Diamond Engineering
Automated Measurement Systems

Installation and Configuration Guide

D6050 Multi Axis Positioner

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Diamond Engineering
Automated Measurement Systems

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D6050 - System Introduction and Package Contents

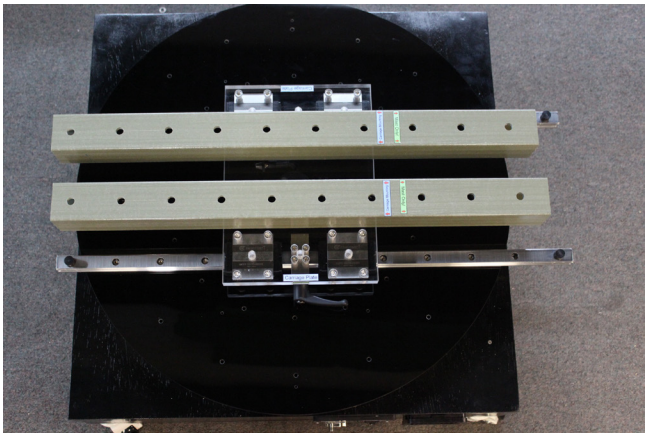
Overview

The Diamond Engineering D6050 multi-axis positioner is a 2-axis positioner (EL/AZ) / (Theta/Phi) with up to two additional linear axis options (Z and X) for automated phase measurements. The positioner can interface directly with the DAMS Antenna Measurement Studio software, or can be controlled via custom software over an RS-232 communications bus.

Package Contents

- D6050 Turntable Base with RF Components
- D6050 Mast Assembly
- Mast Attachment Base
- Two 24" fiberglass rail extensions
- One 8' Phi / Roll Axis RF Cable
- Two 10' RF Cables
- Right Angle RF Adapter* and other RF Connectors
- Roll Axis Control Cable
- 24V Power Supply and Line Cord
- 10' DB9 serial cable (with USB to serial converter)
- Assembly Hardware
- Laser and Digital Level
- AUT Mounting Hardware
- Tools

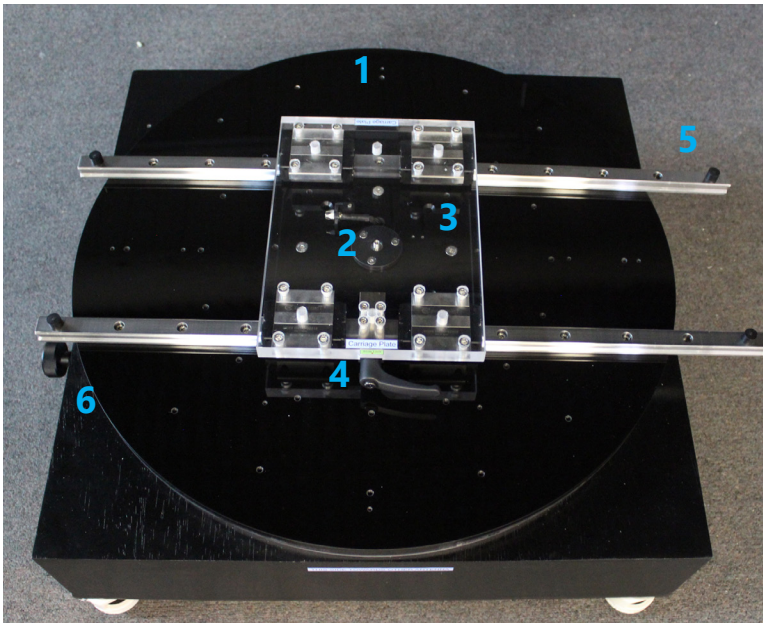
** unless included on roll cable (not applicable to 67 GHz option)*



Positioner Components Overview

D6050 Turntable

1. 24″ Turntable Plate
2. Rotary Joint
3. Main Carriage Plate
4. Linear Guide Brake (to lock rails after centering antenna)
5. Linear Guide stops
6. Manual rotation knob (for pre-positioning or to manually position turntable)



Connector Panel and Fan

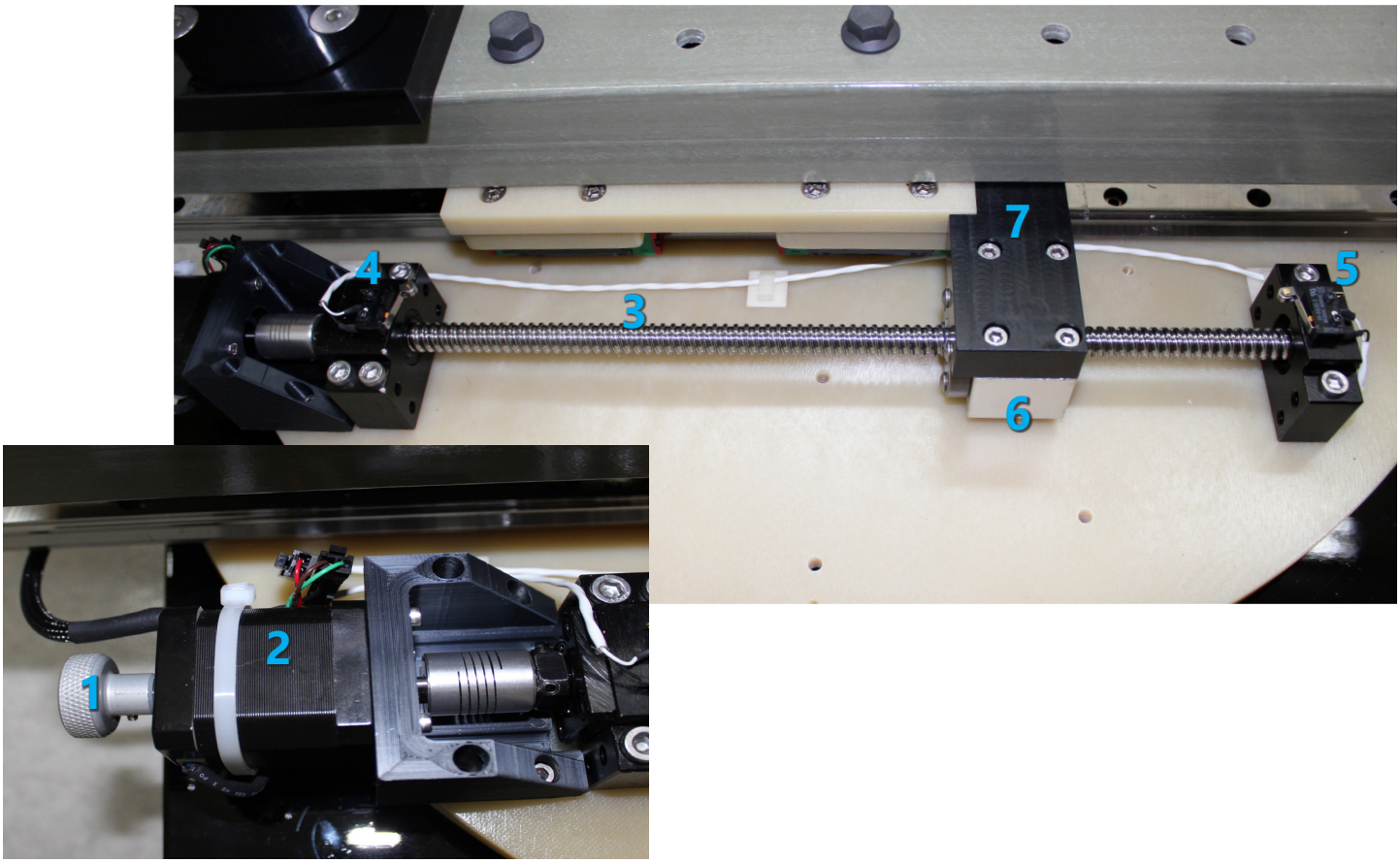
1. Power Switch
2. Power Indicator Light (legacy feature)
3. 24V 5A DC Power Jack (2.5mm barrel)
4. RF Connector
5. Aux (Z) Axis (optional)
6. 9 Pin (DB9) RS-232 Control Connector
7. Cooling Fan

Positioner Components Overview

Automated Z-Axis (mmW or add-on option)

The automated Z axis option connects a 0.02mm resolution precision ball screw actuator to the carriage plate providing precise position of the DUT over the turntable axis. Two limit switches enable stored offset positions and prevent the collision of the ball carriage into the end stops.

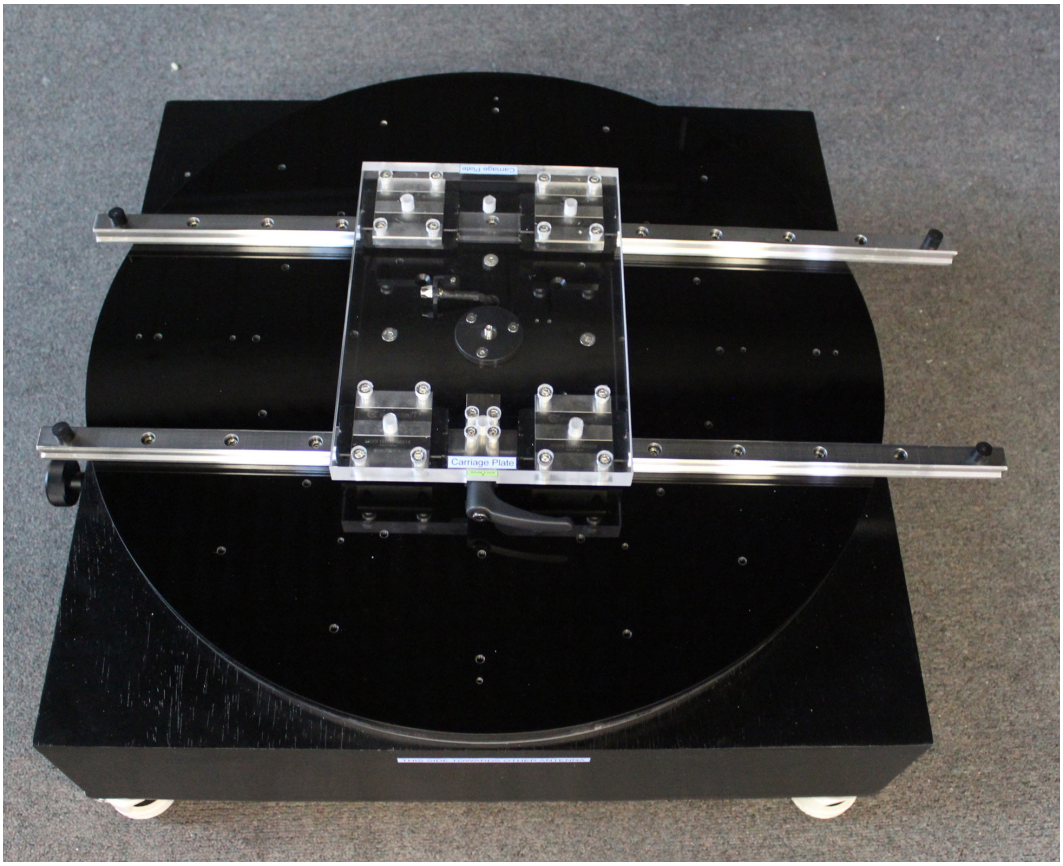
1. Manual Control Knob - To adjust position with controller on and holding current off
2. Drive Motor - NEMA 17 stepper motor
3. Ball Screw - 12mm diameter x 4mm pitch (4mm / turn)
4. Max Limit Switch - configured as normally open
5. Home Limit Switch - configured as normally open
6. Ball Nut
7. Carriage Plate Bracket - connects ball nut block to carriage plate



Hardware Assembly (2-Axis Systems)

Unpacking The System

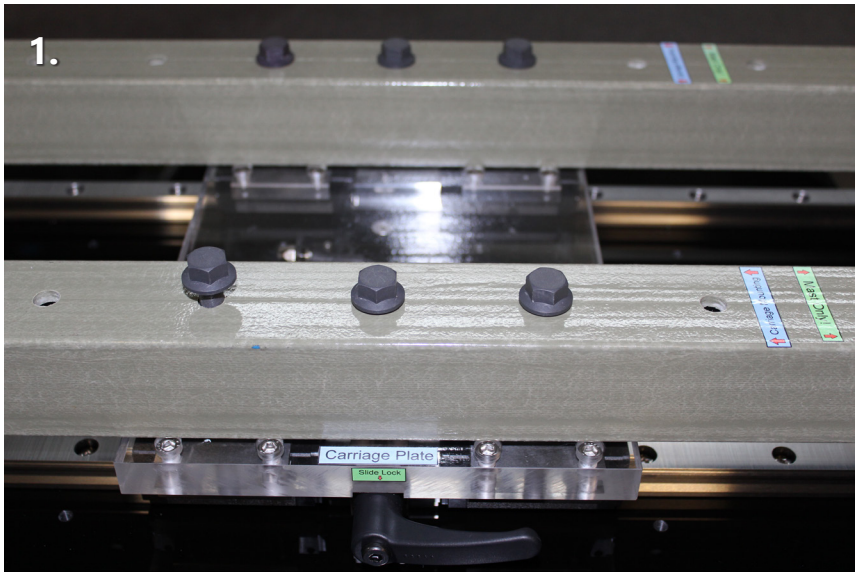
1. Unpack all components where turntable will be installed.
2. If possible, save shipping crates and packing materials in case you need to return system for maintenance or warranty repairs.
3. **IMPORTANT:** Position turntable so **connector panel faces away** from the reference antenna.



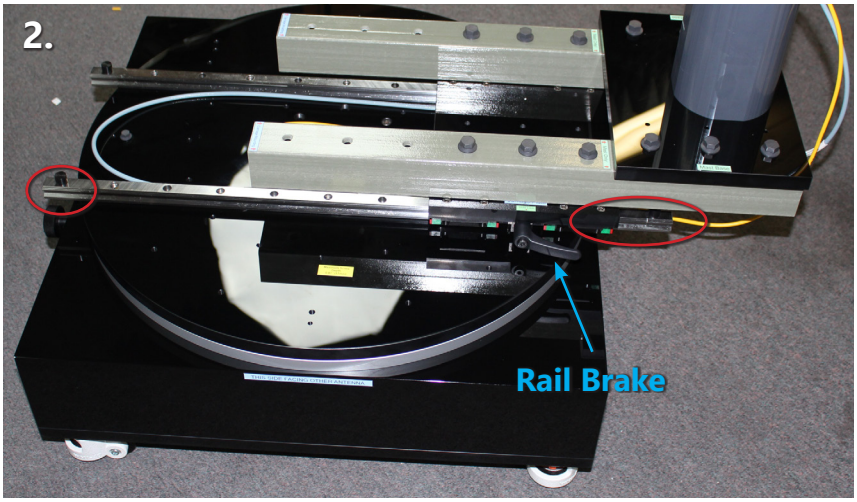
4. Rotate the orange dial on the wheels to lower the rubber feet, disabling wheel rotation.

Extension Rails & Mast Base Installation

1. Using supplied hardware, attach the two green fiberglass rail extensions to the main carriage plate, using the stickers on the rails for proper orientation. For initial installation we recommend using the set of holes shown in the picture #1 below.
2. Attach mast base assembly to the fiberglass rails using supplied hardware as shown in picture #2.



Do not tighten the bolts completely - leave slightly loose until the mast base has been attached, then tighten completely.



Position mast base on extension rails as shown above. Ensure mast base is to right of brake. Also please note the red circles, which are highlighting the length difference on the main steel rails. Mast should be affixed over the long end of rails.

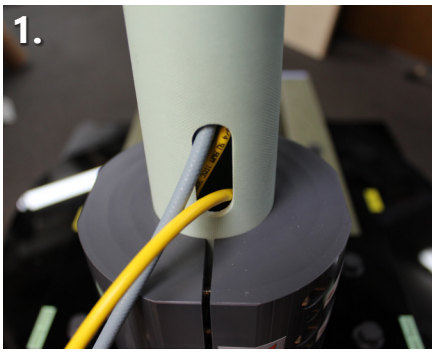
IMPORTANT: Do NOT over-tighten bolts! Never exceed more than 1/4 turn after bolt makes contact with surface.

Worm Driven Head *(Legacy design)*

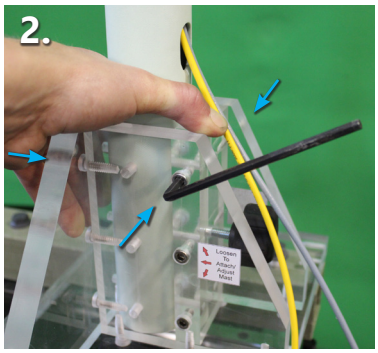
Mast Assembly & Installation

NOT for belt driven heads! See next section.

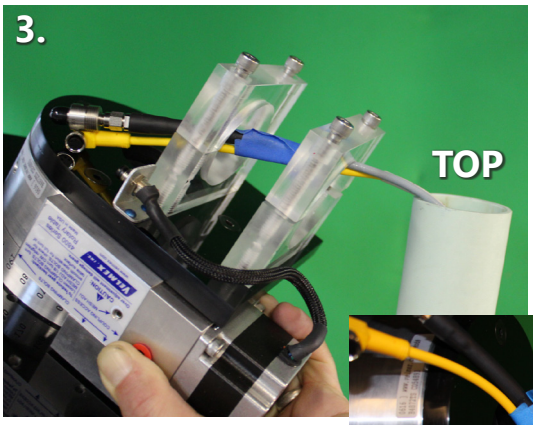
1. Unwrap lower portion of mast, remove cables from bottom of mast tube. Insert mast tube into the circular mast base. Position slot for cables at rear of mount.
2. While pushing against the back plate of the square mast base plate, tighten the screws on each of the three sides of the mast base.
3. Unwrap the cables at the top of the mast and pass them through the clamps on the back of the roll positioner head as shown in pictures #3 and #4.
4. Slide roll positioner head over mast and secure the clamps using the provided 3/16" hex wrench.
5. Connect angled end of yellow roll control cable to connector and **GENTLY** bend RF cable and insert into the roll positioning head

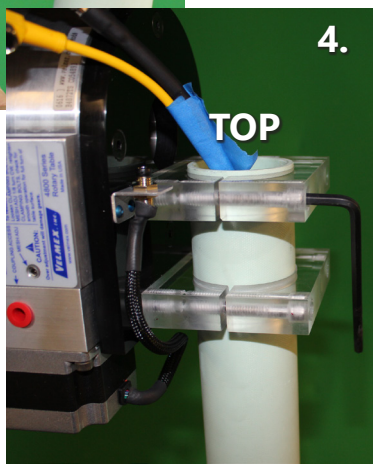


Position slot for cables at rear of mount.



Tighten screws on all three sides.





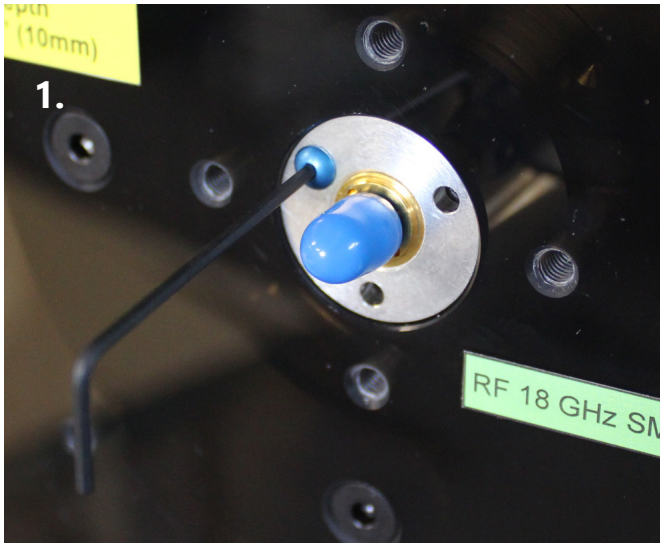
Slide cables through the large holes. Using these same holes, place head on mast and tighten screws.

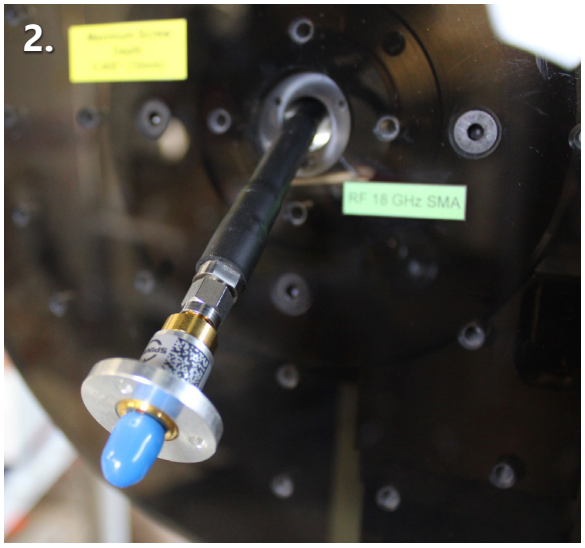
Gently bend RF cable to insert into roll head.

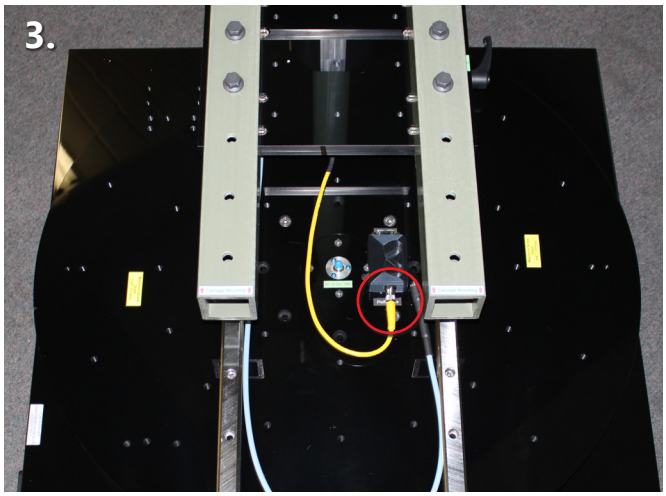
Rotary Joint Configuration

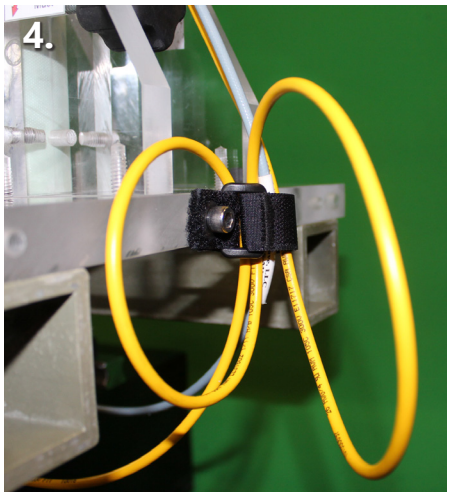
NOT for belt driven heads! See next section.

1. Use 1/16" hex wrench to remove 3 blue screws on the roll axis rotary joint.
2. Using an SMA torque wrench, attach the roll axis cable to the rotary joint then re-attach the rotary joint to the turntable using the 3 blue screws.
3. Using the included right angle SMA "K" adapter, attach the roll positioner cable to the turntable rotary joint. While here, also attach the yellow roll control cable to the port next to the rotary joint (see red circle in picture #3).
4. Use the Velcro wire management tie to hold excess control cable or insert back into the mast so it does not hang up on anything.







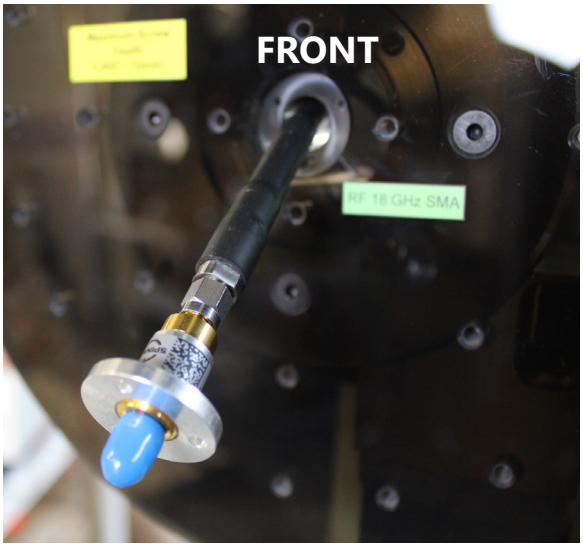


Belt Drive Head

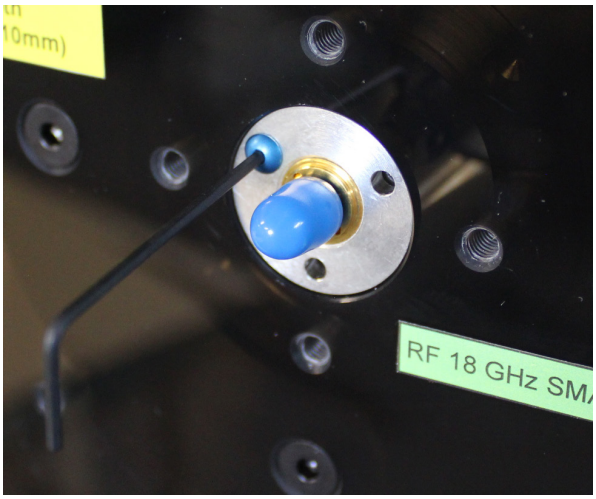
Your system should have arrived with a fully assembled mast assembly. The only tasks required are to attaching the roll plate, connecting RF components and connecting roll cable.

Roll Plate, RF Cable and Rotary Joint Installation

1. Unpack the included rotary joint, 10" roll plate, roll plate screws and the 96" RF cable.
2. Attach roll plate to head using the four included 10-32 x 0.75" screws.
3. Run RF cable through back of 2" hollow axle, all the way through the front center hole in the roll plate.
4. Use RF torque wrench to carefully attach rotary joint to RF cable. *(If RF torque wrench unavailable, torque to no more than 8 pounds.)*
5. Using included blue anodized 4-40 x 1/4" screws and included 1/16" hex wrench, carefully attach rotary joint to roll plate.

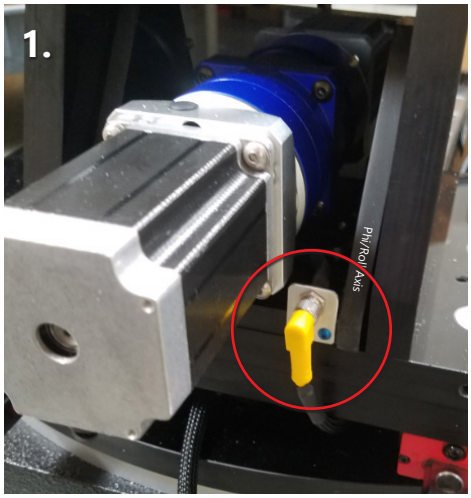


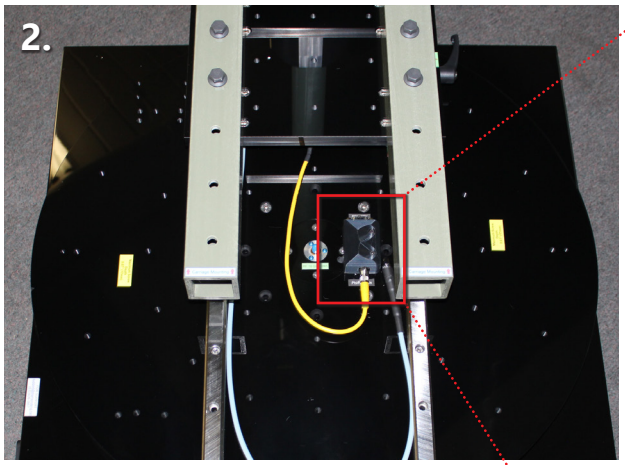
*(Photo depicts **after** rotary joint is connected to RF cable)*



Roll Cable & Turntable RF Connections

1. First connect the right angle female connection to the motor on the bottom of the back of the mast. The connector is designated with a “Phi/Roll Axis” label.
2. Run the cable under the carriage plate and connect the male end to the connection box near the center of the turn table (to the side of the turntable rotary joint).
3. Utilizing the provided right-angle RF connector, attach it to the rotary joint at the center of the turntable. Use an RF torque wrench (or, if unavailable, torque to no more than 8 pounds). Also attach the RF cable using same technique.





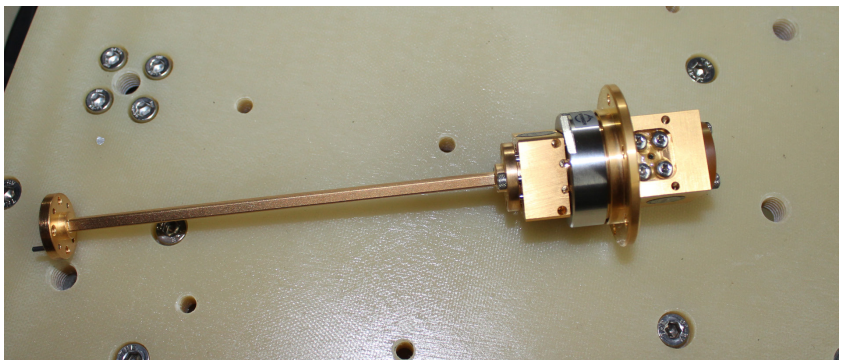
Hardware Assembly (mmW waveguide)

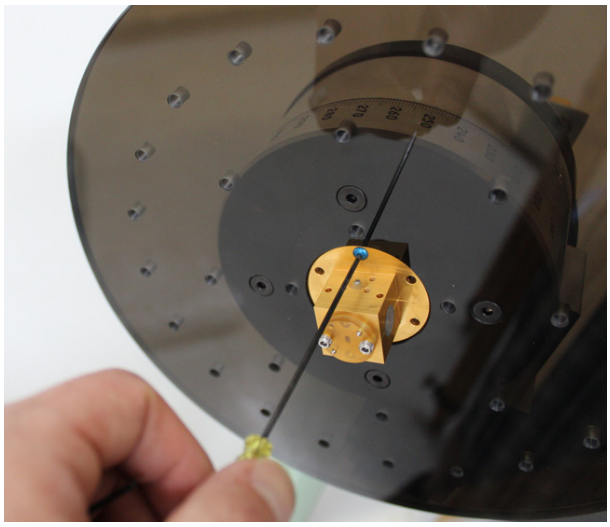
This ONLY covers installation of waveguide components on D6050-mmW systems.

IMPORTANT: **When assembling ensure all waveguide mating is flush across the entire flange!**

Rotary Joint Installation

1. Unpack waveguide parts and attach 5.25" waveguide section to the rotating section of the rotary joint
2. Insert rotary joint with attached waveguide into the roll plate
3. Fasten rotary joint using included 4-40 thread screws

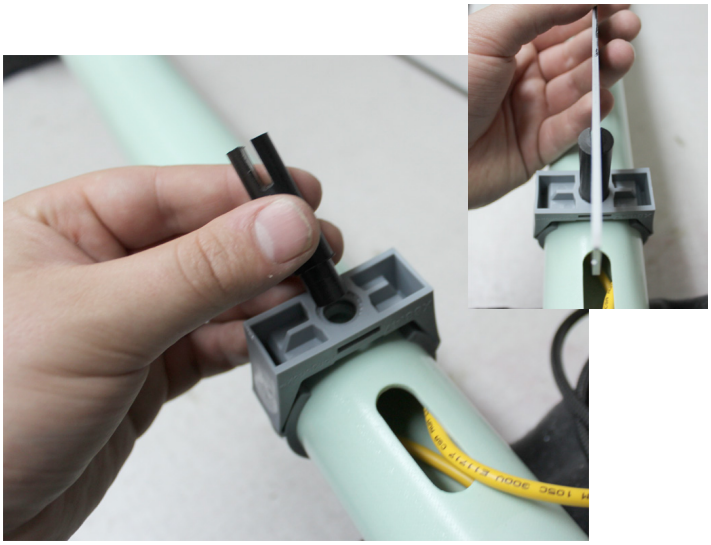


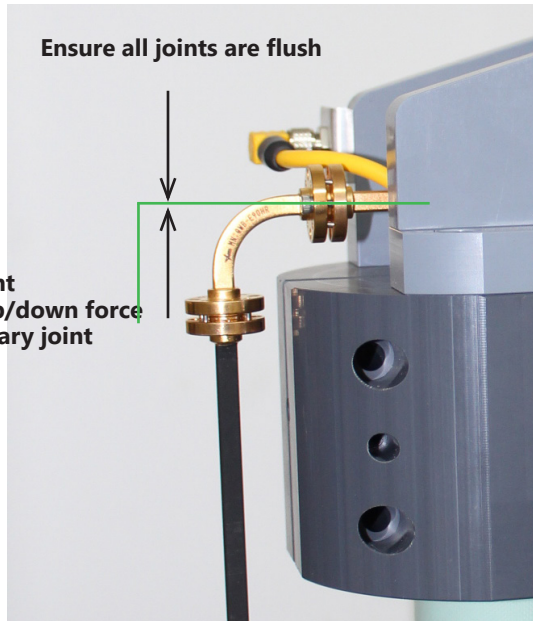


Waveguide and Support Installation

1. Locate waveguide support pieces and insert into grey clamps, keep slot parallel with the vertical mast tube.
2. For Copper Mountain and Anritsu installations connect the “H” plane 90 degree elbow the rotary joint assembly.
3. Carefully Insert long waveguide section into the waveguide supports
4. Fasten long waveguide section to upper 90 degree elbow.

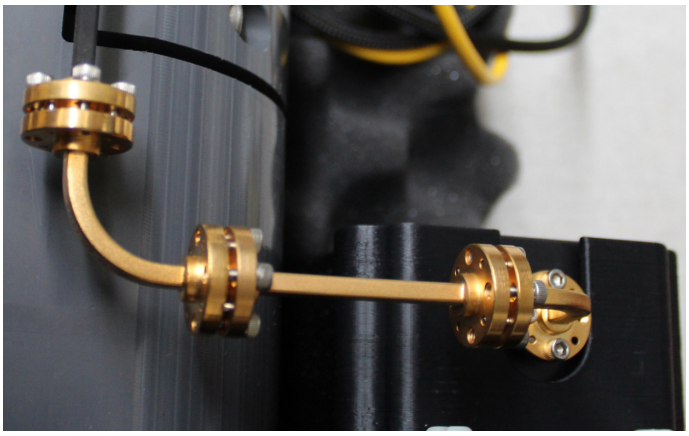
IMPORTANT: Ensure waveguide does not push or pull against the upper waveguide flange, this ensures that no rotational force is being placed onto the rotary joint.





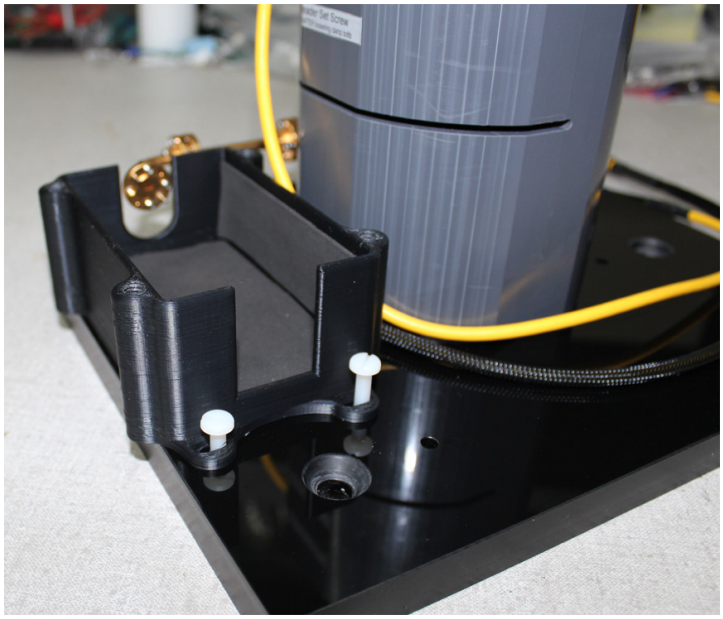
Lower Waveguide Components

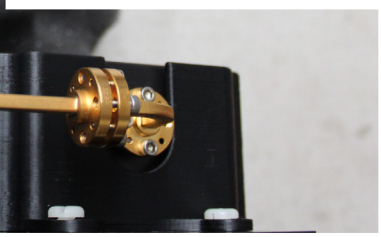
1. For Anritsu and Copper Mountain extenders attach the “E” Plane 90 degree bend to the bottom of the long waveguide section.
2. Attach other waveguide sections as required.



Installing Anritsu Shockline mmW Head Mount

1. Attach the included shockline head mount onto the mast baseplate using the four 10-32 screws. The curved slot should face the waveguide components
2. Verify the proper height of the waveguide components as minor mast height adjustments may be necessary to reach the desired height.



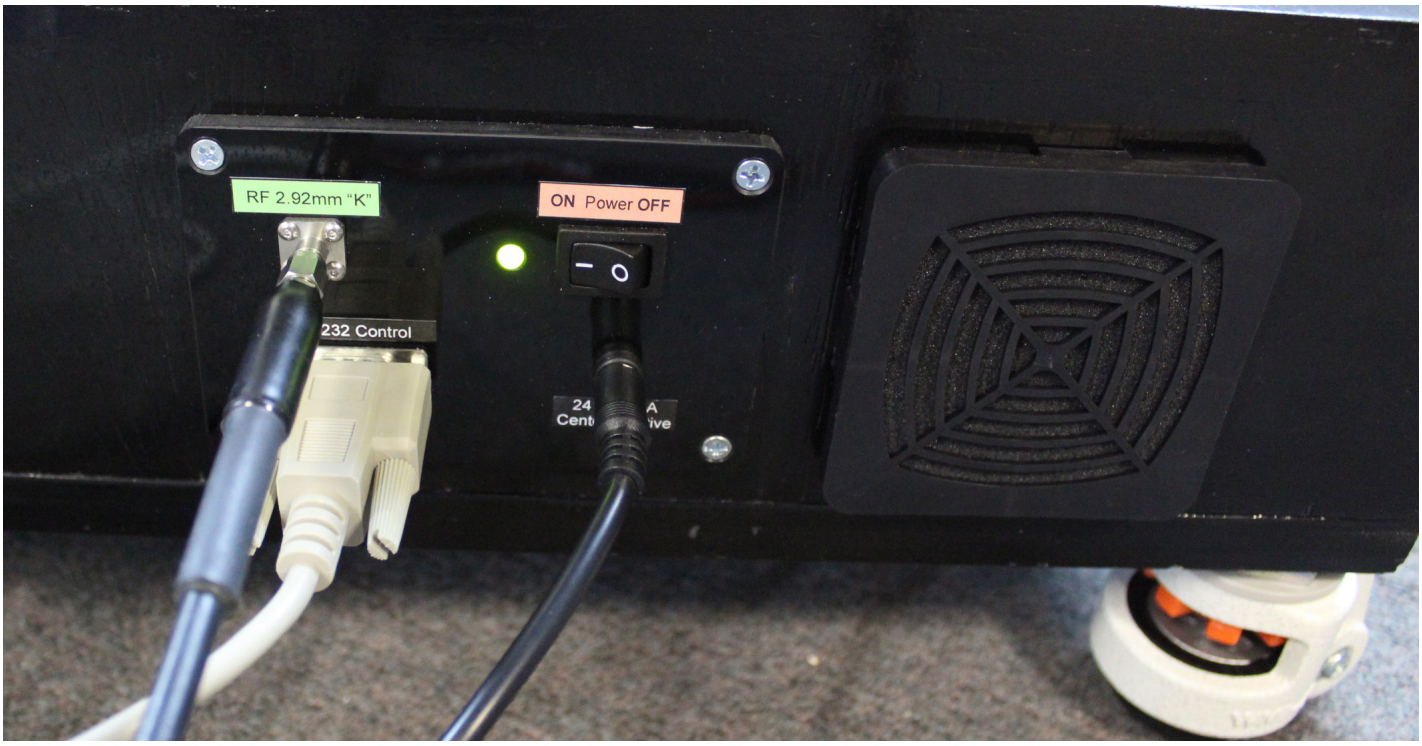


To adjust mast height: Loosen LOWER mast clamp and raise/lower entire assembly until proper waveguide height is achieved.

Cable Attachment

Cable Attachment

1. Attach the RS-232 control cable with USB-to-Serial adapter to the turntable.
2. Attach end of one RF cable to the turntable, attach the other end to port 1 or 2 of your network analyzer.
3. Plug in power supply and connect to DC power jack.



Software Installation

Controller Installation

1. Ensure the Controller is Powered on.
2. Install the DAMS Measurement Software from the Included CD / USB Stick (Note: you must be administrator on the PC)
3. Connect the USB-Serial Adapter to the computer. **IMPORTANT:** If possible, let windows search for an updated driver on the internet. If windows CANNOT locate a driver Proceed with Steps 4. IF windows DOES find and install the driver proceed to step 6.
4. Choose a location for Windows to look for the driver and specify C:\DAMS\driver. (Windows will say the driver is not certified, this is OK), press "Next" and the installation should finish.
5. Open device manager (Control Panel → System → Hardware Tab → Device Manager). Click Ports and note the COM port of the USB/Serial Converter.

Entering License Key

1. Start the DAMS Software and select "License Info" from the "System Options" pull-down in the upper left corner of the software Enter your license key as found on the back of your user's manual.
2. Additionally, If you were supplied a simulator license, select simulator license from the pull-down and enter the key
3. Press the "QUIT" button to exit and save changes,
4. Restart the software, it's now ready to use.

DAMS Software Configuration

IMPORTANT: to prevent damage to positioner, follow configuration instructions listed on the next page!!!!

Support

If you need assistance with any of the steps above or have any questions about the system or software please contact us.

email - Support@diamondeng.net
phone- (530) 626-3857
fax - (530) 626-0495

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Diamond Springs, CA 95619

DAMS Software Configuration for D6050

DAMS Software Configuration for D6050 MC3B 3 Axis Controller or systems manufactured after 8/2017

1. Open the DAMS Measurement software and select "positioner settings" from the upper right corner of the screen.
2. Select USB-SERIAL from "Select Controller"
3. Press "Find" to find the controller
4. Place a check mark in D6025 and Full Spherical Mount

   NOTE: Selecting this box will auto-fill the boxes, but you still must change the settings as defined below.

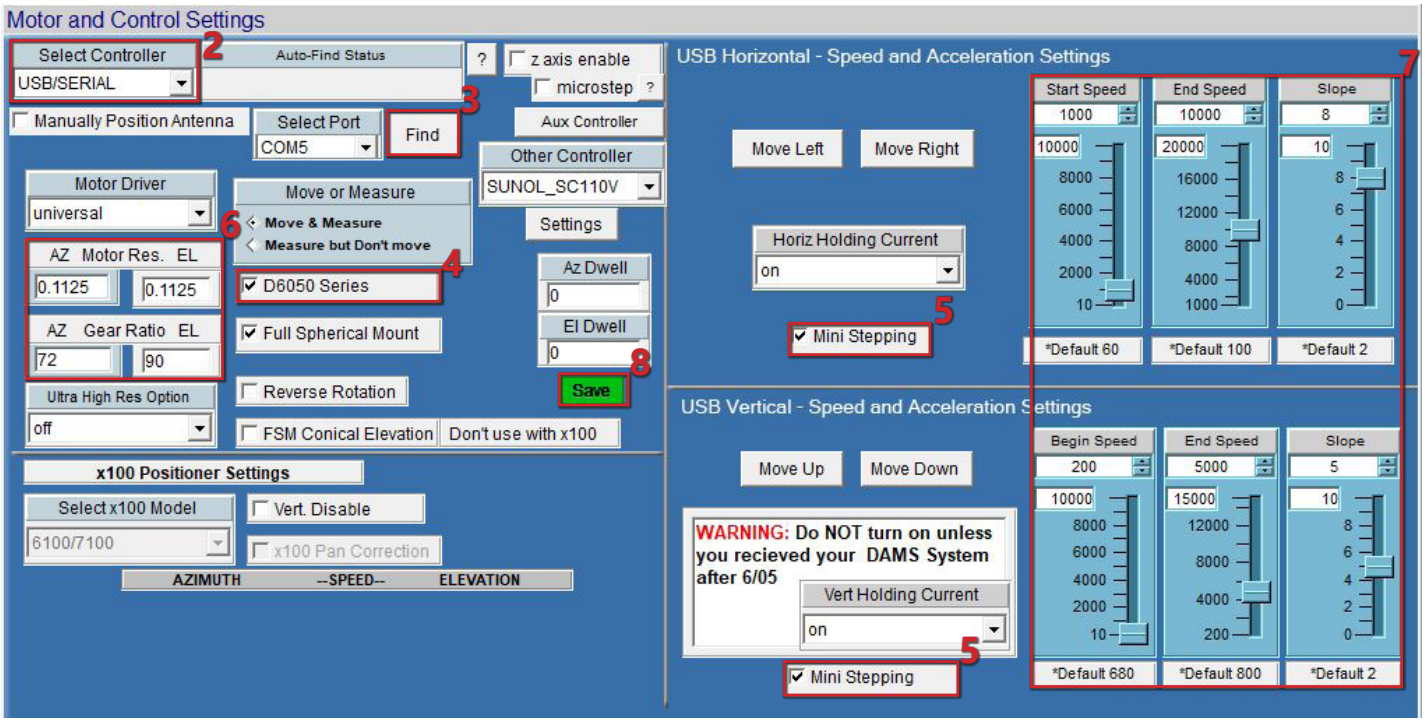
5. Enable Horizontal and Vertical Mini-Stepping (be sure to check both boxes)
6. Adjust motor resolution and gear ratio to the following values (as shown in graphic below):

AZ (Phi / roll)		EL (Theta / turntable)	
Motor Res.:	1.8	Motor Res.:	1.8
Gear Ratio:	144	Gear Ratio:	180

7. On the right hand side, adjust the Speed Settings on all six sliders to the following values:

Horizontal		Vertical	
Start:	1,000	Start:	200
Stop:	8,000	top:	5,000
Slope:	8	Slope:	5

8. Press "SAVE" and on the subsequent pop-up, select "Restart with Default Extents"



DAMS Software Configuration for D6050

DAMS Software Configuration for D6050 2-Axis Controller

1. Open the DAMS Measurement software and select “positioner settings” from the upper right corner of the screen.
2. Select USB-SERIAL from “Select Controller”
3. Select the COM Port that you noted earlier from Device Manager
4. Place a check mark in D6050 and Full Spherical Mount *NOTE: the settings control panel should fill in the rest of the settings below
5. Enable Horizontal and Vertical Mini-Stepping

6. Motor Resolution and Gear Ratio

AZ (phi / roll)

Motor Res: 1.8

Gear Ratio: 144

EL (theta / turntable

Motor Res: 1.8

Gear Ratio: 180

7. Speed Settings

HORIZONTAL

Start: 500

Stop: 3000

Slope: 8

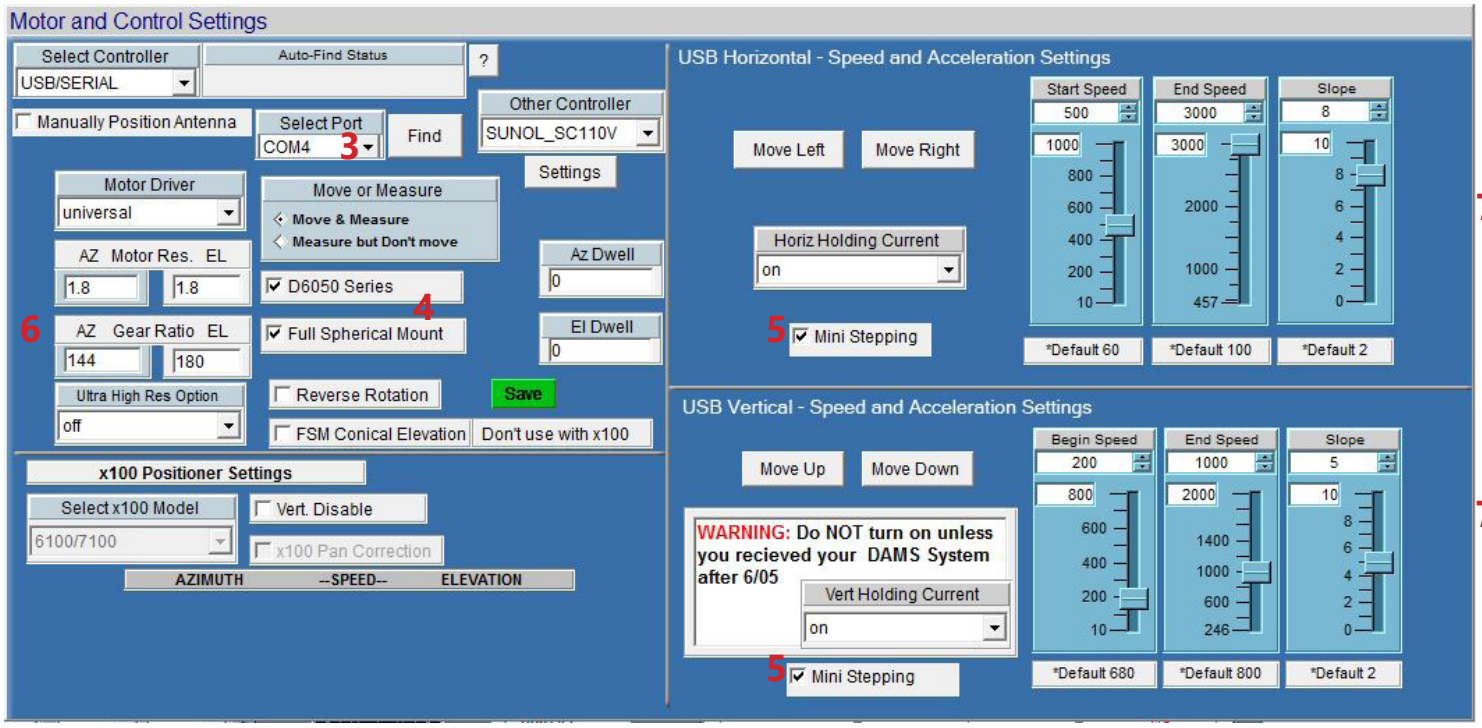
VERTICAL

Start: 200

Stop: 1000

Slope: 5

After you have configured the settings above, press “SAVE” then “Restart with Default Extents”



Basic Positioner Operation Overview

Overview --- See getting started on next page

At time of the writing of this manual, the positioner is configured for Az/El data collection. The Phi/Roll positioner is the azimuth and the turntable is Theta/Elevation. When configured for standard operation, the turntable has a range of +/- 90 degrees and the Phi/Roll positioner has a range of either 0 to 360 or +/- 180 degrees.

Position Tracking / Zeroing ** IMPORTANT **

The D6050 Positioner operates in an "open loop" positioning mode. This means the physical location of the turntable and roll positioner is not tracked using encoders but is tracked within the software. When the software is started, both Azimuth and Elevation are assumed to be 0 degrees. Before making any measurements or jogging the positioner it is critical to set the positioner to it's physical 0/Center locations.

Limit Switches

The D6050 Turntable is equipped with 2 limit switches, a "HOME" (full CW rotation) limit switch and a "MAX" (full CCW rotation) limit switch. These are located at roughly +/- 185 degrees respectively. These switches are critical in preventing the over-rotation of the turntable. If the turntable is over rotated, the Phi/Roll axis cable could become entangled with the centrally located RF Rotary joint causing damage to the cables and/or the positioner.

If the positioner has been properly zeroed before moving or making measurements the limit switches should never be tripped. In the event that either the home or max limit switch is triggered during a movement, it will instantly be stopped and any measurement will be cancelled. The software will then prompt you to move the turntable to either 180 degrees from the limit switch, or to a stored offset position. Once this has been done it is critical to use the Elevation Jog +/- buttons to physically center the turntable before pressing the "zero positioner" button.

The D6050 Phi/Roll Axis does not use limit switches and can be rotated unlimited times in CW or CCW direction.

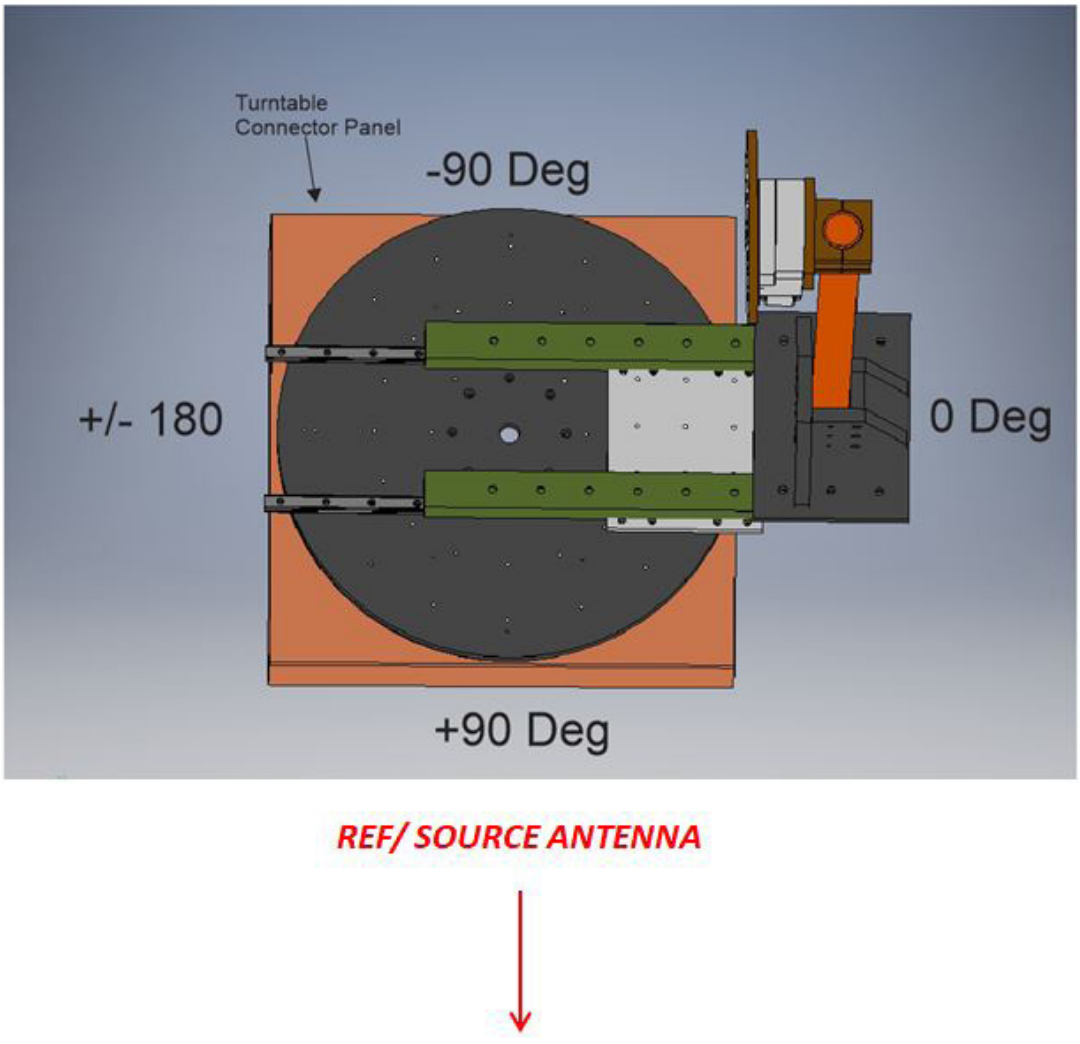
Start software and set positioner to physical zero

After starting the software and before making a measurement it is important that the positioner is set to 0,0 most especially the Turntable / Elevation axis. There are 3 main ways to set 0,0, they are listed below

Basic Software Zero - without storing offsets

1. Start the software.
2. Using the elevation jog buttons, set the turntable so that it is oriented as shown in the graphic below. The roll positioner should be positioned so that the AUT bore sight is facing the stationary antenna.
3. Press the "Zero Positioner" button - select SET ZERO, this will set current turntable and roll position as zero

Proper Orientation of Turntable / Elevation Axis



Software zero with storing offsets (Home or Max)

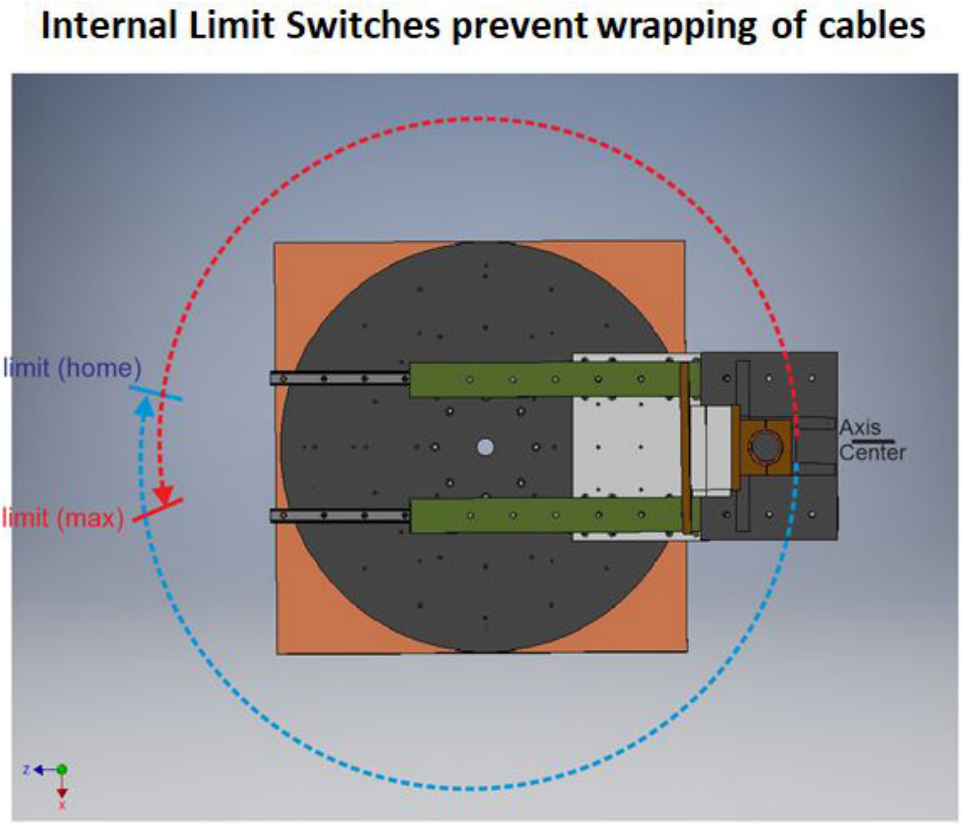
Home and Max limits can be used to re-position the turntable to 0 when a limit has been struck
** NOTE ** A home offset can be used to zero the positioner on startup.

1. After a limit has been struck and the positioner moved off the limit, use the elevation jog buttons to position the turntable to the physical 0 position as shown in the diagram
2. Press the "Zero Positioner" button - select "SET ZERO, REC OFFSET", this will set current turntable and roll position as zero and store the offset degrees from the turntable's limit switch, the offset that is recorded is the one from the last switch that was struck.

Search for home, recall offset

When the software has just been started and you have previously set a HOME offset, the positioner can be moved to that exact position by first finding the home switch then moving the turntable the proper number of offset steps to reach the physical 0 position.

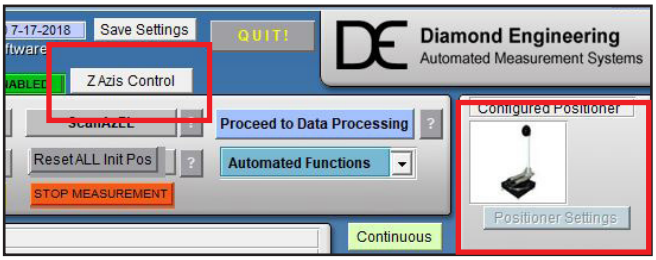
1. Have the DAMS Software running
2. Press "Zero Positioner"
3. Select "Search / move to zero"
4. The positioner will move up to 370 degrees Clockwise to find the limit switch, when the switch has been found use the "Stored position" option to have the software move the turntable to the physical 0 location.

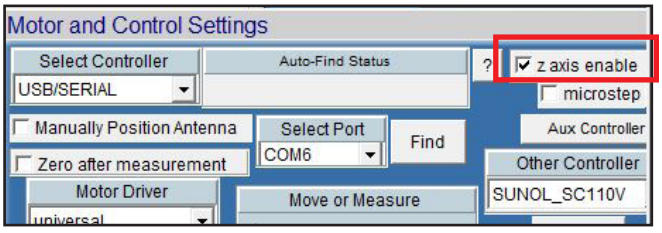


Using the Z-Axis

Applies to mmW models and other models with Z-Axis option

Before you use the axis you must be sure it has been enabled, this will show as an option for "Z-Axis Control" located above the measure buttons. To enable this option open positioner settings and select Z-Axis in the upper section of the page.





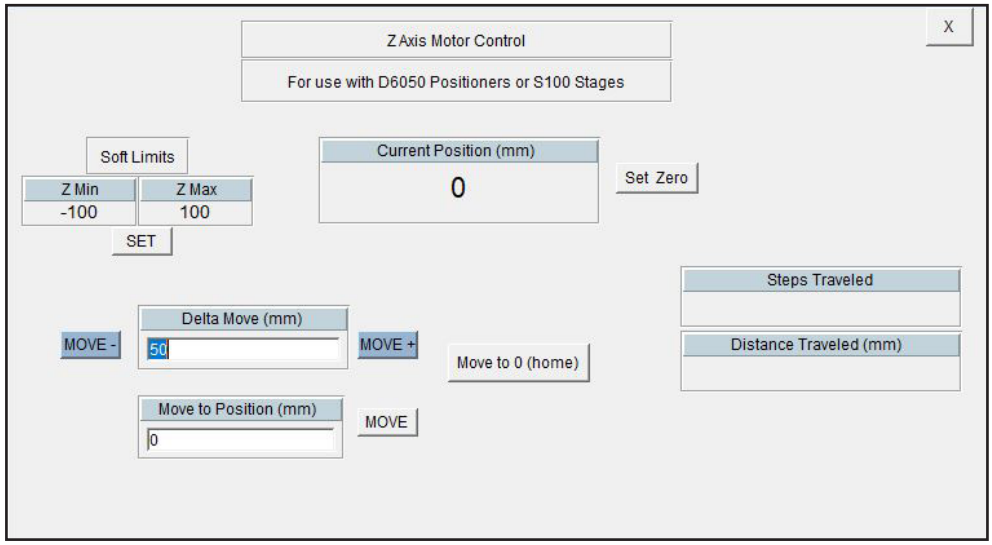
Z-Axis Motor Control

Move to 0 (Home)- moves the axis to the last position set as 0

Delta Move + Move entered distance from current away from turntable center

Delta Move - Move entered distance from current position towards turntable center

Soft Limits - values in mm
typically this is accomplished by setting the positioner to 0 then measuring on each side of the ball nut



Current Position- Displays the current position
Set Zero- offers options for zeroing the axis

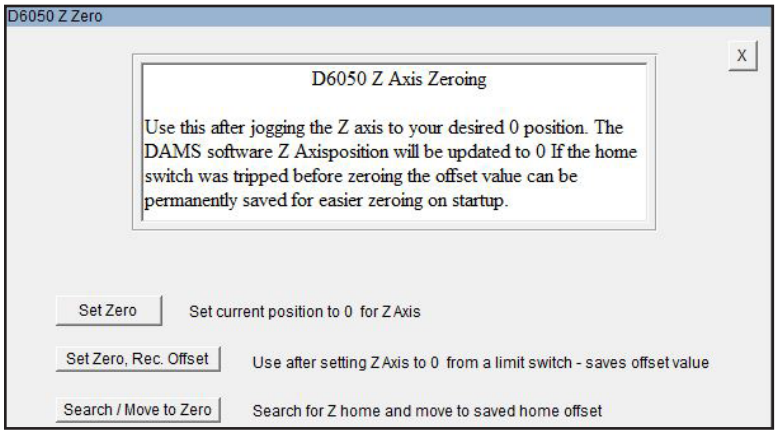
Steps Traveled- Shows the real number of steps the axis was commanded to move
Distance Traveled- shows the distance the z-axis moved during last move

Z-Axis Motor Control

Set Zero- Sets software position to zero

Set Zero, record offset- sets current position to 0, records step offset value (if available to use to re-zero the positioner

Search, Move to zero- Moves the axis until the home limit is struck, from here the positioner can be moved back to a stored zero position.



Z-Axis Homing and Limit Switches

Applies to mmW models and other models with Z-Axis option

The limit switches prevent over-travel of the axis and provide a known reference position for purposes of zeroing. Once the known position has been reached the internal controller count can be the monitored. The axis does not contain an encoder, so if the power to the controller is reset, or the software is restarted, or the axis is manually moved—the software cannot track it's position. In these cases it's necessary to either use a stored offset or create a new offset. The default stored offset is roughly at the center of the ball screw.

Creating a new zero offset

An offset can ONLY be stored once either the Home or Max limit switch has been struck once during the software session.

1. Open Z Motor Control and press "Set Zero"
2. If the home/limit switch has not yet been struck, press "search for home" which will cause the positioner to spin until finding the home limit switch.
3. Next, select "move to standard offset." This will move the Z-axis to the general center or zero position of the axis.
4. Using the Move+/- keys (or the "Move to" button), locate the position you want to set as zero.
5. Open the "set zero" option and press Set Zero/Record Offset, which will record the proper motor step count from the home switch location.
6. The software Z position is now set to zero and all movements will be relative.

Manual Jogging and Soft Limits

1. Press "Zero Positioner"
2. Select "Search / move to zero"
3. The positioner will move up to 370 degrees Clockwise to find the limit switch, when the switch has been found use the "Stored position" option to have the software move the turntable to the physical 0 location.

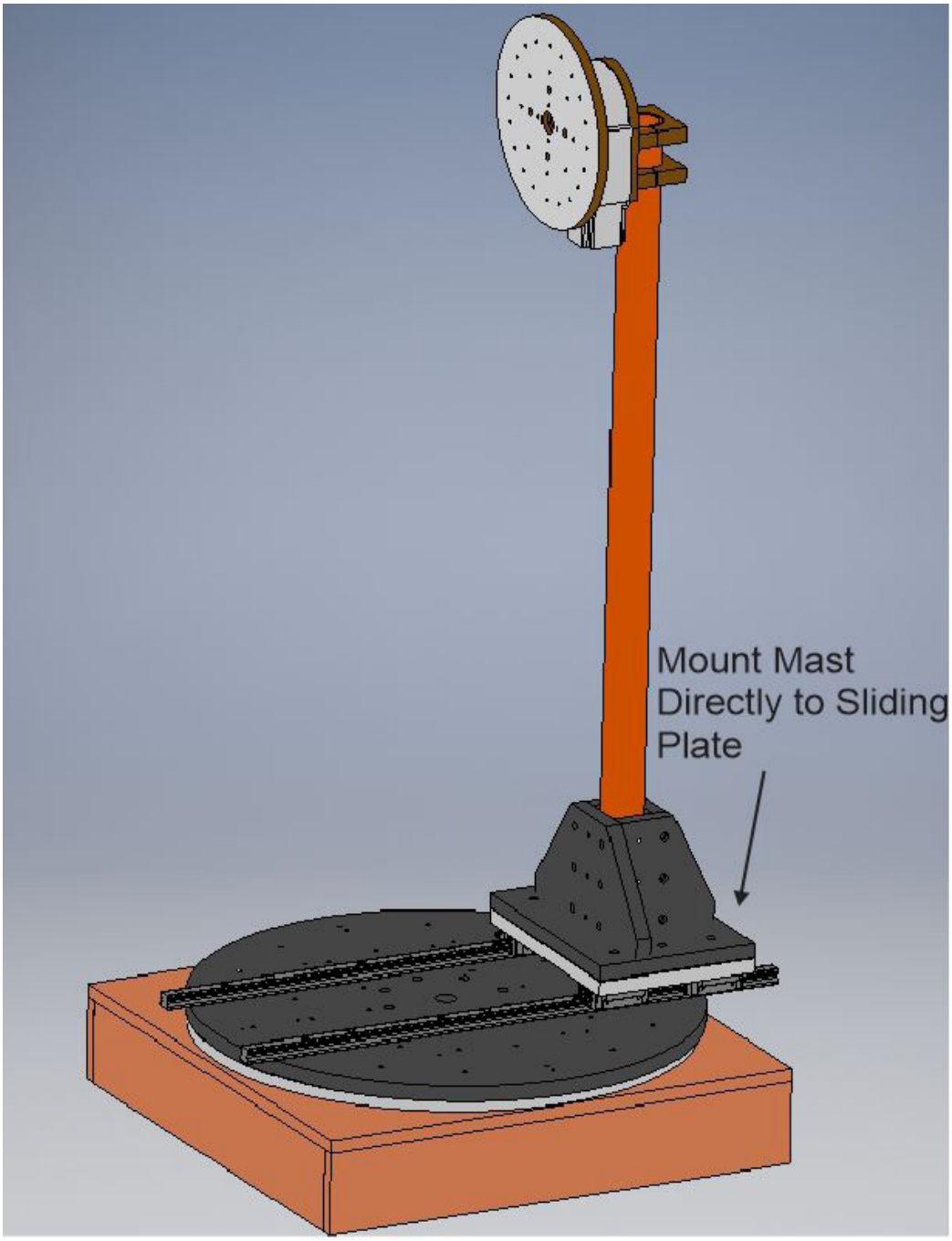
Using a stored offset

1. Open Z Motor Control and press "Set Zero"
2. Select "Search / Move to zero"
3. The positioner will move to the home switch and stop, when prompted select "move to stored offset" this will move the Z axis to the position last stored using the Z axis zeroing function. The software position is reset to zero and all movements are relative.

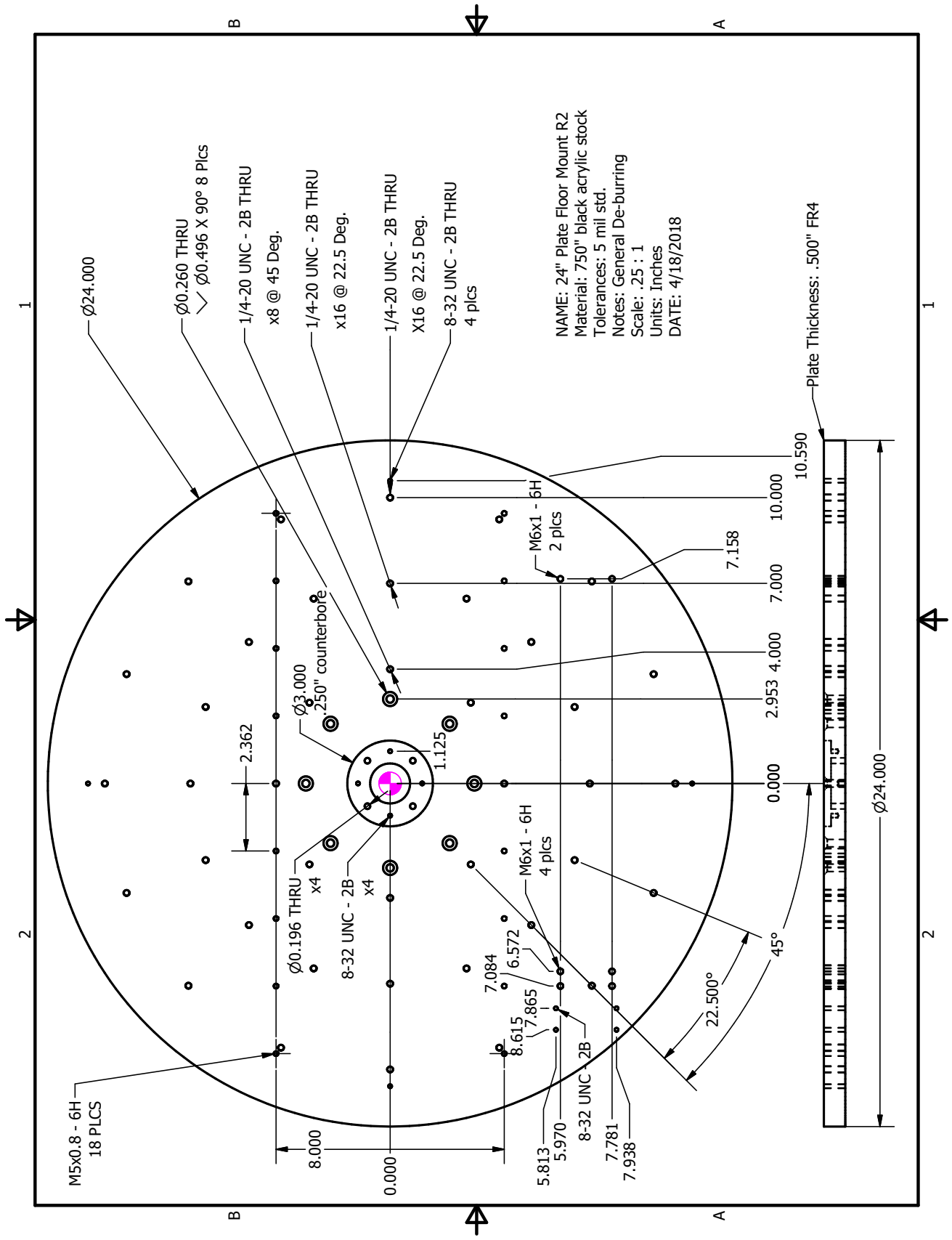
ALTERNATIVE MAST MOUNTING

Description

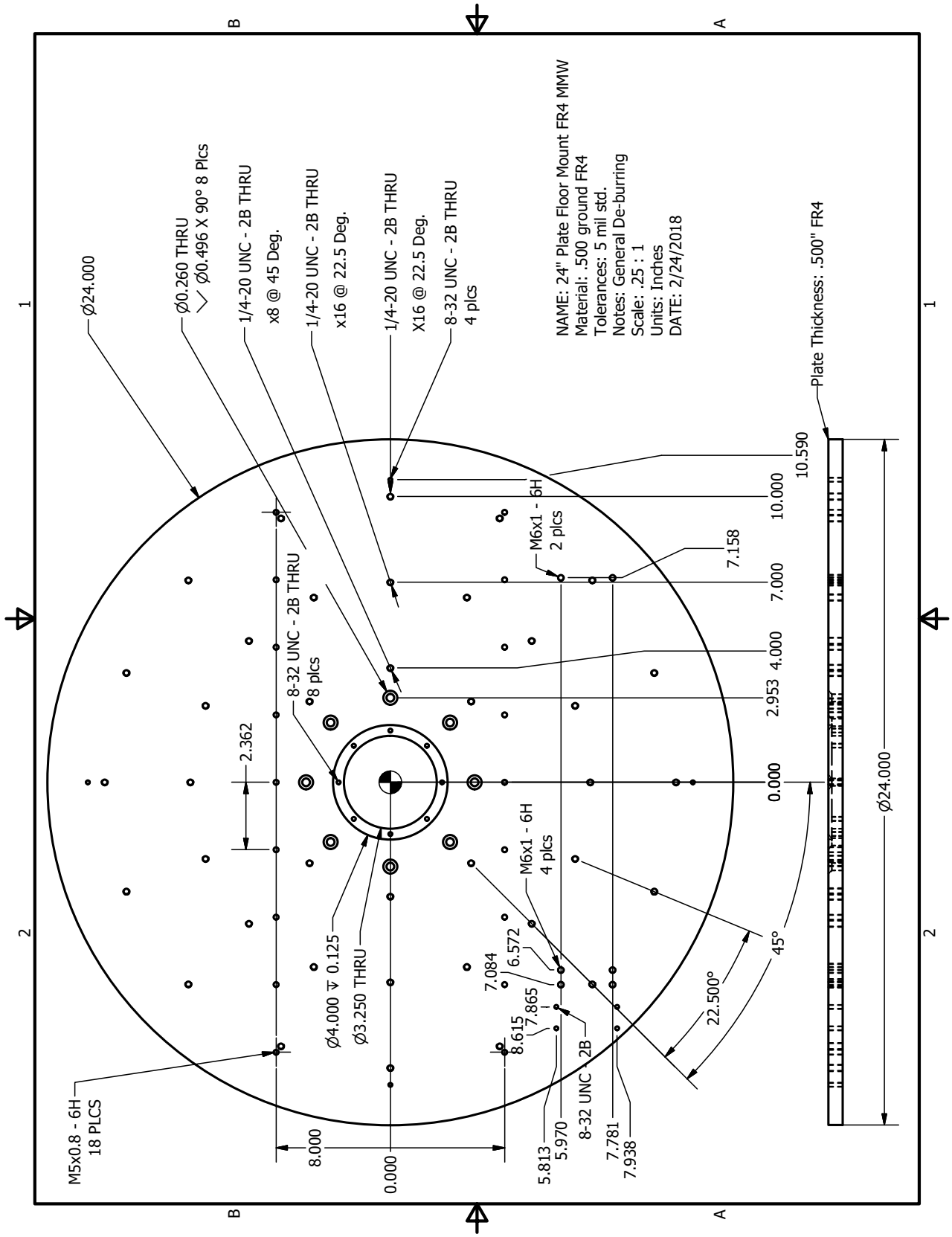
If you do not wish to use the fiberglass rail extensions, the mast base can be mounted directly to the carriage plate using the alternative mast base mounting bolts.



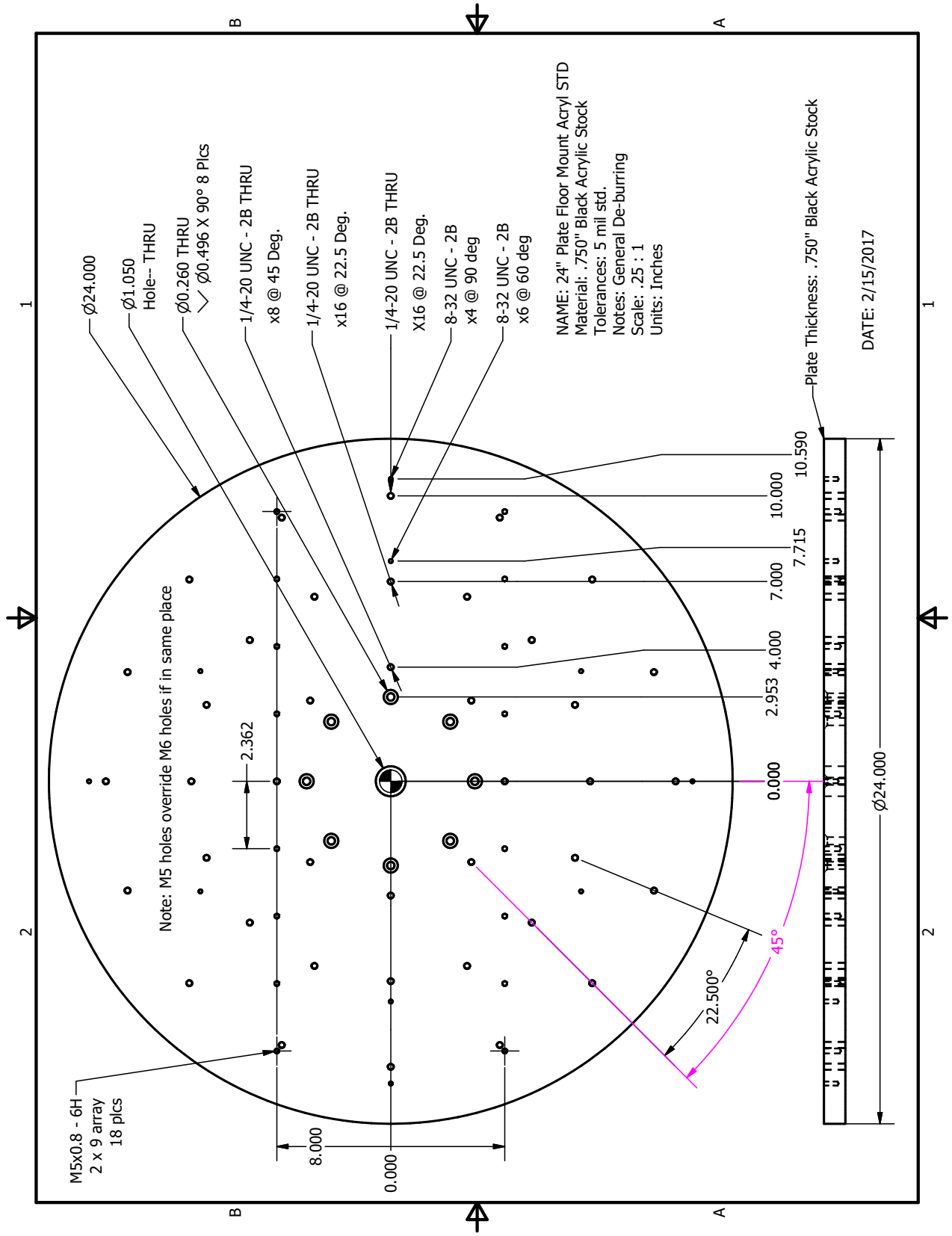
Appendix- Turntable Plate drawing R2- SAE - Inch Units



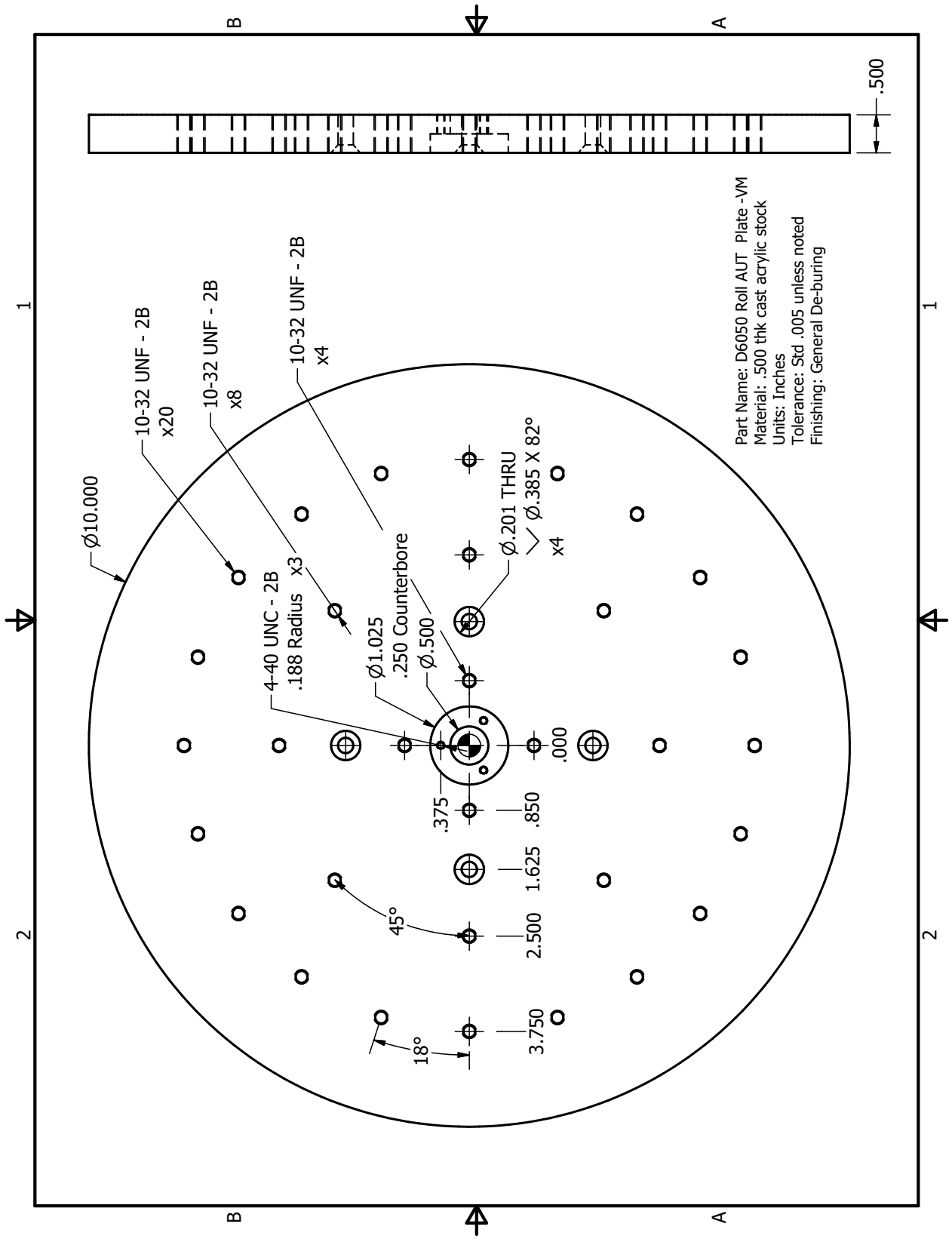
Appendix-Turntable Plate drawing FR4 mmW- SAE - Inch Units



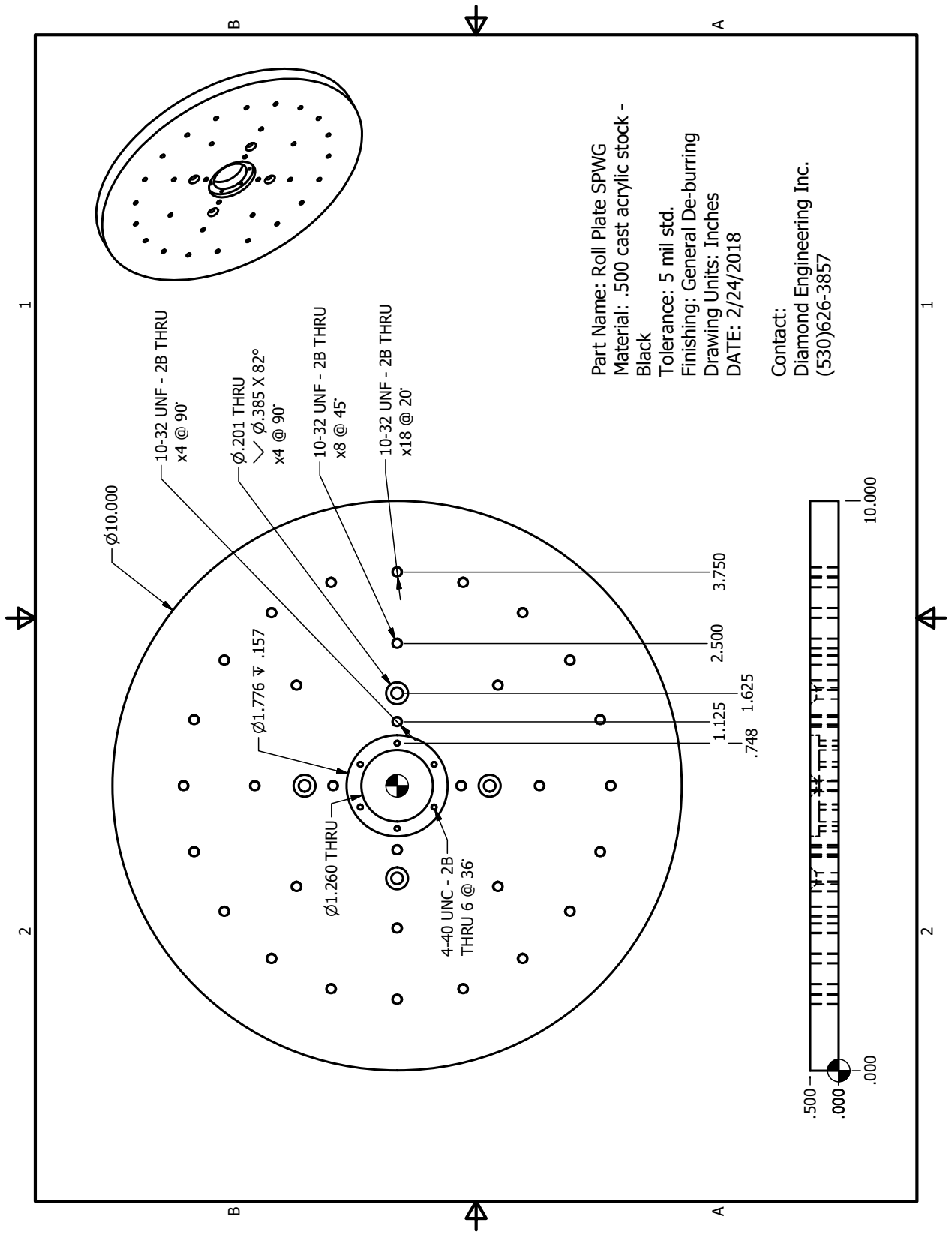
Appendix- Turntable Plate drawing V1 - SAE - Inch Units



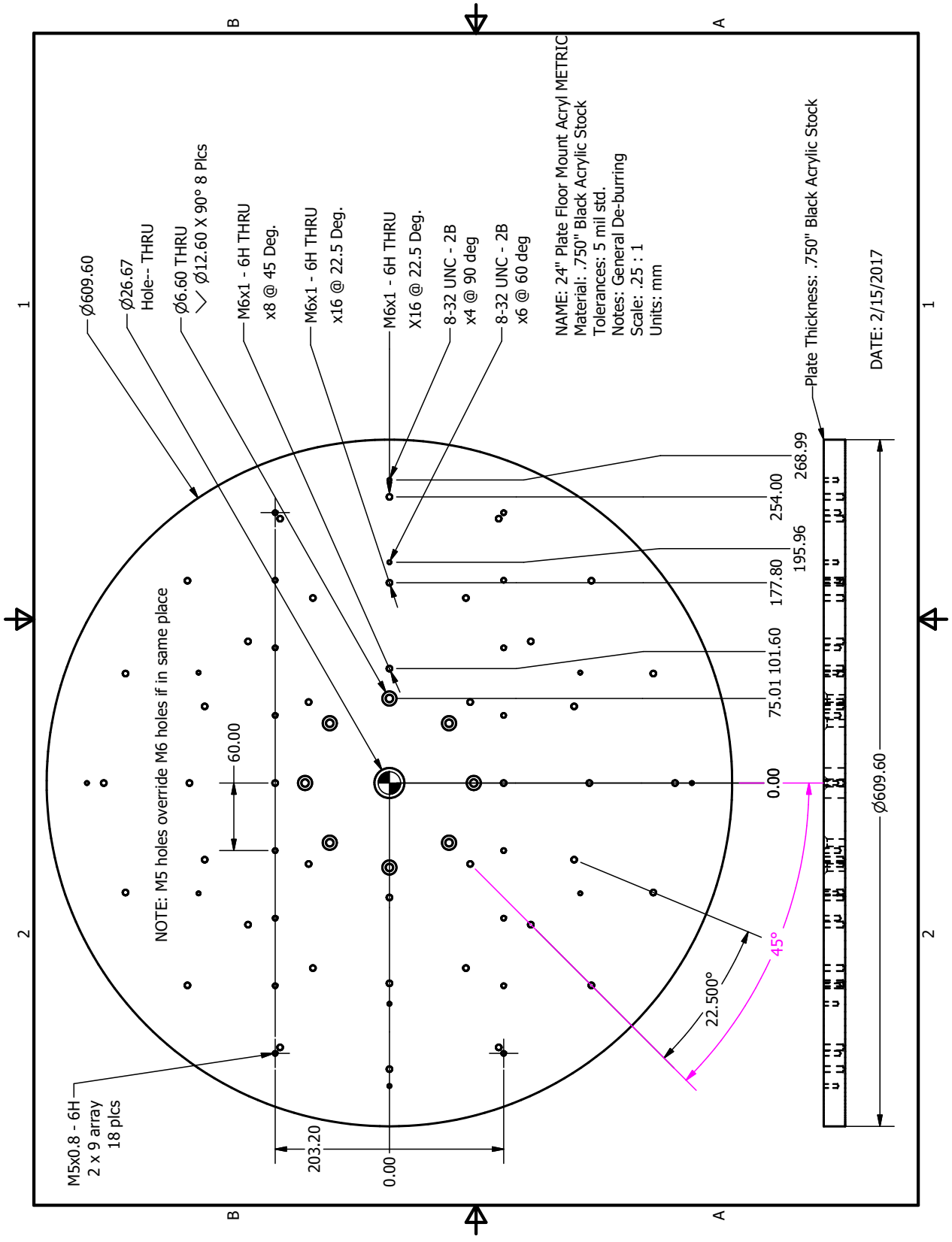
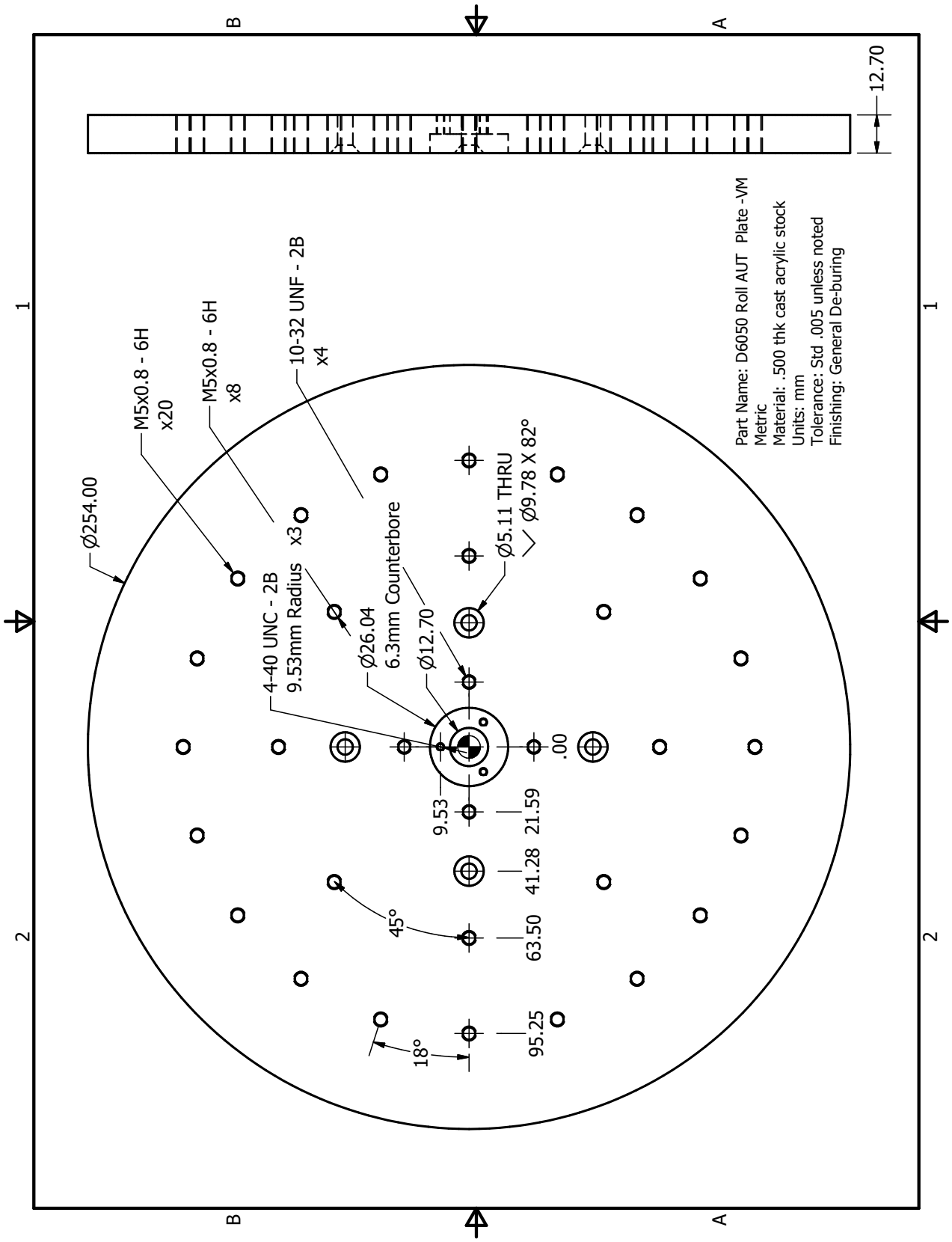
Appendix- Roll Plate drawing - SAE - Inch Units



Appendix- Roll Plate drawing mmW-Spin - SAE - Inch Units



Appendix- Turntable Plate drawing - Metric - mm Units



Appendix- Roll Plate drawing - Metric - mm Units