key then the [INSTALLATION SETUP] softkey. Press the [8], [8], [9], [1], and [ENTER] keys. The readout is now ready for machine parameter setting operations.

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

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 that fails to meet this warranty. This warranty covers both materials and factory labor. In addition, authorized ACU-RITE service representatives will provide service labor (field service) for a period of one year 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 those deemed qualified by ACU-RITE.

Responsibility for loss of operation or diminished performance due to conditions beyond ACU-RITE's control cannot be accepted by ACU-RITE.

The foregoing warranty obligations are in lieu of all expressed or implied warranties. ACU-RITE INCORPORATED shall not be liable under any circumstances for consequential damages.

30 Day Red Carpet Warranty

All ACU-RITE products are covered by a 30-day Red Carpet Warranty. If in the first 30 days this product fails for any reason, repack it in the original packaging materials and contact your Authorized ACU-RITE Distributor for return procedures.

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⚠️ !

This symbol alerts you to the fact that important information concerning the installation and operation of this readout has been included in this manual.

Keep these instructions in a secure place for future reference.

Introduction

ACU-RITE's VRO 300 readout series provides the application-specific features required for you to obtain the most productivity from your manual machine tools.

The VRO 300M is designed specifically for milling and drilling applications. Special features include immediate part-view graphics, bolt hole patterns, tool offsetting, part programming, reference tables, and calculators.

A Tour of the Readout

Front and Back Views

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Connections

Ground wire connection

External video output

Remote switch (pendant) input

Parallel (printer) port

Power switch and voltage selector

CONTRAST

EXT VIDEO

PENDANT

PARALLEL PORT

Model number and Serial number

PN 200x00x
SN 9766554

Control function interface port

CFI

INPUT 6

INPUT 5

INPUT 4

INPUT 3

INPUT 2

INPUT 1

Encoder inputs

EDGE FINDER

TOUCH PROBE

SERIAL PORT

Electronic edge finder input

Serial (RS-232) port

Touch probe input

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Keypad

Selects absolute or
incremental display

ABS / INCR

View the part graphic
or the position displays.

VIEW

MILL   HOLES   MORE

TOOL   POS
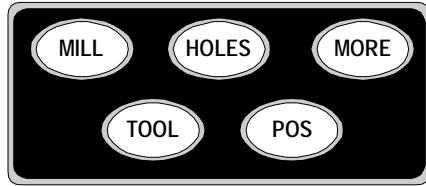
Application-specific
function keys

System
information
and help

INFO   MM   SETUP

System setup
parameters

English / metric
conversion

Begin a preset

X   ZERO   Zero an axis

Y   ZERO

Z   ZERO

W   ZERO

Enter all numeric values
with these

Some of the
number keys are
also used for
tool offset
direction.

7   8   9   CALC

4   5   6   +

1   2   3   -

.   0   +/-   X

CLEAR   ENTER   ÷

Handy
calculator
functions

Move up or
down on the
screen

Lets you switch
between
programming and
Digital ReadOut
displays

↑

↓

PGM

DRO

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Display

The display screen is divided into four sections.
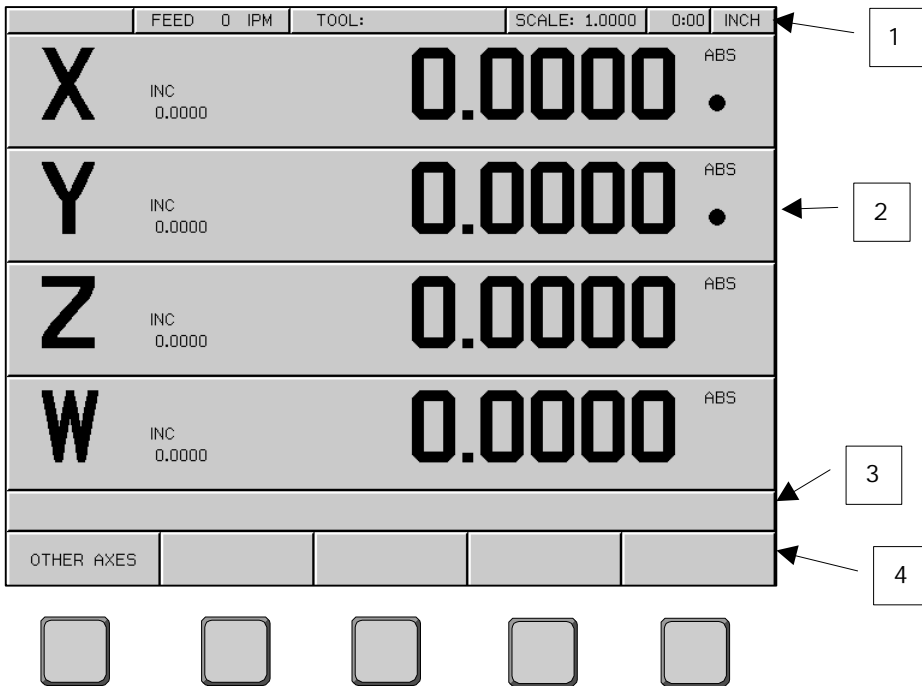
1 — Status bar – displays the feed rate, current tool, scale factor, job clock, and inch/mm status.

2 — Information screen – displays information for the task being performed.

- Used as a readout, the screen will display the current position for each axis.

- When programming, the program steps and the part graphic will be displayed.

3 — Message line – operator prompts and messages will appear here.

4 — Softkeys – variable functions appear here; functions are selected by pressing the hard key directly below the softkey.

Readout and Program Displays

The $\boxed{\text{DRO}}$ and $\boxed{\text{PGM}}$ keys switch between the digital readout (DRO) and program (PGM) display.

In the DRO display, all standard readout operations are available. The display can show up to four axis positions simultaneously. If you use more than four, press the $\boxed{\text{OTHER AXES}}$ softkey to view the other axes. Softkeys for zeroing and presetting these other axes will also appear.

In the PGM screen, you can create and run programs. Many of the readout operations are still available.

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When in the PGM screen, you can press the $\boxed{\text{VIEW}}$ key to switch between the part graphic and the position display. Up to six axes positions can be displayed at the same time in this view.

| FEED | 0 | IPM | TOOL: 0.2500 INCH | SCALE: 1.0000 | 0:00 | INCH |

CURRENT PROGRAM

```
001    SET TOOL
002  ⌐ MILL
003  ‖ MILL
004  ‖ MILL
005  ‖ MILL
006  ‖ MILL
007  ‖ MILL
008  ‖ MILL
009  ⌐ MILL
010    BOLT CIRCLE
```

This is the best view for programming—you can see the results of each step (graphically) as you enter it.

END OF 10

| PROGRAM FUNCTIONS | CLEAR PROGRAM | | | RUN |

VIEW

| FEED | 0 | IPM | TOOL: 0.2500 INCH | SCALE: 1.0000 | 0:00 | INCH |

```
        M001
001   SET TOOL
002  ‖ MILL
003  ‖ MILL
004  ‖ MILL
005  ‖ MILL
006  ‖ MILL
007  ‖ MILL
008  ‖ MILL
009  ⌐ MILL
```
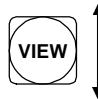
When you RUN a program, the readout automatically switches to this view so you can "move to zero".

Axis	Mode	Value	Position	Unit
X	ABS 0.1250	**0.1250**	INC •⌐
Y	ABS 0.1250	**0.1250**	INC ⌐•
Z	ABS 0.0000	**0.1000**	INC
W	ABS 0.0000	**0.0000**	INC
U	ABS 0.0000	**0.0000**	INC
V	ABS 0.0000	**0.0000**	INC

2 OF 9

| PROGRAM FUNCTIONS | CLEAR PROGRAM | | DONE | NEXT |

Power-On Position Recovery

Position-Trac

Certain ACU-RITE encoders, such as the ENC 150, contain closely-spaced reference marks that enable the display to show the correct position after a power interruption. The readout will indicate when power has been lost, and will prompt you to move each axis until a reference mark is located. By traversing the reference marks once in each axis, you will re-establish the display position relative to the last known zero. The most you will ever have to move an axis is about one inch. You must move in a positive count direction

If you use an encoder that does not have the Position-Trac feature, the procedure for recovering your position is slightly different. Reference marks on these encoders are about 8 inches apart. You must find a convenient reference mark and then use the same mark every time.

    1. Move near the desired reference mark.

    2. Press the $\boxed{\,\cdot\,}$ key.

    3. Move slowly past the reference mark until the readout recalls its position. You must move in a positive direction.

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Readout Operations

Clear Key

Use the CLEAR key to erase digits that you entered by mistake, or to take you back if you've pressed an incorrect function key.

Absolute and Incremental Displays

Absolute Display

Shows the distance from your current position to *absolute zero.*

Absolute Zero, also called datum or Workpiece Zero

The drill is positioned at 1.625 ABS.

1.625
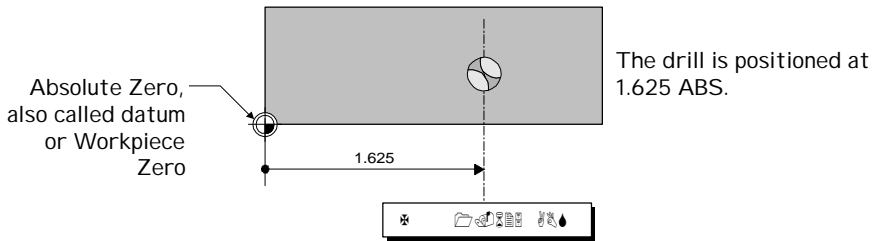
Incremental Display

Shows the distance from your current position to *incremental zero.* An incremental zero is set when you preset a dimension, or when you zero the incremental display.

Absolute zero.

1.000   -0.625

1.625

The drill is 0.625 on the negative side of the incremental zero.

Incremental zero: the incremental display will read 0.000 when the drill is here.
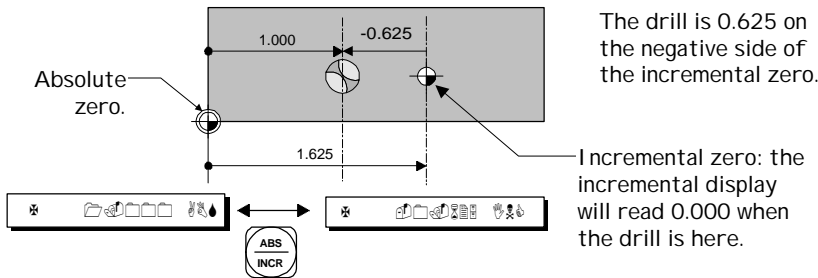
You can always see both absolute and incremental positions at the same time.

X   INC -1.2000   **0.0000** ABS

Large display shows **absolute** position

X   ABS 0.0000   **-1.2000** INC

Large display shows **incremental** position

Zeroing the Displays

Absolute Zero

On many prints, dimensions are measured
from one or two surfaces of the workpiece. By
setting the readout's absolute display to zero
at a well-chosen surface, you can enter
the part's dimensions directly
from the print, using absolute
presets.

Absolute zero

0.72

1.44

2.44
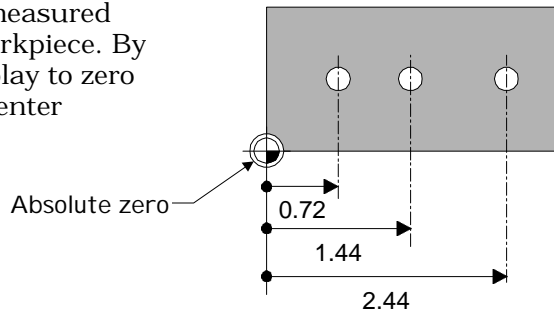
Setting Absolute Zero at the Current Position

    1. Move to desired location.

    2. Make sure that the absolute position is displayed.   `ABS/INCR` `ABS`

                                                               Shortcut

    3. Zero the apropriate axis.   `ZERO` `ENTER`   `ZERO` `ZERO`
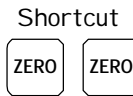
Setting Absolute Zero Using an Electronic Edge Finder

    1. Install the edge finder into the spindle and connect it to the
readout.

    2. Make sure that the absolute position is displayed.   `ABS/INCR` `ABS`

    3. Press the zero key for the appropriate axis.   `ZERO`

    4. Move slowly until the edge finder touches the edge
of the metal workpiece. The absolute position
display will automatically be set to zero at the
workpiece edge.
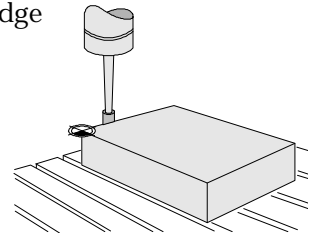
> You don't have to worry about
> overtraveling because the edge
> finder probe shaft is flexible. The
> readout will zero on contact.

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Setting Absolute Zero with a Tool

1. Touch the tool to the edge of the workpiece.

    0.25 DIA

    -0.125

2. Make sure the absolute position is displayed.   ⌈ABS⌉ ⌊INCR⌋   ABS

3. Press the zero key for the appropriate axis.   ⌈ZERO⌉

4. Enter the position of the tool center.

    ⌈+/-⌉ ⌈.⌉ ⌈1⌉ ⌈2⌉ ⌈5⌉ ⌈ENTER⌉
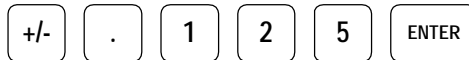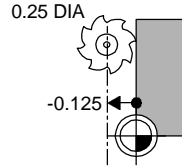
Setting Absolute Zero Using a Tool Offset

1. Enter the tool's diameter.   (TOOL) ⌈.⌉ ⌈2⌉ ⌈5⌉ ⌈RUN⌉
    (Refer to page 18 for more
    information about using tool
    offsets.)

2. Make sure the absolute position is displayed.   ⌈ABS⌉ ⌊INCR⌋   ABS

3. Identify the appropriate edge of the tool.   ⌈6 I⌉

4. Touch the tool to the edge of the workpiece and zero the
    appropriate axis.

                                                 Shortcut

    ⌈ZERO⌉ ⌈ENTER⌉   ⌈ZERO⌉ ⌈ZERO⌉
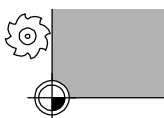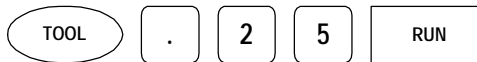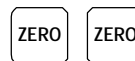
Moving the Absolute Zero

Sometimes you may need to move the absolute zero from its original position on the workpiece to a different position.

Absolute zero is currently here…

1.625

…but you want it to be here.
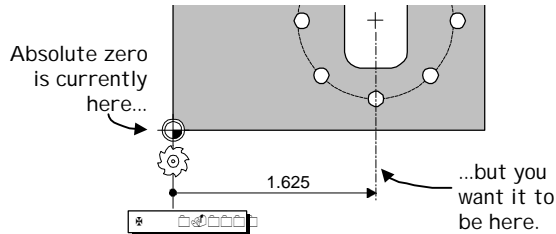
1. Move the tool to absolute zero.

2. Press the ZERO key of the appropriate axis and enter the *new* tool position, from the new absolute zero.

+/- 1 . 6 2 5 ENTER

-1.625

Now zero is here, and the tool position is -1.625

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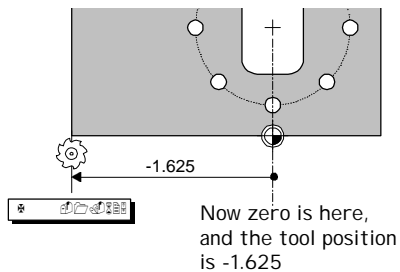
Zeroing at a Center Line

Begin setting absolute zero in the usual way and then tell the readout that you want to use the centerline feature.

ABS/INCR   **ABS**   ZERO   CENTERLINE

Touch the first edge…

ENTER
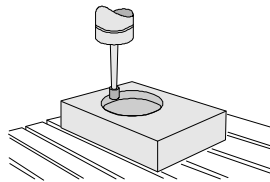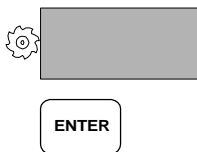
…then the second edge.

ENTER
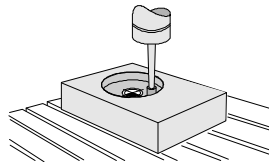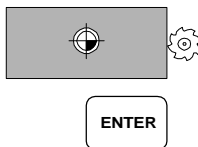
The absolute zero is placed mid-way between the two edges.

Incremental Zero

From the incremental display, press the ZERO key. This sets the incremental display to zero at the current tool position.

Presetting

When you preset a dimension, the readout places an incremental zero at the location you specify. Then the display automatically switches to the incremental display so that you can move to zero.

Begin a preset by pressing an axis key ($\boxed{X}$ for example). The information of the previous preset will appear. The display will show you if the preset is absolute or incremental. Use the $\boxed{\text{ABS} \atop \text{INCR}}$ key to toggle between them. Enter the dimension that you want to preset.

Absolute zero.

The drill is positioned at 0.000 ABS.

1.625
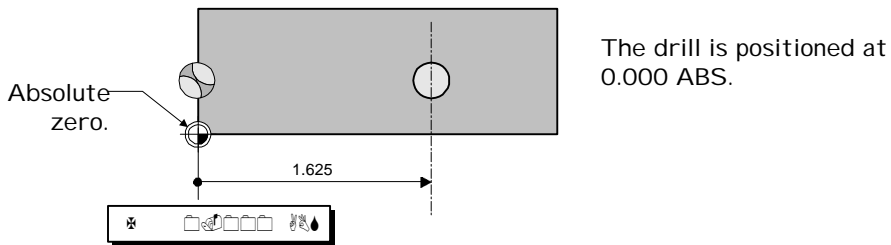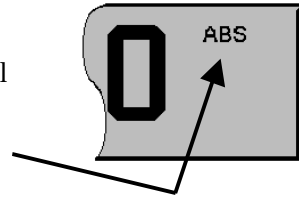
Preset the absolute location of the hole.

$\boxed{X}$ $\boxed{1}$ $\boxed{.}$ $\boxed{6}$ $\boxed{2}$ $\boxed{5}$ $\boxed{\text{ENTER}}$

$\boxed{\text{ABS} \atop \text{INCR}}$
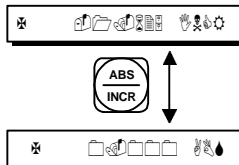
The display automatically switches to incremental.
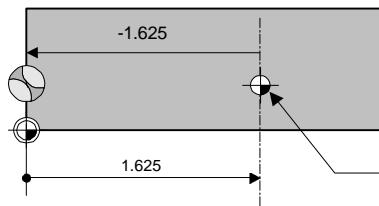
Now the drill is on the negative side of the hole.

-1.625

1.625

Incremental zero: the incremental display will read 0.000 when the drill is positioned over the hole.

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Absolute and Incremental Presets

To maintain the best tolerance and to minimize the chance for errors, use

- absolute presets for absolute dimensions

- incremental presets for incremental dimensions.

When you enter an absolute preset, it **does not matter** where the tool position is. The VRO 300M calculates the desired location automatically.
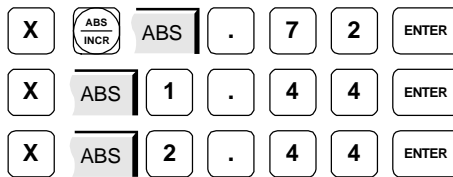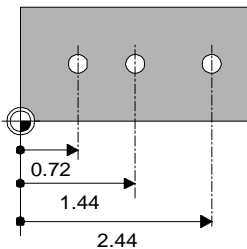
When you enter an incremental preset, the tool **must** be positioned at the location you are dimensioning from.
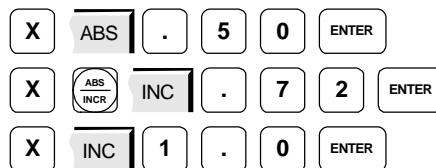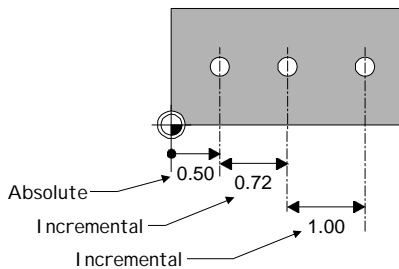
Center-line Presets

You can set a preset at the center of a workpiece, or in the center of a hole.

| X | CENTERLINE |

Move to the first edge…   2.0   Sets an incremental
                                    zero at the tool
                                    location.

ENTER

…then to the second edge

ENTER   Calculates the center
                                    point, and sets an
                                    incremental zero there.
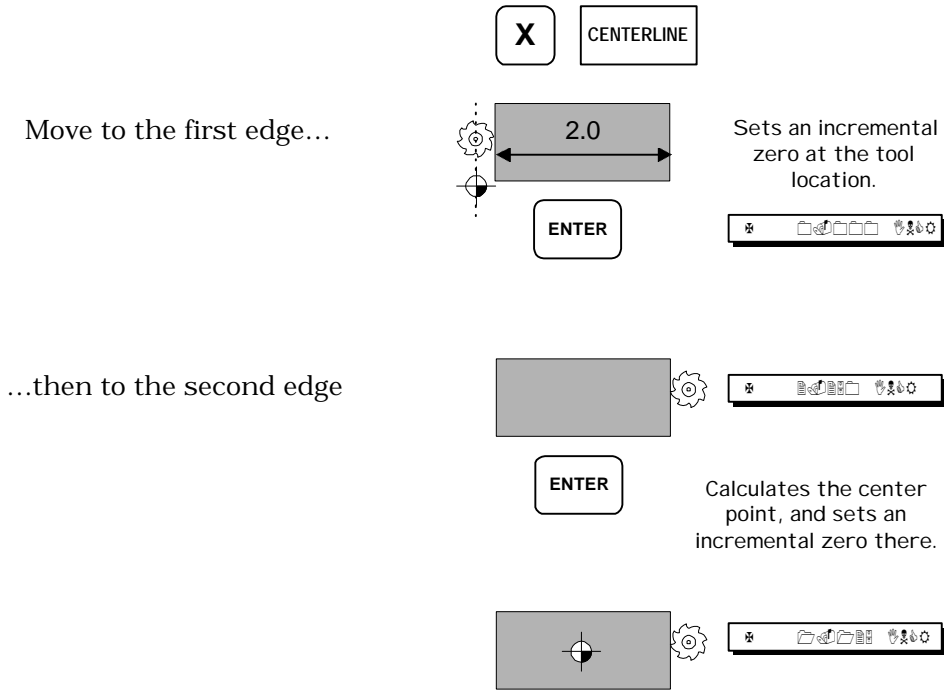
Presetting Using the POS Key

You can enter a preset using the (POS) key for as many as four axes at once. Refer to page 25 for information on how to complete the Position Step. When you have completed it, press the | RUN | softkey to execute the preset operation.

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Near Zero Warning

When you are moving to zero, the readout can "warn" you when you are getting close. This allows you to machine faster and avoid overshooting your desired location.

Near zero range: the indicator appears when you are within the range.

You can set the near zero range in Setup.

| X | ABS 0.0000 | −0.0100 | INC RAD |
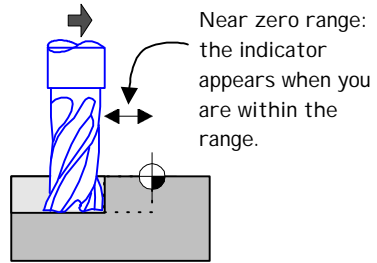
Near zero indicator

Zero is here

Tool Offsetting

If you enter the diameter of the cutting tool you are using, you don't have to add or subtract the tool's radius when you enter a preset. Just select which edge of the tool you want to compensate for, and the VRO 300M automatically adds or subtracts the tool's radius.

Defining the Offset Direction

The symbols on the number keys indicate the offset directions—they represent a top view of the tool and the part edge.

Tool Back
Edge

8

Tool Left
Edge |4   5   6| Tool Right
Edge

2   Tool Center

Tool Front
Edge

8

|4   Inside...

6|

2   ...and outside

2

6| |4

8
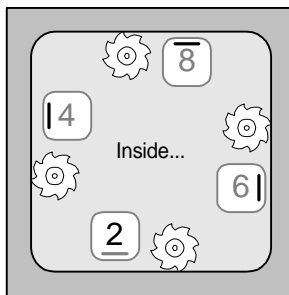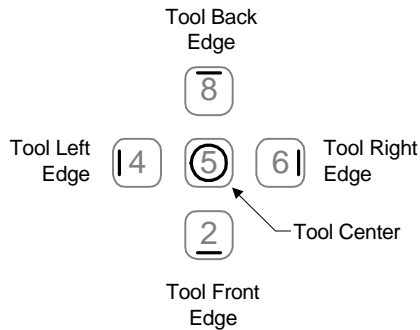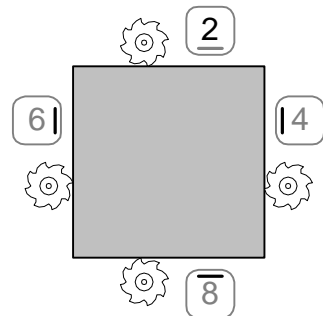
Whenever the readout is displaying an absolute or incremental position, the number keys can be used for tool offset compensation. Just press the key corresponding to the edge of the tool whose position you want to display.

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Using Tool Offsets

First enter the tool diameter.

| TOOL | . | 5 | 0 | 0 | RUN |

SET TOOL

TOOL SIZE
DIA   0.500
LEN

UNIT
                    INCH

TOOL TYPE
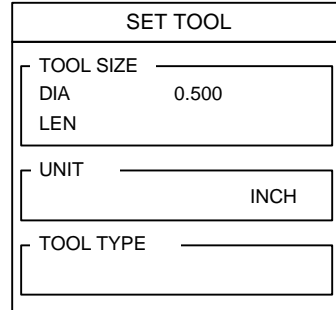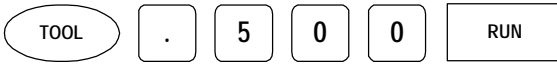
Then select the edge you want to use for the axis you want to move. For example, if the right edge of the tool is touching the workpiece zero, pressing these keys will change the display as shown.

6 ▯

Right edge

▯ 4

Left edge

⑤

Center

(Always use this when drilling.)
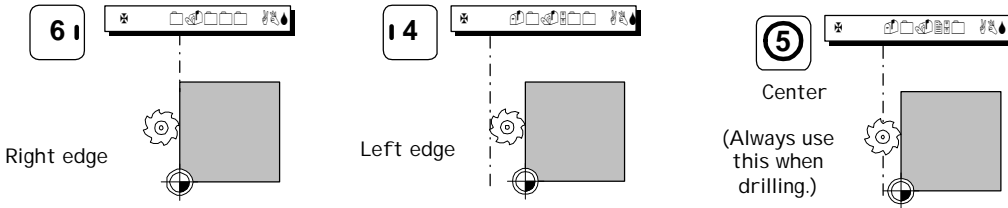
The readout display will always indicate how the tool is being compensated.

▮●   ●▮   ●   ●   ●
Left   Right   Front   Back   Center
edge   edge   edge   edge

SCALE: 1.0000   0:00   INCH

ABS

0.0000 ●▮

Part
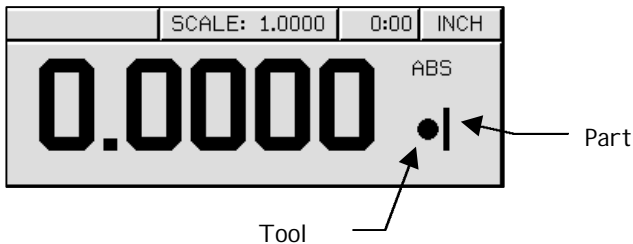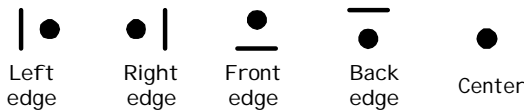
Tool

Program Operations

A *program* is a list of tool changes and position presets that you can save for later use.

Creating a Program

Press the |PGM| key to view the program screen.
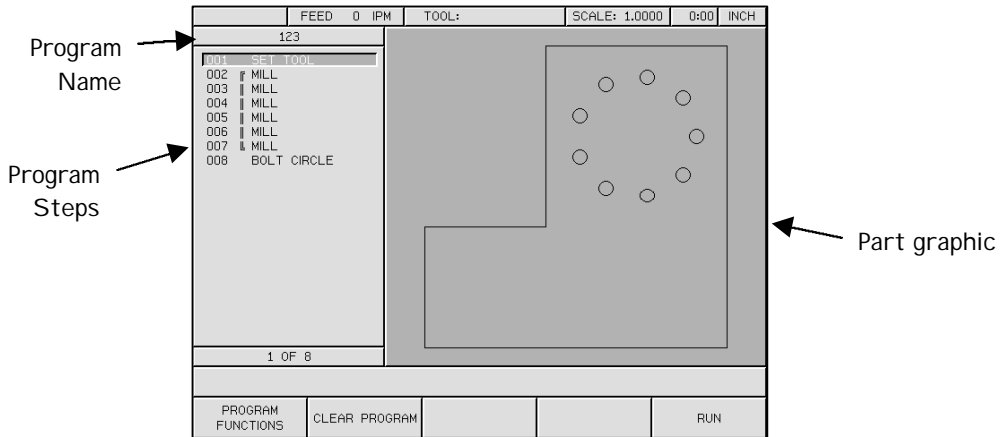
You create a program by entering a list of the steps in the order you want to do them. As you add to your list, each step will be drawn immediately on the screen so you can see a picture of your part in progress.

- To create a new step, press the desired milling function key. Enter the information describing the step into the form, and press the |USE| softkey to accept the data. This updates the program and moves down for the next step.

- To change a step, use the arrow keys to move to the step, and press |USE| or |ENTER|. When you have made your changes, press the |USE| softkey to accept the changed step back into the program.

- To delete a step, move to the step and press the |CLEAR| key.

- To insert a step, move to where you want the new step to go and press the desired milling function key. The new step is inserted and the following steps will move down.

If you decide not to use a step that you have already selected, press the |CANCEL| softkey.

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Saving and Loading Your Programs

Programs can be *saved* in the VRO 300M. If a program is saved, it is safe from power loss. Saving and other program functions are found by pressing the PROGRAM FUNCTIONS softkey.

PROGRAM FUNCTIONS	CLEAR PROGRAM			RUN

LOAD	SAVE	DELETE		CANCEL
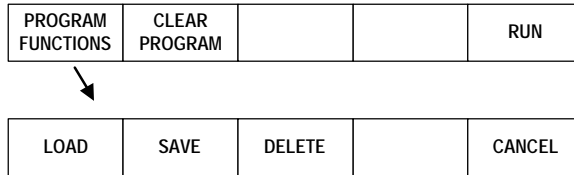
To save a program, press SAVE. Name the program using the numeric keys, or use the ALPHABET softkey to select alphabetic characters. You can use up to 8 characters in the name. When you have named the program, press ENTER or SAVE.

To run or edit a saved program, press the LOAD softkey. Use the arrow keys to select the program name, and press ENTER.

To clear a program which is currently on the screen, press the CLEAR PROGRAM softkey. This does **not** delete any programs which have been saved; it simply clears the program from the display.

To delete a program which has been saved, press the DELETE softkey, move to the program name, and press DELETE again.

> The VRO 300M will ask you for confirmation
> before you clear or delete a program.

Alphabet Entry

When you need to enter alphabetic characters, press the ALPHABET softkey and the alphabet box appears.

```
ALPHABET
    A  B  C
 D  E  F  G  H
 I  J  K  L  M
 N  O  P  Q  R
 S  T  U  V  W
    X  Y  Z
```
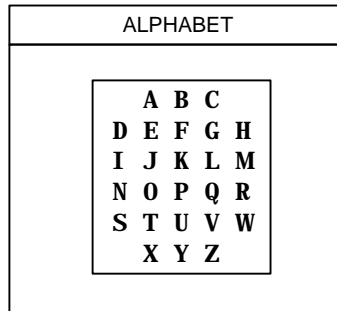
Use the softkeys to move around in the alphabet, and the ENTER key to select a letter.

LEFT	UP	ALPHABET	DOWN	RIGHT

You can mix alphabet characters with numerals from the keypad.

Press the ALPHABET softkey again to clear the alphabet box.

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Running a Program

To run a program, move to the first step and press the [RUN] softkey. You
must now *execute* the step and, when you are done, press the [NEXT] softkey
to run the next step.

When you run a program, the part view graphic is automatically replaced by
the position display so you can move to zero as required.

You can run a program starting from *any* step; just move to the step you
want to start with and press [RUN]. Remember that milling function steps
are normally preceded by a Tool step that is required to calculate the correct
tool offsets.

Tool Steps

If the step is a Tool step, the new tool offsets are used and the new tool
description is shown in the status bar. Check the tool you are using, and
change it if necessary.

Positioning Steps

If the step is a positioning step (such as Mill or Bolt Circle), the programmed
position is preset into the axis displays. The axis display is switched to
incremental. You can now move to zero in each axis.

Programming a Tool Offset

When you are entering a program, you don't have to worry about the actual
tool path. Because of the tool radius compensation capability built into the
VRO 300M, you program only the actual part dimensions. When you program
a cutting step, use the TOOL COMP field to tell the readout which side of the
cut you want the tool to be on.

Picture yourself standing behind the tool as it is moving. If the tool is on the
left of the workpiece, use "left" offset. If the tool is to the right of the
workpiece, use "right" offset.

By using left and right offsets, you
can program the dimensions of the
part as found on the blueprint. The
readout will take care of all cutter
radius compensation. You do not
have to program the tool path.

Left offset   Right offset
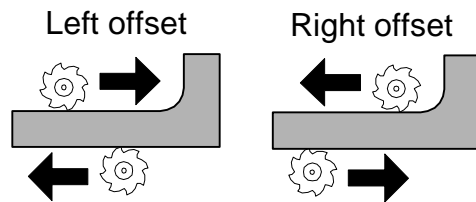
If you use "center" offset, the
programmed dimensions are for the center of the tool.

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Tool Steps

Put this step in your program whenever you need to use a different tool. Press the ⬭ TOOL key to bring up the Set Tool form.

TOOL SIZE—enter the diameter of the tool and, optionally, its length offset.

UNITS—use the softkeys to select inches or millimeters.

```
            SET TOOL
┌ TOOL SIZE ──────────────┐
│  DIA        0.2500       │
│  LEN        0.5210       │
└─────────────────────────┘
┌ UNITS ──────────────────┐
│                  INCH    │
└─────────────────────────┘
┌ TOOL TYPE ──────────────┐
│               FL END ML  │
└─────────────────────────┘
```

TOOL TYPE—use the | TOOL TYPES | softkey to open the list of tool types. If you use the Tool Type feature, the readout can let you know what kind of tool you had in mind when you wrote the program.

If you wish, press the | TOOL LIBRARY | softkey to select a tool directly from the Tool Library. Use the arrow keys to select the tool, and the | ENTER | key to put the selected tool into the Tool Step.

Position Steps

This step lets you program a positioning move. You can preset up to four axes at once. The dimension in each axis can be absolute or incremental.

POINT—press an axis key (`X` for example) to specify which direction you wish to move. Enter the dimension. If the dimension is incremental, press the `(ABS/INCR)` key and enter the number of the step you want to reference. *The reference step must precede the current step in the program.*

Use the arrow keys or the `ENTER` key to move from one axis to another.

003	POSITION

POINT
| X | -1.200 | INCR | 002 |
| Y | 1.000 | ABS | |

Example

1.5
1.0
Absolute Zero
1.20
3.00
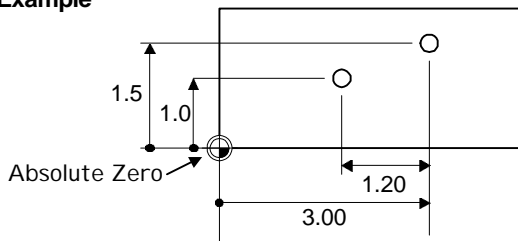
We'll use 2 Position Steps to drill these holes. This example assumes that Step 001 is a Tool Step.

Incremental Zero,
position step 002

1.5
3.00

POS

`X` `3` `.` `0` `ENTER`
`Y` `1` `.` `5` `USE`
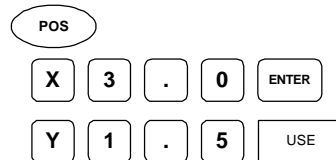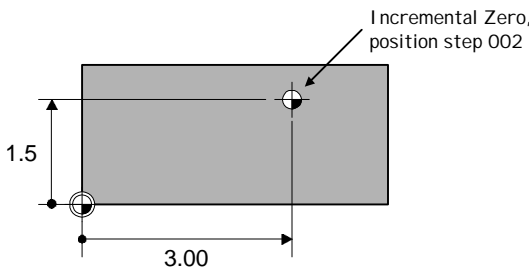
This becomes Step 002. It will be the reference step for Step 003.

Incremental Zero,
position step 003

Hole drilled at Position Step 002

1.0
-1.20

POS

`X` `+/-` `1` `.` `2` `(ABS/INCR)` `2` `ENTER`
`Y` `1` `.` `0` `USE`
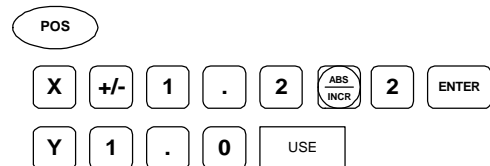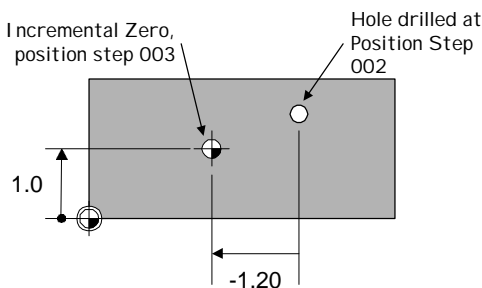
This becomes Step 003. Notice that the X dimension is measured incrementally from Step 002.

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Mill Steps

This function lets you mill a straight line. The readout will first preset the location of the starting point of the line, then the end position of the line.

FROM—enter the start point of the line.

DEPTH—this may be left blank.

TO—use an axis key to select either a horizontal or vertical movement, then enter the end point of the line.

TOOL COMP—use the softkeys to select left, center, or right radius compensation.

MILL
FROM
X   ABS
Y   ABS
DEPTH
Z   ABS
TO
X   ABS
TOOL COMP
CENTER

When you program a continuous contour of milling steps, the readout will compensate for tool offset at the start and end of each cut. For mill steps to be continuous, they must:

• have the same depth,

• be cut with the same tool,

• be cut on the same side (left, right, or center),

• "touch"—the end of one must be the same as the start of the next.

When you follow one Mill Step with another, the readout assumes that you want them to be connected. It automatically fills in the FROM point, DEPTH, and TOOL COMP. All you have to do is fill in the TO point and press | USE | .

The readout will automatically detect continuous contours, and will mark the program listing so you can see the Mill Steps that make up the contour.

CURRENT PROGRAM
001   SET TOOL
002 ⌐ MILL
003	MILL
004 ⌐ MILL

Bolt Circles

You can program full or partial circle patterns.

H OLES —enter the number of holes.

C ENTER —enter the center of the pattern.

R ADIUS —enter the radius of the pattern.

A NGLES —you can rotate the first hole of the pattern by filling in the start angle. You can also do partial circles: the number of holes you entered will be spaced evenly between the angles. Leave the END ANGLE blank if you want a full circle.

BOLT CIRCLE		
HOLES		
CENTER		
X		ABS
Y		ABS
RADIUS		
ANGLES		
	0.000	START
		END
DEPTH		
Z		ABS
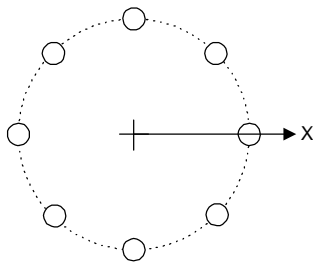
Full Circle

Rotated Circle

Start
Angle

Partial Circle

End
Angle

Start
Angle
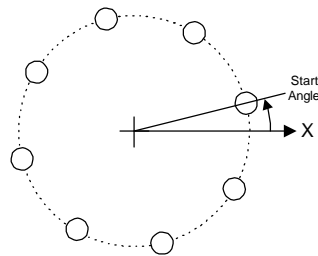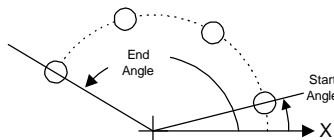
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Hole Frame and Hole Array

The frame and the array hole patterns require the same information. Arrays have holes in the middle of the rectangular pattern, while frames have holes only on the outside edge of the rectangle.

HOLES—enter the number of holes in each direction.

CORNER—enter the center of the lower left hole.

SPACING—enter the distance between hole centers.

ANGLE—you can tilt the hole pattern; measured from the 3 o'clock position.

```
            HOLE ARRAY
 ┌ HOLES ──────────────────┐
 │ X                        │
 │ Y                        │
 └──────────────────────────┘
 ┌ CORNER ─────────────────┐
 │ X                  ABS   │
 │ Y                  ABS   │
 └──────────────────────────┘
 ┌ SPACING ────────────────┐
 │ X                        │
 │ Y                        │
 └──────────────────────────┘
 ┌ ANGLE ──────────────────┐
 │              0.0000      │
 └──────────────────────────┘
 ┌ DEPTH ──────────────────┐
 │ Z                  ABS   │
 └──────────────────────────┘
```


Frame   Array

Corner   Corner

ANGLE

Corner   Tilted
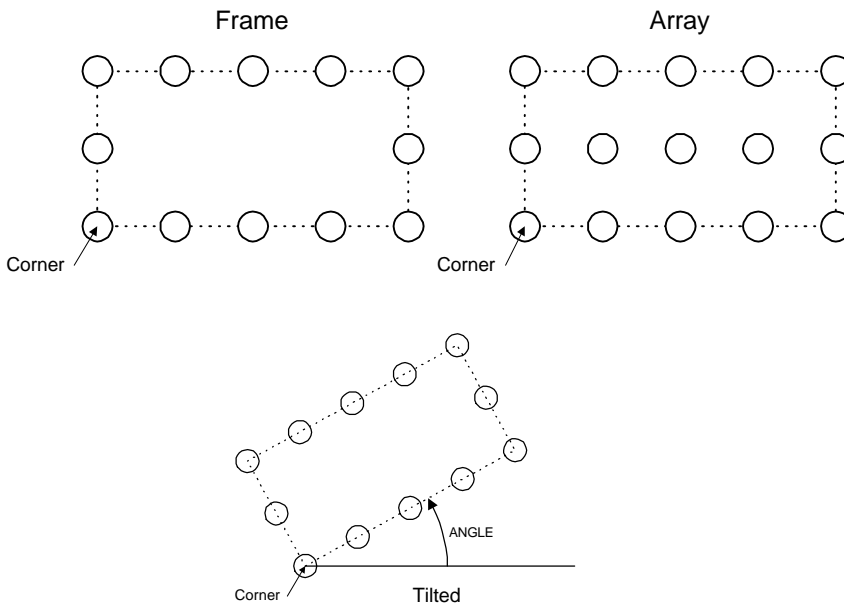
Row of Holes

This step makes it easy to enter a row of equally spaced holes.

HOLES—enter the number of holes.

FROM—enter the center of the first hole.

SPACING—enter the distance between hole centers.

ANGLE—measured from the 3 o'clock position.
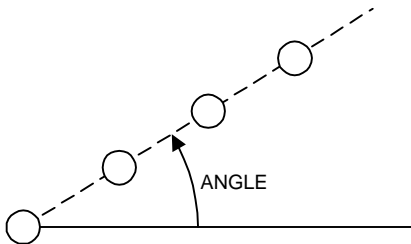
ROW OF HOLES	
HOLES	
	9
FROM	
X	ABS
Y	ABS
SPACING	
0.750	
ANGLE	
0.000	
DEPTH	
Z	ABS

ANGLE

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Rectangular Frame

A frame step lets you mill a rectangular shape. The frame is defined by its lower left corner and its size. You can use this step to specify the edge of a pocket.

CORNER—enter the lower left corner location.

SIZE—enter the width and height of the rectangle.

DEPTH—enter the depth.

DIRECTION—decide between conventional milling and climb milling using the | CW | and | CCW | softkeys.

FRAME TYPE—select the tool offset directions using the softkeys. You can mill a pocket if you use the inside offset.

```
          RECT FRAME
 ┌ CORNER ──────────────
   X                 ABS
   Y                 ABS
 ┌ SIZE ────────────────
   X
   Y
 ┌ DEPTH ───────────────
   Z                 ABS
 ┌ DIRECTION ───────────
     CW
 ┌ FRAME TYPE ──────────
     INSIDE
```


OUTSIDE FRAME   INSIDE FRAME   CENTER FRAME
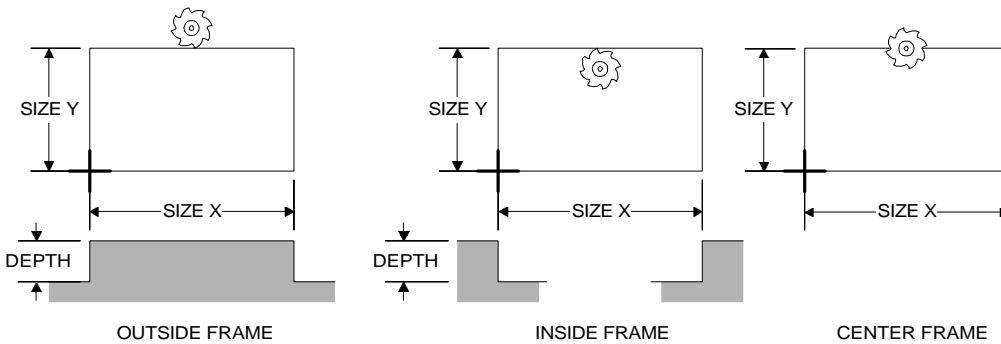
Repeats

Using this step, you can repeat whole parts, or sections of parts, horizontally, vertically, or both.

STEP RANGE—enter the numbers of the first and last steps that you want to repeat.

OFFSET—enter the offset in either X or Y, or both directions. The offset is the distance between repeats.
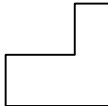
REPEAT—enter the number of repeats you want *in addition to* the original.

```
            REPEAT
  STEP RANGE
  FIRST
  LAST

  OFFSET
  X
  Y
  REPEAT
                    MORE
```

Example:

```
001  ⊓ MILL
002  || MILL
003  || MILL
004  || MILL
005  || MILL
006  ⊔ MILL
```

To repeat the above program once, 6 inches to the right, fill in the Repeat form like this:

```
            REPEAT
  STEP RANGE
  FIRST       001
  LAST        006

  OFFSET
  X          6.00
  Y
  REPEAT
             1   MORE
```

Original   Repeat

|←———6.00———→|
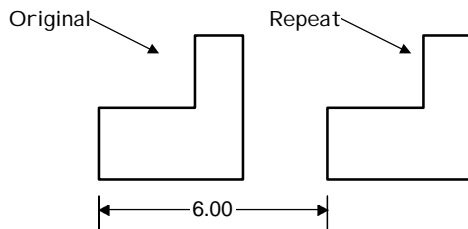
Because the Repeat form hides the program list, you can use the SHOW STEPS softkey to toggle between the form and the list of steps.

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Mirror Images

You can make a mirror image of any section of you program using this step.

STEP RANGE—enter the numbers of the first and
last steps that you want to mirror.

MIRROR ABOUT—enter the position of the "mirror
line", called the *axis of reflection.* Use the X

or Y key to choose the direction, and enter
the location of the axis.

```
                    MIRROR
  ┌ STEP RANGE ─────────────
    FIRST
    LAST
  ┌ MIRROR ABOUT ───────────
    X                    ABS
```

Example:

```
  001  ⊓ MILL
  002  || MILL
  003  || MILL
  004  || MILL
  005  || MILL
  006  ⊔ MILL
```
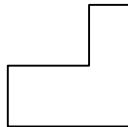
To mirror the above program about a vertical line 1 inch on the negative side
of absolute zero, fill in the Mirror form like this:

```
                 MIRROR
  ┌ STEP RANGE ─────────────
    FIRST        001
    LAST         006
  ┌ MIRROR ABOUT ───────────
    X     -1.00      ABS
```

Left-hand part ↙   Axis of
reflection   ↖ Original

◄1.00►
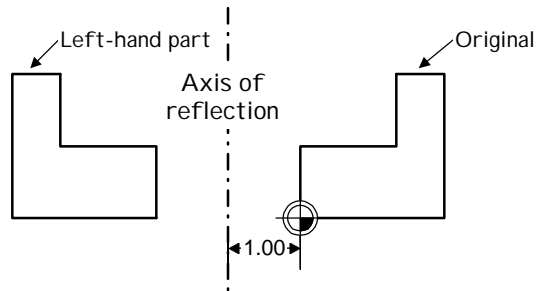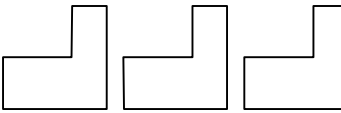
Because the Mirror form hides the program list, you can use the SHOW STEPS
softkey to toggle between the form and the list of steps.

Explode

Any *repetitive* type of step causes the VRO 300M to create copies of one or more simpler steps. For example, the Repeat step below creates 2 copies of the 6-line contour, yet it takes only one step. Similarly, a single Bolt Circle step causes the readout to create several holes.

```
001  ⎵ MILL
002  ‖ MILL
003  ‖ MILL
004  ‖ MILL
005  ‖ MILL
006  ⎵ MILL
007     REPEAT (001-006)
```

Repetitive type steps include Repeat, Mirror, Row of Holes, Hole Frame, Hole Array, and Bolt Circle.

The Explode function will take one of these repetitive type steps and replace it with the individual steps. This is useful when you need to change or eliminate one of the individual steps.

For example, to program an eight-hole bolt circle without the third hole:

   1. Program the eight-hole bolt circle.

   2. Highlight the Bolt Circle step.

   3. Press (MORE) [EXPLODE] . The Bolt Circle step is removed and eight Position steps are inserted in its place.

   4. Move to the third hole and press the [CLEAR] key.
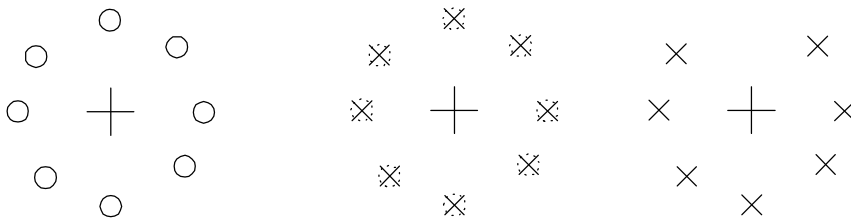
```
   002     BOLT CIRCLE
```

Explode step 002 to get 8
Position steps. Highlight
the third hole and press
the [CLEAR] key.

002	POSITION
003	POSITION
004	POSITION
005	POSITION
006	POSITION
007	POSITION
008	POSITION
009	POSITION

002	POSITION
003	POSITION
004	POSITION
005	POSITION
006	POSITION
007	POSITION
008	POSITION

Teaching a Position

To teach a position to the readout as you are making a part, select a step as you normally would. In any field where a position is needed, instead of entering numerical position values, machine to the position that you want to enter, then use the TEACH POSITION softkey to enter the position value. *Only absolute position values are used.*

Example

The Position step below needs to have the Y-axis entered.

Press the TEACH POSITION softkey and the absolute position from the Y display is automatically placed in the Y field.
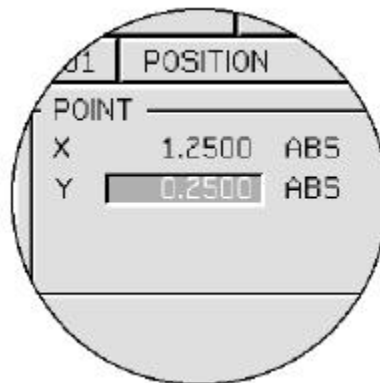
Other Features

Calculator

The four-function calculator keys, $\boxed{+}$ $\boxed{-}$ $\boxed{\textbf{X}}$ $\boxed{\div}$, are available when you are in any numeric data entry field. Just use these keys as you would any calculator.

The keys will act on a number that is already in the field. For example, if you move to a field which already has a value of 3.125, and you want to double it, just press $\boxed{\textbf{X}}$ $\boxed{\textbf{2}}$ $\boxed{\text{ENTER}}$ to get 6.250.

When you have more than one calculation in a field, the calculator will perform multiplication and division before it does addition and subtraction. This means that you can enter $\boxed{\textbf{3}}$ $\boxed{+}$ $\boxed{\textbf{1}}$ $\boxed{\div}$ $\boxed{\textbf{8}}$ to get three and one-eighth (the 1 ÷ 8 is done before the 3 is added).

The VRO 300M can calculate trig functions, tilt angles, and rotational speeds. Press the $\boxed{\text{CALC}}$ key, and the following softkeys appear.

TRIG	TILT	RPM	CANCEL	USE

Trig Functions

When you're entering data for a position function, you may need to calculate dimensions using the trig calculator. Press the $\boxed{\text{TRIG}}$ softkey, and the following function softkeys are shown.

SHIFT	SQR ROOT	SIN	COS	TAN
	SQR	ARC SIN	ARC COS	ARC TAN

Most of the calculator softkeys are divided in half. At first, the top half is "active", while the bottom half is "inactive". Press the $\boxed{\text{SHIFT}}$ softkey and the bottom half of the calculator options becomes active.

SHIFT	SQR ROOT	SIN	COS	TAN
	SQR	**ARC SIN**	**ARC COS**	**ARC TAN**

Typically, a result is calculated by entering a number and then selecting the appropriate math function. For example, to enter a number whose value is the square root of 2, press $\boxed{\text{CALC}}$, $\boxed{\textbf{2}}$, $\boxed{\text{TRIG}}$, and $\boxed{\text{SQR ROOT}}$. The value 1.4142 (the square root of 2) will be displayed. Press $\boxed{\text{USE}}$ to accept the result.

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Trig functions are calculated by entering the angle first and then the appropriate trig function. For example, enter $\boxed{3}\,\boxed{0}$, then select the $\boxed{\text{SIN}}$ softkey. A value of 0.5000 (sin 30º) will be displayed.

Tilt Angle Calculator

You can calculate tilt or rotation anlges either by entering dimensions from a print, or by touching a tilted workpiece with a tool or indicator.

TILT AXES—use the axis keys on the keypad to change the axes if needed.

FIRST POINT—either enter a point from the print, or touch the tool to one point and press the $\boxed{\begin{smallmatrix}\text{TEACH}\\\text{POSITION}\end{smallmatrix}}$ softkey, once for each axis.

SECOND POINT—enter a second point on the workpiece.

TILT ANGLE—is automatically calculated.

TILT ANGLE CALCULATOR		
TILT AXES		
FIRST AXIS		X
SECOND AXIS		Y
FIRST POINT		
X	0.5000	ABS
Y	0.0000	ABS
SECOND POINT		
X	0.7500	ABS
Y	3.2500	ABS
TILT ANGLE		
X	85.6014	DEG
Y	4.3987	DEG
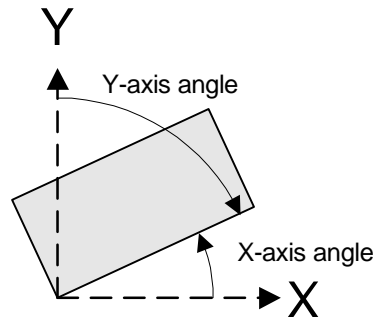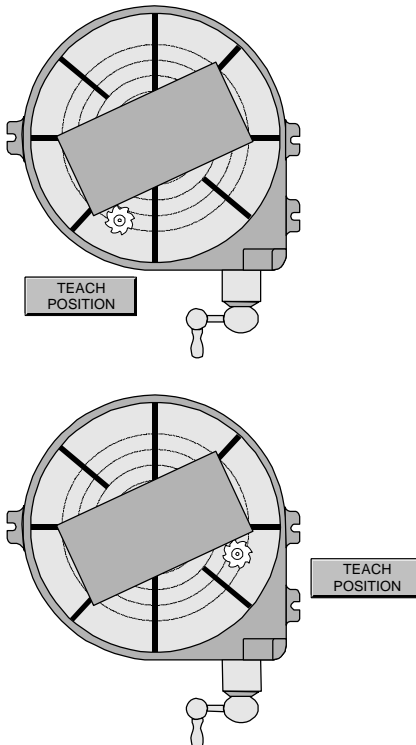
RPM Calculator

This feature lets you calculate a rotational speed based on a diameter and the desired surface speed.

DIAMETER—enter the diameter of the tool. You can change to metric with the ⎡ MM ⎤ key.

SURFACE SPEED—enter the desired surface speed. You can change between feet/minute and meters/minute using the softkeys. For convenience, the ⎡ SURFACE SPEED TABLE ⎤ softkey brings up a table of surface speeds for various materials.

RPM—is calculated automatically.

```
┌─────────────────────────────────┐
│        RPM CALCULATOR           │
│  ┌ DIAMETER ────────────────┐   │
│  │ 2.000              INCH   │   │
│  └──────────────────────────┘   │
│  ┌ SURFACE SPEED ───────────┐   │
│  │  150            FT/MIN    │   │
│  └──────────────────────────┘   │
│  ┌ RPM ─────────────────────┐   │
│  │                    286    │   │
│  └──────────────────────────┘   │
│                                 │
└─────────────────────────────────┘
```

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Printing

If you have a printer connected to the VRO 300M, you can have the readout print various pieces of information. Softkeys are available whenever there is something that you can print.

POSITION—when the axis positions are displayed, press the ⌑ PRINT POSITION ⌑ softkey to print the positions.

Information about the tool in use is printed before the position. The absolute and incremental positions for each displayed axis is printed with the units of measure.

Tool offset symbols indicate whether the printed position is on the positive (+) or negative (-) edge of the tool, or at the tool's center (o).

```
TOOL:  DIAMETER =     0.1250
INCH
        LENGTH    =     1.2500
INCH
      X:+   Y:o
X      ABS                2.9710
INCH
        INC                2.9710
INCH
```

PROGRAM—when the program list is visible, you can press ⌑ PROGRAM FUNCTIONS ⌑, then

the ⌑ PRINT PROGRAM ⌑ softkey to print out each step of the program.

Some setup information, such as scale factor, prints here.

```
PROGRAM NAME:   PART100
DIMENSION UNITS   = INCH



001  SET TOOL
      NUMBER       =  2
      X            =  1.2500
INCH
      Y            =  0.5440
INCH

002  POSITION
      X            =  0.0000
ABS
      Y            = -0.5000
ABS
```

TOOL LIBRARY—when you are looking at the tool library, press the $\boxed{\begin{smallmatrix}\text{PRINT TOOL}\\\text{LIB}\end{smallmatrix}}$ softkey
to print a copy of it.

```
                TOOL  LIBRARY
NUMBER     DIAMETER      LENGTH
UNITS      TYPE

  00          0.5020  /   0.0021
INCH     EDGE  FNDR
  01          0.2953  /   1.3822
INCH     FL  END  ML
  05          2.0030  /   0.2998
```

SYSTEM PARAMETERS—the $\boxed{\text{PRINT SETUP}}$ softkey is displayed in the Job Setup screen.
Both job-related and machine-related parameters are printed.

```
JOB  SETUP  PARAMETERS

DISPLAY  RESOLUTION
X    =    0.0005   INCH
Y    =    0.0005   INCH

SCALE  FACTOR
1.0000

NEAR  ZERO  WARNING
Y    =    OFF
```

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Remote Interface

You can enter commands into the VRO 300M from a remote terminal or computer if you have configured the serial port as a COMPUTER. These remote commands are in the form of ANSI standard ASCII characters. The remote device can request that the readout send information, such as the current position, or the device can control the readout by simulating the pressing of any of the readout's hard keys or softkeys.

Requesting Information

Commands that request information from the readout begin with the question mark character. As soon as the command is recognized, the response data is sent, terminated by a CR character. Invalid commands are ignored.

String	Command	Response
?*	Reset	No information returned. Resets the echo mode and clears input and output buffers.
?E*n*	Set Echo Mode: echo when a keypad command is sent.	*n* is equal to 0, 1, or 2. If n = 0, no echo. If n = 1, echo the control character sent. If n = 2, echo a string describing the key function. Refer to the "Readout Keypress" column in the Keypad Command table on page 41 for the strings.
?I*x*	Get Incremental Position	Returns the position for the axis specified. *x* = 1, 2, 3, 4, 5 or 6. Examples are: "X= -123.4567 INCH", "Y= +123.4567 DEG"
?A*x*	Get Absolute Position	For an undefined axis, the response is "* = ****.**** ***". If an error exists, the response is: "*x* = Error mm".
?U	Get Units	Returns the current display units, "INCH" or "MM".
?X	Get Active Axes	Returns the displayable axes, for example: "X Y Z W ** **" "**" means the axis is not displayed.
?T	Get Current Tool	Returns current tool information, for example: "Current Tool: Diameter: 0.125000 INCH Length: 1.25000 INCH Tool Type: 1"
?Q	Get Port Status	Verifies the operation of the port connected to the computer. The responses are: 0 = No parity, data overrun, or buffer overflow errors have occurred since the last "port status" check. 1 = One of the above errors has occurred since the last "port status" check.

Keypad Commands

Sending one of the control characters from the following table to the readout is equivalent to pressing the corresponding readout key.

Control Character	Readout Keypress
Q	X
W	Y
E	Z
R	W
A	ZERO X
S	ZERO Y
D	ZERO Z
F	ZERO W
!	SOFT KEY 1
@	SOFT KEY 2
#	SOFT KEY 3
$	SOFT KEY 4
%	SOFT KEY 5
Z	TOOL
X	POS
V	MILL
B	HOLES
N	MORE
T	DRO
Y	PGM
U	VIEW
I	INFO
O	SET UP
G	ABS/INCR
H	MM
J	CALC

Control Character	Readout Keypress
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
.	. (decimal)
_ (underscore)	+/-
[	CLEAR
]	ENTER
+	+
-	-
*	x (multiply)
/	÷
<	UP ARROW
>	DOWN ARROW

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Job Clock

The job clock can help you
estimate jobs or monitor
throughput. It records to the
nearest minute. You can start,
stop, and reset the job clock
using the softkeys in Setup.
Refer to page 52.

Hours : Minutes

SCALE: 1.0000   0:59   INCH
                              ABS

Reference Tables

Several useful tables, including tap and drill sizes and machine cutting

speeds, are included in the VRO 300M. Press the [INFO] key, then the [INDEX]

softkey to see the index of topics. Move to REFERENCE TABLES and press the [ENTER]
key.

Setup

The $\boxed{\text{SETUP}}$ key lets you change the system parameters. Some of these parameters are job related, meaning that they may change from job to job. Others are machine related and should be set as part of the installation. The machine-related parameters can be accessed by pressing the $\boxed{\substack{\text{INSTALLATION}\\\text{SETUP}}}$ softkey and entering the access code.

Use the $\boxed{\uparrow}$ $\boxed{\downarrow}$ keys to move from one parameter to the next, and the $\boxed{\text{ENTER}}$ key to select the parameter.

The $\boxed{\substack{\text{USE NEW}\\\text{SETTINGS}}}$ softkey will terminate the setup process and save the changes. Use the $\boxed{\substack{\text{CANCEL}\\\text{CHANGES}}}$ softkey to cancel the changes.

JOB SETUP
TOOL LIBRARY
DISPLAY RESOLUTION
SCALE FACTOR
NEAR ZERO WARNING
ERROR COMPENSATION
JOB CLOCK
FEED UNITS
REMOTE SWITCH

INSTALLATION SETUP
DISPLAY CONFIGURATION
ENCODER SETUP
SERIAL PORT
PARALLEL PORT
PROTECTION
GRAPH ORIENTATION
DIAGNOSTICS

Job Setup

Tool Library

A list of tools is available to you for convenient selection during programming and/or operation of the VRO 300M. There are 100 "slots" in the Tool Library. You can organize tools any way you wish.

```
┌─────────────────────────────────────────────────────────────┐
│              TOOL LIBRARY (DIAMETER / LENGTH)                 │
│                                                               │
│   00   0.2000  /   0.000      INCH       EDGE FNDR            │
│   01   0.2000  /   1.205      INCH       FL END ML            │
│   02   0.2498  /   0.000      INCH       BL END ML            │
│   03   0.1075  /   0.000      INCH       BL END ML            │
│   04   0.375   /   0.000      INCH       DRILL                │
│   05   1.000   /   0.000      INCH       DRILL                │
│   06                                                          │
│ ┌───────────────────────────────────────────────────────┐   │
│ │ 07                                                      │   │
│ └───────────────────────────────────────────────────────┘   │
│   08                                                          │
│   09                                                          │
│   10                                                          │
│   11   1.000   /   0.000      INCH       BROACH              │
│   12                                                          │
│   13                                                          │
│                        7 OF 99                                │
└─────────────────────────────────────────────────────────────┘
```

To add a tool to the tool library, select an unused slot and press the ENTER key. Fill in the diameter, length, units and the type (press the TOOL TYPES softkey for the list of available types). Press DONE to enter the tool into the library.

```
┌──────────────────────────────┐
│      TOOL DESCRIPTION         │
│  ┌─ SIZE ─────────────────    │
│  │ DIA            .3750       │
│  │ LEN            1.25        │
│  ┌─ UNITS ────────────────    │
│  │ INCH                       │
│  ┌─ TYPE ─────────────────    │
│  │           FL END ML        │
└──────────────────────────────┘
```

To change an existing tool, move to that tool and press ENTER. Make any changes and press DONE. The changed tool will now appear in the library.

You can sort the tool library by tool number (so you can see them in numerical order) or by type (so you can see all your drills together) by pressing the SORT BY NUMBER or SORT BY TYPE softkeys. When you do this, the unused tool slots are not shown. To see them again, press DONE or CANCEL to return to the JOB SETUP menu, then select TOOL LIBRARY again.

Display Resolution

The display resolution will normally be the
same as the encoder resolution. However, if the
job tolerance is coarser than the encoder
resolution (for example, the job tolerance may
be ±0.005"), you can adjust the display
resolution so you won't be tempted to waste
time by machining to a finer resolution.

Use the COARSER and FINER softkeys to cycle
through all the possible choices. The choices
available depend upon the resolutions of the
scales.

```
         DISPLAY  RESOLUTION

  X  AXIS
              0.0005        DIA

  Y  AXIS
              0.001

  Z  AXIS
              0.0005

  W  AXIS
              0.0005

  U  AXIS

  V  AXIS
```

Scale Factor

The scale factor can be set to scale the workpiece up or down from the preset
or programmed size. All preset and displayed dimensions are multiplied by
this scale factor. All programmed dimensions will be multiplied by this scale
factor when the program is run. The numbers
in your program are not changed.

A scale factor of 1.000 causes the readout to
use preset or programmed dimensions exactly.
Values greater than 1 cause parts to be made
larger; values less than 1 cause parts to be
made smaller.

```
          SCALE FACTOR

  SCALE
              1.0000
```

Example:

For a scale factor that allows for 3% material shrinkage, use this formula:

$$ScaleFactor = \frac{1}{1-.03} = \frac{1}{.97} = 1.0309$$

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Near Zero Warning

Each axis has its own near zero range. You can activate or deactivate the near zero warning feature by pressing the [ON] and [OFF] softkeys. When the warning is activated, you can enter the range.

The warning indicator appears in the display just before the tool enters the range, and it begins to move when the tool enters the range. The indicator moves faster as it approaches zero. Refer to page 16.

```
      NEAR ZERO WARNING

  X AXIS
                      0.010
  Y AXIS
                      0.020
  Z AXIS
                        OFF
  W AXIS
                        OFF
  U AXIS
                        OFF
  V AXIS
                        OFF
```

Linear Error Compensation

The VRO 300M includes a linear error compensation feature which enables you to compensate for machine tool inaccuracies. You can have up to 99 different compensation segments per encoder.

In order for linear error compensation to function properly, the readout needs to be able to establish the segment boundaries in the same physical locations each time you turn on the readout. This means that you must find the encoder's reference mark. Refer to page 7, "Power-On Position Recovery".

To begin the process, select ERROR COMPENSATION from the JOB SETUP list. Error compensation is applied to each encoder individually, so you must first select the axis that you want to work with. You may use a display axis key

(**X** for example) to select the encoder, unless the encoder is coupled with another one, or the encoder is displayed as the U or V axis. If that is the case, enter the number of the input that the encoder is connected to.

Examples:

- X axis displays encoder 1; you may press **X** or **1** to select this encoder.

- Y axis displays encoders 2 + 3; you may press **Y** or **2** to select encoder 2, but you **must** press **3** to select encoder 3.

Once you have selected the encoder, the readout displays the error compensation table for that encoder. Initially, there is only one segment defined, and it applies from one end of the encoder to the other.

| Segment 1 | Segment 2 | Segment 3 |

+ Count Direction

Machine table front view
(slightly exaggerated)

ENCODER 1 ERROR COMPENSATION

01 0 PPM ENCODER END - ENCODER END

Segment number

Compensation factor in parts per million

Most negative segment boundary

Most positive segment boundary
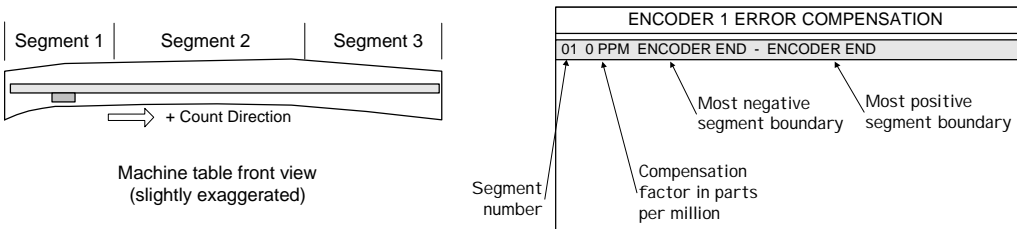
The following softkeys let you begin defining the table.

ENTER COMP	CALCULATE COMP	ANCHOR SEGMENT 1		DONE

Anchoring the Segments

If you *anchor* the beginning of the first segment at a known location on the encoder, then the segment boundary values will be the actual physical distances from the anchor point, as shown below.

ENCODER 1 ERROR COMPENSATION		
01 492 PPM	ENCODER END -- 8.00	
02 -697 PPM	8.00 -- 23.4	
03 -78 PPM	23.4 -- ENCODER END	
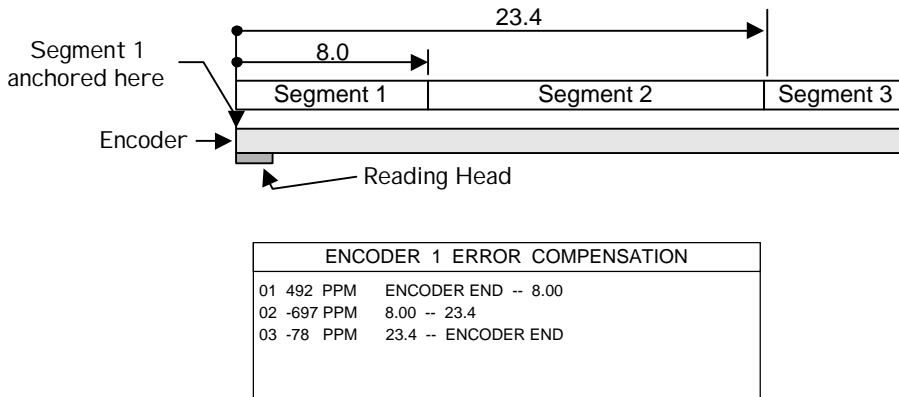
Anchoring the segments is optional: if you don't do it, the segment boundary values may be meaningless to you (although they are understood by the readout).

ANCHOR SEGMENT 1 Pressing this softkey puts the start of Segment 1 at the current tool location. To anchor the segments correctly, move the encoder in the negative count direction as far as it will go, then press **ANCHOR SEGMENT 1**.

Note: If you anchor Segment 1 in a different place *after* you have established the compensation values, then the entire compensation table will be shifted to the new anchor location, as shown below.
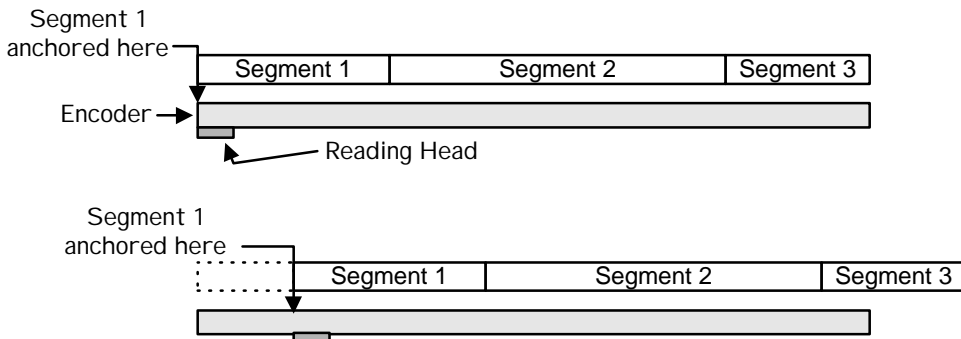
Compensation Entry Methods

You can enter the segment boundaries and compensation factors using the keypad, or you can have the readout calculate them for you. Normally, you would use the keypad entry method only to restore or adjust a known compensation value.

Manual Entry

ENTER COMP

This brings up the softkeys needed to let you enter compensation and segment information using the keypad.

NEW SEGMENT	CLEAR TABLE	ANCHOR SEGMENT 1	CANCEL	DONE
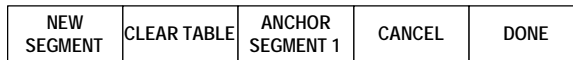
The | NEW SEGMENT | softkey brings up the DEFINE SEGMENT form.

FACTOR—Enter the compensation factor in parts per million.

SEGMENT—You can change only the TO field. Use the | ENCODER END | softkey if the boundary is at the end of the encoder. Use the | POINT | softkey to enter the physical location of the segment boundary. The current

```
           DEFINE SEGMENT
  ┌ FACTOR ──────────────────
  │                   2    PPM
  │
  ┌ SEGMENT ─────────────────
  │  FROM           ENCODER END
  │  TO             ENCODER END
```

reading head location may be entered using | TEACH POSITION | softkey.

The | DONE | softkey saves the segment information in the table.

Continue adding segments with the | NEW SEGMENT | softkey. You must add them in order, from the encoder's most negative end to its most positive end.

The | CLEAR TABLE | softkey will delete the information from the table, erasing all segments and compensation factors, so that the readout will not perform any error compensation.

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Calculated Entry

CALCULATE
COMP

This brings up the softkeys needed to have the readout calculate the compensation factors.

NEW SEGMENT	CLEAR TABLE	ANCHOR SEGMENT 1	CANCEL	DONE

The | NEW SEGMENT | softkey brings up the CALCULATE SEGMENT form.

STANDARD—This is where you enter the actual length of the standard.

TRAVEL—Shows the measured length of the standard. This would normally be slightly different from the actual length because of machine inaccuracies.

FACTOR—This is the compensation factor calculated by the readout.

```
        CALCULATE SEGMENT
  ┌ STANDARD ──────────────
  │  ┌──────────────────────┐
  │  │              0.0000   │
  │  └──────────────────────┘
  ┌ TRAVEL ────────────────
  │                0.0000
  ┌ FACTOR ────────────────
  │        0000   PPM

```

You will need a dial indicator and a measurement standard.

   1.   Position the standard in the center of the segment.

   2.   Enter one edge of the standard.

FIRST POINT   FIRST POINT
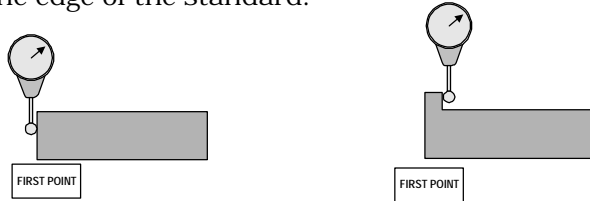
   3.   Enter the other edge of the standard.

SECOND   SECOND
POINT   POINT

   4.   Enter the actual size of the standard, including the probe
           diameter if necessary.

8.1250   8.0000
Opposite sides   Same side
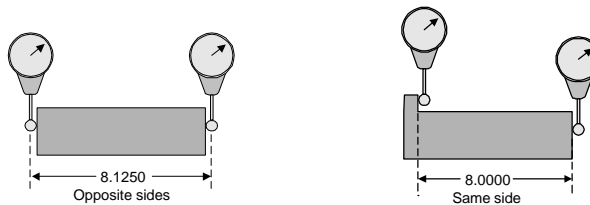
          If the calculated factor is 9999 or –9999, the machine
          inaccuracy is too great and cannot be compensated.

   5.   Press [DONE] to save the segment information into the table.

The readout will automatically set the segment boundaries between the
current segment and the adjacent segments.

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Job Clock

The softkeys let you start and stop the job clock, and let you reset it to zero. The actions do not take effect until you leave setup with the

| USE NEW SETTINGS | softkey.

```
┌──────────────────────────┐
│        JOB CLOCK         │
│ ┌────────────────────────│
│ │ ELAPSED TIME ──────────│
│ │ RUNNING        1:38    │
│ │                        │
│ │                        │
│ │                        │
│ │                        │
│ └                        │
└──────────────────────────┘
```

Feed Rate Units

Use the | IPM | and | MMPM | softkeys to change the feed rate units between inches per minute and mm per minute.

Remote Switch

The external switch (pendant or footswitch) can be enabled to perform any or all of the following functions:

```
┌──────────────────────────┐
│      REMOTE SWITCH       │
│                          │
│ ┌ PRINT ─────────────────│
│ │                     NO │
│ ┌ ZERO ──────────────────│
│ │                    XYZ │
│ ┌ NEXT ──────────────────│
│ │                     NO │
└──────────────────────────┘
```

- PRINT—print the current position. Enable with the | YES | key, disable with the | NO | key.

- ZERO—zero one or more axes. Use the axis keys (| X | for example) to specify which axes will zero when the switch is pressed.

- NEXT—run the next program step. The | YES | and | NO | keys enable or disable this function.

Installation Setup

Display Configuration

Individual encoders are connected to the VRO 300M at inputs numbered 1 through 6. The assignment of each encoder to an axis display (X, Y, or Z for example) is done by completing this form.

Each axis display can be configured in one of the following ways.

Unused—press the ☐ OFF ☐ softkey to delete the axis from the DRO display.

Single Encoder—use the numeric keypad to enter the encoder input number.

Coupled Encoders—you can couple two encoders together using the ⊕, ⊖, or ÷ keys:

> **1** ⊕ **2** will display the sum of encoders 1 and 2.

> **1** ⊖ **2** will display the difference between encoders 1 and 2.

> **1** ÷ **2** will display the average of encoders 1 and 2.

You can display the same encoder in more than one axis.

In the above example, the X, Y, and Z displays show encoders 1, 2, and 3 respectively. The W-axis display will also show encoder 3, and the U-axis display couples the movements of encoders 2 and 3 together. The V display will not appear.

DISPLAY CONFIGURATION	
X DISPLAY	1
Y DISPLAY	2
Z DISPLAY	3
W DISPLAY	3
U DISPLAY	2+3
V DISPLAY	OFF

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Encoder Setup

You must tell the readout something about the encoders. Select ENCODER
SETUP from the Installation Setup list and enter the encoder number (the
number is defined by the input connector number on the back panel of the
readout).

The encoder number you selected is
shown at the top of the form.

RESOLUTION—first use the softkeys to select
between linear and angular movement.

Linear—move the corresponding machine axis
in a positive direction until the readout senses
and displays the resolution. You won't have to
move more than two inches. For encoders
without Position-Trac, you need to enter the
resolution in microns (μm) directly.
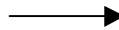
```
                    ENCODER 1 SETUP
            ┌─ RESOLUTION ─────────────┐
            │         10.0000      UM  │
            └──────────────────────────┘
            ┌─ DIRECTION ──────────────┐
            │                 POSITIVE │
            └──────────────────────────┘
```

Angular—For an encoder used to measure angular position, enter the number
of counts per revolution.

DIRECTION—you can change the count direction with the   POSITIVE   and   NEGATIVE
softkeys.

Serial Port

You can configure the serial port to connect to a printer or to a computer. Check the specifications for your printer or computer to determine how to complete the following information. For most items, softkeys let you select values.

FUNCTION—configure to connect to a printer or to a computer. Press | OFF | to disable the serial port.

OUTPUT TAIL—enter the number of blank lines (CR character), from 0 to 9, that you want to print after the information is sent out.

LF AFTER CR—press | YES | if you want to output a line feed character after the carriage return (end of line).

BAUD—press the | LOWER | and | HIGHER | keys to move through the available transmission speeds (baud rate).

```
        SERIAL PORT
┌ PORT CONFIGURATION ──────
  FUNCTION          PRINTER
  OUTPUT TAIL            0
  LF AFTER CR           NO

┌ PORT PROTOCOL ──────
  BAUD                1200
  PARITY              NONE
  DATA BITS              8
  STOP BITS              1
```

PARITY—select none, even, or odd.

DATA BITS—use the softkeys to select 7 or 8 bit word length.

STOP BITS—use the softkeys to select 1 or 2 stop bits.

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Parallel Port

Most printers connect to the parallel port. You can experiment with these settings to format the printed output.

FUNCTION—select [OFF] to disable the port or

[PRINTER] to enable it for printing.

OUTPUT TAIL—enter the number (0 to 9) of blank lines after each printed output.

LF AFTER CR—select to send a line feed character after the CR (end of line); some printers need this.

```
        PARALLEL PORT
 ┌ PORT CONFIGURATION ─────
   FUNCTION        [ PRINTER ]
   OUTPUT TAIL          0
   LF AFTER CR         NO
```

Protection

You have the ability to prevent changes to part programs and to the tool library *without first entering into the* INSTALLATON SETUP *and removing the protection.*

With program protection set to YES, programs cannot be changed or saved. This prevents an inexperienced machine operator from making scrap parts by mistakenly changing or deleting a step.

```
        PROTECTION
 ┌ PROGRAM ──────
                    NO
 ┌ TOOL LIBRARY ──────
                    YES
```

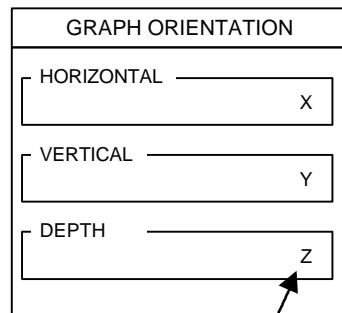If you protect the tool library, it can't be mistakenly changed either.

Graph Orientation

In order for the VRO 300M to draw a graphic representation of parts as you program them, you need to specify which machine axes correspond to the plane of the "drawing".
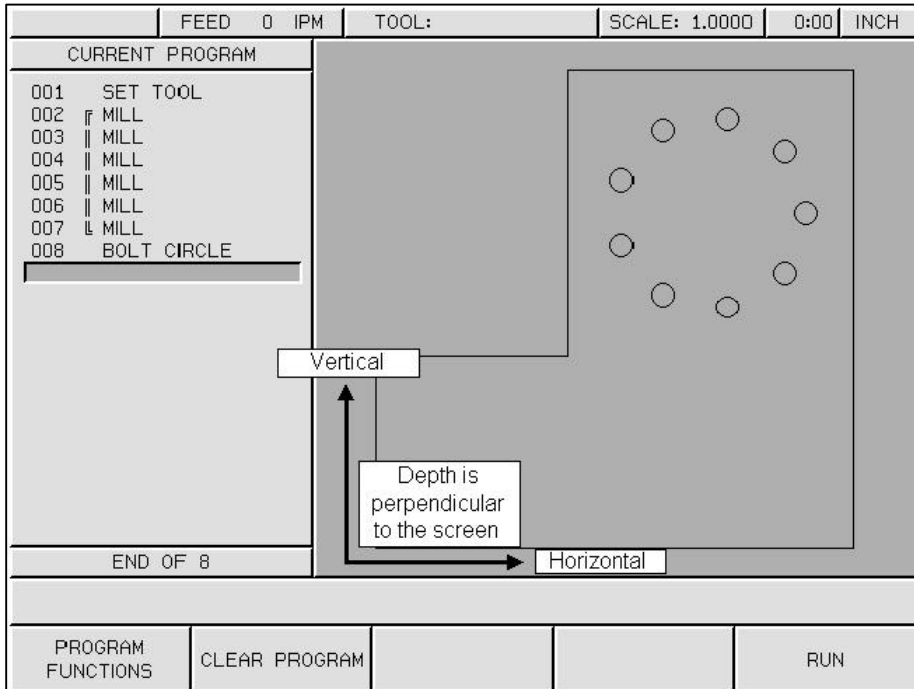
Use the axis keys ($\boxed{\text{X}}$ for example) to select horizontal, vertical, and depth directions.

Factory settings

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Installation

IMPORTANT

Before installing the VRO 300M readout, record the serial number on the warranty card and return it to ACU-RITE INCORPORATED. <u>The serial number label is located on the back of the readout</u>.

Selecting A Location

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

- The readout should be within reach of the operator for easy access to the keypad and other controls.

- The readout should be approximately at eye level.

- Avoid moving components or tools and minimize coolant splash or spray.

- The operating environment must be within the temperature range of 0° to 40°C (32° to 104°F) with a non-condensing relative humidity of 25% to 85%.

Proper Mounting

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

- Column and base machine mountings

- Hardware and mounting instructions

These kits are available from your factory authorized ACU-RITE Distributor or OEM/OEI.

If you fabricate a support device for the readout, it should be large enough and strong enough to accommodate the readout. It must also be stiff enough to minimize any vibration induced by machinery on the shop floor.

Connecting the Encoders

Insert the connector from each encoder into the mating connector on the back of the readout. Fasten it with a small screwdriver.

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

Encoder inputs are assigned to specific axis displays through software. Note which encoder is connected to each input, and refer to page 53 for display configuration instructions.

Connecting a Ground Wire

Connect a ground wire from the terminal on the back of the readout to the machine. The machine should also be connected to a solid earth ground. If not, be sure that the readout is.

Checking Voltage and Connecting Power

Check that the voltage available at the power source is within specification before connecting it to the readout. Refer to page 60.

Connect the readout to the power source using the power cord supplied.

⚠	**CAUTION**
	Connecting the readout to a power source outside of the acceptable range may damage the readout, the encoders, or both.

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Readout Specifications

Characteristic	Specification
Operating conditions	0° to 40°C (32° to 104°F)
	25% to 85% relative humidity (non-condensing)
Storage conditions	-40° to 60°C (-40° to 140°F)
	25% to 95% relative humidity (non-condensing)
Input requirements	
Voltage:	95 – 264VAC single phase
Frequency:	47-63 Hz
Current:	350ma @115V, 200ma @230V
Fuse	¾ A, 250V, 3AG, Slo-blo

Encoder input	Position signals: channels A & B
	       TTL square wave signal in quadrature
	       (90° nominal phase relationship)
	       Maximum input rate: 50 KHz
	
	Reference signal: TTL square wave

Control Function Interface (CFI)	Compatible with ACU-RITE CFI box
Edge finder input	Compatible with ACU-RITE electronic edge finder
Touch probe input	Compatible with Heidenhain touch probe
Ext. video output	VGA 640 x 480 pixels
Pendant input	Compatible with ACU-RITE remote switch
Parallel port	IEEE 1284-A for standard PC printer
Serial port	EIA/TIA-232E, V.28, RS-232C compatible
Size	8.375"H x 15.25"W x 10"D
Weight	17 lbs.
Mounting	Bottom: two ¼ -20 threaded inserts
FCC compliance	Class A

Troubleshooting

This section is intended to provide you with some basic troubleshooting assistance with your readout system. If you cannot correct the problem after following these instructions, contact your authorized ACU-RITE distributor or OEM/OEI for repair or replacement procedures.
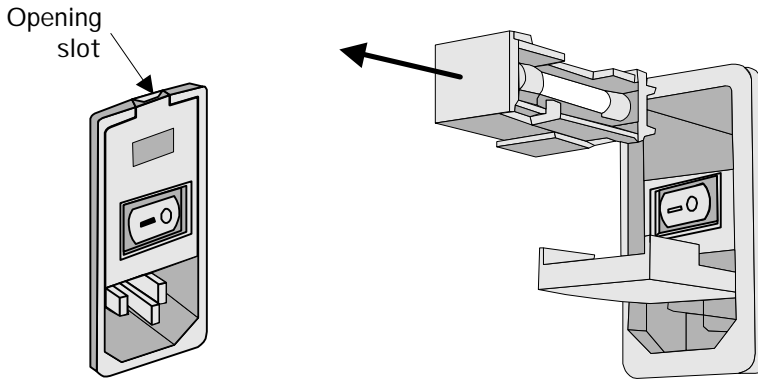
No Operation

NOTICE
If you turn power off, you must wait at least 5 seconds before turning it back on, or the readout may not power up. This is because the power supply, in order to withstand brief power outages and brownouts, requires several seconds to reset itself.

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

- **Check AC power source.** If the readout cannot be powered up, confirm that line voltage is present at the source and that the line voltage meets the required specifications.

- **Check power cord.** Remove the power cord at the electrical input module on the back of the 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. Replace the input module cover by snapping it back into place, and reconnect the power cord.

Opening
slot

⚠	**CAUTION**
	Replace fuses only with the specified type. Using incorrect fuses can present a safety hazard. The readout may also be permanently damaged. Refer to the Readout Specification chart on page 60 for the correct fuse.

Incorrect Operation

If system positioning does not seem to be repeatable, the problem could be with the machine tool or with the readout system.

- **Check the machine tool.** Check that the table is not locked. Ensure that the knee, ram, head bolts, turret-to-column bolts, and head-to-knuckle bolts are properly secured. Check the gib adjustments. Tram the head. Check spindle run-out.

- **Check linear encoders.** Check each encoder and reading head for proper installation. Ensure that the mounting brackets are secure.

If the system seems to be displaying incorrect positions, check the following items.

- *Verify presets.* Make sure the numbers that you entered are correct.

- *Verify tool.* Check that the correct tool is being used. Make sure the correct tool offset has been entered. Check the tool for wear.

- *Verify the scale factor.* Ensure that the correct scale factor is being used.

- *Verify linear error compensation.* Make sure that the factors used for linear error compensation are correct.

Errors

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

Loss of power is indicated by the "Power was off" message. Loss of power means that power to the readout has been interrupted. Since power to the encoders has also been interrupted, position information may no longer be accurate. Press the CLEAR key to clear the error message. Refer to page 7 for information about position recovery.

Counting errors are indicated by the "Scale miscount" message, telling you in which axis the miscount occurred. Counting errors result from distorted electrical signals from an encoder. These signals can be a result of an encoder malfunction, misalignment, mounting problems, or electrical interference. Press the CLEAR key to clear the error message. Follow these steps to determine if your difficulties are associated with the readout or with the encoder.

- Ensure that the linear encoder connectors are correctly seated.

- Swap linear encoder cables at the readout to see if the problem still appears in the same display.

- If the problem remains in the same display, the readout is in error.

- If the problem follows the connection change, the linear encoder may be in error. Refer to the Checking the Linear Encoders section of your encoder reference manual.

Display overflow errors are indicated by a blank 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, setting a new preset, or zeroing the display.
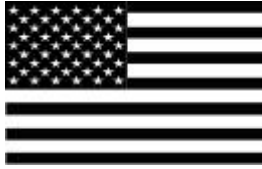
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