MEAM 150
Fundamentals of Mechanical Prototyping

COMPUTER-NUMERICAL CONTROLLED MACHINING

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CNC Machining

Benefits:
- Automated
- Cut complex shapes
- Repeatable

Drawbacks:
- Expensive
- Setup time
- Limited availability
MACHINING CENTER

FLOOD COOLANT
AUTO TOOL CHANGER
X16” x Y12” x Z10”

RETROFIT MILL

MANUAL COOLANT
MANUAL TOOL CHANGER
X31” x Y16” x Z23.5”
THE PROTOTRAK RETROFIT MILL
THE CONTROLLER

ProtoTRAK SMX

ProtoTRAK SMX
Version 2.04 (012706.09 5444)
OPTIONS
ADVANCED FEATURES YES
NETWORK/MEMORY YES
PROGRAMMABLE E HEAD YES
TRAKING/5 HANDWHEELS NO

Select a mode:

<table>
<thead>
<tr>
<th>F1</th>
<th>F2</th>
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<th>F5</th>
<th>F6</th>
<th>F7</th>
<th>F8</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRO</td>
<td>PROG</td>
<td>EDIT</td>
<td>SET UP</td>
<td>RUN</td>
<td>PROG</td>
<td>IN/OUT</td>
<td></td>
</tr>
</tbody>
</table>
Digital-Readout Mode
DRO MODE

3-AXIS DIGITAL READOUT

JOG

POWER FEED

TO SET ABSOLUTE ZERO ON AN AXIS:
PRESS X, Y, OR Z, THEN ABS SET

TO SET INCREMENTAL ZERO ON AN AXIS:
PRESS X, Y, OR Z, THEN INC SET

TO PRESET AN AXIS:
PRESS X, Y, OR Z, ENTER NUMBER, THEN INC SET.
DRO MODE

3-AXIS DIGITAL READOUT

JOG

POWER FEED

TO JOG:
PRESS JOG KEY (MESSAGE WILL FLASH)
CHECK “FEED RATE” BOX - SIGN = DIRECTION
PRESS X, Y, OR Z TO JOG
PRESS RETURN
DRO MODE

3-AXIS

DIGITAL READOUT

JOG

POWER FEED

POWER FEED:

PRESS POWER FEED KEY

PRESS X, Y, OR Z

ENTER THE DISTANCE TO MOVE, THEN INC SET

PRESS GO

RATE AUTO SETS TO 10 IPM
DRO MODE

3-AXIS
DIGITAL READOUT
JOG
POWER FEED

DO ONE:
DO A SINGLE CNC OPERATION
GO TO (ONLY WORKS ON ELECTRONIC HANDWHEELS):
SETS A VIRTUAL STOP AT A GIVEN POINT
RETURN ABS 0:
MOVE THE TABLE AND RAM TO YOUR ABSOLUTE ZERO
SPIN SPEED:
PRESS SPIN SPEED, ENTER VALUE, PRESS SET

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PROGRAMMING: 2 OPTIONS

CONVERSATIONAL PROGRAMMING @ THE MACHINE
FASTER FOR SIMPLE OPERATIONS
TIES UP THE MACHINE

CAD > CAM > MACHINE
DEFINE MORE COMPLEX PARTS
NEED TO LEARN THE SOFTWARE
PROGRAMMING 2.5D
PROGRAM MODE

BASIC PROCEDURE
1. ENTER HEADER INFO
2. PROGRAM “EVENTS”
3. EXECUTE
ASSUMED INPUTS WHEN PROGRAMMING

TOOL OFFSET    EITHER 0 OR LAST USED
FEEDRATE       LAST USED
TOOL #         SAME AS LAST USED
# PECKS        1
CONRAD         0
PROGRAMMING EVENTS

THE HEADER IS “EVENT 0”

to move to the next event, press either SET key

POSN

DRILL

BOLT HOLE

MILL

ARC

POCKET

PROFILE
PROGRAMMING EVENTS

POSN
DRILL
BOLT HOLE
MILL
ARC
POCKET
PROFILE
PROGRAMMING EVENTS

 POSN
 DRILL
 BOLT HOLE
 MILL
 ARC
 POCKET
 PROFILE
PROGRAMMING EVENTS

POSN

DRILL

BOLT HOLE

MILL

ARC

POCKET

PROFILE

(3X) EQUALLY SPACED \( \phi .116 \) \( \uparrow \) THRU, \( \phi 1.344 \) B.C.
PROGRAMMING EVENTS

POSN
DRILL
BOLT HOLE
MILL
ARC
POCKET
PROFILE

LEFT

RIGHT
PROGRAMMING EVENTS

POSN
DRILL
BOLT HOLE
MILL
ARC
POCKET
PROFILE

X CENTER
Y CENTER
X BEGIN
Y BEGIN
X END
Y END
(DIR=2)
Cuts an interior circular, rectangular, or irregular pocket with an optional finish pass.
Cuts an exterior circular, rectangular, or irregular profile with an optional finish pass.
SET UP MODE
### Tool Table

<table>
<thead>
<tr>
<th>TOOL #</th>
<th>DIAMETER</th>
<th>Z OFFSET</th>
<th>Z MODIFIER</th>
<th>TOOL TYPE</th>
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<tbody>
<tr>
<td>REF</td>
<td></td>
<td></td>
<td>SET</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.5000</td>
<td>-0.0100</td>
<td>0.0000</td>
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<tr>
<td>2</td>
<td>0.3750</td>
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<tr>
<td>3</td>
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<td>0.0000</td>
<td>Drill</td>
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<tr>
<td>4</td>
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<td>-0.0200</td>
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<td>Drill</td>
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<tr>
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**Tool #1 Diameter:** 0.5000

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<th>F8</th>
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</thead>
<tbody>
<tr>
<td>DATA DOWN</td>
<td>DATA UP</td>
<td>DATA LEFT</td>
<td>DATA RIGHT</td>
<td>ERASE TABLE</td>
<td>JOG</td>
<td>RETURN</td>
<td></td>
</tr>
</tbody>
</table>
TOOL PATH

Processes the program and displays tool paths.

Verify plan

Discover errors!
RUN MODE