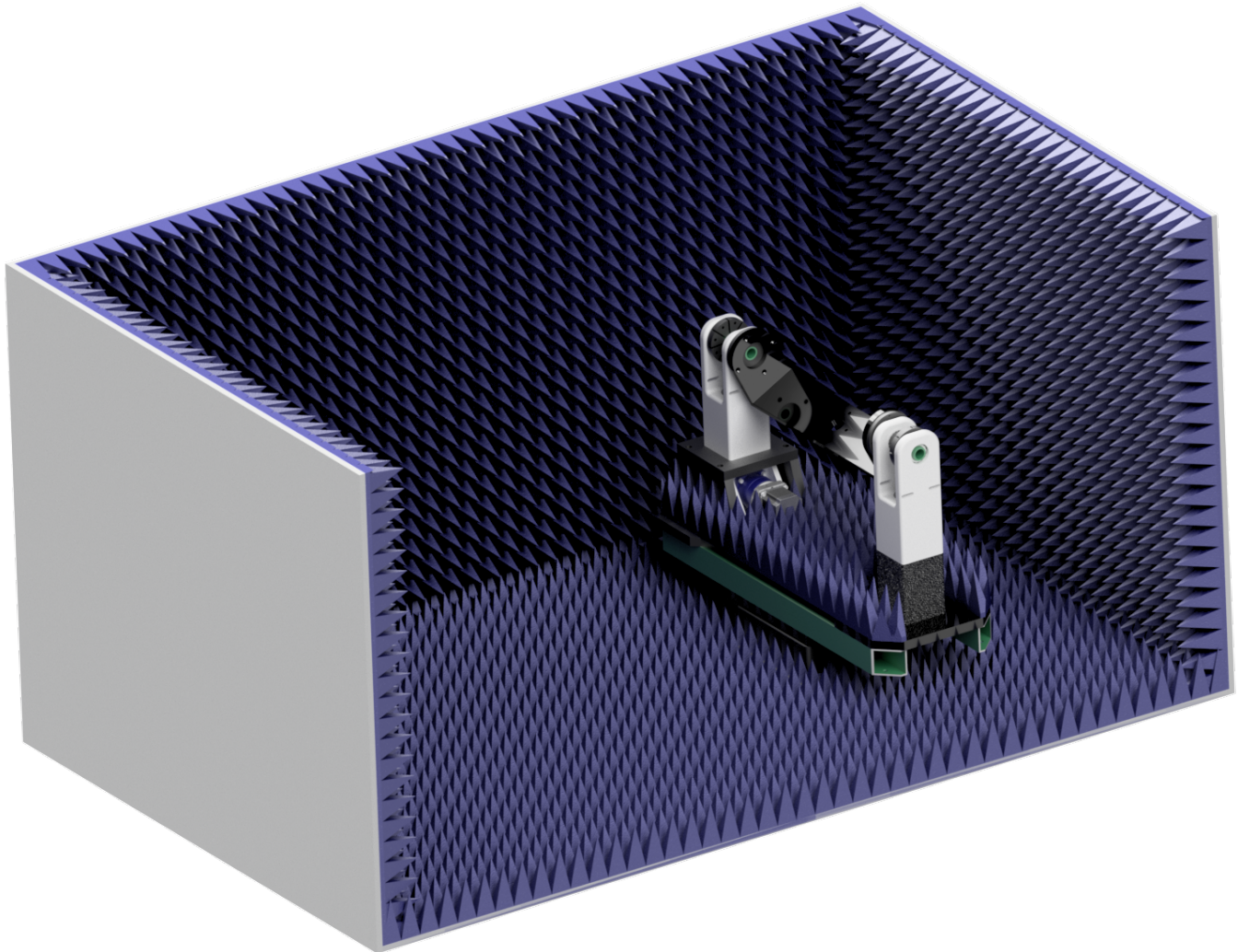# Diamond Engineering
Automated Measurement Systems

Installation and Configuration Guide

DC402 Dual-Axis Precision Positioner

Diamond Engineering
Automated Measurement Systems

Congratulations on your purchase!

Diamond Engineering's Desktop Antenna and positioning systems have been designed to aid in the testing and development of small to medium sized antennas and radiating devices. Using our state of the art software, this system enables you to make many different types of measurements with complete user-definable configuration settings.

This manual will fully assist you with the assembling and configuring as well as teach you how to utilize the many features of your new positioner. To achieve the full functionality of the measurement system, it's expected the user have some working knowledge about the concepts and theories involved in microwaves and antenna design development.

We cannot emphasize the importance of fully reading and understanding this manual before using the equipment to avoid damaging the unit and/or voiding your warranty.

Best regards,

The Diamond Engineering Team

Table of Contents

Diamond Engineering
Automated Measurement Systems

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**P.O. Box 2037 Diamond Springs, CA 95619 · 530-626-3857**

DC402 Dual Axis Positioner - Introduction

Overview

The DC402 is a compact precision 2-axis positioner featuring a heavy duty gimbal with precision azimuth stage configurable for Phi/Theta or EL/AZ movements. The stepper/belt driven gimbal is made from non-metallic components for reduced reflections. This positioner is ideal for mounting within compact mmW chambers.

Package Contents

- DC402 positioner with dual encoders
- Two 1-meter integrated axis control cables
- Pre-assembled azimuth stage with 200mm acrylic mounting plate
- Pre-assembled gimbal
- Optional rotary joint adapter plates
- 24V 5A DC power supply with line cord
- 6-foot serial cable
- USB to serial adapter
- Tools (Allen wrench set and laser level)
- Setup guide and USB resource drive
- Python control module
- Development kit
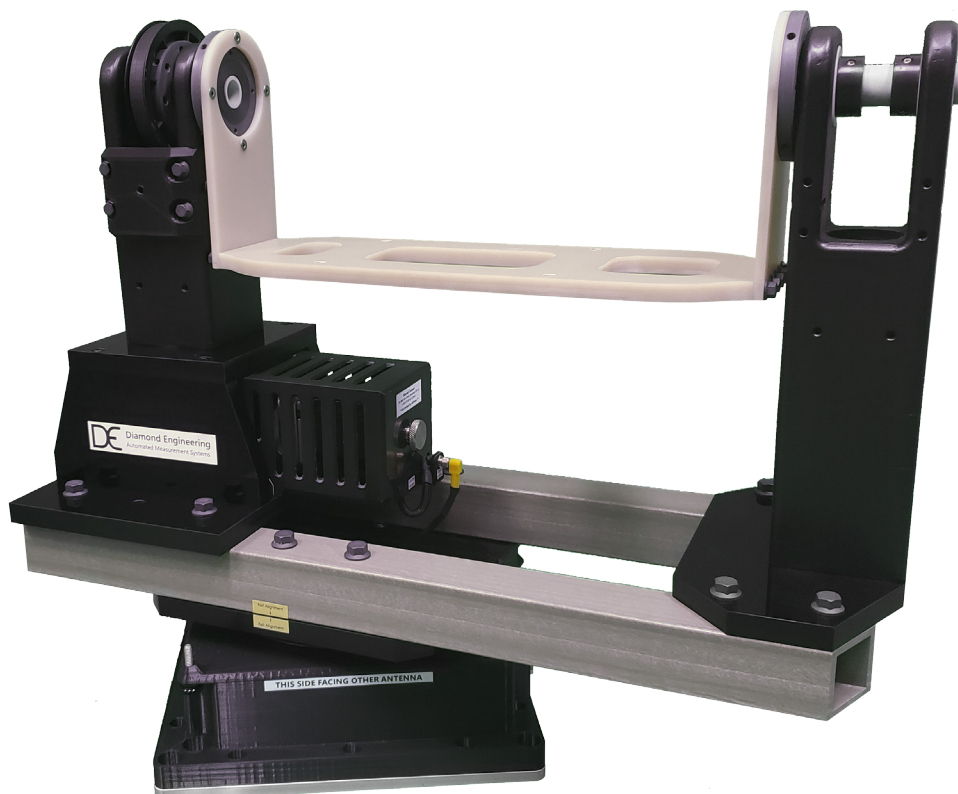
AirSpan Chamber Orientation

Please use the image below for guidance on how to properly orientate your positioner inside your chamber.

This side towards reference antenna

Motor side should face *away* from reference antenna
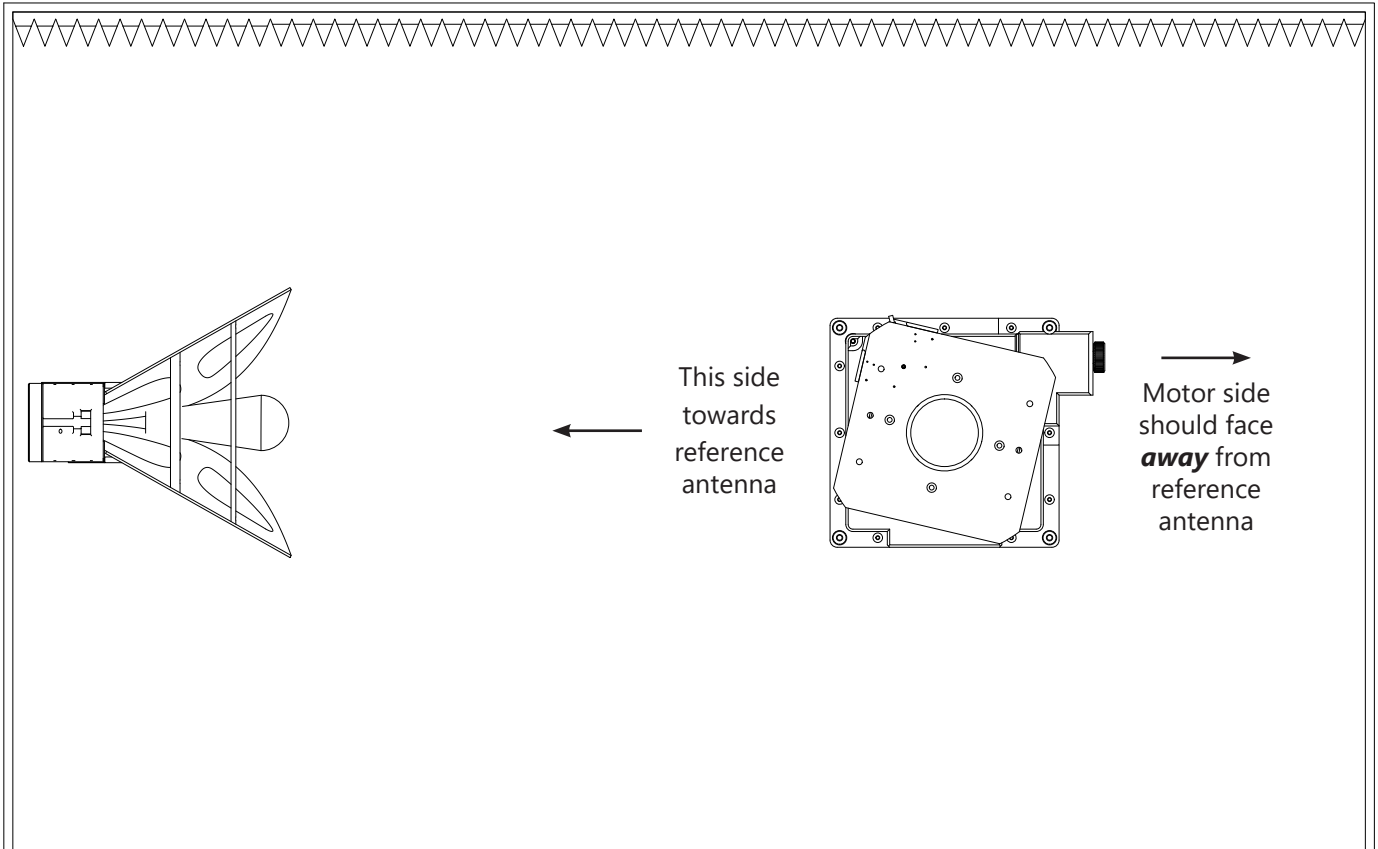
Mounting the DC402 Base Turntable

Assembly

1. Unpack the turntable stage and mounting hardware.
2. Place turntable into chamber over access hole in correct orientation.
3. Carefully connect and route the motor and control cables through the gap in the baseplate (shown in Img A below).
4. Use the four included M8 bolts to secure the turntable through the outer four holes (highlighted in Img B below).

Img A

**Img B**
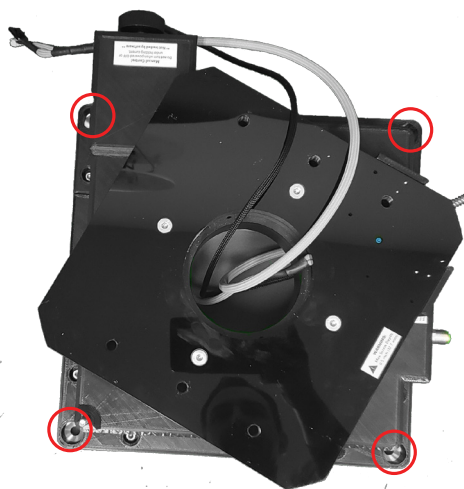
Mounting Gimbal to Turntable

Assembly

1. Place the gimbal next to the turntable as shown.

2. Line up the gray wire (see dotted red lines on Img C) with the encoder access port (circled in red on Img E).

3. This step will be difficult. Carefully plug the encoder connector (denoted in Img D) into the encoder through the port, which is mounted on the back of the motor within in the caged motor housing. Proper orientation of the connector is with the raised latch facing the back of the motor (i.e. facing towards the manual knob). You will feel it latch when properly inserted/seated.

4. Connect the Gimbal Motor using the yellow-headed right-angle connector (as shown in Img F).

Img C

Img D

Encoder

Limit Switch

Img E

Proper Orientation

Img F

Gimbal Motor
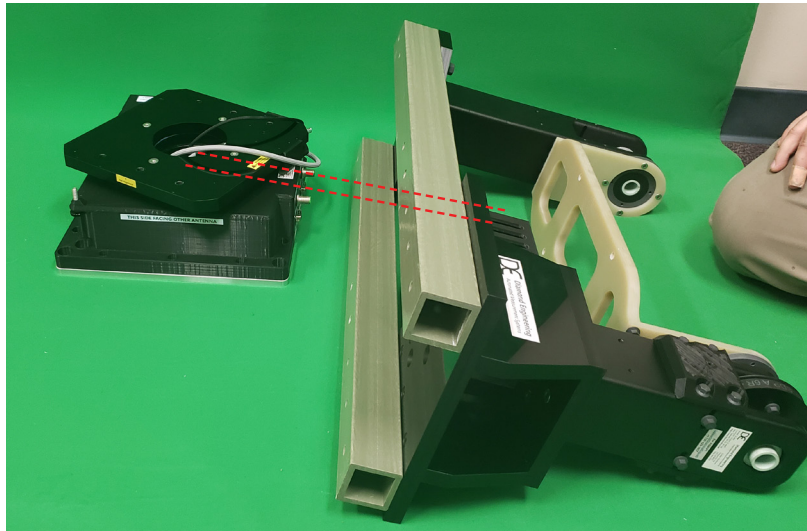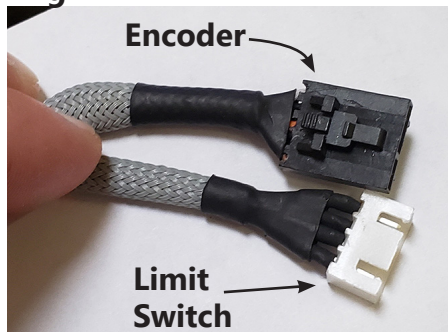
5. Now carefully place the gimbal assembly on the turntable while being mindful to not crush or pull the wiring.

   NOTE: All wiring should be able to move/spin freely. It should also never be allowed to enter the area designated below in Img H, especially while operating.

6. Utilize the rail alignment stickers as shown below. (They're intentionally placed only on one side to avoid confusion on which rail goes on which side.)

7. Line up the holes and use the four large fiberglass bolts to secure the gimbal to the turntable. Do not tighten more than a half-turn after bolt head makes contact.

Img G

Img H

Mounting The Controller

Installation

1. Mount the controller base in the desired location, utilizing the four screw holes which are sized for either #10 wood screws or M6 flathead machine screw.

2. A good location is either on the bottom of the chamber or the rear wall behind the positioner. Drill four separate 3/32" pilot holes, approximately 15mm in depth.

   IMPORTANT: Do not drill into absorber!

3. If desired, tape included template (shown below) to the outside of the chamber. Be sure your desired installation location is within reach of the cables. Also be sure connectors are facing the cables.

4. Using the included screws, fasten the controller mount to the chamber with the "back" towards the control cables.

5. Now you can slide the controller all the way onto the mount. You will feel two clicks once it's fully locked into place.

Controller Base Plate Template
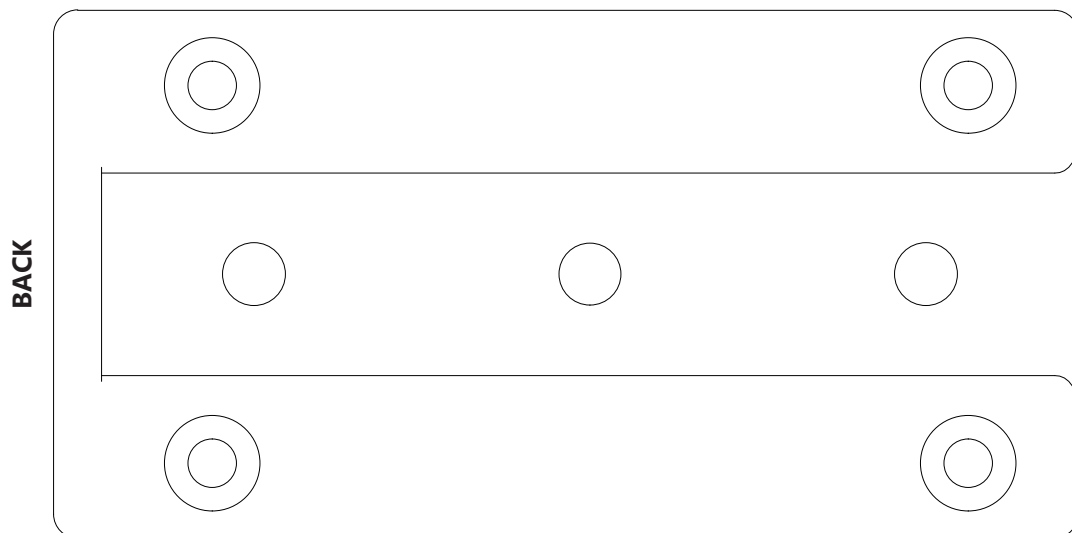
Connecting the Cables

Connecting to the DC402

1. Connect the Motor and I/O Connectors to corresponding locations as designated on the positioning platform.
2. Be mindful of what is going where to ensure no "cross-wiring" or "cross-connecting" takes place.

Connecting to the Controller

1. Connect yellow Motor cable ensuring it's tightly fastened.
2. Connect black I/O cables d-sub 15-pin connectors, tightening both retaining thumbscrews.
3. Connect 9-pin RS232 / serial connector and tighten retaining thumbscrews.
4. Repeat for both axes, ensuring wiring continuity between controller and positioner.

Optional Rotary Joint Adapter Plates

Installation of rotary joint plate

1. Fasten rotary joint to adapter plate before installing to positioner.

2. Pass RF Cable through center of gimbal hub.

3. Connect RF Cable to rotary joint using torque wrench.

4. Mount adapter plate to gimbal.

NOTE: Examine cable routing through turntable to ensure it has adequate room to flex with rotation of the turntable.

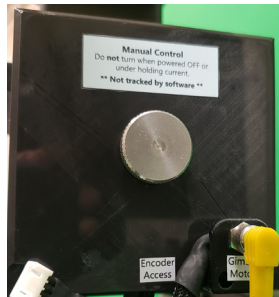Gimbal rotary joint adapter plate installed
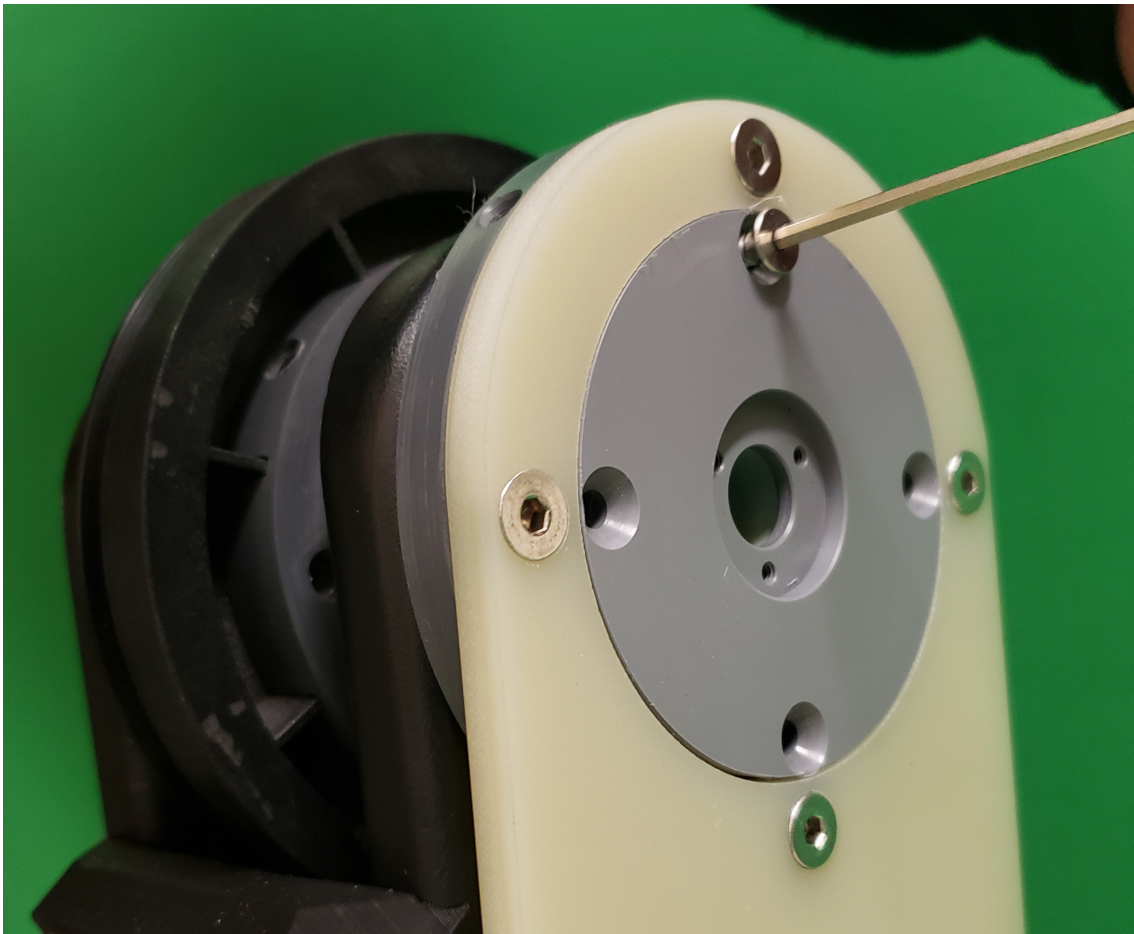
Miscellaneous Notes

Manual Control Knobs

Your system is equipped with two knobs which enable you to manually rotate each axis of the system. Be careful, as the labels warn you, do not turn when powered off or when under holding current. This can lead to incorrect positioning and/or other issues with the encoder. When the knobs are used while the machine is powered off, these movements obviously can not tracked by the software.

<table>
<tr><td align="center">Gimbal (theta)
Manual Control Knob</td><td align="center">Turntable (phi)
Manual Control Knob</td></tr>
</table>

Limit Switches

Your DC402 turntable is equipped with limit switches which prevent the positioner from over-rotating. Over-rotation will cause cables to wrap and destroy them.

The limit switch function on the DC402 is initiated by the contact of the spring to the screw. If you need to disable them, **<u>which we highly advise against</u>**, you can lower the screw so contact cannot be made. If you do this, be extremely careful about the cables inside of the positioner. Diamond Engineering will not be held liable for cables destroyed due to over-rotation. Please use the diagram below to get a <u>rough</u> idea of how the limit switches are setup *(diagram for reference only - not exact!)*
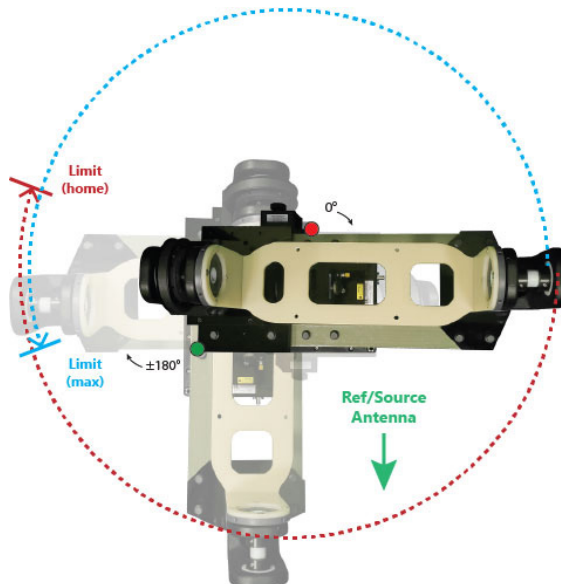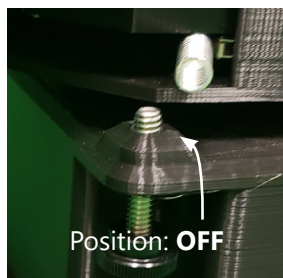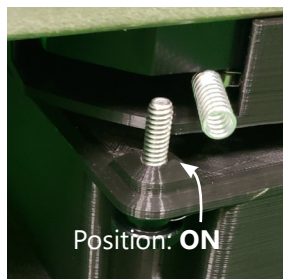
DUT Mounting

DUT Mounting

1. Using the included four M8 screws to fasten your DUT to the positioner.

2. Route the cables from outside the chamber to your DUT ensuring adequate clearance for cable rotation.
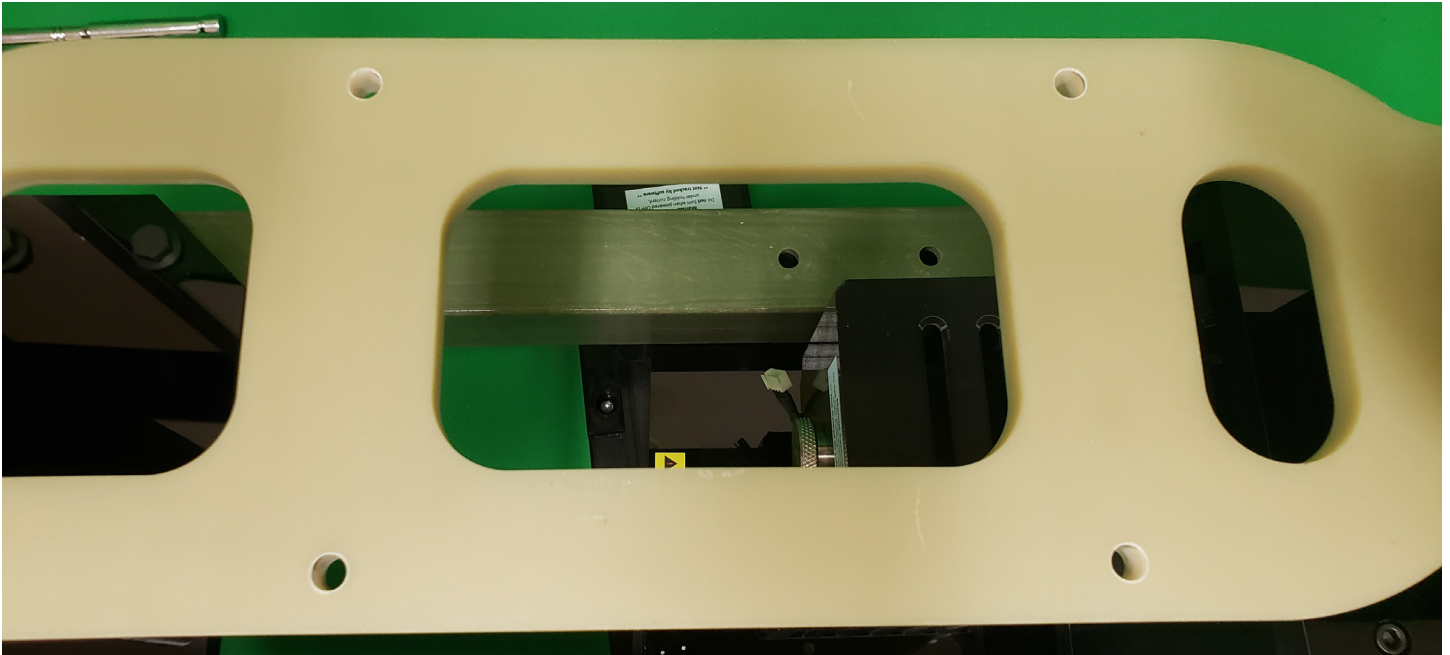
DAMS Software Installation (OPTIONAL)

Basic Instructions

*** Administrator privileges are required. Disregard any Windows 10 incompatibility messages ***

Installing Software & Entering License Key

1. Insert the Antenna Measurement Studio CD and Install the software. Press "Yes" to all following prompts.
2. Start the software. You will see at the top it's running in DEMO MODE.
3. Click the arrow next to system options and click "license info" and enter the License Key, it will say its verified.
4. You MUST click the QUIT button to exit and save changes.
5. The software is now fully unlocked and ready to use.

USB Driver Installation

1. Connect the Windows computer to the internet.
2. Connect the USB cable from the Controller to the PC.
3. Windows XP will ask if you would like to check windows update for the latest driver, press YES. Windows 7/8/10 will automatically check the internet.
4. If the Computer does not offer to use windows update you can select the option to have the computer look in the C:\dams\driver folder to install. The "found new hardware" installation sequence should occur twice. Once for the USB interface and once for the serial port.
5. Start the DAMS software click "Positioner Settings" and press "FIND." It should locate and automatically configure your controller.
6. Enter special settings as shown on next page of this manual for the primary positioner (if using more than one). Press Save then QUIT.
7. If it does not find the controller, check device manager under Ports (COM & LPT). Ensure its not on a COM port higher than COM8. If it is, you'll need to change it to 8 or less.

Matlab Plotting with Windows 7/8/10 - 64 Bit

When using the DAMS software under 64 Bit versions of windows 7 you must follow the instructions below or the software will show a "could not start matlab engine" error code.

1. Open C:\Program Files\Agilent\Vee Pro Runtime\   *(May also be "Program Files (x86)")*
2. Right click on Veerun.exe and select "Properties"
3. Select the compatibility tab and check "Run as Administrator"
4. Click OK and restart DAMS Suite. Attempt to test plot a 3D file.
5. If 3D plotting works, go back and de-select "Run as administrator."

DAMS Software Configuration

Positioner Configuration

*** Install DAMS Software from USB drive as instructed in DAMS Manual or quick setup sheet ***
To setup the primary positioner, do not have the second positioner connected at this time. Open the DAMS software and press "positioner settings" and set the settings to those shown in the image below, the "FIND" button can be used to identify the COM port - the port must be less than COM8.

X and Y Axis

Controller	USB/Serial
Gear Ratio	72
Motor Resolution	0.1125
Start Speed	1000
Stop Speed	8000
Slope	8
Holding Current	ON
Mini-Stepping	ON
Run Current	200 (LC4x controllers)
Idle Current	70
Full Spherical Mount	Enabled
Position Tracking	Enabled

LC4C specific controller commands with above Motor Current / Hold settings
Current Setting w/Holding Current: P200,75,10
Current Setting w/o Holding Current: P200,0,10
Step Mode: H4
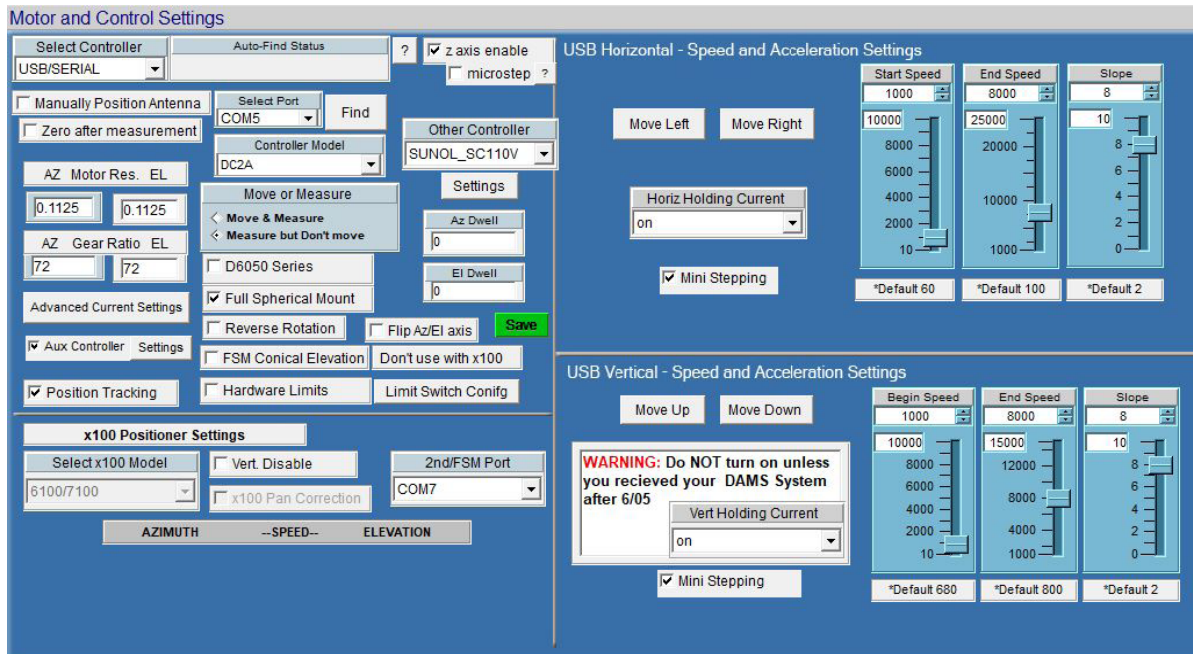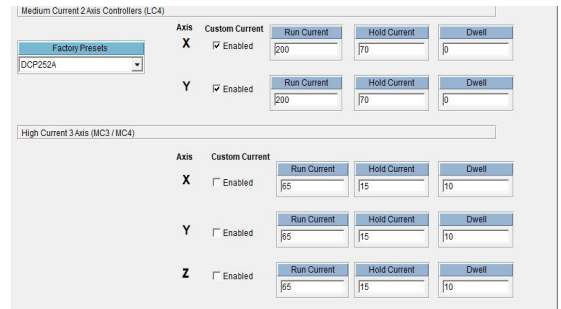
Single / Primary Positioner Control

Controlling the Positioner

Detailed information about the DAMS software settings can be found in the DAMS Antenna Measurement Studio users manual.

The areas highlighted below can be used to set measurement extents and resolution. You can also manually jog and zero the positioner. The upper area allows you to start, pause or stop your measurements and includes a few common automated measurements.

Detailed Motor and Axis Specifications

Default Settings

The settings below are recommended speed settings for quiet and efficient movement, ultimately custom settings will be used based on DUT characteristics The values below are for the MCxx Series Controllers

Turntable Axis

Gear Ratio	90 :1
Motor Resolution	1.8 Degree
Step Mode	1/16th step or full step
Motor Current	3.0 Amps Max
Holding Current	0.44 Amps
Start Speed	1,000 steps per second @ 1/16th step resolution)
End Speed	Up to 10,000 steps per second
Slope	Rate of acceleration from start to end speed
Home /Limit Sensor	Normally Open
Encoder	Programmable Quadrature Incremental - 800 CPR

MC3X specific controller commands with above Motor Current / Hold settings

Current Setting P3,165,75,10
Step Mode: H4

Gimbal Axis

Gear Ratio	36 :1
Motor Resolution	1.8 Degree
Step Mode	1/16th step or full step
Motor Current	2.0 Amps
Holding Current	0.44 Amps
Start Speed	1,000 steps per second @ 1/16th step resolution)
End Speed	Up to 10,000 steps per second
Slope	Rate of acceleration from start to end speed
Home /Limit Sensor	Normally Open
Encoder	Programmable Quadrature Incremental - 800 CPR

MC3X specific controller commands with above Motor Current / Hold settings

Current Setting P3,165,75,10
Step Mode: H4

General System Specifications

General

Dimensions

Footprint:	12" x 12" (304 mm x 304 mm)
Total Height:	22.5" (571.5 mm)
Clearance Radius:	18" (914 mm) clearance radius required for full 360º rotation
Total Weight:	42 lbs (19 kg)

Positioner

Turntable (theta)

Frequency Ranges (GHz):	n/a
Resolution:	0.02º full step
	0.00125º microstep
Drivetrain:	3.0A/phase bipolar stepper motor with worm drive
Holding Torque:	25 ft-lb
Movement Range:	360º continuous or indexed
Position Feedback:	800-line encoder
Limits:	Home & Limit (hardware & software)
Weight (positioner only):	16 lbs (7.27 kg)
Positioner Max Speed:	24º per second
AUT Mounting Options: [1]	3/8"-16 or M6 4-hole pattern for general mounting
Composition:	Acrylic turntable with aluminum base
Weight Capacity:	100 lbs (45 kg)
RF Rotary Joint:	Optional (SMA, 2.92 mm, 2.4 mm, 1.85 mm or waveguide)

Gimbal (elevation)

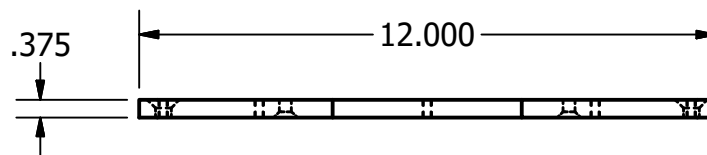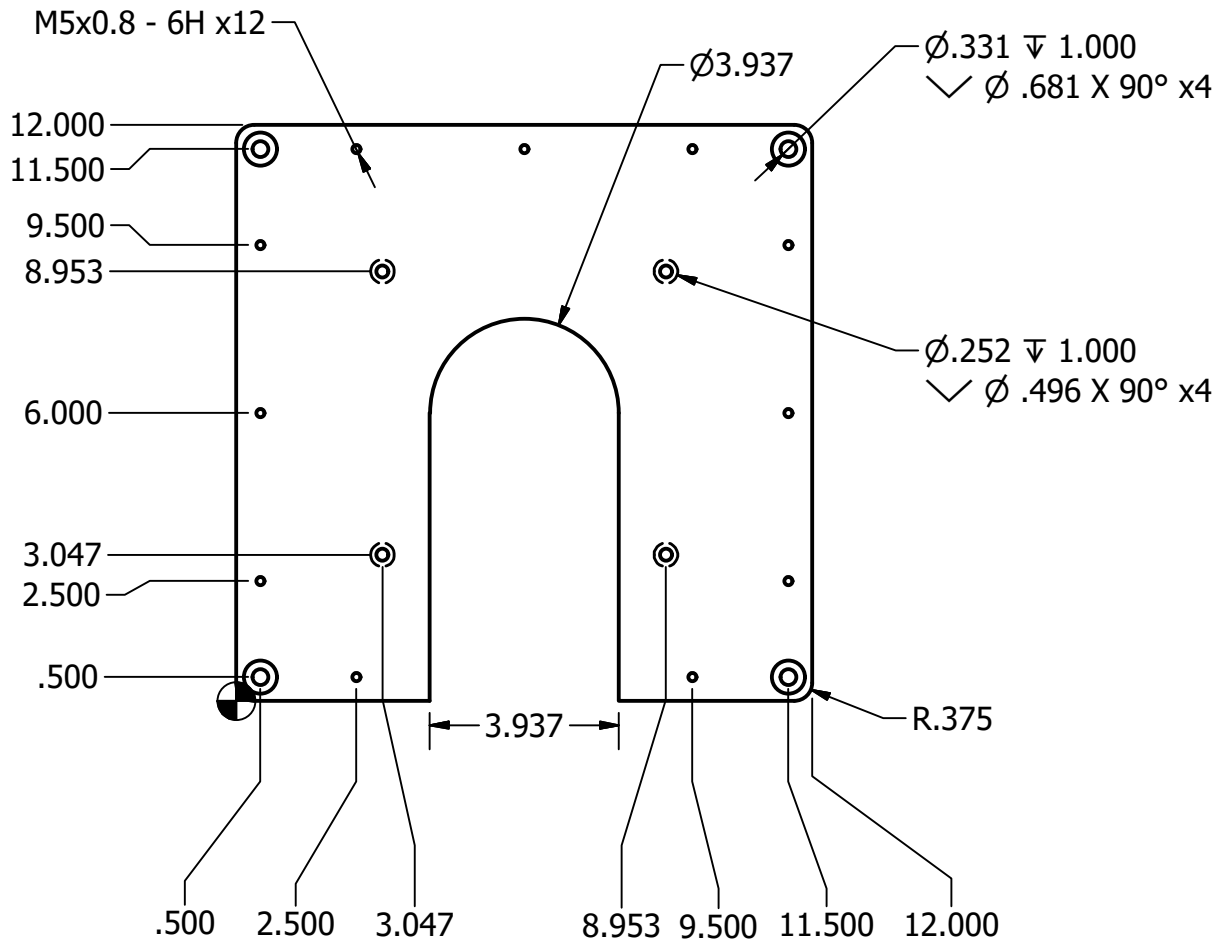|	
Frequency Ranges:	n/a
Resolution:	0.05º full step
	0.00250º microstep
Drivetrain:	2.0A/phase bipolar stepper motor with belt drive
Holding Torque:	20 ft-lb
Movement Range:	360º continuous or indexed
Position Feedback:	800-line Encoder
Limits:	Home (hardware & software)
Weight (gimbal only):	26 lbs (11.7 kg)
Gimbal Max Speed:	24º per second
AUT Mounting Options: [1]	3.625" (92 mm) diameter PVC mounting plate with 10-32 hole array
Composition:	Delrin, ABS, PLA+, fiberglass
Weight Capacity:	40 lbs (18 kg)
RF Rotary Joint:	Optional (SMA, 2.92 mm, 2.4 mm, 1.85 mm or waveguide)

[1] = *Custom mounting solutions available upon request*

Controller specifications on next page...

Controller

Controller type:	3 axis microprocessor based controller
Resolution:	Full step through 1/32 microstep
Motor Current:	3.125A per motor phase max
Cooling:	Dual 40mm 24V fans
Motor Connector:	M12 axial 5-pin connector + 5-pin encoder connector
Communication Interface:	DB9 RS232 serial port with external USB adapter
Communication cable length:	1 meter
Input Voltage:	24VDC 3A
Power Supply (included):	24VDC 5A - 110/220v input
Motor cable length:	1 meter

Part Drawing: Turntable Mounting Hole Pattern

M5x0.8 - 6H x12

Ø3.937

Ø.331 ⊽ 1.000
⌵ Ø .681 X 90° x4

12.000
11.500
9.500
8.953
6.000
3.047
2.500
.500

Ø.252 ⊽ 1.000
⌵ Ø .496 X 90° x4

3.937

R.375

.500   2.500   3.047   8.953   9.500   11.500   12.000

.375

12.000

DETAIL A
SCALE 2 / 3
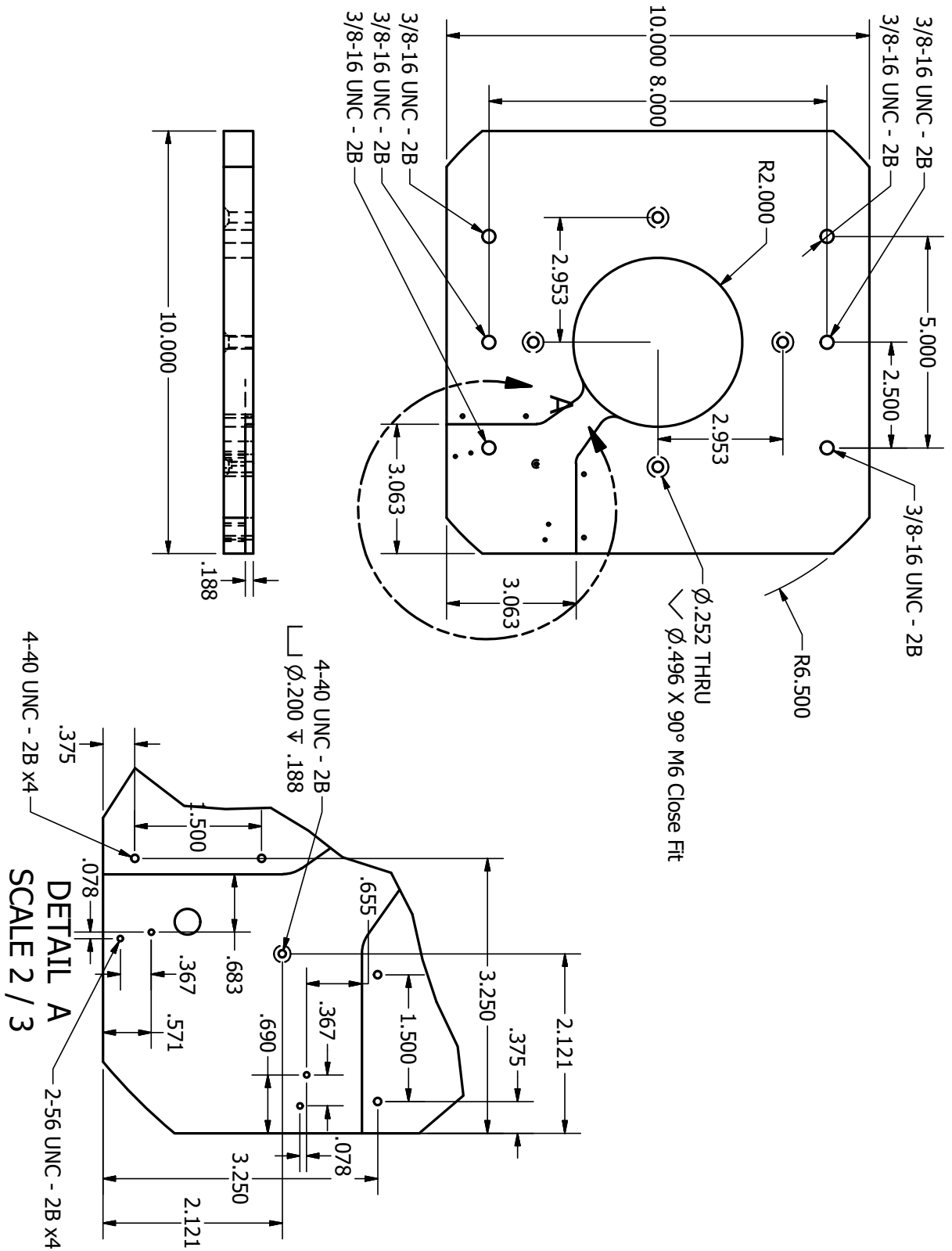
Part Drawing: Rotary Joint Adapter Plate

Ø.170 THRU
⌵ Ø .332 X 82°

Ø2.750
Ø1.005
Ø.500

4-40 UNC - 2B ▼ .224

.375

2.375

Ø2.750

.250

.125
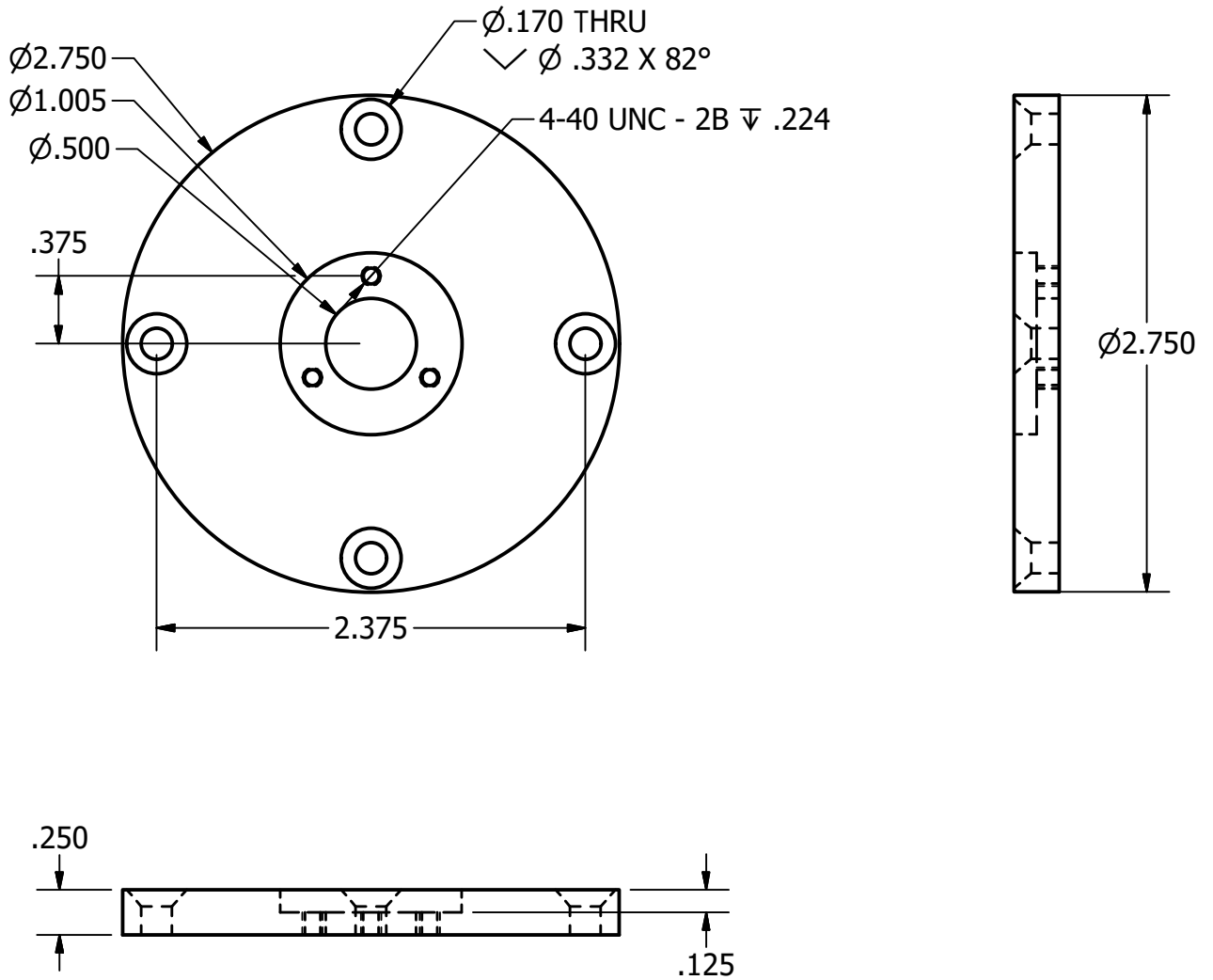
Wiring Pinout

Controller Pinout (DC2A-HC)

The DC2A-HC controller offers 2 - 3 amp stepper motor drivers, encloder and limit switch inputs, user I/O

Description	DB15 Pinout	Controller Pinout
5v 30mA	1	J4-5
Home In	2	J4-6
Home Ground	3	J4-7
Limit In	4	J4-3
Ground	5	J4-4
User I/O 1	6	J6-1
Ground	7	J6-2
500 mA MosFET Sink	8	J4-2
24V Supply	9	J4-1
	10	
Encoder A	11	ENCx - 1
Encoder B	12	ENCx - 2
Index	13	ENCx - 3
5v	14	ENCx - 4
Ground	15	ENCx - 5

Troubleshooting and Support

Contact Us

We're happy to assist you! We encourage you to give us a call or send us an email. It's also very helpful if you're able to take screenshots or photographs of any errors/issues.

Please contact us at one of the methods below:

E-mail: Support@DiamondEng.net
Phone: +1 530.626.3857
Fax: +1 530-626-0495

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