Historic Preservation Services
Community Development & Neighborhood Services
281 N. College Ave.
Fort Collins, CO 80524

970.224.6078
preservation@fcgov.com
fcgov.com/historicpreservation

CERTIFICATE OF APPROPRIATENESS – Minor Alteration
ISSUED: July 31, 2025
EXPIRATION: July 31, 2026

City of Fort Collins
c/o Raime Lanham, Real Estate Services
300 Laporte Ave.
Fort Collins, CO 80521

Dear Property Owner:

This letter provides you with certification that proposed work to your designated Fort Collins landmark property, the Power Plant at 450 N. College Ave., has been approved by the City's Historic Preservation Division (HPD) because the proposed work appears to be routine in nature with minimal effects to the historic resource, and meets the requirements of Chapter 14, Article IV of the Fort Collins Municipal Code.

The alterations reviewed include:

- Installation of rooftop satellite dish, not visible from street (location noted on attached Research Fund Proposal; dish specifications in additional attachments)

Notice of the approved application has been provided to building and zoning staff to facilitate the processing of any permits that are needed for the work.

Please note that work beyond that indicated in your permit application/correspondence requires additional approval.

If the approved work is not completed prior to the expiration date noted above, you may apply for an extension by contacting staff at least 30 days prior to expiration. Extensions may be granted for up to 12 additional months, based on a satisfactory staff review of the extension request.

If you have any questions regarding this approval, or if I may be of any assistance, please do not hesitate to contact me. I can be reached at yjones@fcgov.com or at (970) 224-6045.

Sincerely,

Yani Jones
Historic Preservation Planner

From:	Raime Lanham
To:	Historic Preservation
Cc:	Raime Lanham
Subject:	FW: Letter of Consent - CIRA Satellite Dish Installation at Powerhouse
Date:	Thursday, July 31, 2025 10:59:59 AM
Attachments:	image001.png Letter of consent_CSU_STRATA_Satellite Dish_7-28-25.pdf Scott-High-Impact_CIRA_XL-Band_SatDishInstall_Proposal_SMiller_SUBMITTED[15].pdf 7a- 2.4AEBP-2.4m ANTENNA POSITIONER with OPTIONAL RADOME[62].pdf LiamGumley_Wisconsin_RooftopInstall_0762 1101_ERB_SSEC_Antenna_Replacement_BD Dwgs_2011-07-07[75].pdf MA 400-006 Elevation-Over-Azimuth Antenna Positioner Preinstallation Guide REV D.05 (email version)[75][73].pdf

---

Good morning,

Would you folks mind reviewing and approving this request?

Please let me know if you have additional questions. Thank you for your time!

Best Regards,

Raime Lanham
Specialist, Property Manager
Real Estate Services
City of Fort Collins
300 Laporte Ave
(970) 221-6211 (office)
rlanham@fcgov.com

From: Bosch,Lynsey <Lynsey.Bosch@ColoState.EDU>
Sent: Thursday, July 31, 2025 10:37 AM
To: Raime Lanham <rlanham@fcgov.com>
Cc: Raime Lanham <rlanham@fcgov.com>; Ralph Campano <rcampano@fcgov.com>
Subject: [EXTERNAL] Re: Letter of Consent - CIRA Satellite Dish Installation at Powerhouse

Hi Raime,

The satellite dish will not be visible from the road and the location on the roof was partially chosen for this reason. We do not have the plans yet for the Powerhouse because this projects funding was just received and the group has not yet engaged a GC. I included the University of Wisconsin information as the install will be identical and the person who installed that dish will be the person who is on-site at the Powerhouse for this installation as well.

Thanks,
Lynsey

Lynsey Bosch
Associate Director of Operations
Energy Institute
Colorado State University
P: 970-297-3756 **I** **C**: 970-980-3047
Powerhouse Energy Campus
430 North College Avenue **I** Fort Collins, CO 80524

[Facebook](#) | [Instagram](#) | [LinkedIn](#) | [Twitter](#)

From: Raime Lanham <rlanham@fcgov.com>
Date: Thursday, July 31, 2025 at 10:33 AM
To: Bosch,Lynsey <Lynsey.Bosch@ColoState.EDU>
Cc: Raime Lanham <rlanham@fcgov.com>, Ralph Campano <rcampano@fcgov.com>
Subject: RE: Letter of Consent - CIRA Satellite Dish Installation at Powerhouse

**** Caution: EXTERNAL Sender ****

Good morning Lynsey,

Do you have an image depicting what the antenna will look like on the roof from the road?

As well, it looks like you provided a document that is for the University of Wisconsin. Could you provide the construction drawings for this antenna installation at the Powerhouse?

Once I have this, I can circulate for approvals through the City. Thank you for your time!

Best Regards,

Raime Lanham
Specialist, Property Manager
Real Estate Services
City of Fort Collins
300 Laporte Ave
(970) 221-6211 (office)

rlanham@fcgov.com

From: Bosch,Lynsey <Lynsey.Bosch@ColoState.EDU>
Sent: Thursday, July 31, 2025 10:14 AM
To: Ralph Campano <rcampano@fcgov.com>
Cc: Raime Lanham <rlanham@fcgov.com>
Subject: [EXTERNAL] Letter of Consent - CIRA Satellite Dish Installation at Powerhouse

Dear Ralph,

Please find attached a signed Letter of Consent from Bo Brown at STRATA for your review and signature. A scope of work is also attached along with other supporting information for this research collaboration satellite dish rooftop installation (this will be on the new addition of the Powerhouse).

Please let me know if you have any question.

Kind regards,
Lynsey

Lynsey Bosch
Associate Director of Operations
Energy Institute
Colorado State University
P: 970-297-3756 I **C**: 970-980-3047
Powerhouse Energy Campus
430 North College Avenue I Fort Collins, CO 80524

ENERGY INSTITUTE
COLORADO STATE UNIVERSITY

Facebook | Instagram | LinkedIn | Twitter

WSCOE / Scott Foundation High-Impact Research Fund Proposal

1) Participating Faculty and POC

Prof. Steven Miller, (Project Lead and POC; CIRA and CSU/ATS)
In Collaboration with: Dr. Bryan Willson (Executive Director of CSU's Energy Institute)

2) Project Title: "Enabling the First Real-Time Capture of Low-Earth-Orbiting Environmental Satellite Data at CSU"

3) WSCOE Research Focus Area Addressed

Climate and Weather: ***Understanding and predicting events and effects;***
Earth remote sensing instruments and technologies; Predicting climate, weather, & wildfire risk.

4) Project Description

When it comes to the operational viability of satellite information, *time is of the essence*. The Cooperative Institute for Research in the Atmosphere (CIRA) has operated direct broadcast (DB) Geostationary Operational Environmental Satellite (GOES) ground stations since 1980 to support applied research tied to the National Oceanic and Atmospheric Administration (NOAA), serving National Weather Service forecast offices and national centers with near-real-time imagery and derived products. CIRA also works with low-earth-orbiting (LEO) environmental satellites, most recently with NOAA's Joint Polar Satellite System (JPSS). LEO satellites offer distinct advantages over GOES in terms of spatial resolution, of particular value to wildfire detection, but require a capture system that tracks these satellites as they cross the sky. Due to structural and topographic obstructions on Foothills Campus, CIRA has never operated a LEO DB system, despite the numerous operational benefits of having such data in real-time.

This proposal requests funding for the installation of a 2.4m X/L Band scanning satellite dish to enable DB reception of low-earth-orbiting environmental satellite data at CIRA *for the first time*, and join a global network of such DB stations under the auspices of the National Aeronautics and Space Administration (NASA). The antenna equipment (dish, demodulator, receiver, half-rack, and cabling) would be provided by NASA and operated under the care of the University of Wisconsin-Madison, Space Science and Engineering Center (SSEC), in coordination with CIRA. Together with CSU's Energy Institute, CIRA will work with SSEC (POC: Dr. Liam Gumley) and the U.S. Department of Agriculture (USDA) Forest Service (POC: Dr. Brad Quayle) on the installation. This dish will increase the global DB network and provide critical gap-filling of the intermountain Western United States. The equipment will enable ingest of real-time LEO satellite data from NOAA's JPSS constellation, the European Meteorological Satellite (EUMETSAT) Metop Second Generation, and future polar-orbiting operational constellation (including SmallSats and CubeSats) offering unique environmental observation capabilities of the atmosphere and the surface. The telemetries will be ingested, processed into science data and derived products via the Community Satellite Processing Package (CSPP) hosted both locally and at NASA for global consumption.

A goal of the Scott Foundation High-Impact Research Fund is the "Purchase of Equipment." Since the dish and ingest equipment would be provided to us by NASA (valued at ~$200K), we seek assistance for the installation of that equipment here at CSU. *Importantly, this proposal enables CSU to take advantage of a generous equipment offer and capitalize on a unique opportunity to join an international network of LEO satellite partners.* Interest in the data enabled by the dish are significant and far-reaching. We will share the acquired LEO data available in near-real time not only with the various Colleges/Departments across CSU, but also extramurally: with the USDA Forest Service (who are particularly keen to work with CSU), and other universities and research institutions across the global user community via the NASA DB network coordinated by SSEC.

5) Budget: Cost estimates in general categories (See Appendix for detailed budget)

	Scott Funding	**Cost Share**
Labor Cost: CIRA and CSU Energy Institute	--	$45,400
Antenna Installation Cost with platform	$85,100	--
Materials/Equipment	--	$39,700
TOTAL	**$85,100**	**$ 85,100** (1:1 match)

6) Facilities

After an extensive survey of candidate sites across the CSU campus, it was determined that the Powerhouse Building is an ideal candidate for the dish's rooftop installation (Fig. 1). The science goals of this effort resonate with the environmental research themes of the Energy Institute, making this site a natural fit from a programmatic perspective as well. The Powerhouse is well-equipped with power/network and has ample space for housing the Linux-based command/control, demodulator, and Uninterruptable Power Supply (UPS) equipment. The rooftop provides 360° line-of-site down to 5° above horizon in most directions (small obstructions on rooftop are manageable). It also offers a site near roof-center that is set-back sufficiently so as to prevent this system from being visible from College Avenue, in accordance with City of Ft. Collins policies.

Specifications for the dish (mass and platform requirements) are provided to this proposal in Appendix D. These documents were provided to the Powerhouse building managers and engineers for review. Installation of the dish involves hiring contractors to construct the required base meeting specifications, wind load, rooftop load, and other structural considerations. A crane is required to lift the antenna atop the CSU Powerhouse roof. Contractors will be hired to prepare the site and assist with installation. Dr. Gumley will travel to Ft. Collins to manage and assist on the day of installation. The system runs autonomously and will be scheduled remotely by our partners at U. Wisconsin-Madison/SSEC in coordination with CIRA. Minimal hardware maintenance is required for these systems, with similar deployments running for 10+ years without service.

7) Impact

This project aligns with the WSCOE research focus area of "Climate and Weather: *Understanding and predicting events and effects"* with sub-topics of ***"****Earth remote sensing instruments and technologies; Predicting climate, weather, & wildfire risk."* It is a *high-impact project* by definition, enabling WSCOE to conduct research on near-real-time LEO satellite observations that have the *potential to enable new funding opportunities with regional operational partners*. The USDA Forest Service is already exploring possible FY25 funding for wild-fire research conducted at CSU pending availability of DB system's installation. High-spatial resolution satellite data benefits public warnings, predictions of climate, weather, and natural hazards like fires, floods and dust storms, thus reducing the potential loss of human life, property and economic impacts. The capability will also contribute to both short- and long-term numerical weather forecasts, including those that predict high-impact weather events. We anticipate that with investments in small-sats and CubeSats, such ground stations will become increasingly relevant to providing a DB network for global research and operational systems. *It would be very advantageous and prestigious for CSU to become a partner in this high-profile enterprise.*

8) Involvement of Scott Scholars and/or SURE students:

The data and derived environmental products afforded by this dish will provide a wealth of possible research pathways applicable to CSU students from WSCOE, CNR, and beyond. It also provides a pathway for the students to engage with interdisciplinary research teams across CSU as well as with Federal agencies like NOAA, NASA, and the US Department of Forestry.

9) Matching Funds:
CIRA and CSU's Energy Institute will provide 1:1 matching funds. CIRA will pay for the protective cover for the new satellite dish (Radome) and for additional labor cost related to the installation. Dr. Willson will serve as an advisor for the installation, with his labor cost (½ months total) provided as cost share.

10) Project Timeline: 1 February 2025 – 30 June 2026

Figure 1: The proposed Low-Earth System ground station antenna location: CSU Energy Institute Powerhouse roof top. The location offers nearly 360° obstruction-free line of site down to 5° elevation angle. Photographs: Steve Miller (upper) & Steve Finley (lower).

Appendices:

A) Letters of Support
B) Prof. Steve Miller CV
C) Budget Spreadsheet
D) Low-Earth System X/L Band Satellite Antenna – Technical Details

Appendix A: Letters of Support

- **Bryan Willson**

Executive Director, CSU Energy Institute, Fort Collins, CO

- **Brian Vanderbilt**

Deputy GIO and Deputy Director, USDA, Forest Service Geospatial Office, Salt Lake City, UT

- **Karen Michael**

NASA Land, Atmosphere, Near-Realtime Capability for Earth observations (LANCE) Manager, NASA Goddard Space Flight Center, Greenbelt, MD

- **Liam Gumley**

Distinguished Scientist, Cooperative Institute for Meteorological Satellite Studies, Space Science and Engineering Center, University of Wisconsin-Madison, Madison, WI

Appendix B: Curriculum Vitae - Steve Miller

Appendix C: Budget Spreadsheet

Appendix D:
Low-Earth System X/L Band Satellite Antenna – Technical Details

ENERGY INSTITUTE
COLORADO STATE UNIVERSITY

January 2, 2024

Selection Committee
Scott Foundation High Impact Awards

Re: Support for the CIRA proposal to install satellite dish at Powerhouse

I am writing to confirm the willingness of the CSU's Powerhouse Energy Campus to host the installation of a 2.4m X/L Band satellite antenna and associated processing equipment to enable direct-broadcast reception of low-earth-orbiting environmental satellite data. It is our understanding that Powerhouse's location, height, surroundings, and high-speed links to the CSU network make Powerhouse the optimal location for the installation.

Installation of the dish will provide unique environmental observation capabilities of the atmosphere, which aligns with Powerhouse's purpose statement to "foster innovation and develops solutions to enhance human lives, protect the environment, and educate the next generation of leaders – at a massive scale that will impact the world".

I am also willing to provide ½ month of my time, as well as some staff time, to support the success of the project.

Dr. Bryan Willson
(970)-227-5164
Energy.ColoState.edu
Colorado State University
Bryan Willson Presidential Chair in Energy Innovation
Executive Director, CSU Energy Institute
Professor, Department of Mechanical Engineering

United States Department of Agriculture
Forest Service
Geospatial Office
125 South State Street
Salt Lake City, UT 84138
Phone: 801 975-3750
Fax: 801 975-3478

File Code: 7140
Date: December 18, 2024

Dr. Steven Miller
Director of Cooperative Institute for Research in the Atmosphere (CIRA)
Colorado State University
1375 Campus Delivery
Ft. Collins, CO 80523-1375

Subject: Letter of Support for Installation of X-Band Satellite Antenna at CIRA

Dr. Miller:

On behalf of the USDA Forest Service Geospatial Office, I wish to convey our strong support of CIRA's proposal to install a 2.4m X/L-band satellite antenna and ingest/processing equipment. The Forest Service partners with the NASA Fire Information for Resource Management System (FIRMS) team to provide operational wildland fire detection and monitoring for the United States and Canada. This effort includes coordination with academic and federal partners who maintain ground station infrastructure to collect high-temporal, synoptic-view satellite imagery received via direct broadcast from polar-orbiting Earth observation satellites. Our partners apply the latest NASA algorithms to process satellite imagery and deliver real-time data products to NASA FIRMS. These derived products, including active fire detections, are made available in FIRMS within minutes of satellite observation compared to latencies of one to three hours for satellite data products provided by the NASA near real-time global data stream. Consequently, the extensive regional coverage and considerable reduction in data latency enabled by X-band satellite antennas and associated ground station processing facilities increase the value of these data to the Forest Service and our interagency partners, significantly enhance the situational awareness of national and regional wildland fire managers and inform strategic wildland fire planning and response operations.

An antenna and ground station located at CIRA would fill a key existing gap by extending the current X-band ground station network used by the Forest Service and NASA for active fire detection and monitoring. The proposed antenna site is ideally positioned to facilitate satellite direct readout coverage of the western United States and Canada. The antenna will also enable operational collection and processing of data from numerous current and future Earth observation satellite missions used for active fire monitoring. Consequently, the Forest Service views the presence of the proposed X/L-band satellite antenna and ground station at CIRA as vital to strategic active fire monitoring activities and strongly supports this proposal.

Sincerely,

BRIAN VANDERBILT Digitally signed by BRIAN VANDERBILT
Date: 2024.12.19 05:50:26 -07'00'

Brian Vanderbilt
Deputy GIO and Deputy Director, USDA Forest Service Geospatial Office

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, MD 20771

January 3, 2025

Reply to Attn of: 423

TO: Dr. Steven Miller; Cooperative Institute for Research in the Atmosphere (CIRA)

FROM: NASA GSFC LANCE Manager

SUBJECT: Installation of 2.4m X-Band Satellite Antenna at CIRA

Dear Dr Miller,

I am writing regarding the installation at Cooperative Institute for Research in the Atmosphere (CIRA) of a NASA-supplied 2.4m X/L band satellite antenna and ingest/processing equipment to enable the direct-broadcast reception of low-earth-orbiting environmental satellite data. As a NASA employee, I am not permitted to endorse specific proposals. As the manager of NASA's Land, Atmosphere, Near-Realtime Capability for Earth observations (LANCE), our system routinely leverages operational near real-time data to provide global active fire detection data, imagery, and other data products 90 to 180 minutes after satellite observation. These data, acquired by multiple Earth observation satellite missions, are made available to users to visualize, download, and stream via the NASA Fire Information for Resource Management System (FIRMS). As a value-added data stream that complements the global coverage data provided by LANCE, FIRMS also leverages multiple X-band satellite antennas located in the eastern and midwestern US to provide regional coverage active fire detection data to FIRMS users at very low latency (1-2 minutes after satellite observation). The rapid availability of these data further increases their value for fire detection and monitoring the progression of ongoing wildland fire incidents. Consequently, the installation of an antenna in Ft. Collins at CIRA would expand the X-band ground station network leveraged by NASA and managed by partner agencies and institutions to include very low latency data coverage for the western US. The addition of this additional antenna could expand FIRMS active fire mapping operations in North America and benefit other applications dependent on satellite direct broadcast data for low latency applications. I understand that as NASA has already contributed the antenna, this letter is not a commitment of agency resources.

Sincerely,

KAREN MICHAEL Digitally signed by KAREN MICHAEL
Date: 2025.01.03 09:52:11 -05'00'

Karen Michael

January 3, 2025

To: Professor Steven D. Miller, CIRA, Colorado State University

Dear Steve,

I am writing in support of CIRA's proposal to install a UW-owned X/L band antenna and associated equipment at CSU to enable the direct-broadcast (DB) reception of low-earth-orbiting environmental satellite data. The antenna equipment (reflector, feed, pedestal, demodulator, antenna control server, half-height rack, and cabling; valued at approximately $200,000) is to be installed at CSU and operated remotely by UW under my oversight. CSU will be responsible for initial installation costs and for ongoing costs to support antenna operation (e.g., electrical power, networking). Real time data from the antenna system will be provided free of charge to CIRA.

The antenna system, which is robust and designed for long-term autonomous operation, will enable the real-time capture of data from more than 10 environmental satellites for use by a global community of operational stakeholders. The proposed installation in Colorado will provide an important complement to the DB network operated by UW, which provides real time wildfire detection products to NASA across the continental USA and provides infrared and microwave sounder observations to NOAA to improve weather forecasts generated via numerical weather prediction. The antenna system will be capable of receiving data from current and future US and European operational environmental satellites. The project will further strengthen the relationship between CIRA/CSU and CIMSS/SSEC/UW-Madison and I give this project my strongest endorsement.

Sincerely,

Liam Gumley

Liam E. Gumley, Distinguished Scientist
Cooperative Institute for Meteorological Satellite Studies (CIMSS)
Space Science and Engineering Center (SSEC)
University of Wisconsin-Madison

1225 W. Dayton St.
Madison WI 53706
United States
+1 608 265 5358
Liam.Gumley@ssec.wisc.edu

Appendix B

Steven. D. Miller - Curriculum Vitae

Present Position

2021-Present: Professor, Atmospheric Science Department Graduate School, Walter Scott, Jr. College of Engineering, Colorado State University, Fort Collins, CO

2021-Present: Director, Cooperative Institute for Research in the Atmosphere (CIRA), Walter Scott, Jr. College of Engineering, Colorado State University, Fort Collins, CO

2007-2021: Deputy Director and Research Scientist (RS-III 2007-2011, Sr. RS 2012), Cooperative Institute for Research in the Atmosphere (CIRA), Walter Scott, Jr. College of Engineering, Colorado State University, Fort Collins, CO

2000-2007 Senior Satellite Meteorologist, Naval Research Laboratory, Marine Meteorology Division (Code 7541), Monterey, CA

Education

2000	PhD Colorado State University, Atmos. Aci. / Rad. Transfer & Rem. Sensing
1995-1997	MSc Colorado State University, Atmos. Sci. / Rad. Transfer & Rem. Sensing
1990-1995	BSc U. California at San Diego, Electrical and Computer Engineering

Honors, Awards, And Other Achievements

2023 NASA - Exceptional Achievement for Science to JPSS-2 Imagery Cal/Val Teams: For "outstanding mission-critical support to the pre and post launch calibration/validation of the JPSS-2 satellite".

2017 Colorado Laboratories (CO-LABS) Governor's Award: For "pioneering the development of an algorithm to display true-color imagery for the new era of geostationary satellites."

2017 CIRA Research and Service Initiative Award:
For "Outstanding contributions to scientific research: True-Color Imagery from GOES-16."

2017 NASA Honor Award - GOES-R Team Group Achievement Award: For "Excellence resulting in the successful GOES-R satellite launch, providing the nation's foundation for the world's highest quality weather monitoring and forecasting."

2016 CSU College of Engineering Faculty and Staff Awards: "Outstanding Administrative Professional Researcher."

Selected Major Grants & Contracts (PI Or Co-PI)

- Served as PI for **>$ 12M/year** in total, ongoing sponsored research (NOAA, NASA, and DoD)
- PI of 5-year (2024-2029) DOD/ONR OVERCAST; $10M
- PI of 5-year (2024-2028) DOD/ONR Congress. RAM-HORNS; $7.5M

Teaching/Lecturing Experience

2021-Present: Professor, Atmospheric Science Department Graduate School, Walter Scott, Jr. College of Engineering, Colorado State University, Fort Collins, CO

2007-2020: Associate Instructor in the Atmospheric Science Department

Student Advisership

Currently advise six graduate students (2 PhD, 4 MS)

Service

2019: Joined NOAA Sensor performance Assessment Team (SAT), providing science support to NOAA's next-generation space architecture effort, as a remote sensing expert (Invitation)

2019: Joined the NASA Land, Atmosphere Near real- time Capability for EOS (LANCE) User Working Group (UWG), the group that provides user community guidance to LANCE. (Invitation)

Publication History and Citations Publication History And Citations

ResearchGate: https://www.researchgate.net/profile/Steven-Miller-35

Selected Publications

Zhou, M., J. Wang, X. Chen, Y. Wang, P. R. Colarco, R. C. Levy, **S. D. Miller**, 2024: First lunar-light mapping of nighttime dust season oceanic aerosol optical depth over North Atlantic from space. *Remote Sensing of Environment*. **Vol 312**, 1 October 2024, 114315. https://doi.org/10.1016/j.rse.2024.114315

Elvidge C. D., M. Zhizhin, T. Sparks, T. Ghosh, S. Pon, M. Bazilian, P. Sutton, **S. D. Miller**, 2023: Global Satellite Monitoring of Exothermic Industrial Activity Via Infrared Emissions. *Remote Sens.*, **2023**, *15*(19), 4760; https://doi.org/10.3390/rs15194760
Special Issue **Advances in Thermal Infrared Remote Sensing**

Zhang, J., Reid, J. S., **Miller, S. D**., et al., S., 2023: Sensitivity studies of nighttime TOA radiances from artificial light sources using a 3-D radiative transfer model for nighttime aerosol retrievals, *Atmos. Meas. Tech. Discuss*. https://doi.org/10.5194/amt-2022-232

Rogers, M. A., **S. D. Miller**, et al., 2023:VIIRS after 10 Years—a Perspective on Benefits to Forecasters and End-Users. *Remote Sens.* ***15***(4), 976, Special Issue "VIIRS 2011–2021: Ten Years of Success in Earth Observations". https://doi.org/10.3390/rs15040976

Combs, C., and **S. D. Miller**, 2023: The Far-Reaching Usage of Low-Light Nighttime Data. *Remote Sens*. **2023**, **15**(3), 623, Special Issue "VIIRS 2011–2021: Ten Years of Success in Earth Observations", https://doi.org/10.3390/rs15030623

Noh, Y.-J., J. M. Haynes, **S. D. Miller**, et al.,, 2022: A Framework for Satellite-based 3D Cloud Data: An Overview 2 of the VIIRS Cloud Base Height Retrieval and User Engagement for Aviation Applications. *Remote Sens.*, 14(21), 5524, Special Issue "VIIRS 2011–2021: Ten Years of Success in Earth Observations". https://doi.org/10.3390/rs14215524

Miller S. D., et al., ,2022: A Physical Basis for the Overstatement of Low Clouds at Night by Conventional Satellite Infrared-Based Imaging Radiometer Bi-Spectral Techniques. *Earth and Space Science.* **9** (2), e2021EA002137, https://doi.org/10.1029/2021EA002137
Paper selected as AGU Editor's Highlight

Yue, J., **Miller, S. D**., et al. (2022). La Soufriere volcanic eruptions launched gravity waves into space. *Geophysical Research Letters*, *49*, e2022GL097952. https://doi.org/10.1029/2022GL097952

Miller S. D., et al., 2022: A Physical Basis for the Overstatement of Low Clouds at Night by Conventional Satellite Infrared-Based Imaging Radiometer Bi-Spectral Techniques. *Earth and Space Science.* **9** (2), e2021EA002137, https://doi.org/10.1029/2021EA002137
Paper selected as an AGU Editor's Highlight

Miller, S.D., et al.,, 2021: Honing in on bioluminescent milky seas from space. *Sci Rep* **11**, 15443 (2021). https://doi.org/10.1038/s41598-021-94823-z

Miller, S. D., et al., 2020: GeoColor: A Blending Technique for Satellite Imagery. *J. Atmos. Oceanic Tech.*, **37**(3), 429-448, https://doi.org/10.1175/JTECH-D-19-0134.1.

Miller, S. D., et al, 2019: A Tale of Two Dust Storms: Analysis of a Complex Dust Event in the Middle East. *Atmos. Meas. Tech.*, **12**(9), 5101–5118, https://doi.org/10.5194/amt-12-5101-2019.

Miller, S. D., et al., 2018: The Dark Side of Hurricane Matthew—Unique Perspectives from the Day/Night Band. *Bull. Amer. Meteor. Soc.*, **99**(12*)*, 2561-2574, doi: 10.1175/BAMS-D-17-0097.1.

Miller, S. D., et al., 2017: DEBRA - A Dynamic Enhancement with Background Reduction Algorithm: Overview and Application to Satellite-Based Dust Storm Detection. *J. Geophys. Res.: Atmospheres*, **122**(23), 12,938–12,959, doi.org/10.1002/2017JD027365. *"Highlight" Article"*

Miller, S. D., et al., 2016: A Sight for Sore Eyes: The Return of True Color Imagery to Geostationary Satellites. *Bull. Amer. Meteor. Soc*., **97**(10), 1803-1816, https://doi.org/10.1175/BAMS-D-15-00154.1.
NOTE: *BAMS* Cover Article

Miller, S. D., et al., 2015: Upper atmospheric gravity wave details revealed in night glow satellite imagery, *Proc. Nat. Acad. Sci*., **112**(49), 6728-6735, https://doi.org/10.1073/pnas.1508084112.
NOTE: *PNAS* Cover Article

Appendix C: Budget Spreadsheet

BUDGET

Enabling the First Real-Time Capture of Low-Earth-Orbiting Environmental Satellite Data at CSU

2/1/2025 - 06/30/2026

			2/1/2025-1/31/2026	2/1/2025-6/30/2026	TOTALS
I.		**OTHER DIRECT**			
	1	Structural Assessment	$10,000		
		Total Other Direct	**$10,000**	**$0**	**$10,000**
II.		**MATERIALS AND SUPPLIES**			
	1	Heliax Cable	$5,000		
	2	Pulling Cables (Heliax/data and GPS)	$2,500		
	3	Contingency	$7,222		
		Total Materials and Supplies	**$14,722**	**$0**	**$14,722**
III.		**EQUIPMENT**			
	1	Antenna Platform	$60,378		
		Total Equipment	**$60,378**	**$0**	**$60,378**
IV.		**TOTAL**	**$85,100**	**$0**	**$85,100**

COST SHARE BUDGET

Enabling the First Real-Time Capture of Low-Earth-Orbiting Environmental Satellite Data at CSU

2/1/2025-6/30/2026

		PERSONNEL	2/1/2025-1/31/2026			2/1/2026-6/30/2026			**TOTALS**
I.		Salaries	Rate	Mths	Total	Rate	Mths	Total	
	1	S. Miller	$22,255	0.1864	$4,148	$22,528	0.0776	$1,748	
	2	N. Tourville	$10,988	0.8477	$9,315	$11,123	0.3534	$3,931	
	3	R. Brummer	$14,525	0.1766	$2,565	$14,703	0.0734	$1,079	
	4	B. Willson	$30,496	0.3201	$9,762	$30,871	0.1414	$4,365	
		Fringe Benefits							
	1	S. Miller	27.4%		$1,137	27.4%		$479	
	2	N. Tourville	27.4%		$2,552	27.4%		$1,077	
	3	R. Brummer	27.4%		$703	27.4%		$296	
	4	B. Willson	27.4%		$2,675	27.4%		$1,196	
		Total Salaries and Benefits			**$32,857**			**$14,171**	**$47,028**
II.		**OTHER DIRECT**							
	1	Computer Infrastructure*			$51			$21	
		Total Other Direct			**$51**			**$21**	**$72**
III.		**EQUIPMENT**							
	1	Antenna Radome Assembly			$38,000				
		a. Antenna Radome			$33,000				
		b. Radome Base Access Hatch, Anchor Bolt Template and Bolt Kit			$5,000				
		Total Equipment			**$38,000**			**$0**	**$38,000**
IV.		**TOTAL**			**$70,908**			**$14,192**	**$85,100**
	*	**Computer Infrastructure**	**Rate**	**Mths**	**Total**	**Rate**	**Mths**	**Total**	
	1	S. Miller	$47	0.1864	$9	$47	0.0776	$4	
	2	N. Tourville	$0	0.8477	$0	$0	0.3534	$0	
	3	R. Brummer	$235	0.1766	$42	$235	0.0734	$17	
	4	B. Willson	$0	0.3201	$0	$0	0.1414	$0	
					$51			$21	

Appendix D:
Low-Earth System X/L Band Satellite Antenna – Technical Details

Dish Specifications:
The satellite dish specifications are provided as an Appendix document. It is a 2.4 m X/L band antenna, identical to other systems deployed by NASA. The antenna system weight is 1245 lbs. Detailed specifications in manuals provided by vendor will be made available to contractors for installation guidance.

Satellites Receivable by Dish:
- Legacy NOAA 18/19 satellites
- NOAA JPSS constellation (current and future)
- European operational constellation (current and future)
- China FY3D/E/F polar orbiters
- Selected satellites having ARGOS data systems on board
- Future smallsats/cubesats providing X-band telemetry

Dish Operation:
There is no regular hardware maintenance needed for the dish. Similar dishes from this family have been running for over 10 yrs at other deployment stations. Software included as part of the turn-key system does satellite pass-predictions based on a catalogue of updated two-line-element data. The software also commands and controls (C&C) dish scanning. These (C&C) operations will be conducted by Dr. Gumley's SSEC team in Wisconsin, who manage the entire network remotely, in collaboration with CIRA.

The dish tracks in zenith/azimuth to collect overpasses to within 5 degrees of horizon. Thus, a site far removed from blockages was desired for this installation. A location on the foothills campus, and CIRA in particular, posed too many physical obstacles including the mountains immediately to the west. As western coverage is most desired from this system, the PowerHouse site provided far better line-of-site conditions.

Indoor Equipment Requirements:
- reliable electrical power
- reliable hi-speed internet
- half-height rack inside Powerhouse (supplied as part of dish equipment)
- Demodulators for X and L band, UPS, Linux server to command the antenna, receive data that comes out of demodulator (supplied as part of dish equipment)

Installation:
A crane will be required to lift antenna atop the CSU Powerhouse roof. Contractors will be hired to prepare site and assist with installation. Dr. Gumley will provide oversight and technical assistance.

The following additional Technical Documents can be provided if requested
1) Orbital Systems – Installation Guide
2) Infinite Technologies RCS, Inc. (ITIRCS) : Sandwich Radome

STRATA
COLORADO STATE
UNIVERSITY SYSTEM

July 28, 2025

Ralph Campano
Real Estate Services Manager
City of Fort Collins
300 Laporte Ave, Building B
Fort Collins, CO 80521

Dear Ralph,

As the managing landlord of the Powerhouse Energy Campus located at 430 N. College Ave, CSU STRATA is requesting approval for the following building alteration from the City of Fort Collins, as the property owner and lessor under the Lease Agreement between the City and CSU dated February 29, 2012 ("Lease").

The request for this work is related to a collaborative project between the CSU Energy Institute and the Cooperative Institute for Research in the Atmosphere (CIRA) which will enable the first real-time capture of low-earth-orbiting environmental satellite data at CSU. Please see the attached Scope of Work in the form of the funding application and antenna schematics for more details.

The CSU Energy Institute will complete these activities in accordance with Article VIII and any other applicable provisions of the Lease and will obtain all permits as well as fulfill any requirements that that may be required by federal, state or local jurisdictions during the project.

We agree with the CSU Energy Institute that these efforts are in support of the research mission of the Powerhouse Energy Campus and support the activities as described above.

Sincerely,

Michael S. 'Bo' Brown
Senior Facilities Manager
CSU STRATA

Property Owner has agreed to the above-described activities relative to the Leased Premises.

Property Owner Signature: ______________________________ Date: ____________

Ralph Campano
Real Estate Services Manager, City of Fort Collins

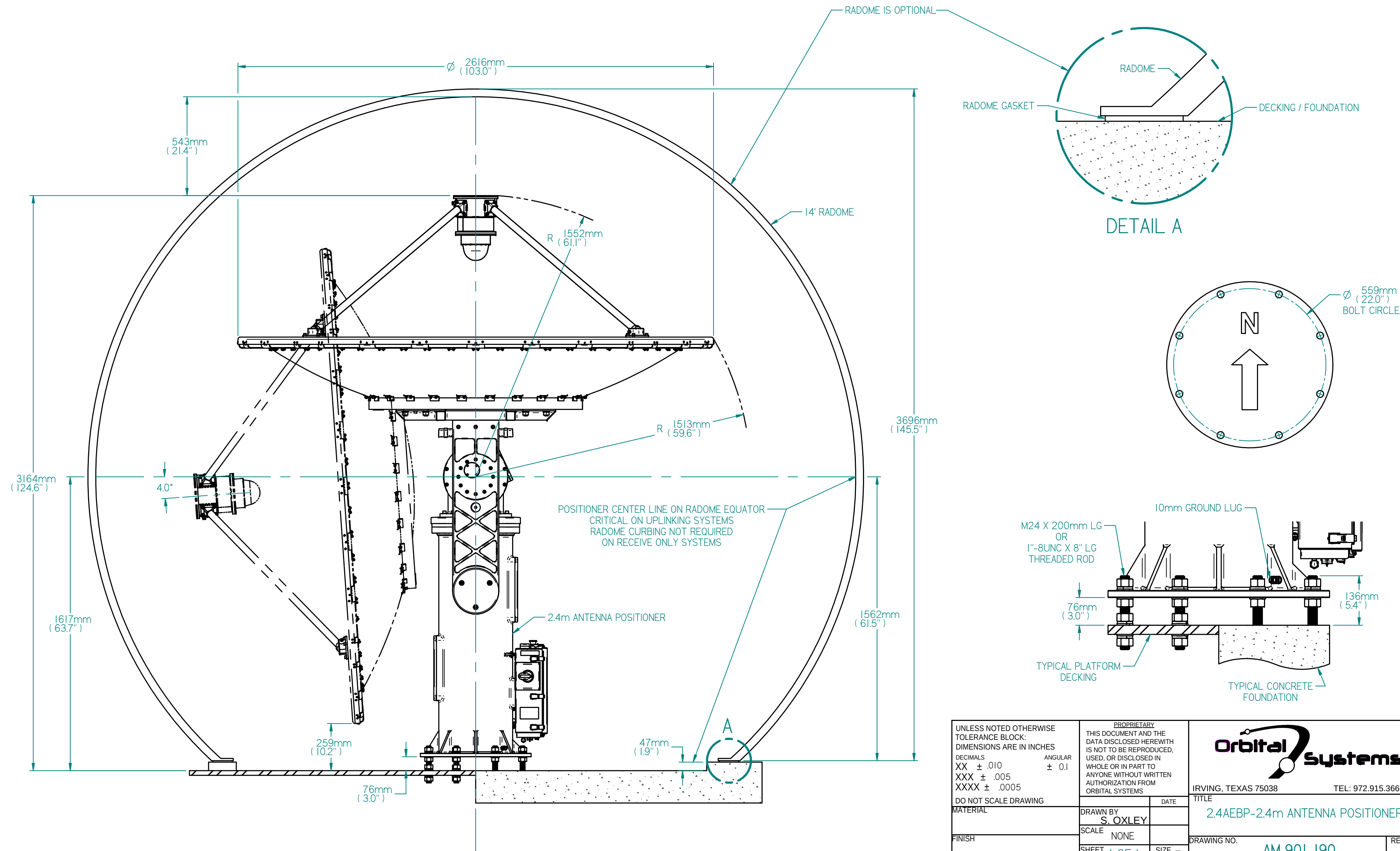
NOTES: Unless Otherwise Specified

1. DEBURR AND REMOVE ALL SHARP EDGES .02 AS REQD.
2. TUMBLE FINISH BEFORE PLATING, ANODIZING OR POWDER COATING
3. MASK ALL TAPED HOLES BEFORE ANODIZING OR POWDER COAT

REVISION BLOCK

REV	ECO #	ZONE	DESCRIPTION OF CHANGE(S)	DATE	CHANGED / APPROVED

DWG NO AM 901-190 REV C.1



UNLESS NOTED OTHERWISE TOLERANCE BLOCK: DIMENSIONS ARE IN INCHES

DECIMALS		ANGULAR
XX	± .010	± 0.1
XXX	± .005	
XXXX	± .0005	

DO NOT SCALE DRAWING

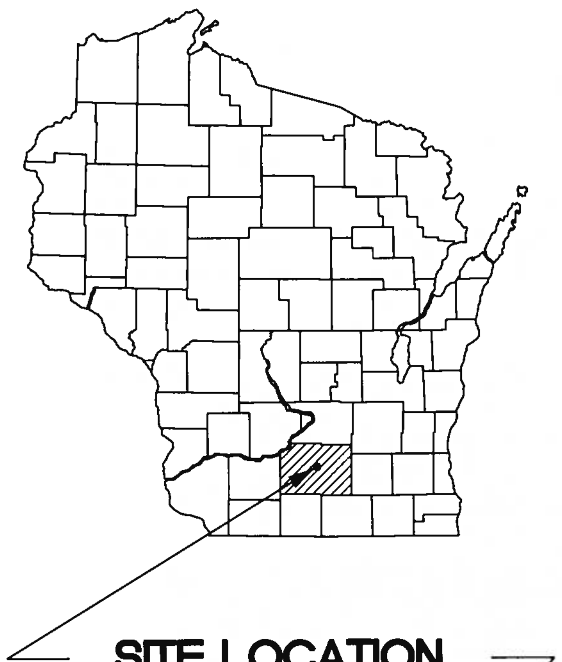
Orbital Systems

IRVING, TEXAS 75038 TEL: 972.915.3669

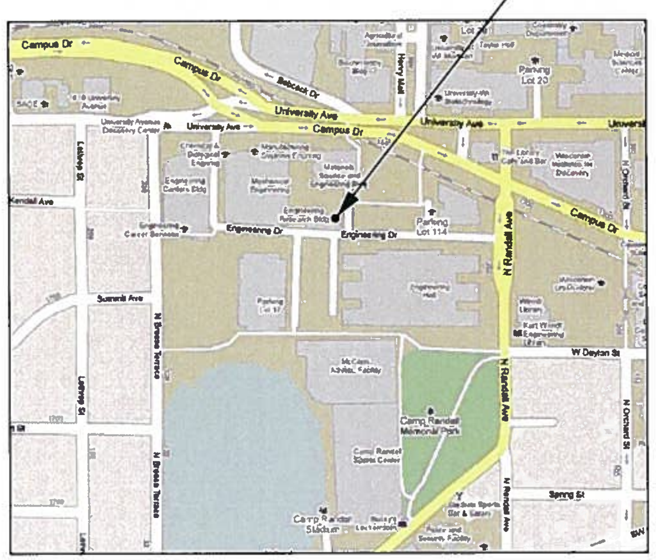
MATERIAL	
FINISH	
DRAWN BY	S. OXLEY
DATE	
SCALE	NONE
SHEET	1 OF 1
SIZE	B
TITLE	2.4AEBP-2.4m ANTENNA POSITIONER
DRAWING NO.	AM 901-190
REV	C.1

REPLACE SSEC ANTENNA ON ROOF
ENGINEERING RESEARCH BUILDING
UNIVERSITY OF WISCONSIN - MADISON
MADISON, WISCONSIN

CONSTRUCTION DRAWINGS
UW #0762 1101



SITE LOCATION



SITE LOCATION MAP

SCALE: NTS

NORTH

PROJECT DIRECTORY

A/E CONSULTANT:
EDGE CONSULTING ENGINEERS, INC.
624 WATER STREET
PRAIRIE DU SAC, WI 53578
CONTACT: RYAN READER
PHONE: 608.644.1449
FAX: 608.644.1549

AGENCY CONTACT:
UW-MADISON PHYSICAL PLANT
PROJECT ADMINISTRATION CENTER
ROOM 201H - SERVICE BUILDING
1217 UNIVERSITY AVE.
MADISON, WI 53715
CONTACT: CINDY STATZ
PHONE: 608.263.3088

PROJECT INFO

SITE LOCATION:
ENGINEERING RESEARCH BUILDING
1500 ENGINEERING DR.
MADISON, WI 53706

SHEET INDEX

TO OBTAIN LOCATION OF PARTICIPANTS' UNDERGROUND FACILITIES BEFORE YOU DIG IN WISCONSIN

CALL DIGGERS HOTLINE
1-800-242-8511
TOLL FREE

FAX A LOCATE 1-800-338-3860
TDD(FOR HEARING IMPAIRED) 1-800-542-2289

WIS. STATUTE 182.0175 (1974) REQUIRES MIN. OF 3 WORK DAYS NOTICE BEFORE YOU EXCAVATE.

ENGINEER SEAL:

WISCONSIN
RYAN J. READER
E-39360
BLACK EARTH, WI
PROFESSIONAL ENGINEER

I HEREBY CERTIFY THAT THIS PLAN SET WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF WISCONSIN.

SIGNATURE: [signature]

DATE: 07/07/11

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Consulting Engineers, Inc.
624 Water Street
Prairie du Sac, WI 53578
608.644.1449 voice
608.644.1549 fax
www.edgeconsult.com

State of Wisconsin
Department of Administration
Division of State Facilities

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MADISON CAMPUS

Project Title:
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UNIVERSITY OF WISCONSIN - MADISON

Project Location:
MADISON, WISCONSIN

Sheet Title:
TITLE SHEET

Revisions:

No.	Date:	By:	Description:
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Date Issued	07/07/2011
Sheet Number	T100

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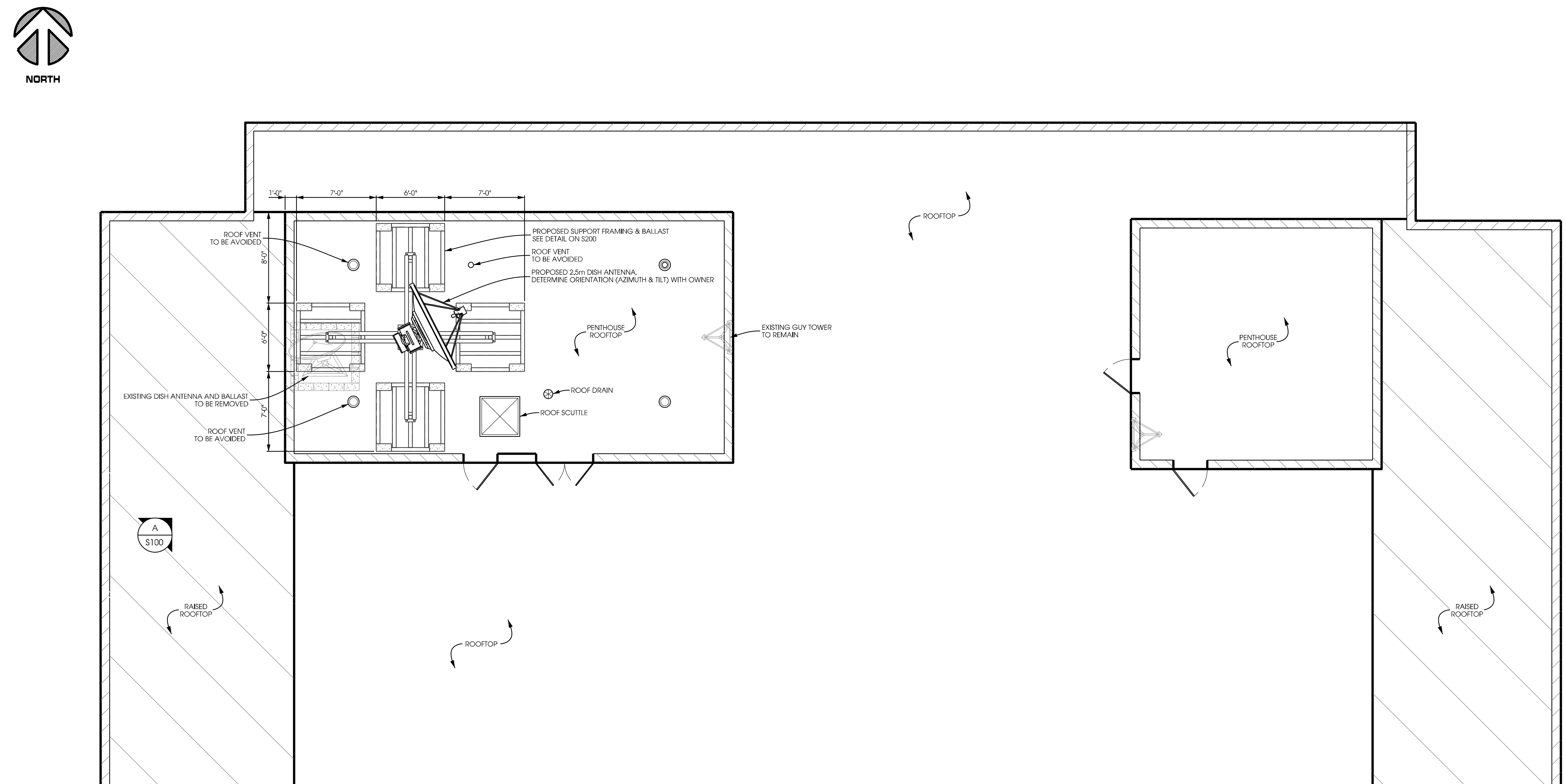

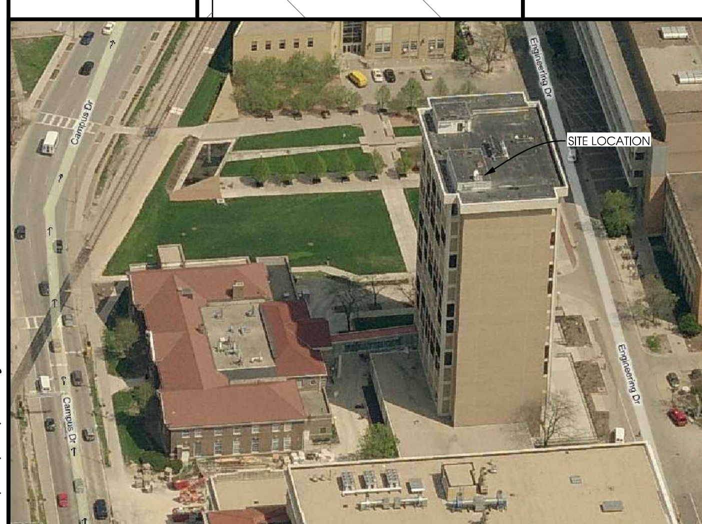

BIRD'S EYE VIEW
[LOOKING EAST]

A
S100
EXISTING HARD POINT SPANS

5' 0 5' 10'
SCALE: 11" x 17" - 1" = 10'
22" x 34" - 1" = 5'

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Project Location:
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Sheet Title:
ROOFTOP PLAN

Revisions:

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Date Issued	07/07/2011
Sheet Number	S100

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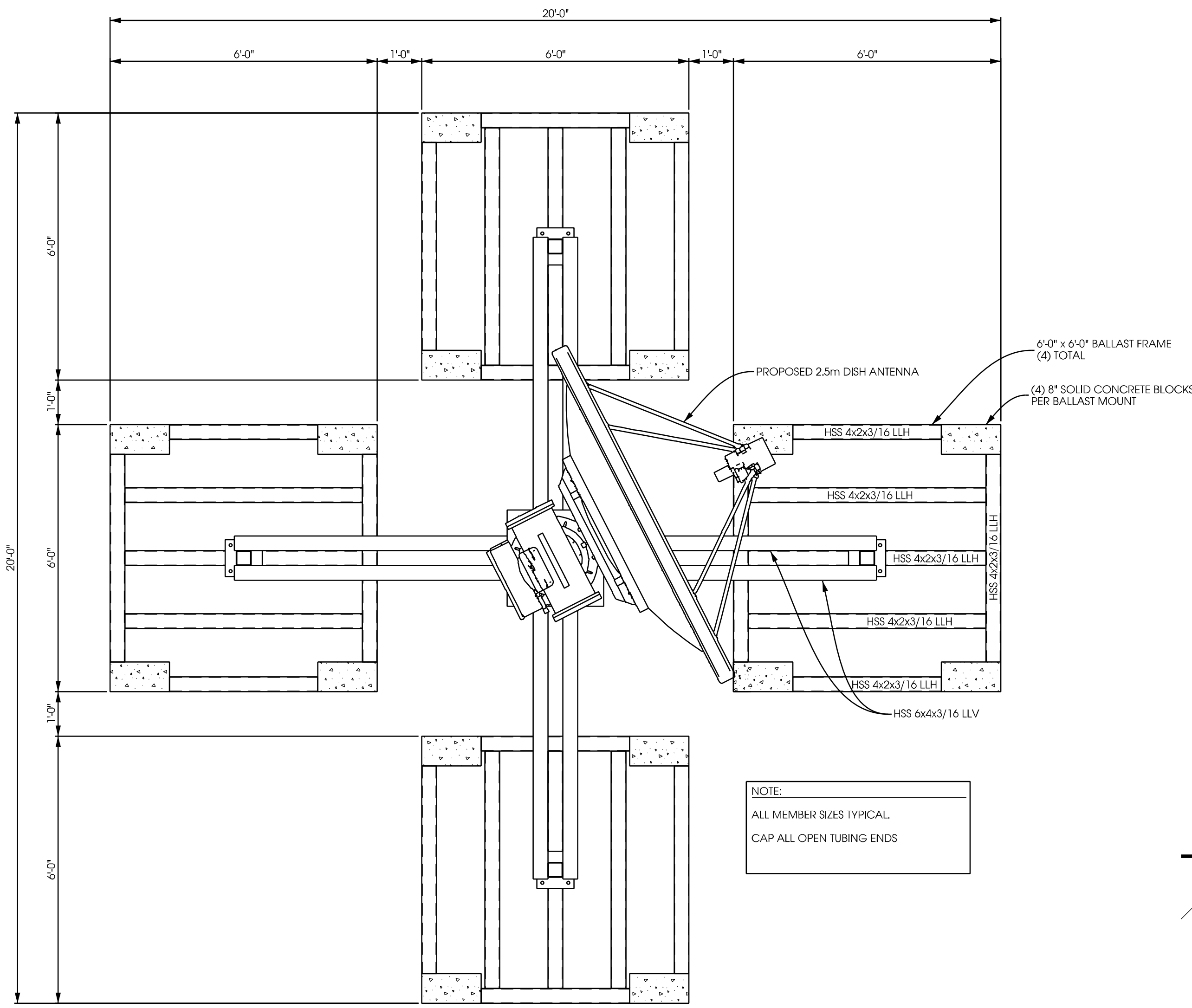
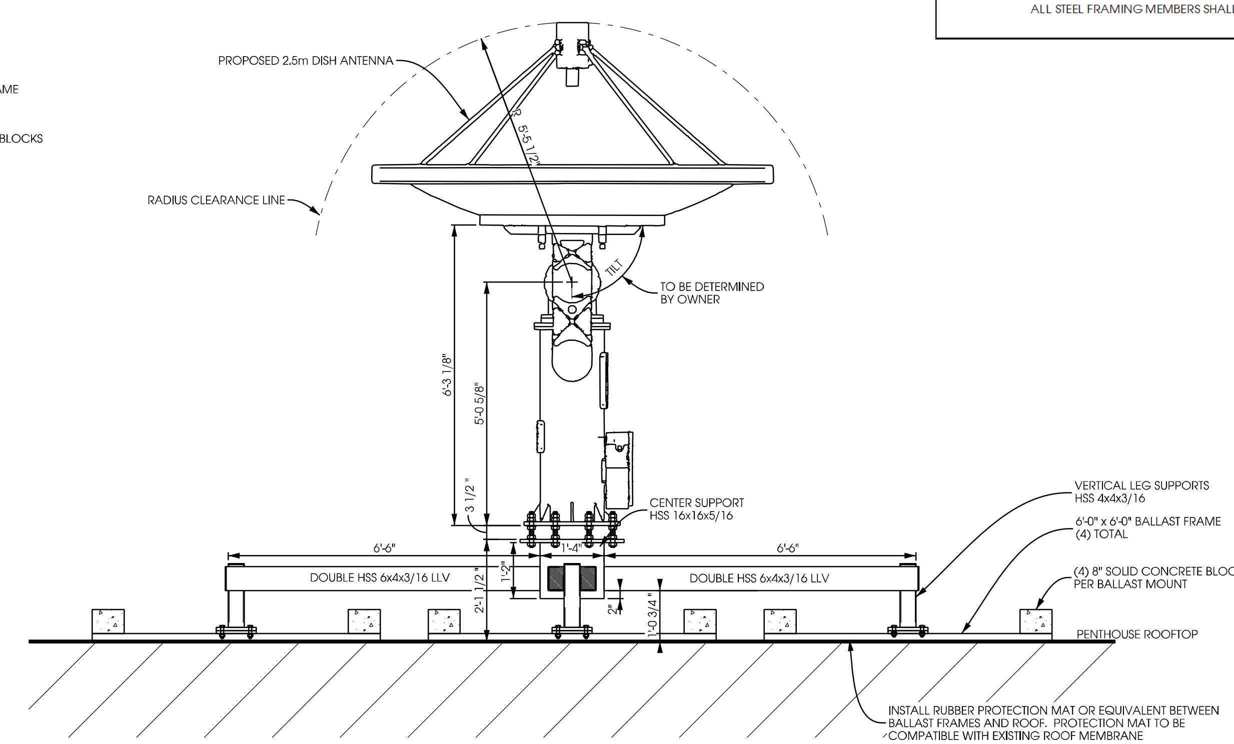


NOTE:

ALL MEMBER SIZES TYPICAL.

CAP ALL OPEN TUBING ENDS



CODE / LOADING INFORMATION

APPLICABLE BUILDING CODES

2008 WISCONSIN COMMERCIAL BUILDING CODE

VERTICAL LOADS

TYPICAL ROOF LIVE .... 30 psf
ROOF DEAD LOAD .... 70 psf
SNOW LOAD .... 22 psf + DRIFT

WIND DESIGN DATA (ASCE 7)

BASIC WIND SPEED (V) (3 SECOND GUST) .... 90 mph
WIND IMPORTANCE FACTOR (Iw) 1.15
BUILDING CATEGORY III
WIND EXPOSURE CATEGORY C
INTERNAL PRESSURE COEFFICIENT .... +/-0.18
BASIC VELOCITY PRESSURE .... 33.0 psf

STEEL FRAMING NOTES

MATERIAL

- HSS (A500 GRADE B) — Fy = 46,000 psi
- CHANNELS, ANGLES, BARS, THREADED ROD (A36) — Fy = 36,000 psi
- WELDING ELECTRODES
  - SMAW PROCESS — E7015, E7016, E7018, or E7028
  - OTHER WELD PROCESS — E70XX

STEEL ERECTION

STEEL ERECTION SHALL COMPLY WITH ALL OSHA, STATE, LOCAL AND UNION REGULATIONS.

STRUCTURAL BOLTS

ALL BOLTS FOR STRUCTURAL STEEL CONNECTIONS PER ASTM A325.

WELDING

ALL WELDING FOR STRUCTURAL STEEL CONNECTION TO BE PERFORMED BY CERTIFIED WELDERS IN ACCORDANCE WITH AWS D1.1

FIELD WELDED ITEMS

UNLESS NOTED OTHERWISE ON DETAILS, FIELD WELD HEADERS FRAMES, OUTRIGGERS, ETC. TO THEIR SUPPORTS WITH A MIN (2) 1/8" FILLET WELDS, 1 1/2" LONG

STEEL FINISH

ALL STEEL FRAMING MEMBERS SHALL BE SHOP PRIMED AND PAINTED PER SPECIFICATIONS.

Edge
Consulting Engineers, Inc.
624 Water Street
Prairie du Sac, WI 53578
608.644.1449 voice
608.644.1549 fax
www.edgeconsult.com

State of Wisconsin
Department of Administration
Division of State Facilities

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REPLACE SSEC ANTENNA ON ROOF
ENGINEERING RESEARCH BUILDING
UNIVERSITY OF WISCONSIN - MADISON

Project Location:
MADISON, WISCONSIN

Sheet Title:
FRAMING PLAN + ELEVATION

Revisions:

No.	Date:	By:	Description:
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22" x 34" - 1/2" = 1'

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Date Issued	07/07/2011
Sheet Number	S200

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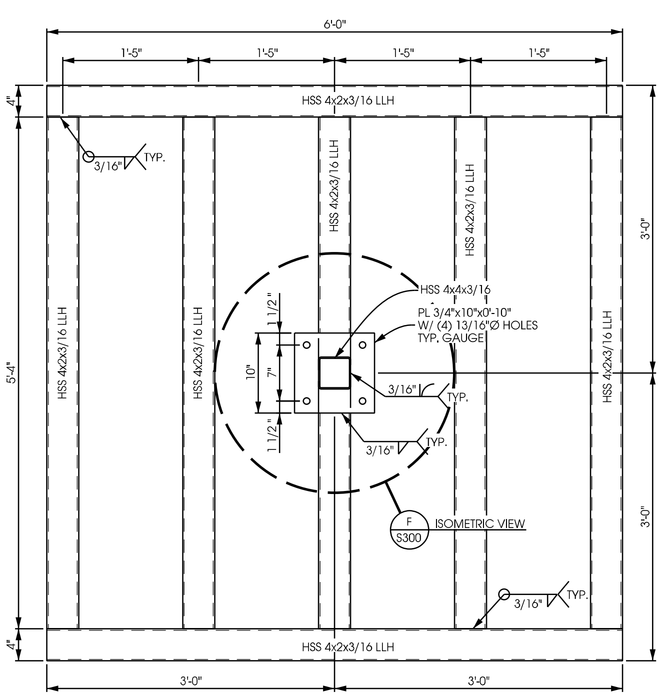
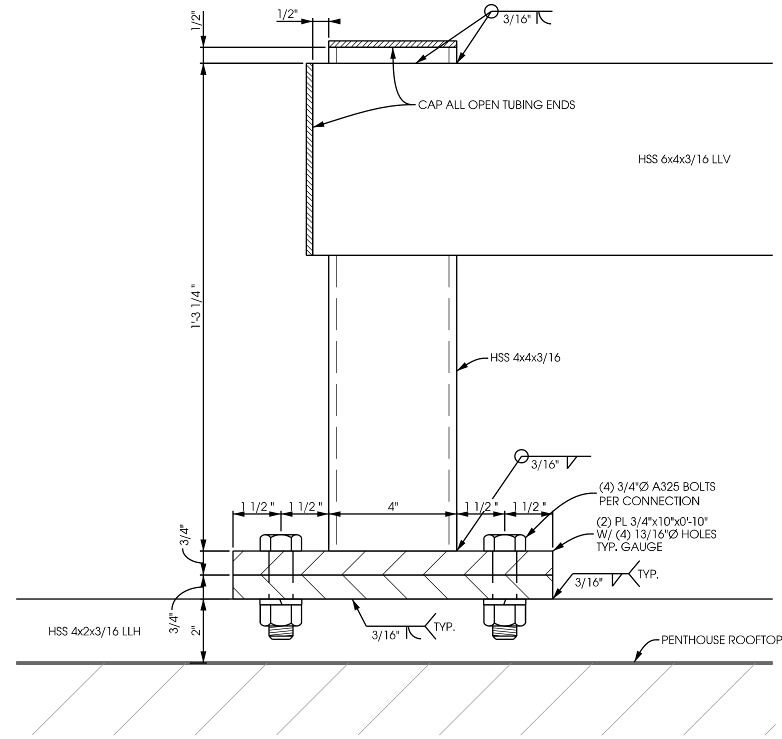
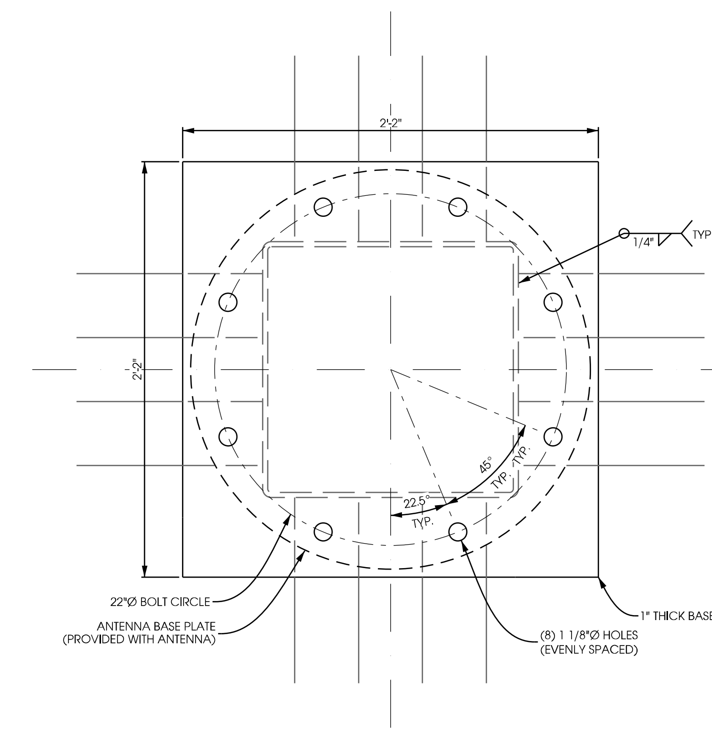


A
S300
BALLAST FRAME DETAIL
SCALE: 11 X 17 - 1/2" = 1'-0"
22 X 34 - 1" = 1'-0"

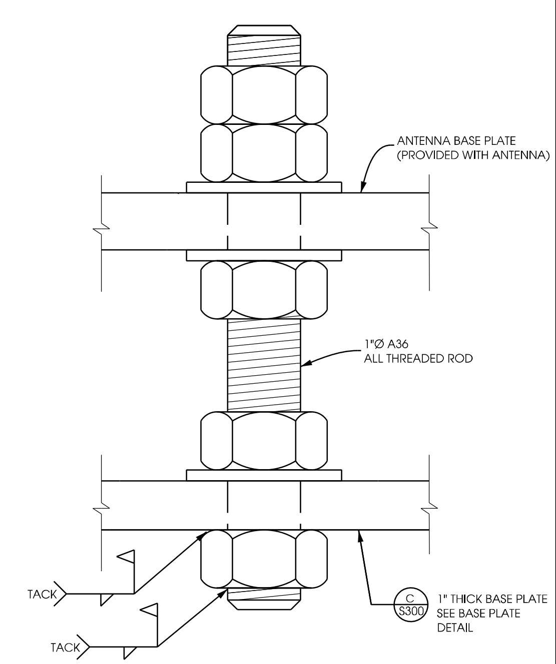


B
S300
BALLAST FRAME CONNECTION
SCALE: 11 X 17 - 1" = 0'-6"
22 X 34 - 1" = 0'-3"



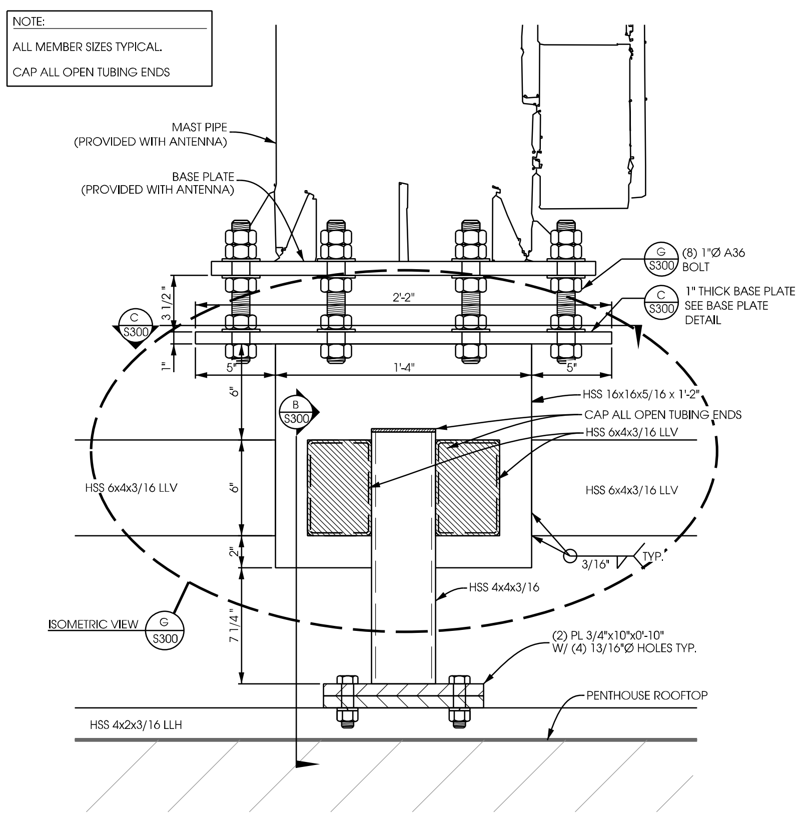
C
S300
BOLT PLATE DETAIL
SCALE: 11 X 17 - 1" = 1'-0"
22 X 34 - 1" = 0'-6"

NOTE: (5) NUTS & (3) WASHERS PER ROD

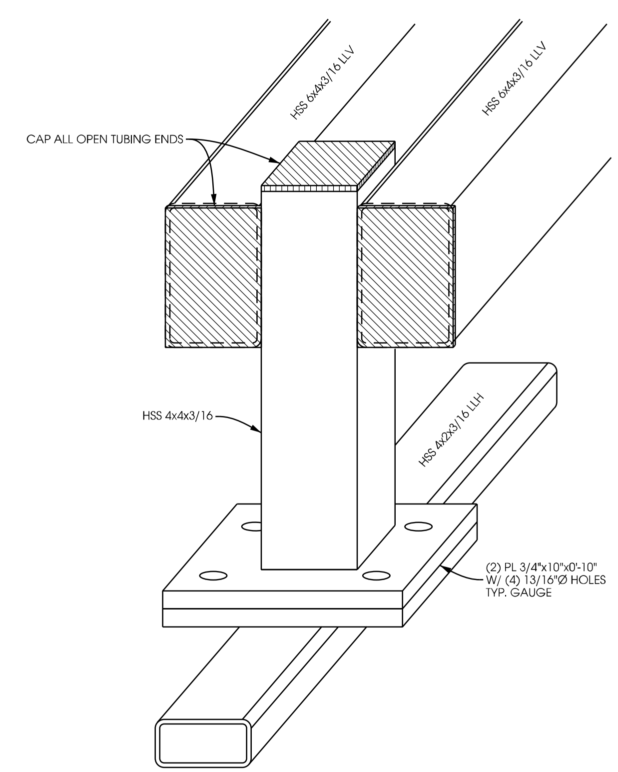


D
S300
THREADED ROD DETAIL
SCALE: 11 X 17 - NTS
22 X 34 - NTS

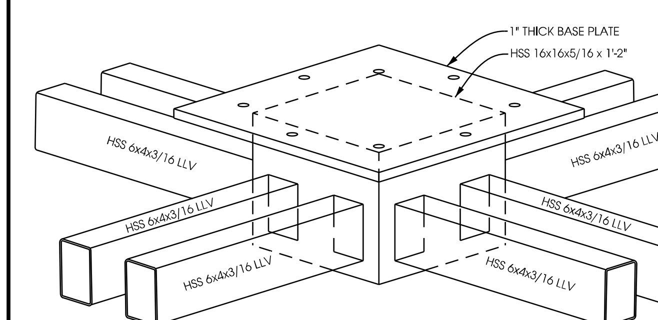
NOTE:
ALL MEMBER SIZES TYPICAL.
CAP ALL OPEN TUBING ENDS



E
S300
CONNECTION AT MAST PIPE
SCALE: 11 X 17 - 1" = 1'-0"
22 X 34 - 1" = 0'-6"



F
S300
BALLAST FRAME CONNECTION - ISOMETRIC VIEW -
SCALE: 11 X 17 - NTS
22 X 34 - NTS



G
S300
CONNECTION AT MAST PIPE - ISOMETRIC VIEW -
SCALE: 11 X 17 - NTS
22 X 34 - NTS

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Sheet Title:
FRAMING SECTIONS AND DETAILS

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ELEVATION-OVER-AZIMUTH ANTENNA POSITIONERS

PRE-INSTALLATION GUIDE

Manual P/N:	MA 400-006
Revision:	D.04
Release Date:	2023-02-17

Orbital Systems, LLC
www.OrbitalSystems.com

3807 Carbon Rd.
Irving, TX 75038 USA

Printed in the United States of America

Version History					
Rev No.	**Implemented By**	**Revision Date**	**Approved By**	**Approval Date**	**Reason for Change**
A.01	R. Chuvarsky	2011-10-04	P. Scheffler	2011-10-13	New Document
A.02	R. Chuvarsky	2012-02-15	P. Scheffler		Added appendix with instructions for electrician
A.03	R. Chuvarsky	2012-05-08	P. Scheffler		Replaced base bolt pattern drawing in paragraph 4.2.8
B.01	M. Morgan	2014-07-11	P. Scheffler	2014-08-07	Updates Requested by Customer
C.01	M. Morgan	2015-02-15	P. Scheffler		Updated sections, removed True North requirement, Added Access Methods
C.02	M. Morgan	2015-06-01	P. Scheffler	2015-06-18	New Orientation and Conduit Drawings
C.03	M. Morgan	2015-06-19	P. Scheffler		Updated Drawings and Radome Options
C.05	M. Morgan	2016-10-10	P. Scheffler		Updated Conduit and Template Images
C.06	M. Morgan	2016-10-28			Added 5.0AE3BP
C.07	M. Morgan	2017-08-31			Updated Foundation Load Requirements
C.08	M. Morgan	2018-01-25			Updated Drawings
C.09	M. Morgan	2018-02-02			Updated 5m Drawing
C.10	M. Morgan	2018-05-21			Added Power Consumption
C.11	A. Bohannon	2019-07-19			Formatting
C.12	A. Bohannon	2019-08-07			Added structural load data and radome diagram for 5.0AE3BP-6.1m system
C.13	A. Bohannon	2019-08-23	P. Scheffler	2019-08-23	Updated instructions for installing the mounting studs
D.01	A. Bohannon	2021-05-04			Added 7.3AE3BP; other various updates
D.02	A. Bohannon	2021-05-05			Updated Appendix E with transformer requirements
D.03	A. Bohannon	2021-11-23			Updates for 1.8AEBP-1.5m
D.04	M. Snow	2022-05-18			Updated Section 4.2.11
D.05	M. Snow	2023-02-17			Updated dead weight and added foundation stiffness details to Appendix D.

Legend

A warning that if ignored could cause injury or death to a person

A caution that if ignored could cause damage to the equipment

A notice from the manufacturer containing information that is highly recommended

TABLE OF CONTENTS

List of Tables

List of Figures

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SECTION 1 INTRODUCTION

1.1 SCOPE OF THIS MANUAL

This manual explains all site preparation and other Pre-Installation requirements that must be completed prior to installation of the antenna positioner. The customer or an authorized Orbital Systems LLC distributor is responsible for completing all the tasks described in this manual. After each Pre-Installation task has been completed, it is verified on a checklist in Appendix A. After the checklist has been completed, it is provided to Orbital Systems LLC or the authorized distributer performing the installation.

This manual includes the following supplemental documents that can be used to assist with the Pre-Installation tasks:

- Engineering drawings for system dimensions and mounting bolt patterns
- A system components interconnection diagram for XLC and XLD systems
- If you have purchased a Front End Server from Orbital Systems LLC, then the customer must complete a Front End Server (FES) configuration worksheet

Notice

Unless otherwise notated, the phrase **Elevation-over-Azimuth Antenna Positioners** or **Antenna Positioner** refers to all current models in production by Orbital Systems LLC. These models include:

- 7.3AE3BP-7.5m
- 7.3AE3BP-7.3m
- 5.0AE3BP-6.1m
- 5.0AE3BP-5.0m
- 3.0AEBP-3.7m
- 3.0AEBP-3.0m
- 2.4AEBP-3.0m
- 2.4AEBP-2.4m
- 2.4AEBP-1.8m
- 2.4AEHP-3.0m
- 2.4AEHP-2.4m
- 2.4AEHP-1.8m
- 1.8AEBP-1.8m
- 1.8AEBP-1.5m
- 1.8AEHT-1.8m
- 1.8AEHT-1.5m

The Elevation-Over-Azimuth antenna positioner Pre-Installation is completed in two phases. Adhering to each phase and executing each phase in the correct sequence ensures that the installation can be completed efficiently. The customer or an Orbital Systems LLC authorized distributor performs these phases.

Phase 1: Site Preparation

- Select the site for the antenna positioner
- Select and prepare the location for the interior (indoor) equipment
- Design and construct the foundation
- Determine conduit requirements, if used
- Determine the route, length, and type of RF and data cables to be used; inform Orbital Systems LLC of cable lengths and types

Phase 2: Cable and Power Installation; Dehydrator Location

- Install system cables and dehydrator tube (shipped with pre-installation kit)
- Determine dehydrator location
- Provide AC power to the foundation and dehydrator
- Prepare and set up site for installation day

1.1.1 Pre-Installation Kit

Orbital Systems LLC ships a Pre-Installation kit with each antenna positioner. This kit is shipped to the customer's site approximately 4 weeks prior to the scheduled installation date. The Pre-Installation kit components must be installed prior to the system installation. Contents of the kit are described in Table 1.

Parts List for the Pre-Installation Kit	
Part	***Description***
RF Cables	• The RF cable typically is made of LMR400, which is a high-performance, low-loss coaxial cable approximately 1 centimeter (0.40 inch) in diameter. This cable is rated for continuous exposure to sunlight, ozone, and extreme temperature applications (-40°C to more than 60°C). It is provided with connectors. • The RF cable is supplied on a spool. The ends are marked **Antenna** and **Rack**. The end marked **Rack** unrolls first to accommodate running the cable from the antenna positioner location to the rack equipment.
Data Cables	• All AEBP and AEHT positioners use multi-mode or single-mode fiber optic connections for data transmission. • All AEHP positioners use the RS-422 data cable that is rated for continuous exposure to sunlight, ozone, and extreme temperatures. • The Data cable is supplied on a spool. The ends are marked **Antenna** and **Rack**. The end marked **Rack** unrolls first to accommodate running the cable from the antenna positioner location to the rack equipment.
Notice	Orbital Systems LLC anticipates that during installation the cables will be pulled through the conduit from the antenna positioner location to the indoor equipment rack. On the data cables, the connectors on the ends marked **Rack** are smaller than the connectors on the ends marked **Antenna**. Because the smaller connectors are easier to pull through the conduit, the ends marked **Rack** should be pulled through the conduit from the antenna positioner location to the equipment rack.
Single Mode Fiber Optic Communications Option	• **THIS IS AN OPTIONAL ITEM PURCHASED BY THE CUSTOMER.** • Outside Fiber Link converts data control to single mode fiber signals. • Inside Fiber Link is a self-contained data and RF interface for operating the antenna system over three single mode fibers

Table 1 - Parts List for the Pre-Installation Kit

Table 1 (Continued): Parts List for the Pre-Installation Kit	
Part	***Description***
Air Tubing	• The air tubing runs from the antenna to the dehydrator. The air tubing typically is routed with the RF and Data cables from the antenna positioner location until it is rerouted to the dehydrator. • The air tubing is rated for continuous exposure to sunlight, ozone, and extreme temperature applications (-40°C to more than 60°C).
Plywood Mounting Template	• This template is used to ensure that the antenna mounting studs are installed correctly. This is crucial to ensuring that the antenna positioner can be mounted correctly to the foundation.
Active GPS Antenna With Mounting Tube and Cable	• The GPS antenna is equipped with an active internal amplifier. A low-voltage feed delivered through the RF cable from the antenna positioner powers the GPS antenna. The RF cable also is used to transmit the GPS microwave signals to the GPS receiver.
GPS Antenna Mounting Kit	• The mounting kit is supplied with stainless steel tubing clamps, which are used to secure the antenna and its mounting tube. The mounting tube is 30.5 centimeters (12 inches) long. • The GPS antenna's location must be in an area where it has unobstructed signal reception from GPS satellites. - If the positioner is installed in the northern hemisphere, the GPS antenna is mounted south of the positioner. - If the positioner is installed in the southern hemisphere, the GPS antenna is mounted north of the positioner.
GPS Antenna Cable	• A 10 meter (35 foot) cable with TNC connectors is provided. One end of the cable connects to the antenna positioner lower bulkhead, and the other end connects to the base of the GPS antenna.

1.2 GENERAL INFORMATION

1.2.1 Site Safety

The customer is responsible for ensuring that the site is safe for personnel.

1.2.2 Electrical Requirements

Refer to APPENDIX E: for detailed information on the electrical requirements for the Elevation-Over-Azimuth Antenna Positioner.

- The 7.3AE3BP system requires a three-phase AC circuit (delta configuration), 230 to 240 VAC, 50 to 60 Hz, which is protected with a 30 to 32 Amp fuse. If the system is used inside a Radome, the circuit protection can be reduced to 20 Amps.

- The 5.0AE3BP system requires a single-phase AC circuit, 208 to 240 VAC, 50 to 60 Hz, which is protected with a 20 Amp fuse. If the system is used inside a Radome, the circuit protection can be reduced to 5 Amps.

- The 3.0AEBP system requires a single-phase AC circuit, 208 to 240 VAC, 50 to 60 Hz, which is protected with a 16 to 20 Amp fuse. If the system is used inside a Radome, the circuit protection can be reduced to 5 Amps.

- The 2.4AEBP system requires a single-phase AC circuit, 208 to 240 VAC, 50 to 60 Hz, which is protected with a 16 to 20 Amp fuse. If the system is used inside a Radome, the circuit protection can be reduced to 5 Amps.

- The 2.4AEHP system requires a single-phase AC circuit, 208 to 240 VAC, 50 to 60 Hz, which is protected with a 16 to 20 Amp fuse. If the system is used inside a Radome, the circuit protection can be reduced to 5 Amps.

- The 1.8AEBP system requires a single-phase AC circuit, 120 or 208 to 240 VAC, 50 to 60 Hz, which is protected by a 16 to 20 Amp fuse. If the system is used inside a Radome, the circuit protection can be reduced to 5 Amps.

- The 1.8AEHT system requires a single-phase AC circuit, 115 or 208 or 225 or 240 VAC, 50 to 60 Hz, which is protected by a 16 to 20 Amp fuse. If the system is used inside a Radome, the circuit protection can be reduced to 5 Amps.

The system includes an IP65 sealed disconnect switch, which is mounted on the left side of the electrical cabinet. The disconnect box is nonmetallic and CE/UL marked. The location of the disconnect box on various positioner models are shown in the drawings in APPENDIX F:. The customer is responsible for providing an appropriate electrical supply cable into the disconnect switch. This cable must be protected at the source with a dedicated fuse or circuit breaker. The cable must have an independent ground conductor rated for (at minimum) the full system load, which is specified by positioner model in section E.2 of this document. The ground conductor must be connected to the power source electrical panel in conformance with local electrical codes. A power transformer may be required to meet the system voltage requirements (especially for three-phase power). Refer to APPENDIX E: for detailed electrical requirements for cabling and circuit protection.

The dehydrator can use 110 or 220 VAC, 50 to 60 Hz. The unit is fused at 4 A and average power consumption is 55 W. The dehydrator has been configured to support a desiccant regeneration cycle. Due to this cycle, the typical power consumption is up to 1 A @ 110 V or 0.5 A @ 220 V for 50% of the time; and 0.2 A @ 110 V or 0.1 A @ 220 V for the other 50%.

1.2.3 Electrical Grounding

The system is grounded internally at the azimuth tube, upper enclosure, and feed, which are connected to a common ground inside the electrical cabinet. The electrical cabinet ground is connected to the ground point in the disconnect switch. The customer is responsible for ensuring that the electrical components on the site are properly connected and grounded in accordance with local codes.

1.2.4 Optional Antenna Positioner Ground Lug

An optional ground lug is provided on the Elevation-Over-Azimuth Antenna Positioner. It is located on a gusset below the electrical cabinet. Use this ground lug if local codes require grounding the system to an external ground.

1.2.5 Lightning Protection

Because electrical codes and soil conditions differ globally, the customer is responsible for proper lightning protection at the installation site. Lightning protection must be provided as an external system that surrounds the site area. Lightning protection systems typically include special grounding requirements, which are not connected to the antenna positioner system power grounds unless local electrical codes require it.

- Use only contractors who can install the lightning protection to conform to local electrical codes.

- Refer to Figure 1 for typical lightning rod placement distance from the antenna positioner; refer to Figure 2 for typical lightning rod height.

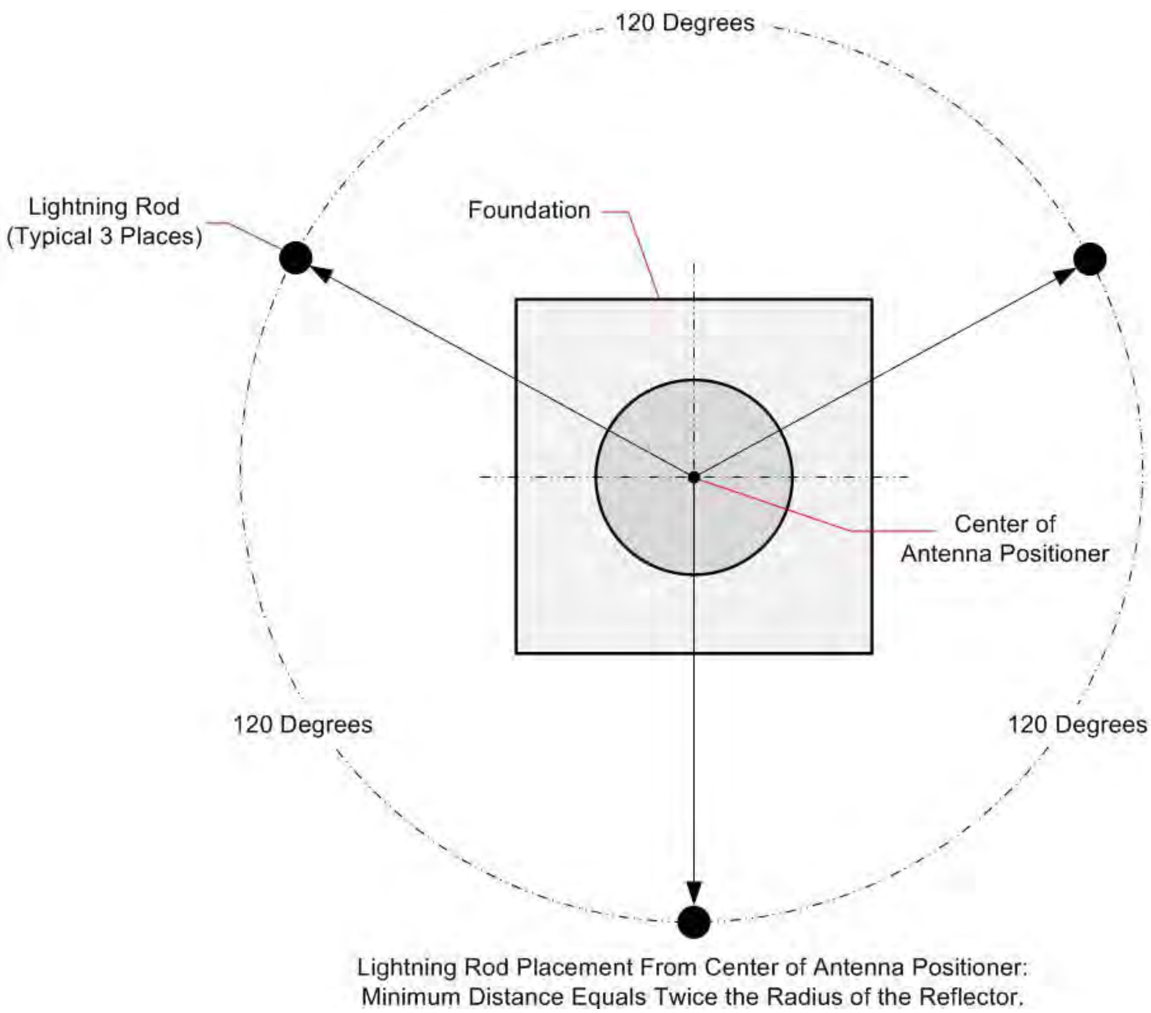

Figure 1 - Lightning Rod Placement, Top View
(Not to Scale; for Reference Only)

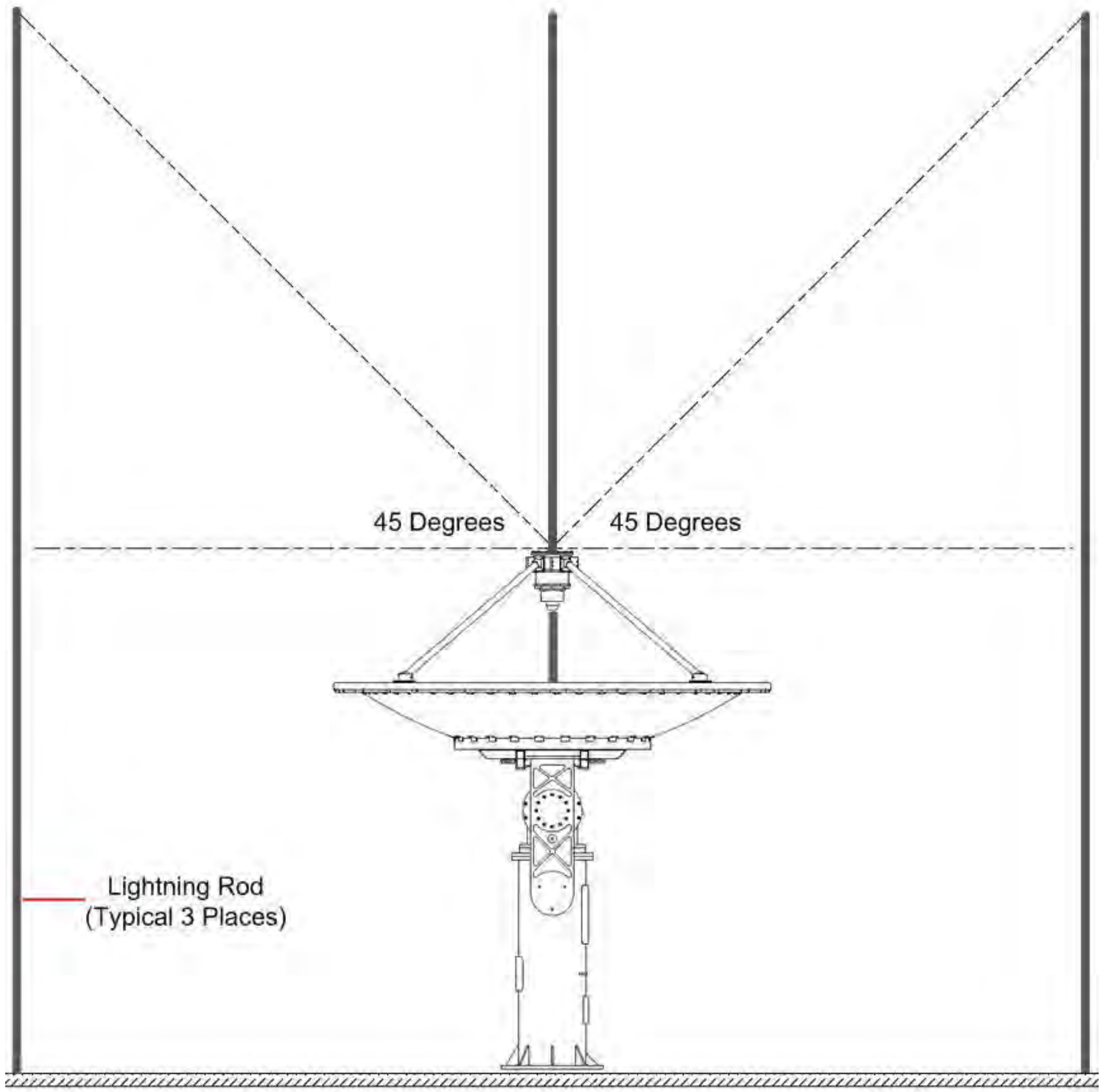

Figure 2 - Lightning Rod Typical Height
(Not to Scale; for Reference Only)

The lightning rods should have sufficient height to enable a 45-degree angle, drawn from the top of each lightning rod, to intersect at the center of the feed.

1.2.6 Antenna Positioner Bulkhead Connections

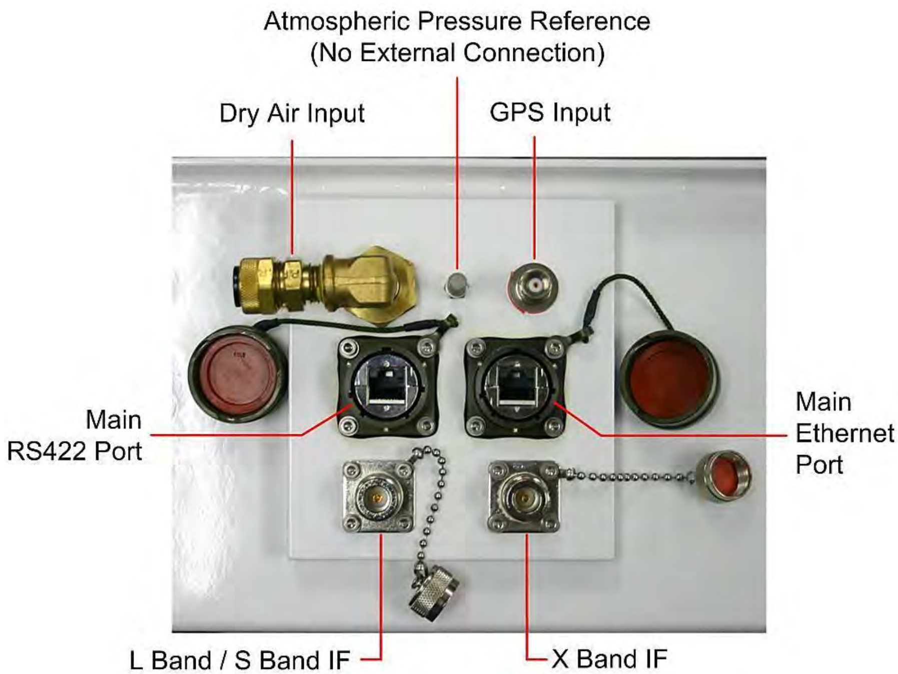

Figure 3 - 2.4AEHP Main Bulkhead

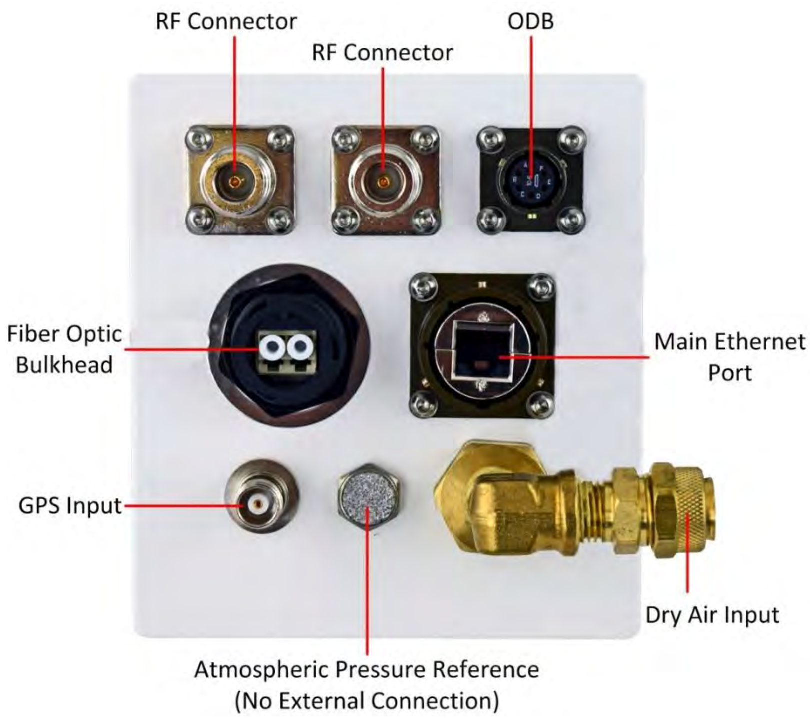

Figure 4 - 2.4 & 3.0AEBP Main Bulkhead

The main bulkhead interfaces are located on the bottom of the electrical cabinet. A typical main bulkhead includes:

- The main bulkhead uses 2 type-N fittings for RF or IF. These fittings provide cable connections to the indoor receivers.

- The main RJ45 Ethernet port on the bulkhead is used for accessories such as PoE cameras.

- The main bulkheads use an RF TNC fitting for the GPS time reference antenna. A small GPS antenna and a 10-meter cable with TNC connectors are supplied with the antenna positioner.

- The main bulkheads use a fitting for the 13 millimeter (0.5 inch) dehydrator air hose. Orbital Systems LLC supplies an appropriate length of UV stable tubing and the required fittings for the dehydrator.

- The main system data interface for all AEBP and AEHT Elevation-Over-Azimuth positioners is supplied over either a single-mode or multi-mode fiber.

- The main system data interface for the 2.4AEHP is supplied on an RJ45 connector housed in a special IP67 circular connector shell on the main bulkhead. This connection carries data to and from the antenna positioner on an isolated RS-422 connection. After the data has been transmitted to the indoor receivers, it is converted to Ethernet by a signal converter contained within the dual rack mount receivers or by a separate Orbital Systems LLC supplied converter. The data cable is a heavy duty shielded cable that is rated for outdoor service.

- The Single-Mode Fiber Optic Communications Option converts data control to single-mode fiber signals. Two RF signals are transported from the antenna system across RF single-mode fiber to the indoor interface. A RF fiber receiver converts RF optical signals into RF signals. Two data fibers carry a full duplex control link.

SECTION 2 PHASE 1: SELECT THE SITE FOR THE ANTENNA POSITIONER

Phase 1 Tasks:

→ **Select the site for the antenna positioner**
- Select and prepare the location for the interior (indoor) equipment
- Design and construct the foundation
- Determine conduit requirements, if used
- Determine the route, length, and type of RF and data cables; inform Orbital Systems LLC of cable lengths and types

2.1 PRE-INSTALLATION REQUIREMENT SUMMARY

Summary of requirements for selecting the site for the antenna positioner:

1. **Wind Forces**
   - Verify that expected wind forces are within tolerance for normal operation (paragraph 2.2.1).
2. **System Clearance**
   - Make sure the site provides adequate system clearance for existing structures and that it is safe for operation and maintenance personnel (paragraph 2.2.2).
3. **Microwave Interference**
   - Make sure that no microwave interference is present (paragraph 2.2.3).
4. **Optional Radome**
   - If a Radome has been purchased, make sure that plans have been made for its installation and to ensure the safety of personnel working inside the Radome (paragraph 2.2.4).
5. **People and Animals**
   - Verify that animals and unauthorized personnel cannot enter the site (paragraph 2.2.5).
6. **Building Permits**
   - Make sure that all building permits and approvals have been obtained, if required (paragraph 2.2.6).

2.2 PRE-INSTALLATION REQUIREMENT DETAILS

2.2.1 Step 1: Wind Forces

The customer or an Orbital Systems LLC authorized distributor locates and clears the site, and performs a site survey, if required. The system must be located in an area that is secure and where a foundation can be constructed. The site location must be in an area where nearby structures cannot concentrate wind forces that exceed system ratings. See APPENDIX D: for information on ratings for wind forces.

2.2.2 Step 2: System Clearance

The overall system clearance dimensions are provided in APPENDIX F:. These dimensions enable the customer or an Orbital Systems LLC authorized distributor to plan adequate clearance for such existing obstructions as pipes, handrails, walls, and other encumbrances. Provide enough room for personnel to stand between the system while it is moving and any mechanical obstruction. This system can move rapidly, and adequate clearance between personnel and the system must be provided for safety reasons.

2.2.3 Step 3: Microwave Interference

The customer is responsible for ensuring that the site does not have signal interference. The customer should conduct a site survey to detect signals that are within the system's band(s) and strong signals outside the system's band(s) that would prevent normal system operation. Orbital Systems LLC can assist with analyzing the results of a site survey and can provide suggestions for eliminating such interference.

2.2.4 Step 4: Optional Radome

If a Radome has been purchased, it is preassembled into sections (if required) prior to the arrival of the crane on the day of installation. The crane lifts the sections over the antenna positioner, after which they are fastened together.

If the system is installed inside a Radome and the clearance is inadequate for personnel to stand safely while the system is in operation, Orbital Systems LLC recommends use of an Orbital Systems Radome entry control module to indicate that the Radome is occupied.

The reflector size determines Radome diameter. The following Radome sizes are used:

- 7.3AE3BP-7.3m systems require a 10.8 meter (35.5 foot) diameter Radome.
- 5.0AE3BP-6.1m systems require a 9.1 meter (30 foot) diameter Radome.
- 5.0AE3BP-5.0m systems require a 7.6 meter (25 foot) diameter Radome with a riser installed.
- 3.0AEBP-3.7m systems require a 5.5 meter (18 foot) diameter Radome with a riser installed.
- 3.0AEBP, 2.4AEBP-3.0m, and 2.4AEHP-3.0m systems require a 5.5 meter (18 foot) diameter Radome.
- 2.4AEBP and 2.4AEHP systems require a 4.25 meter (14 foot) diameter Radome.
- 2.4AEBP-1.8m, 2.4AEHP-1.8m, and 1.8AEHT systems require a 3.5 meter (10 foot) diameter Radome.
- 1.8AEHT-1.5m systems require a 2.5 meter (8 foot) diameter Radome.

Radome dimensions and other technical data are provided in APPENDIX F:.

2.2.5 Step 5: People and Animals

People and animals must be kept away from the site. Use appropriate fencing or obstacles, and place the barrier(s) at a distance that permits the full range of the antenna positioner's motion.

2.2.6 Step 6: Building Permits

If building permits or approvals are required for new construction or structural changes, make sure they are obtained prior to beginning construction.

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SECTION 3 PHASE 1: SELECT AND PREPARE THE LOCATION FOR THE INTERIOR (INDOOR) EQUIPMENT

Phase 1 Tasks:

- ✓ Select the site for the antenna positioner
- → **Select and prepare the location for the interior (indoor) equipment**
- Design and construct the foundation
- Determine conduit requirements, if used
- Determine the route, length, and type of RF and data cables; inform Orbital Systems LLC of cables lengths and types

Several pieces of equipment are installed in a rack located inside a building. This equipment can be purchased from Orbital Systems LLC and shipped with the system; or it can be provided by the customer. This equipment typically includes receivers, down-converters, and the Front End Server (FES) or Control Server. If it is purchased from Orbital Systems LLC, then all necessary racks and hardware are provided.

3.1 PRE-INSTALLATION REQUIREMENT SUMMARY

Summary of requirements for selecting the location for the interior (indoor) equipment:

1. **Receivers**
    - Provide proper rack ventilation for receivers or down-converters (paragraph 3.2.1).
2. **Control Server**
    - Provide adequate support for control server extender rails and provide proper rack ventilation (3.2.2)
3. **Preparation for Indoor Rack Mounted Systems (If equipment is not purchased from Orbital Systems LLC)**
    - Make sure the rack space has been designed correctly (paragraph 3.2.3).
    - Make sure required rack space is ready for equipment installation (paragraph 3.2.3).
    - Make sure climate control is available to maintain the proper temperature range (paragraph 3.2.3).
    - Provide an adequate number of power outlets for rack mounted systems (paragraph (paragraph 3.2.3).
    - Provide an adequate number of Ethernet ports to interconnect the hardware (paragraph 3.2.3).
    - Make sure a KVM (customer or installer supplied) is available to connect to the servers (paragraph 3.2.3).

3.2 PRE-INSTALLATION REQUIREMENT DETAILS

3.2.1 Step 1: Receivers

System configuration typically requires one or two receivers.

If rack-mount receivers or down-converters were purchased with the system, they require rear rack rails for proper support. These rails are shipped with the units. The rear support rails are attached prior to mounting the receiver in the rack. The receivers produce heat, and they require proper ventilation. Mounting a receiver or down-converter directly above or below other rack devices is not recommended.

3.2.2 Step 2: Control Server

Control Servers are provided with extender rails to enable the Control Server to slide in and out of the rack. The extender rails require front and rear rack rails for proper support. The Control Server produces heat and requires proper rack ventilation. Mounting the Control Server directly above or below other rack devices is not recommended.

3.2.3 Step 3: Preparation for Indoor Rack Mounted Systems

Make sure the following requirements are in place for the indoor equipment:

If the indoor equipment is customer provided

Make sure the required rack space is ready. The typical installation has the following components:

- Rack Mounted Fiber Media Converter or Indoor Single-Mode Fiber Module (1U) – Provided by Orbital Systems LLC
- A Control Server (1 or 2U)
- One or two demodulators (1U each)
- A data switch (1U)
- Additional equipment (UPS, KVM, etc.)
- 1U of extra space between each piece of equipment

If the customer is providing the indoor equipment, Orbital Systems will provide the customer with either a Rack Mounted Fiber Media Converter or Indoor Single-Mode Fiber Module. Either module occupies 1U of rack space. Both modules include a universal power supply that accepts 100-240 VAC 50/60 Hz and is supplied with a power cord appropriate to the country of installation. Both units draw approximately 15 W.

If the indoor equipment was purchased from Orbital Systems LLC

Orbital Systems LLC supplies the rack and all essential hardware for the Elevation-Over-Azimuth Antenna Positioner to function and track properly. The customer will be responsible for ensuring that there is an adequate and dedicated space for this equipment. This means,

- Make sure the room for the equipment is climate controlled and can maintain between 15°C (59°F) to 27°C (80.6°F).
- All indoor rack equipment is anticipated to draw less than 5 amps continuous at 220 VAC 50 to 60Hz.

Notice

The equipment rack is approximately 58.5 centimeters (23 inches) wide by 102 centimeters (40 inches) deep, the customer needs to ensure that the room where this rack will be placed has enough clearance for personnel to maneuver around the rack without creating a trip hazard and potentially damaging the equipment.

Make sure the customer has completed the FES server configuration worksheet and returned it to Orbital Systems LLC. The customer's IT department should complete this worksheet, and it must contain the information required to integrate the FES into the customer's network. This information must specify the following data:

- IP address
- Name of the FES server
- NTP setup
- Location information to set up the FES maps.

The IT organization also must make sure that the FES can access port 80 and port 443 outbound to the internet. This access enables automatic ephemeris updates from the Orbital Systems LLC web site, which ensures that the antenna positioner can track properly. These are the standard ports used on the internet for web browsers and secure web browsing. No inbound access from the internet to the FES is necessary.

- Make sure that the customer has IP data access to the FES from the desktop computers.

  - The FES has a separate Ethernet port connected to the customer network. This port enables users to run the Commander application on their desktop computers. By using a web browser to access the FES, the Commander application can be downloaded and run to monitor and control the antenna positioner.

  - As many as 10 copies of the Commander application can run simultaneously.

  - Orbital Systems LLC does not supply a customer computer.

  - If the customer does not have a computer available to run the Commander application, application will be run on the installer's laptop computer for demonstration purposes.

The FES can be configured several different ways with regards to remote access capabilities. The level of remote access configured can have a large impact on not only performance of the system, but also remote diagnostics and troubleshooting provided by Orbital Systems LLC. Listed below are the typical remote access configurations used.

Remote Access Level 0: No incoming or outgoing traffic to the Internet allowed.

The EOS-FES is designed to use a SOAP web service on the www.orbitalsystems.com website to update TLEs for tracking and solar flux data for automated antenna performance testing. Without the TLE data the antenna will not be able to track satellites as their orbits drift away from the ones described in the TLEs that shipped with the EOS-FES server.

In some cases, the TLE updaters can be adapted on the EOS-FES to point to another server on the customer's internal network where the EOS-FES resides. This will allow the antenna to track satellites properly, provided the customer's server keeps the TLEs updated properly.

For a select few satellites, a TLE updater can be enabled that will download a set of TLEs from the Multi-Mission Administrative Message broadcast on the METOP series of satellites. This allows proper tracking of those satellites whose TLE's are included in that message, provided that a METOP satellite is being tracked at least once per day. The accuracy of the TLEs in this message for X-band tracking has not yet been evaluated, however.

Remote support in this mode is extremely complicated, and consists of emails going back and forth for diagnosis and suggestions on fixes. This is the slowest method to resolve any issues, and where there are significant time zone offsets and multiple iterations involved in finding the issue resolving the problem could take up to a week. This level of remote access is highly discouraged.

Remote Access Level 1: Outgoing traffic allowed. No incoming traffic allowed.

This setup will allow the normal operation of the EOS-FES server without any issue. Outgoing traffic for these purposes should all be originating on port 80 from the EOS-FES. It is normal in this setup to also allow outgoing DNS queries, although this can be avoided if required by using a DNS server internal to your network, or keeping a hard-coded host table up to date manually on the EOS-FES server.

As long as outbound traffic on port 80 and port 443 is allowed, Orbital Systems can then use a Bomgar support server hosted at Orbital Systems for remote support. This server is essentially a monitor and keyboard sharing system (read more about this system at www.bomgar.com). Establishing a Bomgar support session requires coordination between both parties so that the customer can initiate the connection to the support server from the EOS-FES desktop, or another machine on the customer's internal network that can connect to the EOS-FES server. This support allows for remote control and screen sharing of the EOS-FES server, as well as limited file transfers between the support server at Orbital Systems and the customer EOS-FES server. Once a Bomgar session has been started, it is possible to "pin" the session where a support representative can access the EOS-FES server during non-coordinated hours. This "pinned session" feature requires that the EOS-FES user remain logged into the desktop, and is primarily used to enable follow up support sessions after a fix is made.

There are some cases where the Bomgar support system will not work, however, and it is not possible to determine in advance if it will be blocked or not. TeamViewer software can sometimes be used where the Bomgar support system has been blocked.

Resolving an issue on the system with this level of remote access may take a couple of days, depending on being able to coordinate this type of access between both parties. In some cases where coordination is very quick or there is already a "pinned session" active on the EOS-FES server, resolving an issue can be done within hours.

Remote Access Level 2: Outgoing traffic allowed. Incoming SSH traffic allowed.

SSH is a secure, encrypted command line access that operates on TCP port 22. Customers often restrict access to this service to Orbital Systems IP addresses only.

This setup will allow Orbital Systems support technicians access to the EOS-FES server at any time, although this access is limited to the command line only. For the majority of support issues command line access is all that is required to diagnose and often fix problems. In this case, problems with the system are very often diagnosed and fixed within just a few hours of contacting Orbital Systems.

Diagnosing and fixing problems with GUI applications may not be possible with this method. However, if this is required a customer can usually coordinate a remote support session with our Bomgar support system (see Remote Access Level 1, above), to allow access for fixing the problem.

Remote Access Level 3: Outgoing traffic allowed. Incoming EOS-FES traffic allowed.

This method allows access to the various services provided by the EOS-FES server. This can be limited to just the Orbital Systems IP address block, if necessary. The services provided by the EOS-FES are:

FTP port 20/21
SSH port 22
HTTP port 80
HTTPS port 443
MySQL port 3306
Simulcast port 3502 (optional)
LogHubServer port 4560
ImageStreamer port 15000

The EOS-FES itself runs an IPTables firewall blocking all other incoming connections that are not on the list above.

Opening these services up will allow Orbital Systems to run the Commander remote GUI management application. This allows Orbital Systems to diagnose hardware problems faster, and also allows Orbital Systems to address any issues that may come up with the Commander application itself.

This level of remote access allows the fastest support, where almost any issue can be diagnosed and/or fixed very shortly by Orbital Systems support technicians. Further, after a fix or change is made to the system, Orbital Systems can then use Commander to monitor the system remotely for several days after the change to ensure no more issues arise.

SECTION 4 PHASE 1: FOUNDATION DESIGN, CONSTRUCTION, AND CONDUIT REQUIREMENTS

Phase 1 Tasks:

- ✓ Select the site for the antenna positioner
- ✓ Select and prepare the location for the interior (indoor) equipment
- → **Design and construct the foundation**
- → **Determine conduit requirements, if used**
- Determine route, length, and type of RF and data cables; inform Orbital Systems LLC of cable lengths and types

4.1 PRE-INSTALLATION REQUIREMENT SUMMARY

Summary of requirements for foundation design, construction, and conduit requirements:

1. **Customer Responsibility**
    - Customer knows that the foundation design and construction is the customer's responsibility (paragraph 4.2.1).
2. **Foundation Design Considerations**
    - Determine the foundation type: concrete slab mount, rooftop mount, other type (paragraph 4.2.2).
    - If the foundation is a concrete slab, determine the method for mounting the studs in the concrete (paragraphs 4.2.10, 4.2.11, and 4.2.12).
    - Hire an engineering firm to design the foundation (paragraph 4.2.2).
    - Verify that the foundation conforms to structural load and wind load requirements (APPENDIX D:).
3. **Radome and Positioner Orientation**
    - Ensure the positioner is mounted so that there is unobstructed access to all system controls and access panels (paragraph 4.2.3).
4. **Foundation Mounting Hardware**
    - Make sure that the foundation builder provides the correct quantity and type of foundation hardware (paragraph 4.2.4).
5. **Cable and Conduit Considerations During Foundation Design**
    - Make sure that the foundation is provided with conduits or routing passages for power, data, and GPS cables (paragraph 4.2.5).
    - Verify that the conduits or routing passages conform to placement criteria (paragraph 4.2.5).
    - Verify that all conduits terminate in a 180 degree bend (U fitting) to prevent rainwater intrusion (paragraph 4.2.5).
6. **Conduit Requirements**
    - Make sure that the conduits are the correct diameter and material type (paragraph 4.2.6).
7. **Conduit and Cable Bend Radius**
    - Make sure that the conduits have the correct extended bend radii to prevent the cables from binding (paragraph 4.2.7).
8. **The Foundation Template**
    - Make sure that the foundation builder uses the wood foundation template and understands how to use it (paragraph 4.2.8).

4.2 PRE-INSTALLATION REQUIREMENT DETAILS

4.2.1 Step 1: Customer Responsibility

Notice

Orbital Systems LLC does not design foundations or evaluate their designs, but does provide load data. The customer is responsible for providing a foundation for mounting the antenna positioner. Structural or civil engineers usually design and approve the foundation.

Notice

Rooftop-mount foundations must be planned carefully because they can flex under wind loads. A small change at the base of the antenna positioner can introduce errors that can equal the pointing accuracy of the system. The structural engineer should plan base support tilt of no more than 0.05 degrees from a zero-load condition to a full-load condition with an 88 km/hr (55 mph) wind.

4.2.2 Step 2: Foundation Design Considerations

- What type of foundation will be constructed?
  - Concrete slab mount
  - Rooftop mount
  - Other type

- One of three methods typically is used to install the mounting studs in the concrete foundation:

  1. Studs placed in wet concrete (paragraph 4.2.10)
  2. Studs placed in dry concrete using adhesive (paragraph 4.2.11)
  3. Studs placed in dry concrete using concrete anchors (paragraph 4.2.12)

- Has an engineering firm been hired to make sure the foundation will not fail and cause damage to nearby structures?

- Structural loading requirements and weights for engineering calculations are provided in APPENDIX D:.

- The overall size and other dimensions for the Elevation-Over-Azimuth antenna positioners are described in APPENDIX F:.

4.2.3 Step 3: Radome and Positioner Orientation

There are several considerations that must be taken into account when determining the orientation of the Radome and the antenna positioner.

- Personnel Safety – Can personnel safely move around the positioner while it is in operation regardless of antenna azimuth and elevation?

- System Mode Control Switch – Can personnel safely approach and access the System Mode Control switch?

- Cable Conduits – Is the Radome and antenna positioner oriented in such a way that all required conduits can be safely routed to limit trip and other safety hazards? Once the conduits are in place, can the System Mode Control switch still be safely accessed?

If Installing the Antenna Positioner without a Radome

To determine the orientation of an antenna positioner being installed outside of a Radome, first survey the roof or other structure that the positioner will be mounted on. How is the positioner most safely approached and done so within the limitations of limiting long term damage to the roof or structure? Once this is known, the right side of the electrical cabinet containing the System Mode Control Switch should be oriented towards this approach. This orientation will “clock” the orientation of the antenna positioner (see Figure 5).

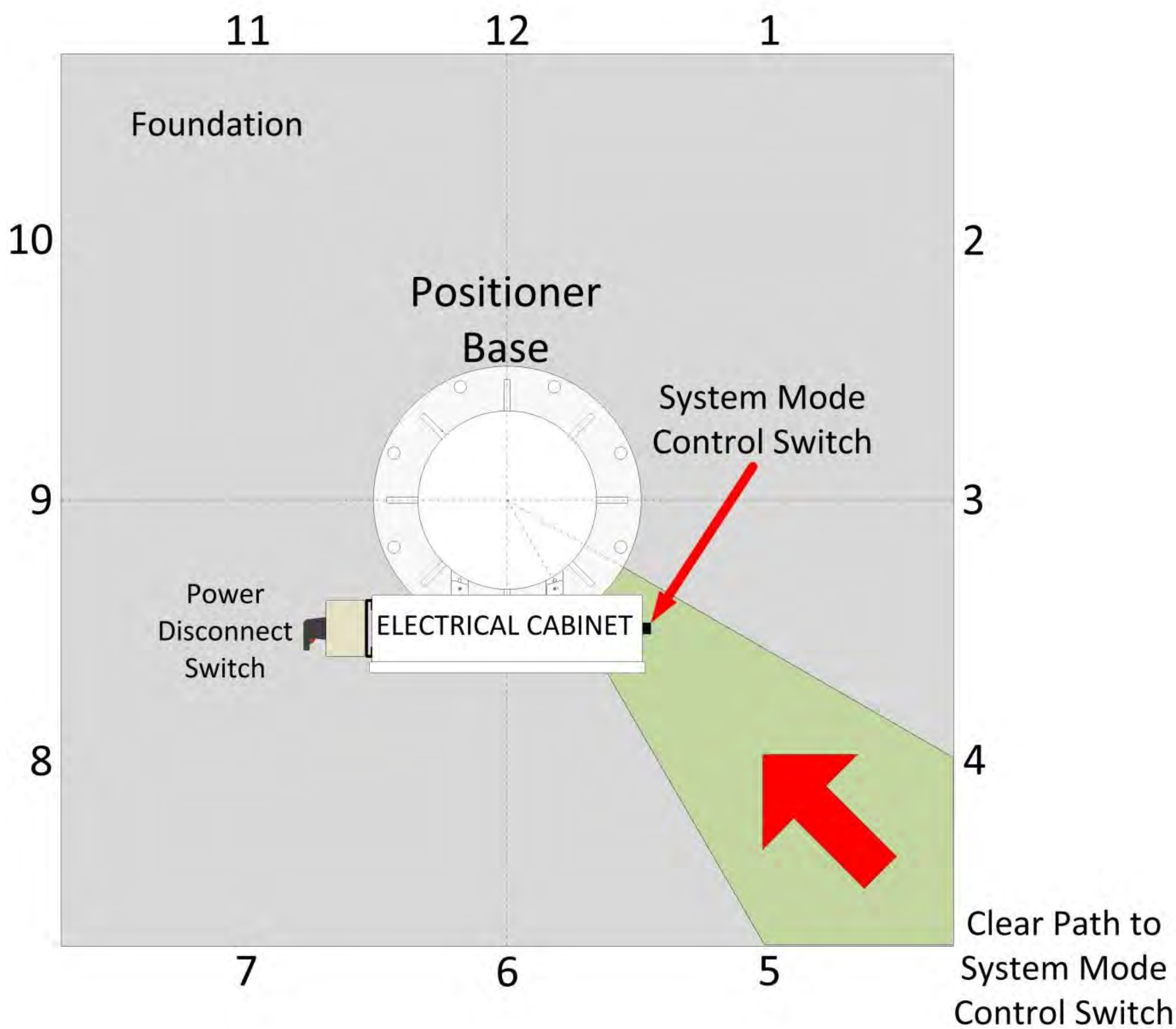


Figure 5 - Orientation of the Positioner without a Radome

If Installing the Antenna Positioner Inside of a Radome

In order to determine the final orientation of the antenna positioner, the Radome orientation must be established. To do this, first survey the roof or other structure that the Radome will be placed on. How is the Radome most safely approached and done within the limitations of minimizing long term damage to the surface of the roof or structure? Once this is known, the access hatch of the Radome should be oriented towards this approach. This orientation will "clock" the orientation of the Radome hatch.

When the Radome access hatch orientation is known, with the hatch opened, the right hand side of the electrical cabinet should face the hatch opening. This System Mode Control Switch is located on this side of the electrical cabinet and should be facing the Radome access hatch. This will "clock" the orientation of the positioner.

Refer to Figure 6 for a visual representation.

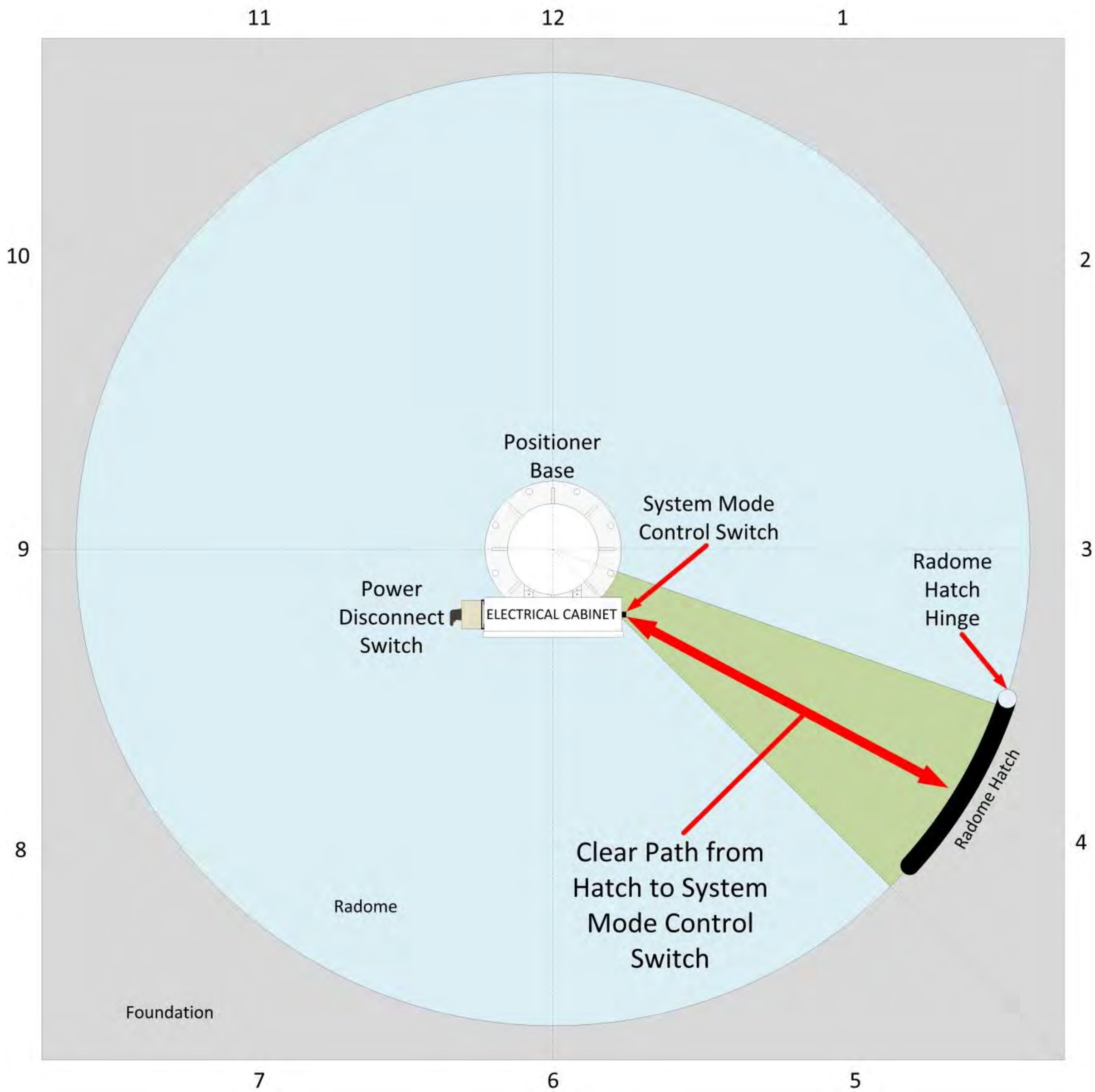


Figure 6 - Orientation of Radome and Positioner

The numbers around the perimeter of Figure 6 are "clock" references and should aid in orienting the Radome and the antenna positioner. There should always be a clear path from the Radome access hatch to the System Mode Control Switch.

4.2.4 Step 4: Foundation Mounting Hardware

- Because mounting hardware can differ due to foundation design, the customer must supply this hardware. The customer's structural engineer selects the anchor studs; they must be of appropriate size and strength for the foundation design and not fail under load.

- Verify that the foundation builder provided the necessary studs, nuts, and washers required to fasten the antenna positioner to the foundation. This hardware should be hot-dip galvanized or stainless steel to resist corrosion.

If the foundation studs are embedded in concrete (Figure 7):

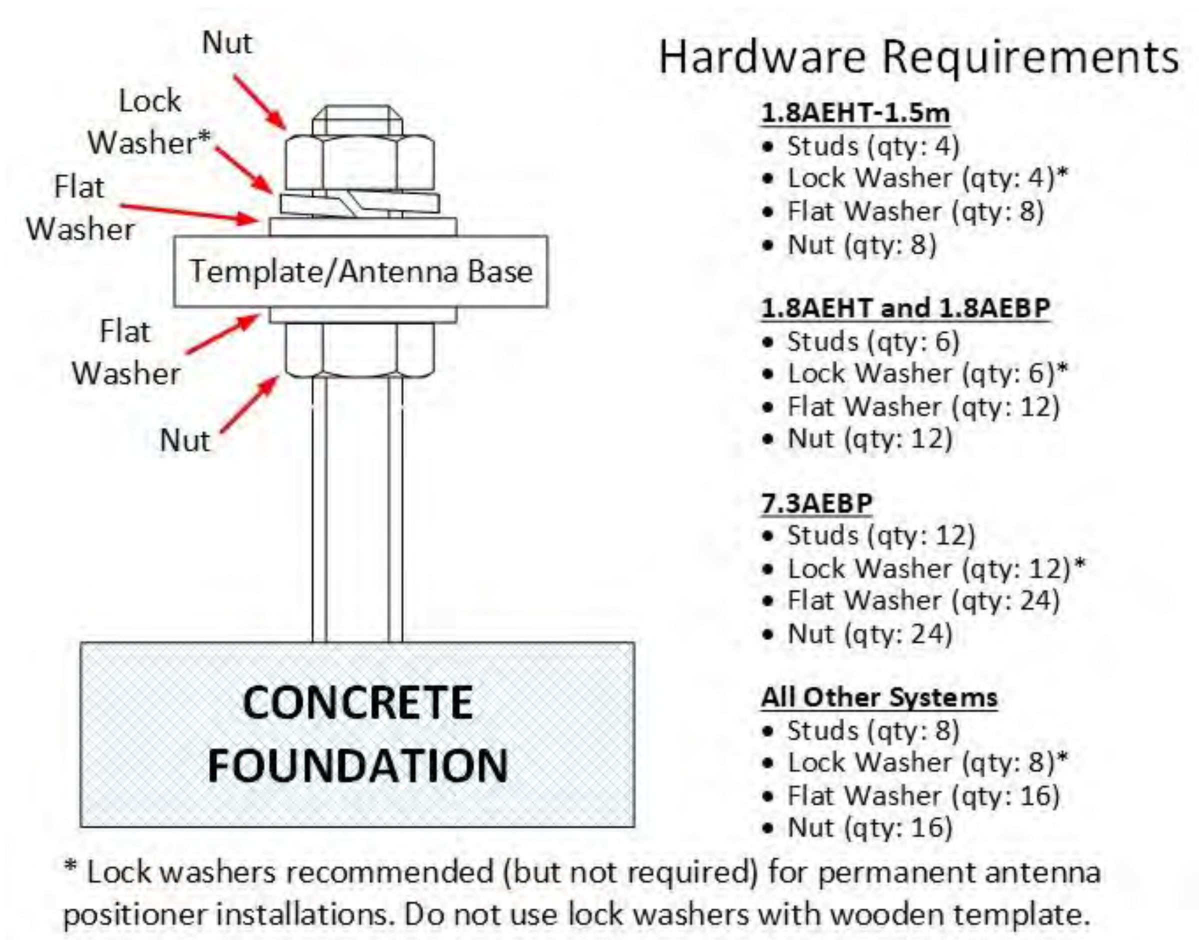
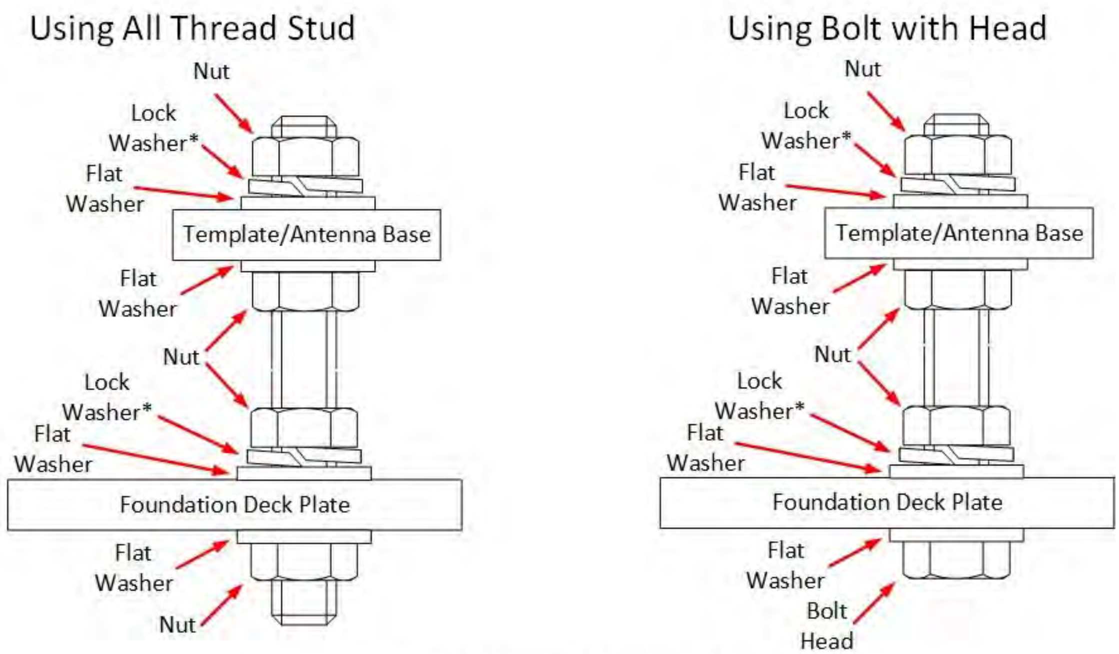


Figure 7 - Mounting Hardware Requirements for Concrete Foundation

If the foundation is a plate, the mounting studs are mounted to the plate using bolts with heads or with all threads (Figure 8):



Hardware Requirements

Using All Thread Stud

1.8AEHT-1.5m
- Studs (qty: 4)
- Lock Washer (qty: 8)*
- Flat Washer (qty: 16)
- Nut (qty: 16)

1.8AEHT and 1.8AEBP
- Studs (qty: 6)
- Lock Washer (qty: 12)*
- Flat Washer (qty: 24)
- Nut (qty: 24)

7.3AEBP
- Studs (qty: 12)
- Lock Washer (qty: 24)*
- Flat Washer (qty: 48)
- Nut (qty: 48)

All Other Systems
- Studs (qty: 8)
- Lock Washer (qty: 16)*
- Flat Washer (qty: 32)
- Nut (qty: 32)

Using Bolt with Head

1.8AEHT-1.5m
- Bolt (qty: 4)
- Lock Washer (qty: 8)*
- Flat Washer (qty: 16)
- Nut (qty: 12)

1.8AEHT and 1.8AEBP
- Bolt (qty: 6)
- Lock Washer (qty: 12)*
- Flat Washer (qty: 24)
- Nut (qty: 18)

7.3AEBP
- Studs (qty: 12)
- Lock Washer (qty: 24)*
- Flat Washer (qty: 48)
- Nut (qty: 36)

All Other Systems
- Bolt (qty: 8)
- Lock Washer (qty: 16)*
- Flat Washer (qty: 32)
- Nut (qty: 24)

* Lock washers recommended (but not required) for permanent antenna positioner installations. Do not use lock washers with wooden template.

Figure 8 - Mounting Hardware required if using a Mounting Plate

4.2.5 Step 5: Cable and Conduit Considerations during Foundation Design

Once the antenna positioner and Radome (if used) orientation have been determined; the locations where the conduits will emerge from the foundation can be established. These locations should be determined based on the location of the electrical cabinet.

- Verify that the foundation includes conduits or routing holes to bring power and system cables to the antenna, and that they are positioned to reduce trip and fall hazards.

- The supplied system cables are rated for outdoor exposure and can be placed across the surface; however, conduits are used for an optimal installation.

If Installing the Antenna Positioner without a Radome

Three conduits will need to be installed (Power, System Cables, and GPS).

With the electrical cabinet oriented arbitrarily at the 6 O'clock position:

The power supply conduit should emerge underneath the power disconnect switch on the left side of the electrical cabinet, which is approximately 430 millimeters (17 inches) from the center of the foundation at the positioners 8 O'clock.

The system cables conduit emerges from the foundation on the right side of the electrical cabinet, approximately 430 millimeters (17 inches) from the center of the foundation at the positioners 3 O'clock. This conduit typically has a 75 millimeter (3 inch) diameter, but could have a 50 millimeter (2 inch) diameter. Refer to paragraph 4.2.6.

Notice

The GPS Receiver Antenna should be mounted relative to the positioner and the equator. That is if the antenna positioner is being installed in the Northern Hemisphere then the GPS antenna should be installed ± 45 degrees of True South, if it is being installed in the Southern Hemisphere then it should be installed ± 45 degrees of True North.

The GPS cable conduit emerges from the foundation just above the system cables conduit. Allow for approximately a 13 millimeter (0.5 inch) space between the GPS and system cable conduits.

Refer to Figure 9 and Figure 10.

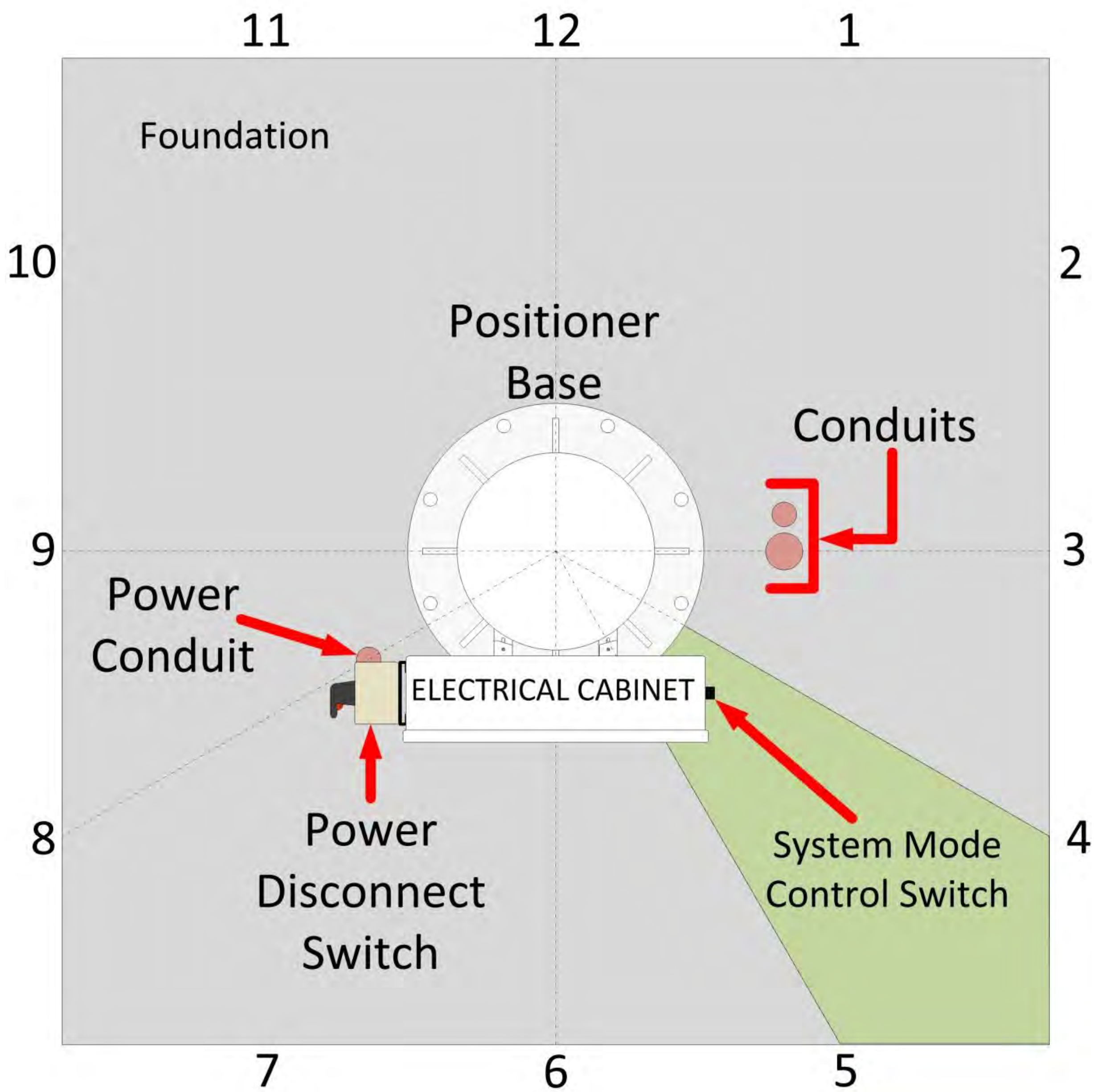


Figure 9 - Overview of Conduit Locations without a Radome

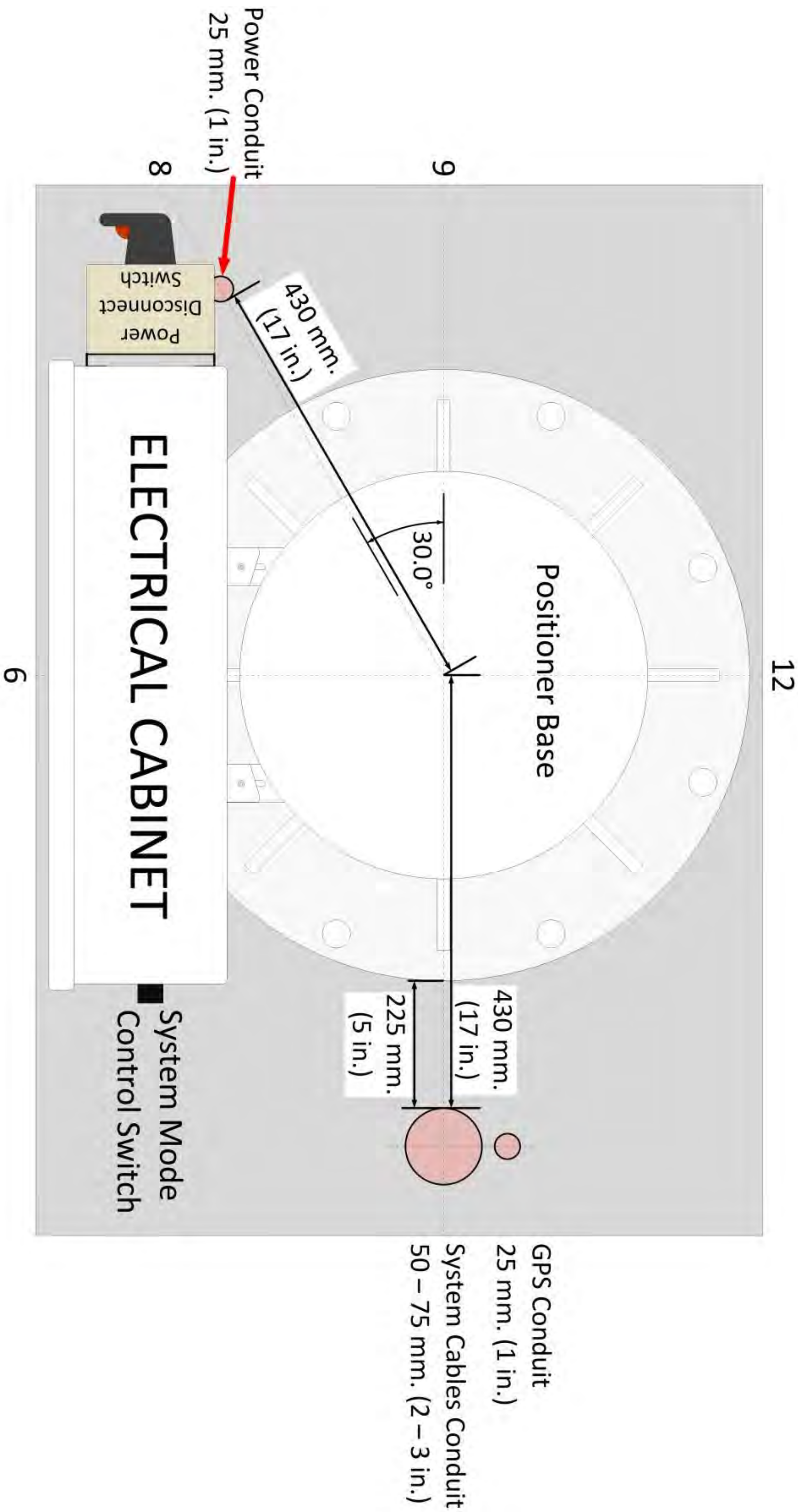


Figure 10 - Close-up of Conduit Locations without a Radome

If Installing the Antenna Positioner Inside of a Radome

Five conduits will need to be installed (Power, System Cables, GPS, Radome Entry Control, and Radome Entry Control Box)

Four optional conduits may be installed if Radome lighting or a Radome network camera are required.

With the electrical cabinet oriented arbitrarily at the 6 O'clock position:

The System Cables conduit emerges from the foundation on the right side of the electrical cabinet, approximately 430 millimeters (17 inches) from the center of the foundation at the positioners 3 O'clock. This conduit typically has a 75 millimeter (3 inch) diameter, but could have a 50 millimeter (2 inch) diameter. The other end of this conduit should emerge in the room where the indoor rack equipment will be located. Refer to paragraph 4.2.6.

Notice

The GPS Receiver Antenna will be mounted inside the Radome. It should be mounted on the side of the Radome closest to the equator. That is if the antenna positioner is being installed in the Northern Hemisphere then the GPS antenna should be installed on the Radome wall ± 45 degrees of True South, if it is being installed in the Southern Hemisphere then it should be installed on the Radome wall ± 45 degrees of True North.

The GPS cable conduit emerges from the foundation just above the system cables conduit. Allow for approximately a 13 millimeter (0.5 inch) space between the GPS and System Cable conduits. The other end of this conduit should emerge where the GPS antenna will be mounted within the Radome approximately 25 millimeters (1 inch) from the Radome wall.

The Radome Entry Control Box conduit emerges just to the left of the Radome entry hatch approximately 25 millimeters (1 inch) from the Radome wall (see Figure 13). The other end of this conduit should emerge just below the System Cables conduit to the right of the positioner. Allow for approximately a 13 millimeter (0.5 inch) space between the Radome Entry Control Box and System Cable conduits. This conduit should not leave the perimeter of the Radome.

The Power Supply conduit should emerge underneath the power disconnect switch on the left side of the electrical cabinet, which is approximately 430 millimeters (17 inches) from the center of the foundation at the positioners 8 O'clock. It is recommended that along with the main power circuit for the positioner, a 120 V circuit be run through the same conduit. This 120 V circuit would terminate into an outdoor rated outlet box. The other end of this conduit should be run to the room where the indoor rack equipment will be located as power to the positioner is provided by the UPS located in the equipment rack.

The optional Radome Lighting conduit should emerge from approximately 25 millimeters (1 inch) from the Radome wall just to the left (away from the Radome Hatch) of the Radome Entry Control Box Conduit. The other end of this conduit should emerge just above the Power Supply conduit. Allow for approximately a 13 millimeter (0.5 inch) space between the Radome Lighting and Power Supply conduit. A 120 V circuit is required to be run with the main power circuit for the positioner through the Power Supply conduit. This 120 V will then either terminate into an outdoor rated outlet box or be directly connected to the Radome Lighting kit. This conduit should not leave the perimeter of the Radome.

The optional Radome Network Camera conduit should emerge approximately 25 millimeters (1 inch) from the Radome wall between the positioners 6 and 7 O'clock. The other end of this conduit should emerge just below the Radome Entry Control Box conduit to the right of the positioner. Allow for approximately a 13 millimeter (0.5 inch) space between the Radome Network Camera Conduit and the Radome Entry Control Box conduit. This conduit should not leave the perimeter of the Radome.

Refer to Figure 11, Figure 12 and Figure 13.

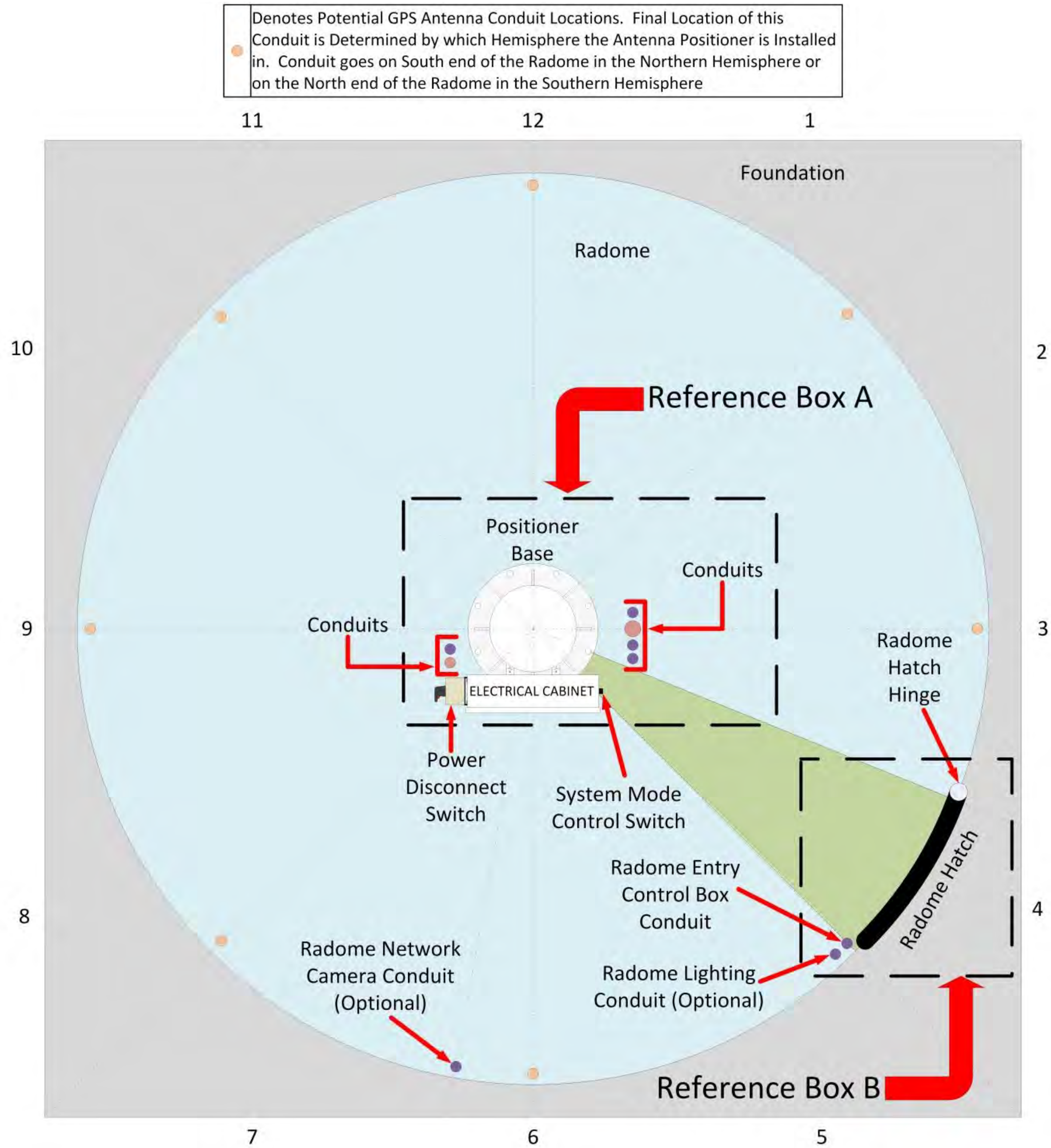


Figure 11 - Conduit Locations Inside of a Radome

Reference Box A is illustrated in Figure 12.

Reference Box B is illustrated in Figure 13.

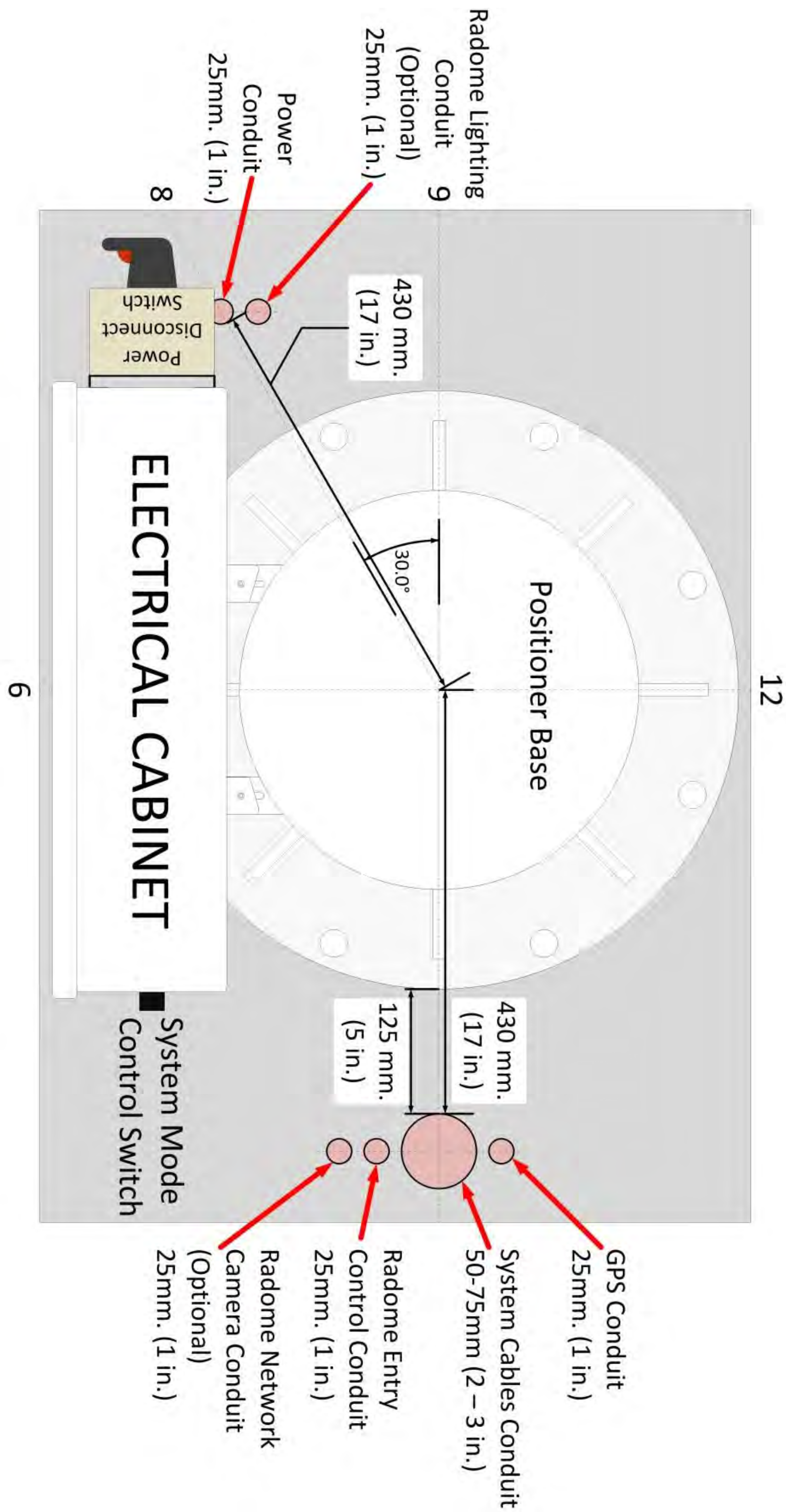


Figure 12 - Close-Up of Conduit Locations within a Radome

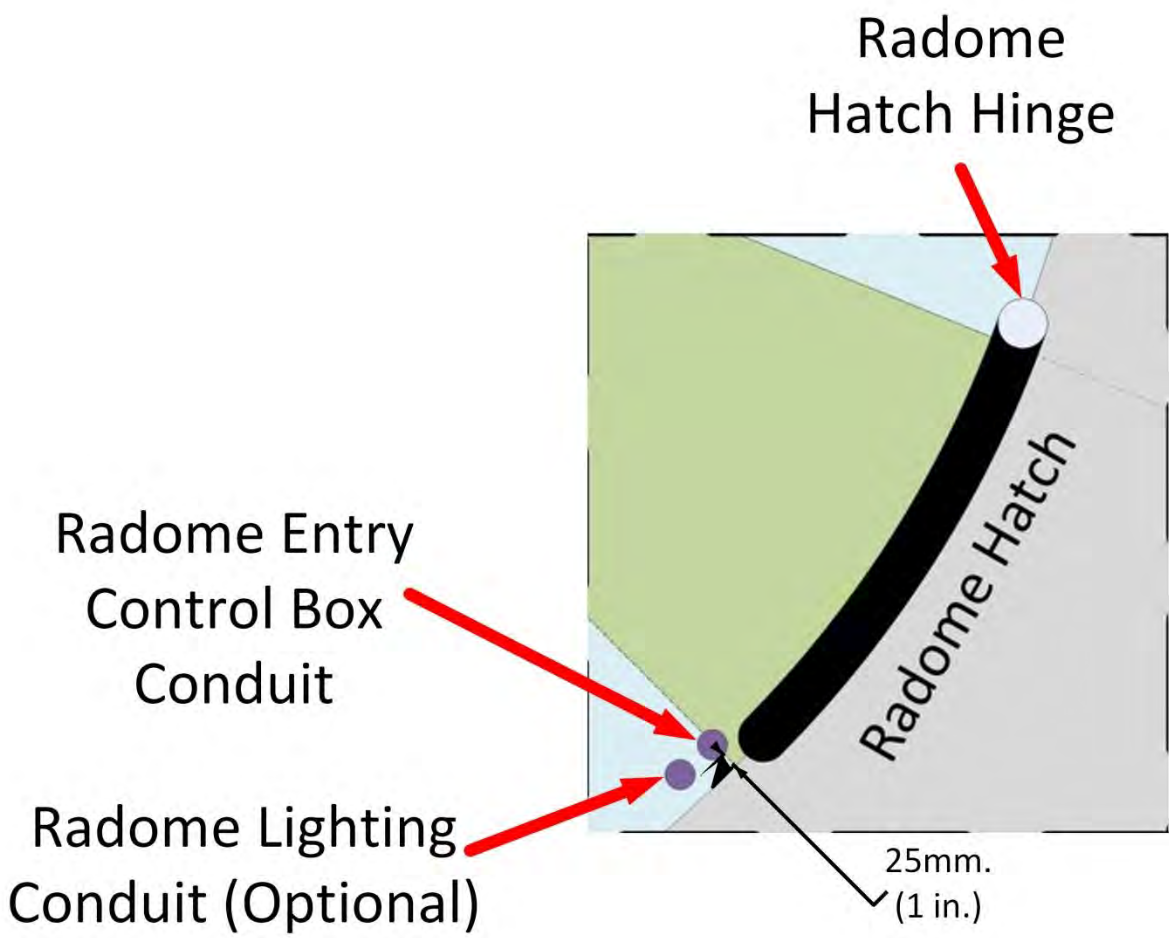


Figure 13 - Close-Up of Conduit Location near Radome Hatch

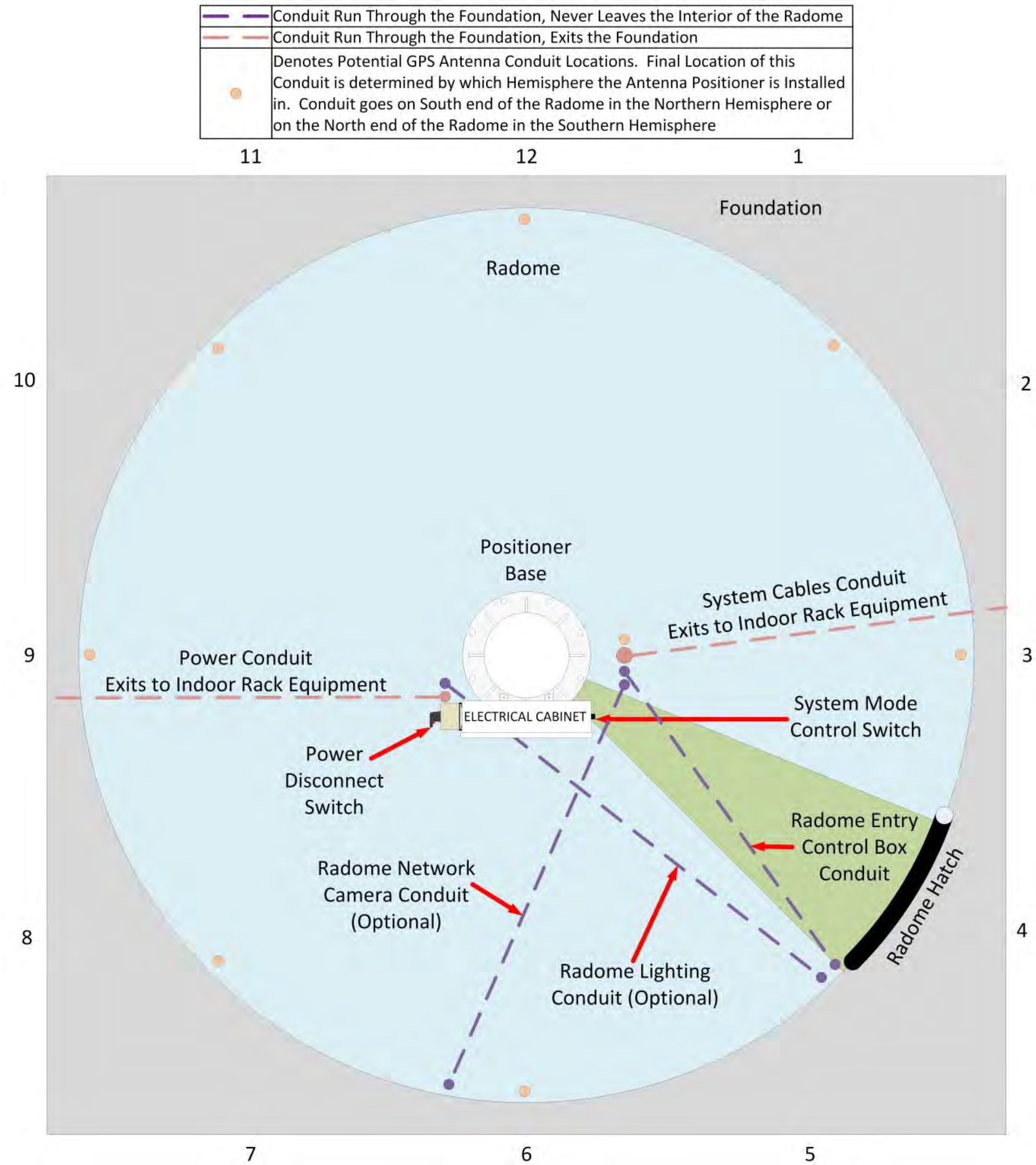


Figure 14 - Conduit Routing Paths (Potential)

Conduit Information (with or without a Radome)

All conduits should extend no more than 1 to 4 inches from the surface of the foundation and then terminated with either a bushing or a U-Joint (see Figure 15).

Figure 15 - 180 Degree Bend (U Joint)

Notice

Do not glue or otherwise permanently fasten the U joint to the conduit. It must be removable to facilitate servicing of the cables.

These conduit locations are recommended by Orbital Systems as the most optimal locations to minimize safety risks and ease installation. These locations can be varied depending on safety considerations, foundation design, or other factors. When determining conduit locations, conduits and cables should be kept out of the space at the positioners 11 to 1 O'clock and 4 to 7 O'clock to allow access to maintenance openings and the System Mode Control Switch (see Figure 16).

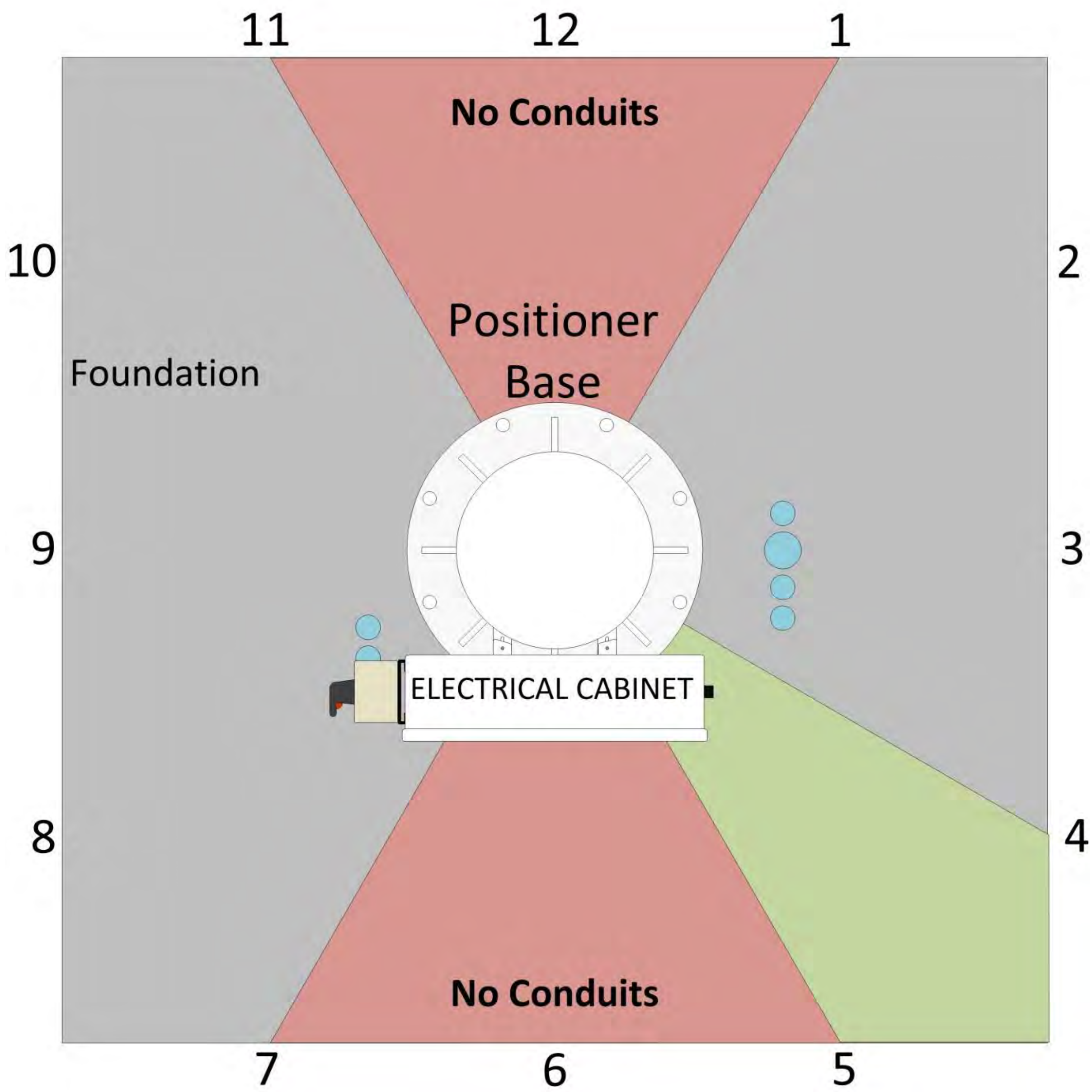


Figure 16 - Paths that should be clear around the Positioner

Green shaded area denotes the path to the System Mode Control Switch that should remain unobstructed and clear at all times.

Red shaded areas should be clear of all conduits, cables, or other equipment to allow access to the electrical cabinet and access doors for maintenance, troubleshooting, etc.

4.2.6 Step 6: Conduit Requirements

If conduit is used, it must have a minimum diameter of 25 millimeters (1 inch). This diameter is sufficient to permit all the terminated cables to fit through the conduit. If the conduit will be exposed to moisture, the use of plastic conduit is recommended to avoid corrosion. Plastic conduit is also recommended if the conduit is installed in a concrete foundation.

4.2.7 Step 7: Conduit Bend Radius and Cable Bend Radius

If bends are required in the conduit, they must have extended bend radii; that is, the bends cannot be abrupt 90 degree angles. Extended bend radii allow the cables to be pulled through the conduit without binding. The minimum extended bend radius of the standard cable is 100 millimeters (4 inches). A 50 millimeter (2 inch) conduit typically has about a 150 millimeter (6 inch) minimum bend radius. See Figure 17 for examples of conduits with extended bend radii.

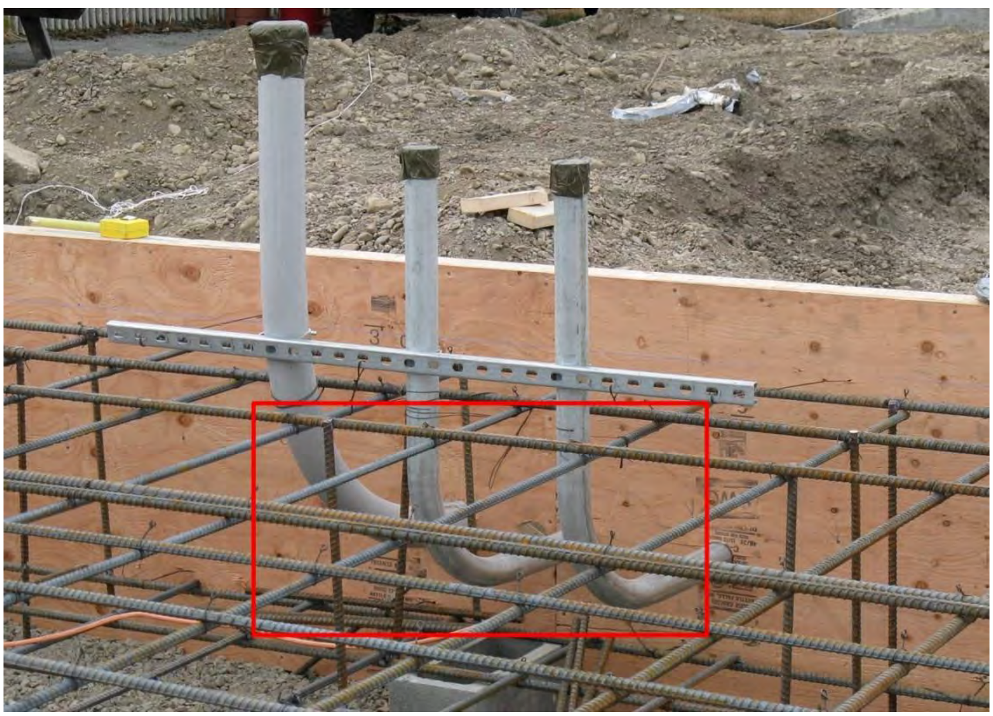


Figure 17 - Examples of Extended Bend Radii

4.2.8 Step 8: The Foundation Template

A wood foundation template is included with the pre-installation kit. It has holes that correspond to the bolt pattern on the base of the antenna positioner.

- Make sure that the personnel constructing the foundation are aware of the template.

- Make sure the personnel constructing the foundation know how to use the foundation template to install the mounting studs and to verify they are correctly placed.

- Review the system-appropriate drawing in APPENDIX F: for the specifications of hardware and mounting dimensions.

This template is used for the following purposes:

- To align and support the studs while the concrete dries
- To align glued studs
- To align studs used with concrete anchors
- To check the alignment of studs fastened in a metal plate with pre-drilled holes.

The holes in the template have a tighter tolerance than the holes in the base of the antenna positioner; if the template can fit on the studs, the antenna positioner will fit on them.

If the template is used as a guide to align the studs for setting in concrete or for gluing, install a nut and washer on each stud above and below the template to keep the studs parallel to each other (see Figure 18). Orbital Systems LLC does not provide these nuts and washers. If the studs are not parallel to each other, the template could fit on the studs when they are installed, but it cannot be removed afterward. In this situation the studs are not properly aligned and the antenna positioner cannot be installed on them.

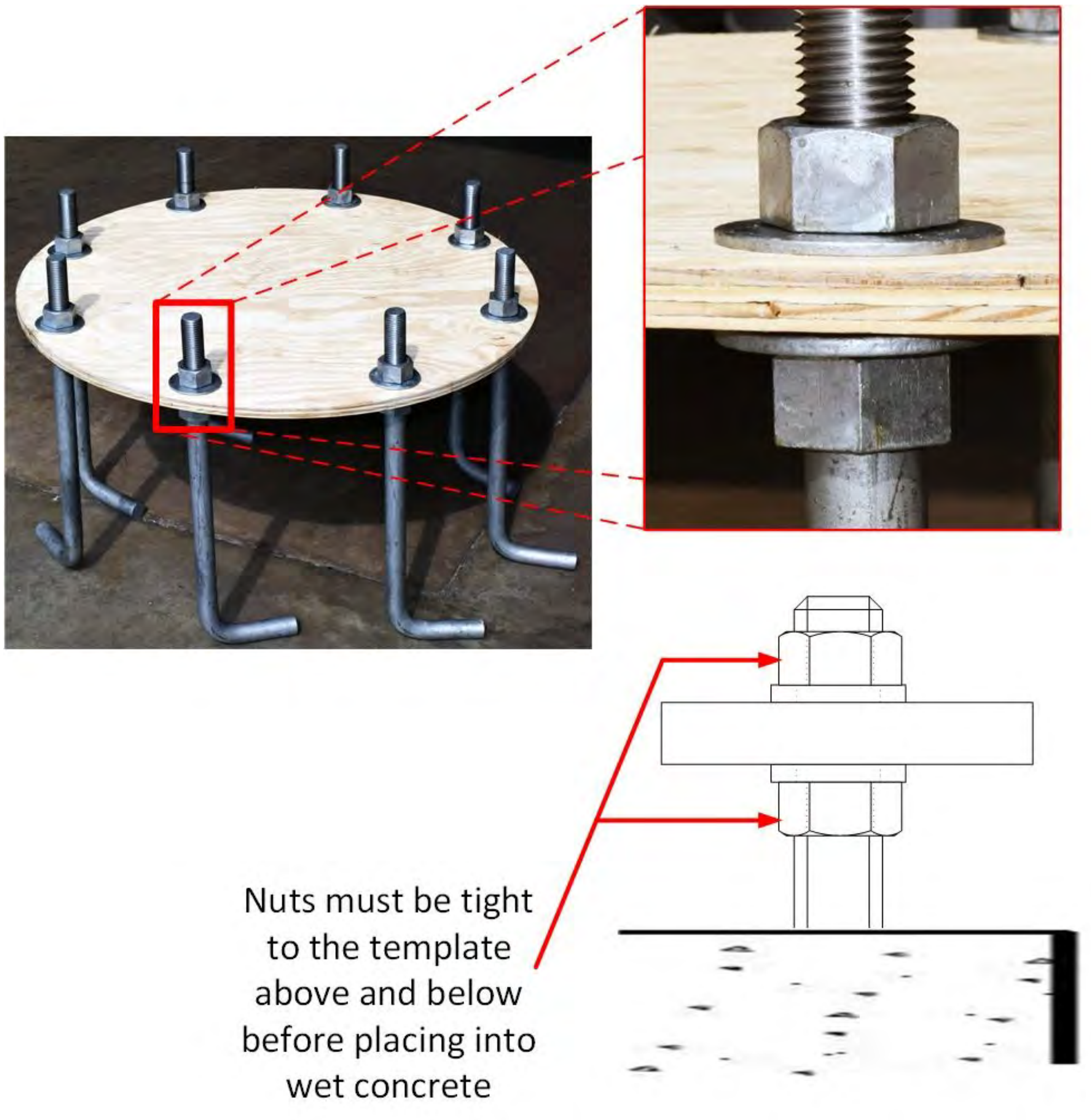


Figure 18 - Nuts Above and Below Foundation Template

- Do not be concerned if the template fits tightly to the studs. If it can be removed (using force if necessary), the studs are aligned, and the antenna positioner can be installed.

Figure 19 identifies the various plywood templates for the Elevation-Over-Azimuth antenna positioners:

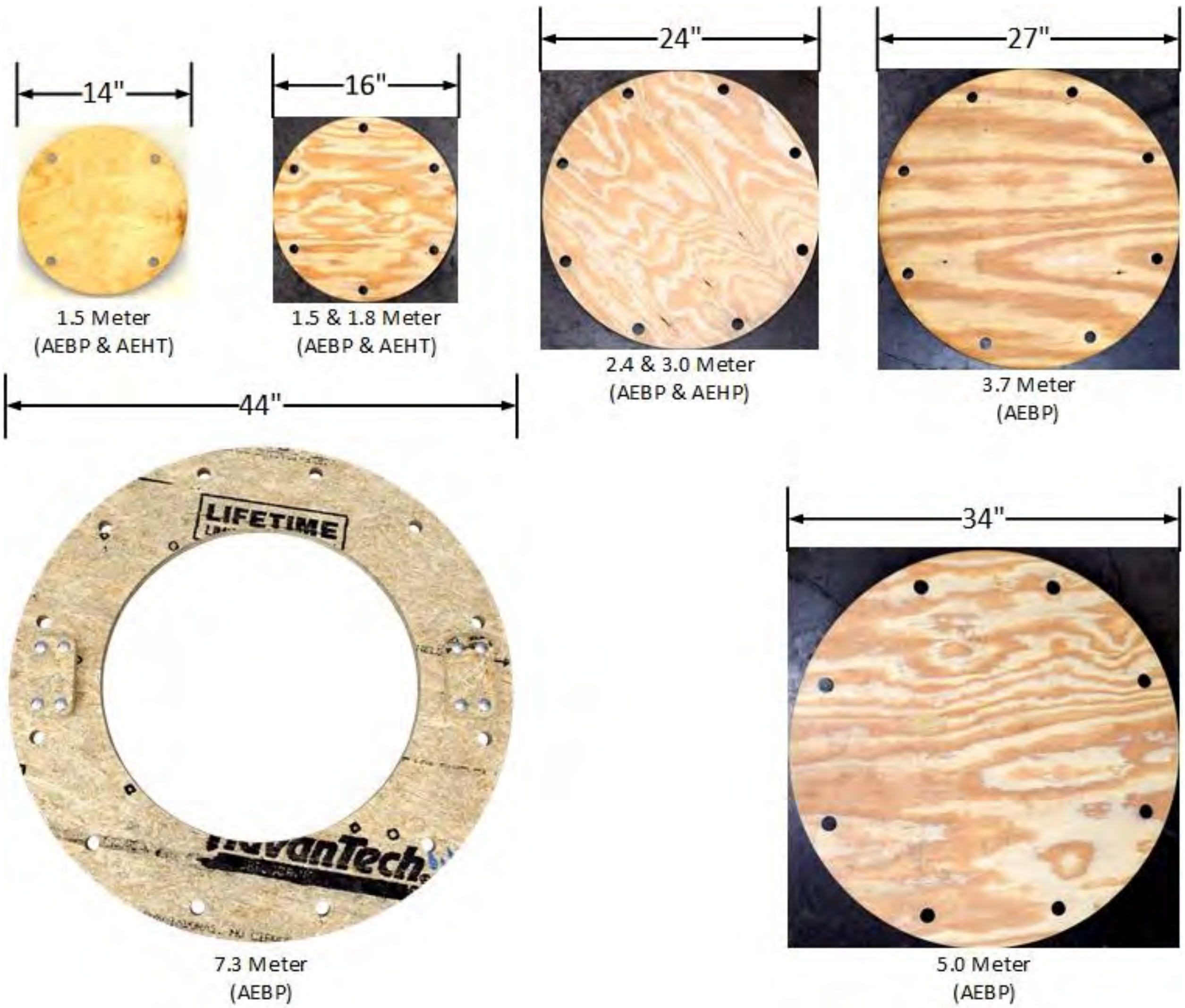


Figure 19 - Examples of Foundation Templates

4.2.9 Mounting Studs and Plywood Template

One of three methods typically is used to install the mounting studs in the concrete foundation:

1. Studs placed in wet concrete (paragraph 4.2.10)
2. Studs placed in dry concrete using adhesive (paragraph 4.2.11)
3. Studs placed in dry concrete using concrete anchors (paragraph 4.2.12)

Each method for mounting the studs requires use of the plywood template (supplied in the installation kit) to ensure that the studs are parallel to each other and perpendicular to the foundation. See Figure 20.

Caution

The plywood template is used to ensure the mounting studs are installed correctly. If the studs are not installed correctly, the antenna positioner cannot be mounted.

4.2.10 Anchoring Studs in Wet Concrete

If setting the studs into wet concrete, install the studs, nuts, and washers onto the plywood template. Push the template down towards the concrete until the studs project approximately the correct distance out of the concrete. Reference APPENDIX F: for mounting dimensions of the system. Ensure that the template is level on two axes before the concrete begins to dry. See Figure 20 and Figure 22.

Figure 20 - Plywood Template with Studs Prior to Installation in Wet Concrete

Figure 21 - Concrete Foundation for Ground Mounted Positioner (Example Only)

Figure 22 - Installing Studs in Wet Concrete Using the Plywood Template

4.2.11 Using Epoxy Adhesive in Dry Concrete

Drilling or coring holes in the foundation is necessary if glued studs are used. Coring the holes is recommended because drilling may deflect the direction of the hole if the drill hits rebar or hard rock.

The diameter of the hole drilled is dependent on the size of the studs and the chemical anchor epoxy used. Reference APPENDIX F: for stud dimensions and check the chemical anchor epoxy data sheet to determine the appropriate drill hole diameter.

The oversized holes permit slight movement of the studs during the gluing process so that the studs can be positioned parallel to each other and perpendicular to the foundation (see Figure 23). Use the Orbital Systems LLC template when drilling/coring holes and placing studs.

Galvanized studs are recommended because they typically have stronger adhesion than stainless steel studs. Stainless steel studs may have poor chemical adhesion to the epoxy, which can result in the studs moving after the epoxy has set.

Account for both installation site weather and chemical anchor epoxy product manufacturing timelines:

Ambient temperature has a significant effect on epoxy cure time. It may be necessary to use cold temperature rated chemical anchor epoxy for installations during cold weather. Use the appropriate chemical anchor epoxy material for the installation site's location (cold or regular).

Chemical anchor epoxy product has a shelf life of about one year and potentially a long lead time (up to 6 months) before it is available to buy. Arrange for the appropriate chemical anchor epoxy to be already onsite, especially for cold weather anchor. Buy outside the country of the installation site if necessary.

Concrete becomes much harder over time. If your concrete is more than a few years old, use a heavy-duty hammer drill with attachments to ensure it is perpendicular to the concrete surface. If this is not done, the holes will not be properly aligned, preventing the flange from fitting over the bolt circle. Ensure the studs are parallel to each other or the holes will not line up with the positioner base flange. For larger bolts (e.g., the nominal 1-3/8" used in the 7.3m), consider hiring a contract concrete coring company to core the holes. Spray paint and a template can be used to demonstrate drilling points.

Use the following procedure to install studs in chemical anchor epoxy:

1. To prevent poor adhesion from dust particles, clean the drilled holes before installing chemical and stud. Use a bottle brush to remove larger particles from the sides of the holes, followed by a vacuum or pressurized

air to remove all remaining dust. Wear proper eye protection while performing dust removal.

2. Attach one stud using two washers and two nuts. Ensure that the nuts are tight to the foundation template top and bottom. Reference Figure 23 for hardware setup.
3. To avoid having to remove chemical anchor epoxy from stud threads (which can be done with a die and a wrench if necessary), use electrical tape to cover the stud threads that will be between the concrete and the plywood template.
4. Fill one of the mounting holes with chemical anchor epoxy. When pouring the chemical anchor epoxy at the bottom of the hole, do not leave any pockets of air underneath. Water can soak through the concrete and pool in these gaps, causing corrosion of the stud.
5. Set the template by inserting the stud into the mounting hole filled with epoxy until the stud projects approximately the correct distance out of the concrete. Reference APPENDIX F: for mounting dimensions of the system. Support the foundation template in the center using a brick or a cinder block.
6. Wipe away excess epoxy, “caulking” the remaining epoxy so no water buildup is possible around the stud.
7. Ensure that the template is level on two axes.
8. Insert the second stud through the template (opposite of the first stud) and install a washer and nut on the bottom side of the template.
9. Fill the mounting hole with epoxy and screw the stud down into the hole. Install a washer and nut on the top of the template once the stud is projecting approximately the correct distance out of the epoxy.
10. Ensure the foundation template remains level on two axes.
11. Repeat this procedure for all studs and continue to check that level on two axes is close.
12. After all studs have been installed, ensure the template is level on two axes before the epoxy dries.
13. Once the epoxy cures, remove the hardware template and tape.

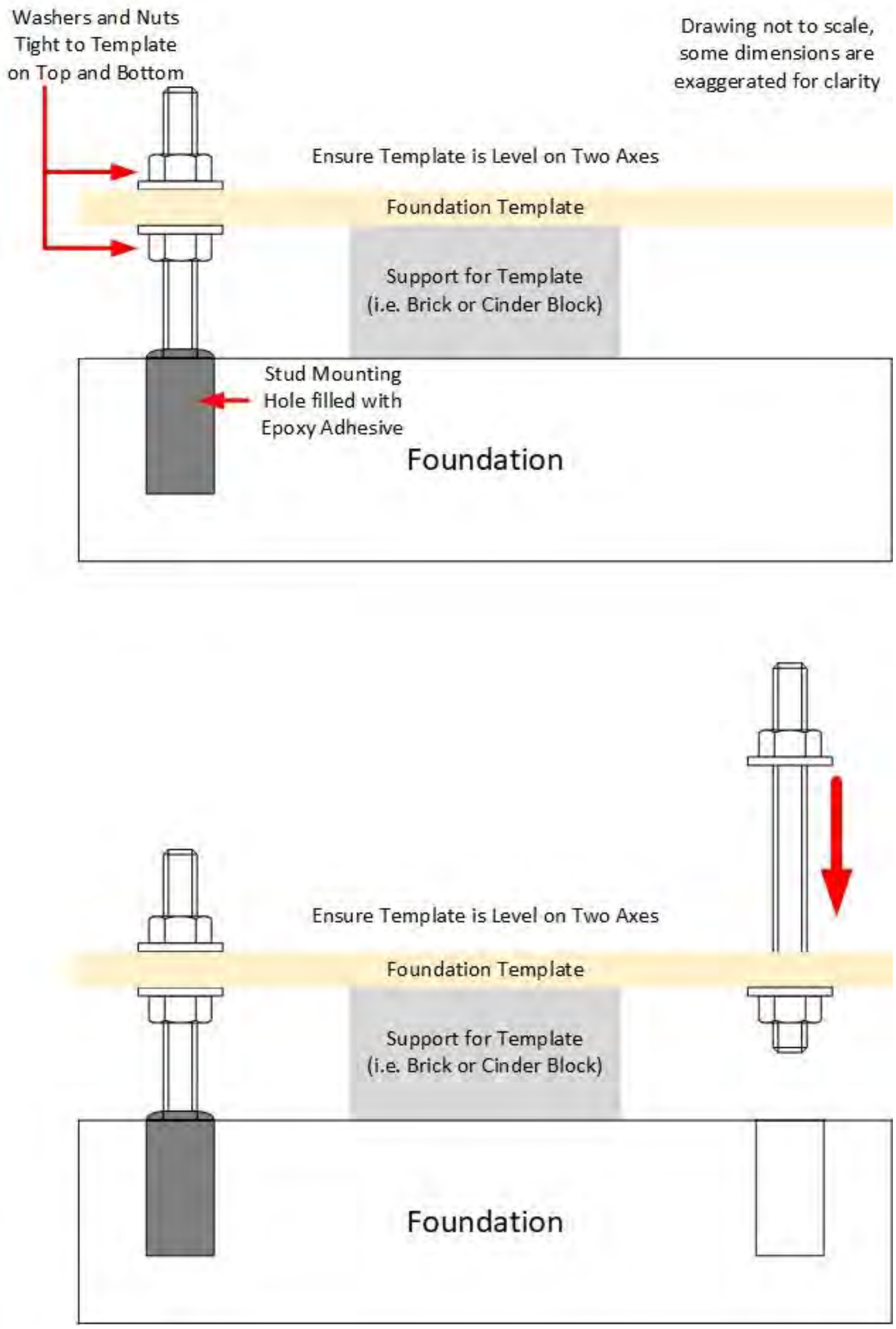


Figure 23 - Installing Glued Studs

4.2.12 Anchoring Studs in Dry Concrete

If concrete anchors are used to mount the studs, the holes are drilled to fit the anchors. These holes must be precisely drilled.

Notice

Drilling the holes parallel to each other and perpendicular to the foundation is critical; if the holes are not drilled correctly, the antenna positioner cannot be mounted.

Use the Orbital Systems LLC supplied plywood template to ensure the holes are drilled correctly. The plywood template has a snug fit on all mounting studs when the holes are drilled correctly.

Concrete anchors must have upward tension. Follow these steps to obtain this tension:

- Install a washer and a nut on the stud.
- Tighten the nut, which pulls the anchor upward to generate tension.
- Tighten the studs in an even pattern to ensure that the positioner can be leveled.

SECTION 5 DETERMINE THE ROUTE, LENGTH, AND TYPE OF RF AND DATA CABLES

Phase 1 Tasks:

- ✓ Select the site for the antenna positioner
- ✓ Select and prepare the location for the interior (indoor) equipment
- ✓ Design and construct the foundation
- ✓ Determine conduit requirements, if used
- → **Determine the route, length, and type of RF and data cables; inform Orbital Systems LLC of cable lengths and types**

5.1 PRE-INSTALLATION REQUIREMENT SUMMARY

Summary of requirements for determining the route, length, and type of RF and data cables:

1. **Cable Routing Considerations**
   - Determine cable routing and location (paragraph 5.2.2).
   - Determine if conduits and cable trays are used; if they are used, determine their requirements (paragraph 5.2.2).
   - Determine if vertical drops are required; if they are required, measure their height (paragraph 5.2.2).
   - Determine if additional cable length is required and where to store it (paragraph 5.2.2).
2. **Vertical Drops without Riser Cables**
   - Measure vertical cable drops to determine if cables must be fastened to structural supports (paragraph 5.2.3).
3. **Use of Riser Cables**
   - Measure vertical cable routes and then consult Orbital Systems LLC to determine if riser cables are required (paragraph 5.2.4).
4. **Plenum Cables**
   - Consult fire and building codes to determine if plenum-rated cables are required (paragraph 5.2.5).
5. **Fiber Option**
   - If antenna positioner is located more than 300 meters (1000 feet) from the equipment rack, consult Orbital Systems LLC to determine if fiber modems are required (paragraph 5.2.6).
6. **Measure Cable Distance**
   - Measure cables to determine lengths of the cables supplied in the installation kit (paragraph 5.2.7).
7. **RF Loss Due to Cable Length**
   - Verify that RF loss will be within system specifications (paragraph 5.2.8).

5.2 PRE-INSTALLATION REQUIREMENT DETAILS

5.2.1 Determining the Route, Length, and Type of RF and Data Cables

Notice

Orbital Systems LLC supplies cables with the Pre-Installation kit. They are standard system cables and they are included in the cost of the system.

The system cables have connectors, and the cables are the correct length for the installation based on the information provided to Orbital Systems LLC. They are used to connect the antenna positioner to the equipment rack. After the locations for the positioner and the equipment rack have been determined, the cable route is measured (see paragraph 5.2.7).

5.2.2 Step 1: Cable Routing Considerations

When planning the cable routing, use the following criteria:

- Will the cables be routed and positioned to prevent trip and fall hazards?
- Will the cables run in a conduit or a cable tray?
- Will the cables require a vertical drop of 8 meters (26 feet) or more?
- Will the cables be routed above ceilings or other areas that require plenum rated cables?
- Will additional cable length be required?
  - If additional cable length were needed, where will it be stowed?
  - Additional cable length typically is coiled into a 1 meter (39 inch) spool and stored in an attic, fastened to a wall, or placed under the equipment rack.

If the antenna positioner is located more than 300 meters (1000 feet) from the equipment rack, you should consult with Orbital Systems LLC. This distance could require adding the single mode fiber option to the RF and Ethernet connections.

Notice

Riser cables, plenum cables, and the fiber option are not standard equipment, and they are not included in the system cost. Orbital Systems LLC can supply these items at an additional cost.

Caution

Having exposed cables on a rooftop is not advisable. Damage from foot traffic or other causes degrades the RF characteristics. If cables are routed across a rooftop, consider using cable trams or conduits.

5.2.3 Step 2: Vertical Drops without Riser Cables

If the installation has a vertical drop of 8 meters (26 feet) or more, fasten the cable bundle to a structural support at a minimum of 45 centimeters (18 inches) intervals to prevent the cables from stretching.

5.2.4 Step 3: Use of Riser Cables

Riser rated cables could be necessary for the following applications:

- The cables are routed vertically at a height of 8 meters (26 feet) or more
- The antenna positioner is mounted on an elevated platform

Consult with Orbital Systems LLC to determine if riser rated cables are required for the installation.

5.2.5 Step 4: Plenum Cables

When planning the cable installation, know if fire and building codes for the location require plenum rated cables. If plenum rated cables were required, Orbital Systems LLC can supply them.

Plenum rated cables cannot be exposed to direct sunlight. A transition connection is required from the exterior (outdoor) rated cable to the plenum rated cable. An extra junction box is required for this transition connection. The minimum dimensions for the junction box typically are 30 x 30 x 10 centimeters (11.8 x 11.8 x 3.9 inches). Orbital Systems LLC can supply the junction box.

5.2.6 Step 5: Fiber Option

For cable distances of more than 300 meters (1000 feet), the fiber option could be required. The fiber option enables the antenna positioner to operate as far away as 15 kilometers (9.3 miles) from the equipment rack.

5.2.7 Step 6: Measure Cable Distance

Notice

> Measuring the cables accurately is important. Cables of improper length cannot be easily terminated in the field.

Cable length measurements are necessary to determine the lengths of the cables supplied with the installation kit. The measurements must include the entire distance the cables will be routed and include additional lengths, if required.

Two measurements are used if plenum or riser-rated cables were required. The first measurement is to determine the length of the exterior (outdoor) rated cable:

1. Measure the distance from the connection point on the antenna positioner (bottom of the electrical cabinet) to the plenum or riser cable.

The second measurement is to determine the length of the plenum or riser cable:

2. Measure the distance from the exterior-rated cable to the rear of the equipment rack.

5.2.8 Step 7: RF Loss Due to Cable Length

Maximum RF loss of about 18 dB (between the antenna positioner and the equipment rack) typically is permitted for the operating frequency of the equipment. Larger RF cable conductors can be specified to reduce RF loss. If an Orbital Systems LLC receiver is not used, consult the vendor documentation for RF loss specifications.

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SECTION 6 PHASE 2: INSTALL SYSTEM CABLES AND DEHYDRATOR AIR TUBE

Phase 2 Tasks:

→ **Install system cables and dehydrator air tube**
- Determine the dehydrator location
- Provide AC power to the foundation and the dehydrator
- Prepare and set up site for installation day

Notice

Using a licensed electrician to pull the cables through the conduits is recommended.

Caution

Care must be exercised to avoid damaging cables while pulling them through conduits. Cable pulling lubricant is recommended for pulling RF and data cables through a conduit.

6.1 PRE-INSTALLATION REQUIREMENTS SUMMARY

Summary of requirements for installing RF cables, data cables, and the dehydrator air tube:

1. **Preparation**
   - Make sure the system and power cables have been installed (paragraph 6.2.1).

2. **Install RF and Data Cables and the Dehydrator Air Tube**
   - Make sure cables and air tube are pulled through the conduit in the correct order (paragraph 6.2.2).
   - Stagger the connectors when pulling the cables through the conduits (paragraph 6.2.2).
   - Make sure the cable spool is at the proper location and the labeled ends of the cables are unrolled in the correct order (paragraph 6.2.2).
   - Exercise care when pulling cables through the conduits (paragraph 6.2.2).

6.2 PRE-INSTALLATION REQUIREMENT DETAILS

6.2.1 Step 1: Preparation

The system installation cannot be completed if cables have not been installed. Cables are typically installed by the customer; however, Orbital Systems LLC can provide this service at an additional cost. Fixed-priced system installation quotes do not include cable installation, and a separate quote for cabling will be applied to have Orbital Systems LLC install system cables.

The protective plastic bags must remain on the cable connectors until the cables are connected to the antenna positioner and equipment rack. The connectors are marked **Antenna** and **Rack**. Orbital Systems LLC anticipates the cable reel will be placed at the antenna positioner foundation and the cables pulled to the equipment rack. If the cables will be pulled from the equipment rack to the antenna positioner, they must be unrolled to expose the end marked **Antenna**.

6.2.2 Step 2: Install RF and Data Cables and the Dehydrator Air Tube

When pulling the cables and air tube through the conduit, pull the cables in the following order (pulling the cables with the largest connectors first is easier):

1. Data cable
2. Coaxial cables
3. Air tube

The data cable has the largest connector, the coaxial cables have smaller connectors (straight N connectors), and the air tube has only protective plastic bags.

When the cables are pulled together as a bundle, stagger the connections so the largest connector is first, and then the next largest connector, and so on. The connectors are taped together to enable them to flex so they can accommodate bends in the conduit. The typical distance between the taped connectors should be 50 to 75 millimeters (2 to 3 inches). The total length of the taped area should be about 200 millimeters (8 inches).

Care must be exercised to avoid damaging cables while pulling them through conduits. If cables or connectors are damaged, inform Orbital Systems LLC so special tools can be delivered to the site to repair the cables. Proper use of cable pulling lubricants is recommended to minimize the risk of damage to cables.

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SECTION 7 DETERMINE THE DEHYDRATOR LOCATION

Phase 2 Tasks:

- ✓ Install system cables and dehydrator air tube
- → **Determine the dehydrator location**
- Provide AC power to the foundation and the dehydrator
- Prepare and set up site for installation day

7.1 PRE-INSTALLATION REQUIREMENTS SUMMARY

Summary of requirements for determining the dehydrator location:

1. **Location Requirements**
   - Verify that the dehydrator location conforms to all requirements (paragraph 7.2.1).
2. **Power**
   - Make sure that a power source has been provided within the specified distance from the dehydrator (paragraph 7.2.2).
3. **Air Tube**
   - Verify that the air tube was installed during the system cables installation.
   - Verify that the air tube is routed properly to the dehydrator location (paragraph 7.2.3).

7.2 PRE-INSTALLATION REQUIREMENTS DETAILS

The dehydrator unit is shipped with an installation template. It typically is mounted to a wall. The air tubing is shipped as part of the Pre-Installation kit.

7.2.1 Step 1: Use the Following Guidelines to Determine the Dehydrator Location

- The dehydrator must be installed level on a wall inside a building or other enclosure in which freezing temperatures cannot occur. If the dehydrator were exposed to freezing temperatures, it ceases to function and its moisture filters could be damaged.
  - Possible locations are basements, equipment rooms, or an elevator motor room.

- The dehydrator cannot be located more than 300 meters (1000 feet) from the antenna positioner.

- The dehydrator installation template is used to ensure the mounting holes are located correctly and to ensure the dehydrator is mounted level.

- The dehydrator produces low noise level during operation. This noise could disturb personnel in an office environment.

- Depending upon the dehydrator location, the tubing length could be different from the system cable length.

7.2.2 Step 2: Dehydrator Power

- An electrical outlet must be provided for the dehydrator. This outlet must be within 2 meters (6.5 feet) of the dehydrator's location. The dehydrator is supplied with a power cord and a power plug appropriate for the country in which it is used.

- The dehydrator can use 115 or 230 VAC, 50 to 60 Hz (if 230 VAC is used, a factory-installed jumper is provided). The unit is fused at 4 A and average power consumption is 55 W. Maximum power consumption is 350 watts at 115 VAC 50 to 60 Hz or 390 watts at 230 VAC 50 to 60 Hz.

7.2.3 Step 3: Dehydrator Air Tube

- Make sure that the air tube is installed when the system cables are installed.

- Make sure that the tubing is routed correctly if the dehydrator location is different from the indoor equipment location. The dehydrator air tube is 0.5 inch in diameter.

- Cut the dehydrator air tube to length at both ends and place a protective plastic bag on each end of the tubing. The bags must remain in place to prevent foreign objects from entering the tube

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SECTION 8 PROVIDE AC POWER TO THE FOUNDATION AND DEHYDRATOR

Phase 2 Tasks:

- ✓ Install system cables and dehydrator air tube
- ✓ Determine dehydrator location
- → **Provide AC power to the foundation and dehydrator**
- Prepare and set up site for installation day

Notice

Do not run the AC power cables in the conduits containing the RF or data cables.

8.1 PRE-INSTALLATION REQUIREMENT SUMMARY

Summary of requirements for providing AC power to the foundation and the dehydrator:

1. **Licensed Electrician**
   - Make sure a licensed electrician is scheduled to be on site (paragraph 8.2.1).
2. **Antenna Positioner Power Requirements**
   - Make sure the electrician knows the system power requirements and provides a line that is rated accordingly (paragraph 8.2.2).
3. **Dehydrator Power Requirements**
   - Make sure the electrician knows the dehydrator power requirements and provides a line and outlet that is rated accordingly (paragraph 8.2.3).

8.2 PRE-INSTALLATION REQUIREMENT DETAILS

8.2.1 Step 1: Use of a Licensed Electrician

A licensed electrician must install the dedicated AC power line to the foundation and the dehydrator. This installation must adhere to all local code requirements.

8.2.2 Step 2: Antenna Positioner Power Requirements

Reference APPENDIX E: for detailed power requirements.

- The **7.3AE3BP** system requires a three-phase AC circuit (delta configuration), 230 to 240 VAC, 50 to 60 Hz, which is protected with a 30 to 32 Amp fuse. If a Radome is used, the circuit protection can be reduced to 20 Amps.
- The **5.0AE3BP** system requires a single-phase AC circuit, 208 to 240 VAC, 50 to 60 Hz, which is protected with a 20 Amp fuse. If a Radome is used, the circuit protection can be reduced to 5 Amps.
- The **3.0AEBP** system requires a single-phase AC circuit, 208 to 240 VAC, 50 to 60 Hz, which is protected with a 16 to 20 Amp fuse. If a Radome is used, the circuit protection can be reduced to 5 Amps.
- The **2.4AEBP** system requires a single-phase AC circuit, 208 to 240 VAC, 50 to 60 Hz, which is protected with a 16 to 20 Amp fuse. If a Radome is used, the circuit protection can be reduced to 5 Amps.
- The **2.4AEHP** system requires a single-phase AC circuit, 208 to 240 VAC, 50 to 60 Hz, which is protected with a 16 to 20 Amp fuse. If a Radome is used, the circuit protection can be reduced to 5 Amps.
- The **1.8AEBP** system requires a single-phase AC circuit, 120 or 208 to 240 VAC, 50 to 60 Hz, which is protected with a 16 to 20 Amp fuse. If a Radome is used, the circuit protection can be reduced to 5 Amps.
- The **1.8AEHT** system requires a single-phase AC circuit, 115 or 208 or 225 or 240 VAC; 50 to 60Hz, which is protected by a 16 to 20 Amp fuse. If a Radome is used, the circuit protection can be reduced to 5 Amps.

8.2.3 Step 3: Dehydrator Power Requirements

The dehydrator can use 110 or 220 VAC, 50 to 60 Hz. The unit is fused at 4 A and average power consumption is 55 W. The dehydrator has been configured to support a desiccant regeneration cycle. Due to this cycle, the typical power consumption is up to 1 A @ 110 V or 0.5 A @ 220 V for 50% of the time; and 0.2 A @ 110 V or 0.1 A @ 220 V for the other 50%.

SECTION 9 PREPARE AND SET UP SITE FOR DAY OF INSTALLATION

Phase 2 Tasks:

✓ Install system cables and dehydrator air tube

✓ Determine dehydrator location

✓ Provide AC power to the foundation and dehydrator

→ **Prepare and set up site for installation day**

9.1 PRE-INSTALLATION REQUIREMENTS SUMMARY

Summary of requirements to prepare and set up site for Installation Day:

1. **A Crane and Operator Are Scheduled to be on the Installation Site**
    - Verify that a crane and operator will be available (paragraph 9.2.1).
2. **The Required Labor is Scheduled to be on the Installation Site**
    - Verify that personnel will be available (paragraph 9.2.2).
3. **An Electrician is Scheduled to be at the Installation Site**
    - Verify that an electrician will be on site to make the permanent power connection to the antenna positioner (paragraph 9.2.3).
4. **The Crates Have Been Delivered to the Installation Site and are Accessible to the Crane**
    - Crates must be located near the foundation (paragraph 9.2.4).
    - Open the crates and inspect the contents for damage (paragraph 9.2.4).
5. **An Extension Cord Has Been Provided for a Temporary Power Connection**
    - The antenna positioner requires temporary power for installation (paragraph 9.2.5.
6. **Access Permits or Security Passes for Installation Personnel Have Been Obtained, if Required**
    - Verify that arrangements have been made to allow installation personnel to access the site (paragraph 9.2.6)
7. **A Hardware Store or Similar Retail Outlet is Located Near the Installation Site**
    - Make sure a source for additional items is available if they are needed (paragraph 9.2.7).

9.2 PRE-INSTALLATION REQUIREMENT DETAILS

9.2.1 Step 1: A Crane and Operator Are Scheduled to be on the Installation Site

On the day of the installation, a crane is used to lift the antenna positioner and reflector in place. A crane and operator must be at the installation site to perform this part of the installation. The crane must have the capacity to lift and move the antenna positioner and the reflector.

The customer is responsible for making arrangements to hire the crane and operator, and for obtaining the required permits to restrict access to the area where the crane is operating.

9.2.2 Step 2: The Required Labor Is Scheduled to be on the Installation Site

Lifting heavy objects is required during the installation. Having one or two assistants available to unpack and lift equipment is recommended.

9.2.3 Step 3: An Electrician Is Scheduled to be at the Installation Site

An electrician is required to make permanent power connections to the antenna positioner. The customer is responsible for hiring the electrician. Reference APPENDIX E: for detailed electrical requirements specified by system type. If the antenna positioner is not installed inside a Radome, it has the following power requirements:

- **7.3AE3BP system:** A three-phase 230 to 240 VAC (delta configuration), 50 to 60 Hz circuit rated for a minimum of 25 Amps.
- **5.0AE3BP system:** A single-phase 208 to 240 VAC, 50 to 60 Hz circuit rated for a minimum of 20 Amps.
- **3.0AEBP system:** A single-phase 208 to 240 VAC, 50 to 60 Hz circuit rated for a minimum of 15 Amps.
- **2.4AEBP system:** A single-phase 208 to 240 VAC, 50 to 60 Hz circuit rated for a minimum of 15 Amps.
- **2.4AEHP system:** A single-phase 208 to 240 VAC, 50 to 60 Hz circuit rated for a minimum of 15 Amps.

- **1.8AEBP system:** A single-phase 120 or 208 to 240 VAC, 50 to 60 Hz circuit rated for a minimum of 15 Amps.

- **1.8AEHT system:** A single-phase 115, 208, 225, or 240 VAC, 50 to 60 Hz circuit rated for a minimum of 15 Amps.

9.2.4 Step 4: The Crates Been Delivered to the Installation Site and Are Accessible to the Crane

The first task on the day of installation day is to open the antenna positioner crate, inspect the antenna positioner for damage, and remove the tool kit. This tool kit contains the tools required to open the other crate and to install the system.

A Philips screwdriver is needed to open the crates. An electric screwdriver or drill motor with a Philips screwdriver bit installed is preferred.

- Make sure this tool is available; the customer must provide the electric screwdriver because the Orbital Systems LLC installation personnel cannot transport it through customs.

- Make sure the screwdriver is charged if it is a battery powered unit. Having a battery charger and a charged spare battery is recommended.

Depending upon the customer’s shipping and storage plans, the system crates could be stored at a location other than the installation site. They would be relocated to the installation site immediately prior to when the system installation is scheduled to occur. The customer is responsible for arranging this relocation and for paying the costs.

9.2.5 Step 5: An Extension Cord Has Been Provided for a Temporary Power Connection

Make sure a temporary extension cord is available at the foundation. This extension cord is used to provide temporary power to the system. Temporary power enables the reflector to be installed and basic alignment procedures to be performed without the delay that would occur while waiting for the permanent electrical connection. After the installation has been completed, the electrician removes the extension cord and then makes the permanent power connection to the antenna positioner. The antenna positioner is shipped with a plug that corresponds to those used in the country of installation.

- The customer is responsible for hiring and paying the electrician.

9.2.6 Step 6: Access Permits or Security Passes for Installation Personnel, if Required

Verify whether access permits or security passes are required for installation personnel and equipment. If access permits or security passes are required, make sure that all identification and access issues have been arranged to avoid installation delay.

9.2.7 Step 7: A Hardware Store or Similar Retail Outlet Is Located Near the Installation Site

Make sure that the location of a hardware store or similar retail outlet located near the installation site is known to the installation personnel. If small hardware items, tools, or other such things are required during the installation, knowing the location can save time.

APPENDIX A: SITE PREPARATION CHECKLIST

Completing the tasks listed in the site preparation checklist is the customer's responsibility. This checklist must be completed and submitted to Orbital Systems LLC prior to the day Orbital Systems LLC personnel install the antenna positioner. Complete the following steps:

- Check off each task on the list after it has been completed.
- Sign and date the checklist the day it is completed.
- Send the completed checklist to Orbital Systems LLC either by fax or by email.

This completed form must be signed and emailed or faxed to Orbital Systems LLC (or your project manager) prior to the antenna installation (fax number: 972-915-3699; email: info@orbitalsystems.com). Please provide photos of the following items with the checklist:

- Foundation with wooden template installed on bolts
- Cable ends at antenna foundation showing ends marked **Antenna**
- Cable ends at interior (indoor) equipment rack showing ends marked **Rack**

Notice

Orbital Systems LLC antenna installation personnel will not travel to the installation site until this checklist is submitted to indicate the site is ready.

Site Preparation Checklist

1. **Site Selection for the Antenna Positioner**
   - ☐ Expected wind loads are within tolerance
   - ☐ Site provides adequate system clearance for existing obstructions and personnel safety
   - ☐ No microwave interference is present
   - ☐ If a Radome was purchased, plans have been made for its installation and for safety of personnel working inside the Radome
   - ☐ People and animals cannot enter the site

2. **Location Selection for Interior (Indoor) Equipment**
   - The following is optional if supplied or applicable
     - ☐ Receivers and down-converters have proper ventilation
     - ☐ Rack space has been designed correctly
     - ☐ Rack space is ready for equipment installation
     - ☐ Location had adequate climate control
     - ☐ Adequate number of power outlets available
     - ☐ Adequate number of Ethernet ports are available
     - ☐ A KVM is available
   - ☐ The FES configuration worksheet has been completed and returned to Orbital Systems LLC
   - ☐ The FES has desktop computer access

3. **Foundation**
   - ☐ Building permits and approvals have been obtained (if required)
   - ☐ Structural or civil engineers have designed the foundation in accordance with structural load and wind load requirements
   - ☐ Foundation has been constructed
   - ☐ Foundation mounting hardware have been provided and is the correct type and quantity
   - ☐ Mounting stud placement and fit have been verified using the wood foundation template provided

Site Preparation Checklist

3. Foundation (cont'd)

- ☐ Foundation has been provided conduits or routing passages
- ☐ Conduits or routing passages are correctly placed
- ☐ Conduits are correct diameter and material type
- ☐ Conduits have correct extended bend radii

4. Cable, Length, Route, and Type

- ☐ Cable lengths and types have been determined, and those length and type requirements have been provided to Orbital Systems LLC

5. RF and Data Cables and Dehydrator Air Tube

- ☐ Cables provided in the Pre-Installation kit have been installed between the antenna positioner foundation and the indoor rack equipment
- ☐ The dehydrator air tube is installed and properly routed

6. Dehydrator

- ☐ Dehydrator is located in an area that is protected from freezing temperatures and has been mounted level using its mounting template
- ☐ The dehydrator is located within 300 meters (1000 feet) of the antenna positioner
- ☐ A power source has been provided that is no more than 2 meters (6.5 feet) from the dehydrator

Check ONE of the following voltages. DO NOT CHECK BOTH!!

- ☐ 115 VAC Supply
- ☐ 230 VAC Supply

- ☐ Determine the plug type required for region (i.e. North America, UK, Europe)

____

7. Providing AC Power to the Antenna Foundation and Dehydrator

- ☐ Power has been provided to the foundation
- ☐ Power has been provided to the dehydrator

Site Preparation Checklist

8. Installation Day Preparation and Set Up

- ☐ Crane and operator are scheduled to be on site
- ☐ Required labor is scheduled to be on site to uncrate and assemble the positioner
- ☐ An electrician is scheduled to be on site to connect AC power to the antenna positioner
- ☐ Crates have been delivered onsite at least 2 hours prior to installation
- ☐ An extension cord is provided for temporary power
- ☐ Access permits or security passes have been obtained (if required)
- ☐ Location of a hardware store or similar retail outlet is known
- ☐ Customer IT support is scheduled to make FES (Control Server) IP settings (assigning server name, IP address, installing server in DNS, assigning customer NTP host, providing optional remote access)

9. Language

- ☐ English is the language used for the Elevation-Over-Azimuth Antenna Positioner Pre-Installation Guide and all its ancillary documentation

10. Information, Style, and Format

- ☐ All the information, the style, and the format contained in this documentation is deemed satisfactory

11. Please Document the Following Settings

- ☐ Server Name: ____
- ☐ Server IP Address: ____________________________________
- ☐ Server Subnet Mask: __________________________________
- ☐ Default Gateway: ____________________________________
- ☐ NTP Host Name or IP Address: _________________________
- ☐ DNS Primary IP Address: ______________________________
- ☐ Remote Access Permitted? Yes ___________ No __________

APPENDIX B: FRONT END SERVER (FES) PRE-INSTALLATION WORKSHEET

Enterprise Network Configuration for the EOS-FES:

IP Address: _________ . _________ . _________ . _________

Subnet Mask: _________ . _________ . _________ . _________

Gateway: _________ . _________ . _________ . _________

Hostname: ____

DNS Servers: _________ . _________ . _________ . _________

_________ . _________ . _________ . _________

NTP Servers: ____

____

____

Installation Location Information:

Site Name (a short descriptive name for this installation, which will display on Commander and in the simulcast filename): ______________________________

Latitude (Dec. Deg.): ______________________________

Longitude (Dec. Deg.): ______________________________

Altitude (Meters): ______________________________

Customer Provided Physical Requirements:

- **Rack Space:** 27 inches deep, minimum. 2U is required for the EOS-FES, and another 2U is required for the receiver rack.
- **Ethernet Switch for Hardware Network:** Rack Mounted 5-port minimum and quantity five (5) 2m Ethernet cables.

Power: 1000W maximum for the server (250W typical), and 150W maximum for the receiver. The following power specifications apply:

- Permissible voltage range: 100 to 250 V
- Permissible frequency range: 49 to 62 Hz
- Please note the type of power plug used at your site. Some typical plug types are North America, Continental, UK, NEMA, among others.

____

Data Delivery Configuration (EOS-FES to Customer's High-Level Processing):

If FTP PUSH-style data delivery is required, please enter the following details required for data delivery:

FTP Server Address (or name): ____

Username: ____

Password: ____

Output Directory: ____

Administrative Contact:

Upon installation, usernames and passwords for the EOS-FES and optional camera equipment are given to this site contact. Please provide the following contact information for this person:

Name: ____

Phone Number: ____

Email Address: ____

Optional Camera Equipment Configuration:

The optional network camera must reside on the public portion of the network, to enable the Commander GUI running on external hosts to access the video. Do not place the network camera on the hardware network with the antenna or receivers.

Enterprise network setup for the camera:

IP Address: _________ . _________ . _________ . _________

Subnet Mask: _________ . _________ . _________ . _________

Gateway: _________ . _________ . _________ . _________

Hostname: ____

DNS Servers: _________ . _________ . _________ . _________

_________ . _________ . _________ . _________

NTP Servers: ____

____

____

A midspan Power over Ethernet (PoE) adapter can be supplied with the customer's optional camera. Is customer's server configured with the PoE feature?

- Is a PoE adapter for optional camera is needed? Yes______ No______

The default non-administrative user and password for the camera will set as the default indicated below. If you want alternate values, please enter the new values.

Username: CmdrCam ____

Password: Or6C4m ____

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APPENDIX C: TORQUE VALUES

C.1 TORQUE VALUES FOR THE ANTENNA POSITIONER

Torque values are listed in Newton meters (Nm) and foot pounds (ft. lbs.).

Caution

Applying excessive torque to a fastener can damage the antenna positioner. Exercise care when applying torque to or hand tightening fasteners.

Torque Values			
Fastener Size	***Stainless Into Aluminum***	***Stainless Into Insert***	***Stainless Steel Into Steel***
M4	Hand-tighten only; **do not torque**.	Not Used	Not Used
M5	Hand-tighten only; **do not torque**.	Not Used	Not Used
M6	Hand-tighten only; **do not torque**.	Not Used	Not Used
M8	27 Nm (20 ft. lbs.)	27 Nm (20 ft. lbs.)	Not Used
M10	40 Nm (30 ft. lbs.)	40 Nm (30 ft. lbs.)	81 Nm (60 ft. lbs.)
M12	67 Nm (50 ft. lbs.)	81 Nm (60 ft. lbs.)	135 Nm (100 ft. lbs.)

Table 2 - Torque Values

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APPENDIX D: FOUNDATION REQUIREMENTS FOR THE ELEVATION-OVER-AZIMUTH ANTENNA POSITIONER

The antenna positioner requires a solid foundation for proper operation. Orbital Systems LLC does not provide structural engineering recommendations for the foundation; however, loading information is provided in this appendix for the structural engineer.

Mounting the antenna positioner on the roof of a building or the top of another structure requires special considerations. Such considerations are necessary because of flexing due to wind. Such flexing can cause damage to the building structure.

A small shift at the base of the positioner can introduce errors that negatively affect the accuracy of the system. The structural engineer should plan for the base support to provide stability that prevents shifting from exceeding the following values:

- 0.02 degrees from no load to 88 kph (55 mph) when used for Ka band
- 0.05 degrees from no load to 88 kph (55 mph) when used for X band
- 0.10 degrees from no load to 88 kph (55 mph) when used for S or L band

D.1 FOUNDATION LOADING

Load information the structural engineer needs is provided in Table 3 and Table 4.

D.2 STRUCTURAL LOADING

The numbers for 201 kph (125 mph) are calculations of estimated loads that would be experienced during high wind conditions with the antenna positioner in stow mode. **No safety margin has been applied to these numbers.** These values were calculated based upon system dimensions and from the manufacturer’s wind load calculation. The values for 88 kph (55 mph) are for wind load during operation.

Structural Load; 201 kph (125 mph); Reflector Positioned in Stow Mode			
Positioner Model	***Moment***	***Shear***	***Dead Weight***
7.3AE3BP-7.3m	89,620 Nm (66,100 lb. ft.)	16903 N (3,800 lbf.)	7,000 kg (15,400 lbs.)
5.0AE3BP-6.1m	51,521 Nm (38,000 lb. ft.)	12,375 N (2,782 lbf.)	2,540 kg (5,600 lbs.)
5.0AEBP-5.0m	34,022 Nm (25,093 lb. ft.)	8,305 N (1,867 lbf.)	2,300 kg (5,071 lbs.)
3.0AEBP-3.7m	28,104 Nm (20,732 lb. ft.)	6,914 N (1,554 lbf.)	1,134 kg (2,500 lbs.)
3.0AEBP-3.0m	16,508 Nm (12,178 lb. ft.)	4,805 N (1,080 lbf.)	972 kg (2,145 lbs.)
2.4AEBP-3.0m	16,508 Nm (12,178 lb. ft.)	4,805 N (1,080 lbf.)	615 kg (1,356 lbs.)
2.4AEHP-3.0m	16,508 Nm (12,178 lb. ft.)	4,805 N (1,080 lbf.)	615 kg (1,356 lbs.)
2.4AEBP-2.4m	8,912 Nm (6,575 lb. ft.)	3,070 N (690 lbf.)	565 kg (1,245 lbs.)
2.4AEHP-2.4m	8,912 Nm (6,575 lb. ft.)	3,070 N (690 lbf.)	565 kg (1,245 lbs.)
2.4AEBP-1.8m	4,062 Nm (2,987 lb. ft.)	1,726 N (388 lbf.)	522 kg (1,150 lbs.)
2.4AEHP-1.8m	4,062 Nm (2,987 lb. ft.)	1,726 N (388 lbf.)	522 kg (1,150 lbs.)
1.8AEBP-1.8m	4,062 Nm (2,987 lb. ft.)	1,726 N (388 lbf.)	240 kg (530 lbs.)
1.8AEBP-1.5m	2,686 Nm (1,981 lb. ft.)	1,245 N (280 lbf.)	211 kg (465 lbs.)
1.8AEHT-1.8m	4,062 Nm (2,987 lb. ft.)	1,726 N (388 lbf.)	240 kg (530 lbs.)
1.8AEHT-1.5m	2,686 Nm (1,981 lb. ft.)	1,245 N (280 lbf.)	211 kg (465 lbs.)

Table 3 - Structural Load: 201 kph (125 mph) with Reflector Positioned in Stow Mode

Structural Load; 88 kph (55 mph); Reflector Positioned in 55 Degrees			
Positioner Model	**Moment**	**Shear**	**Dead Weight**
7.3AE3BP-7.3m	110,499 Nm (81,500 lb. ft.)	24910 N (5,600 lbf.)	7,000 kg (15,400 lbs.)
5.0AE3BP-6.1m	57,092 Nm (42,109 lb. ft.)	16,503 N (3,710 lbf.)	2,540 kg (5,600 lbs.)
5.0AEBP-5.0m	36,884 Nm (27,204 lb. ft.)	11,070 N (2,490 lbf.)	2,300 kg (5,071 lbs.)
3.0AEBP-3.7m	16,010 Nm (11,884 lb. ft.)	6,041 N (1,358 lbf.)	1,134 kg (2,500 lbs.)
3.0AEBP-3.0m	9,536 Nm (7,035 lb. ft.)	4,197 N (944 lbf.)	972 kg (2,145 lbs.)
2.4AEBP-3.0m	9,536 Nm (7,035 lb. ft.)	4,197 N (944 lbf.)	615 kg (1,356 lbs.)
2.4AEHP-3.0m	9,536 Nm (7,035 lb. ft.)	4,197 N (944 lbf.)	615 kg (1,356 lbs.)
2.4AEBP-2.4m	5,285 Nm (3,899 lb. ft.)	2,687 N (604 lbf.)	565 kg (1,245 lbs.)
2.4AEHP-2.4m	5,285 Nm (3,899 lb. ft.)	2,687 N (604 lbf.)	565 kg (1,245 lbs.)
2.4AEBP-1.8m	2,494 Nm (1,840 lb. ft.)	1,903 N (428 lbf.)	522 kg (1,150 lbs.)
2.4AEHP-1.8m	2,494 Nm (1,840 lb. ft.)	1,903 N (428 lbf.)	522 kg (1,150 lbs.)
1.8AEBP-1.8m	2,494 Nm (1,840 lb. ft.)	1,903 N (428 lbf.)	240 kg (530 lbs.)
1.8AEBP-1.5m	1,663 Nm (1,227 lb. ft.)	1,089 N (245 lbf.)	211 kg (465 lbs.)
1.8AEHT-1.8m	2,494 Nm (1,840 lb. ft.)	1,903 N (428 lbf.)	240 kg (530 lbs.)
1.8AEHT-1.5m	1,663 Nm (1,227 lb. ft.)	1,089 N (245 lbf.)	211 kg (465 lbs.)

Table 4 - Structural Load: 88 kph (55 mph) with Reflector Positioned to 55 Degrees

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APPENDIX E: INFORMATION FOR THE ELECTRICIAN

See APPENDIX F: for power installation diagrams, which vary depending on system type.

E.1 WIRING AND CONNECTION REQUIREMENTS

An electrical plug is delivered with the antenna positioner. This plug is correct for the country in which the system is installed; use it to make a temporary power connection to facilitate the installation and alignment of the antenna positioner.

Remove the plug after the installation and alignment have been completed, and then make the permanent power connection to the system power disconnect switch. Use a waterproof flexible conduit for this connection.

The customer is responsible for providing the circuit breaker for the antenna positioner and the wires to deliver power to the system disconnect switch. Power installation diagrams with this information are provided in APPENDIX F:. Depending on the system type, the circuit breaker must be either a two-pole circuit breaker rated at 20 Amps or a three-pole circuit breaker rated at 30 Amps, and it must have a trip curve similar to that used in lighting circuits. Reference the power installation diagrams in APPENDIX F: to determine which configuration to use based on system type. Do not use a GFI (Ground Fault Interrupt) type breaker; a GFI type breaker will cause false trips. The wires must have a cross-sectional area of 4 mm^2 (approximately 12 gauge). For a two-pole circuit breaker requirement, if one of the two power input wires is neutral, it can be connected to either L1 or L2.

A power transformer may be required to meet the system voltage requirements, especially if the system requires three-phase power. The selection, purchase, and installation of a power transformer (if necessary) is the responsibility of the customer. Orbital Systems LLC systems that require three-phase power use a Delta configuration. If the site's three-phase power is also a Delta configuration, three single-phase buck-boost transformers can be used to meet system requirements; if the site's three-phase power is a 3- or 4-wire Wye configuration, an isolation transformer is required.

After the antenna positioner has been installed, it must be connected to an earth ground (PE) in accordance with local electrical codes. If no local electrical codes exist, the antenna positioner must be grounded in accordance with appropriate national or European Community (CE) standards. An optional ground lug is provided on the antenna positioner. It is located on a gusset below the electrical cabinet. Use this ground lug if local codes require grounding the system to an external ground.

E.2 ELECTRICAL SPECIFICATIONS AND REQUIREMENTS

7.3AE3BP Systems

- Three-pole, three-phase 230 to 240 VAC nominal (delta configuration); 50 to 60 Hz with an earth ground (PE) connection
- Full system load is 25 Amps
- 120,000 Amp short circuit interrupt capacity
- Maximum system power consumption: 13 kW
- Typical operating states power consumption:
  - IDLE (system awaiting commands): 300 W
  - TLE or vector tracking (no wind; radome): 1300 W
  - TLE or vector tracking (very windy): 2400 W
  - Heaters enabled: + 1200 W
  - High Power Amplifier (HPA) enabled: + 50 W to + 350 W

5.0AE3BP Systems

- Two-pole, single-phase 208 to 240 VAC nominal; 50 to 60 Hz with an earth ground (PE) connection
- Full system load is 20 Amps
- 120,000 Amp short circuit interrupt capacity
- Maximum system power consumption: 4 kW
- Typical operating states power consumption:
  - IDLE (system awaiting commands): 225 W
  - TLE or vector tracking (no wind; radome): 1000 W
  - TLE or vector tracking (very windy): 1750 W
  - Heaters enabled: + 800 W
  - High Power Amplifier (HPA) enabled: + 50 W to + 350 W

3.0AEBP Systems

- Two-pole, single-phase 208 to 240 VAC nominal; 50 to 60 Hz with an earth ground (PE) connection
- Full system load is 15 Amps
- 120,000 Amp short circuit interrupt capacity
- Maximum system power consumption: 4 kW
- Typical operating states power consumption:
  - IDLE (system awaiting commands): 150 W
  - TLE or vector tracking (no wind; radome): 750 W
  - TLE or vector tracking (very windy): 1350 W
  - Heaters enabled: + 400 W
  - High Power Amplifier (HPA) enabled: + 50 W to + 350 W

2.4AEBP Systems

- Two-pole, single-phase 208 to 240 VAC nominal; 50 to 60 Hz with an earth ground (PE) connection
- Full system load is 15 Amps
- 120,000 Amp short circuit interrupt capacity
- Maximum system power consumption: 4 kW
- Typical operating states power consumption:
  - IDLE (system awaiting commands): 150 W
  - TLE or vector tracking (no wind; radome): 750 W
  - TLE or vector tracking (very windy): 1350 W
  - Heaters enabled: + 400 W
  - High Power Amplifier (HPA) enabled: + 50 W to + 350 W

2.4AEHP Systems

- Two-pole, single-phase 208 to 240 VAC nominal; 50 to 60 Hz with an earth ground (PE) connection
- Full system load is 15 Amps
- 120,000 Amp short circuit interrupt capacity
- Maximum system power consumption: 4 kW
- Typical operating states power consumption:
  - IDLE (system awaiting commands): 150 W
  - TLE or vector tracking (no wind; radome): 750 W
  - TLE or vector tracking (very windy): 1350 W
  - Heaters enabled: + 400 W
  - High Power Amplifier (HPA) enabled: + 50 W to + 350 W

1.8AEBP Systems

- Two-pole, single-phase 120 or 208 to 240 VAC nominal; 50 to 60 Hz with an earth ground (PE) connection
- Full system load is 15 Amps
- 120,000 Amp short circuit interrupt capacity
- Maximum system power consumption: 2.4 kW
- Typical operating states power consumption:
  - IDLE (system awaiting commands): 125W
  - TLE or vector tracking (no wind; radome): 500 W
  - TLE or vector tracking (very windy): 1000 W
  - Heaters enabled: + 200 W
  - High Power Amplifier (HPA) enabled: + 50 W to + 350 W

1.8AEHT Systems

- Two-pole, single-phase 115 or 208 or 225 or 240 VAC nominal; 50 to 60 Hz with an earth ground (PE) connection
- Full system load is 15 Amps
- 120,000 Amp short circuit interrupt capacity
- Maximum system power consumption: 2.4 kW
- Typical operating states power consumption:
  - IDLE (system awaiting commands): 125 W
  - TLE or vector tracking (no wind; radome): 500 W
  - TLE or vector tracking (very windy): 1000 W
  - Heaters enabled: + 200 W
  - High Power Amplifier (HPA) enabled: + 50 W to + 350 W

APPENDIX F: ENGINEERING DRAWINGS

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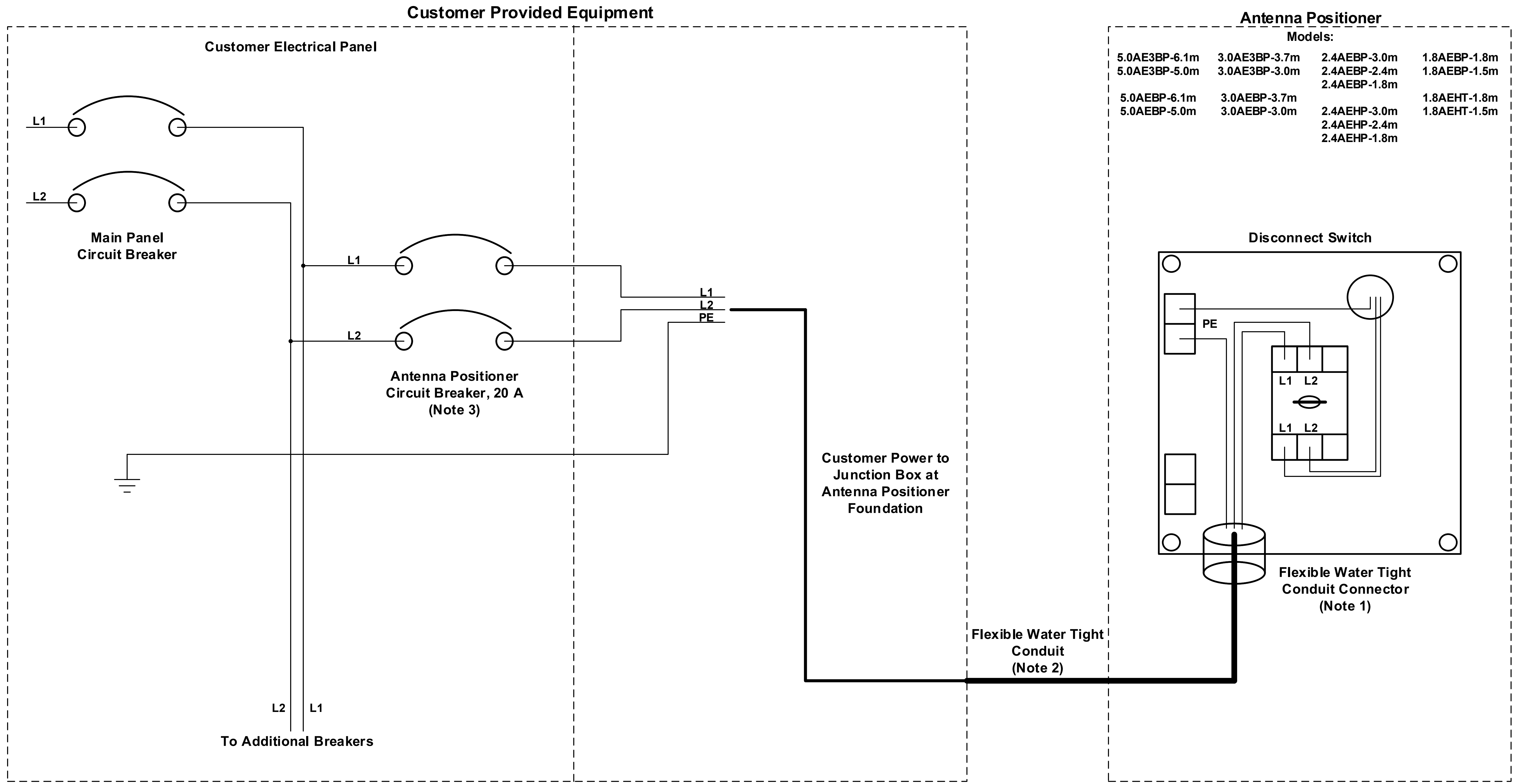


Notes:

Note 1: The Flexible Water Tight Conduit Connector is provided by the customer

Note 2: The Flexible Water Tight Conduit is provided by the customer

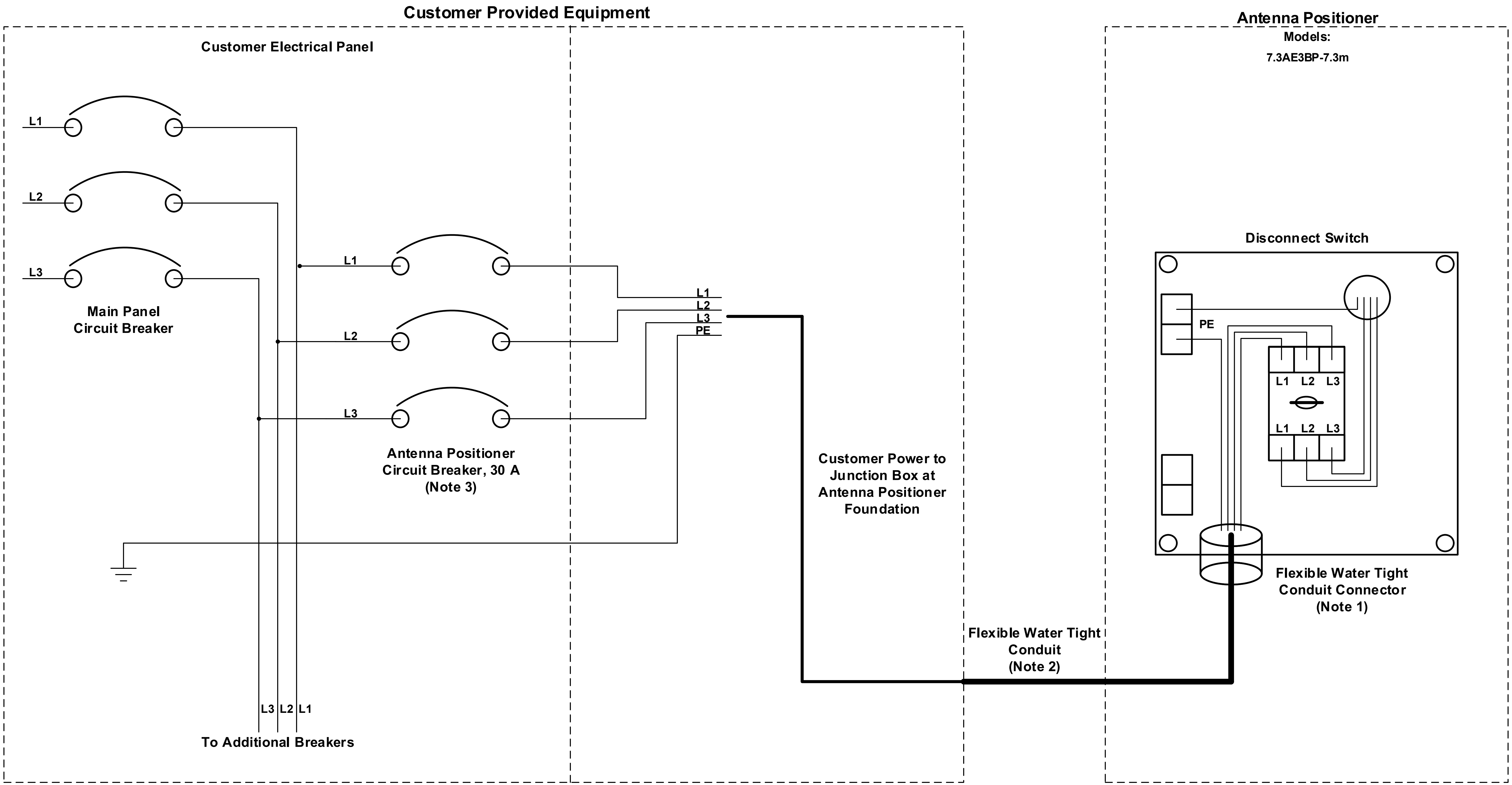
Note 3: The Antenna Positioner Circuit Breaker is provided by the customer.

2-Phase Power Installation Diagram

Orbital Systems LLC, Irving TX, USA

Proprietary Information

2021-01-22 ver A.3



Notes:

Note 1: The Flexible Water Tight Conduit Connector is provided by the customer

Note 2: The Flexible Water Tight Conduit is provided by the customer

Note 3: The Antenna Positioner Circuit Breaker is provided by the customer.

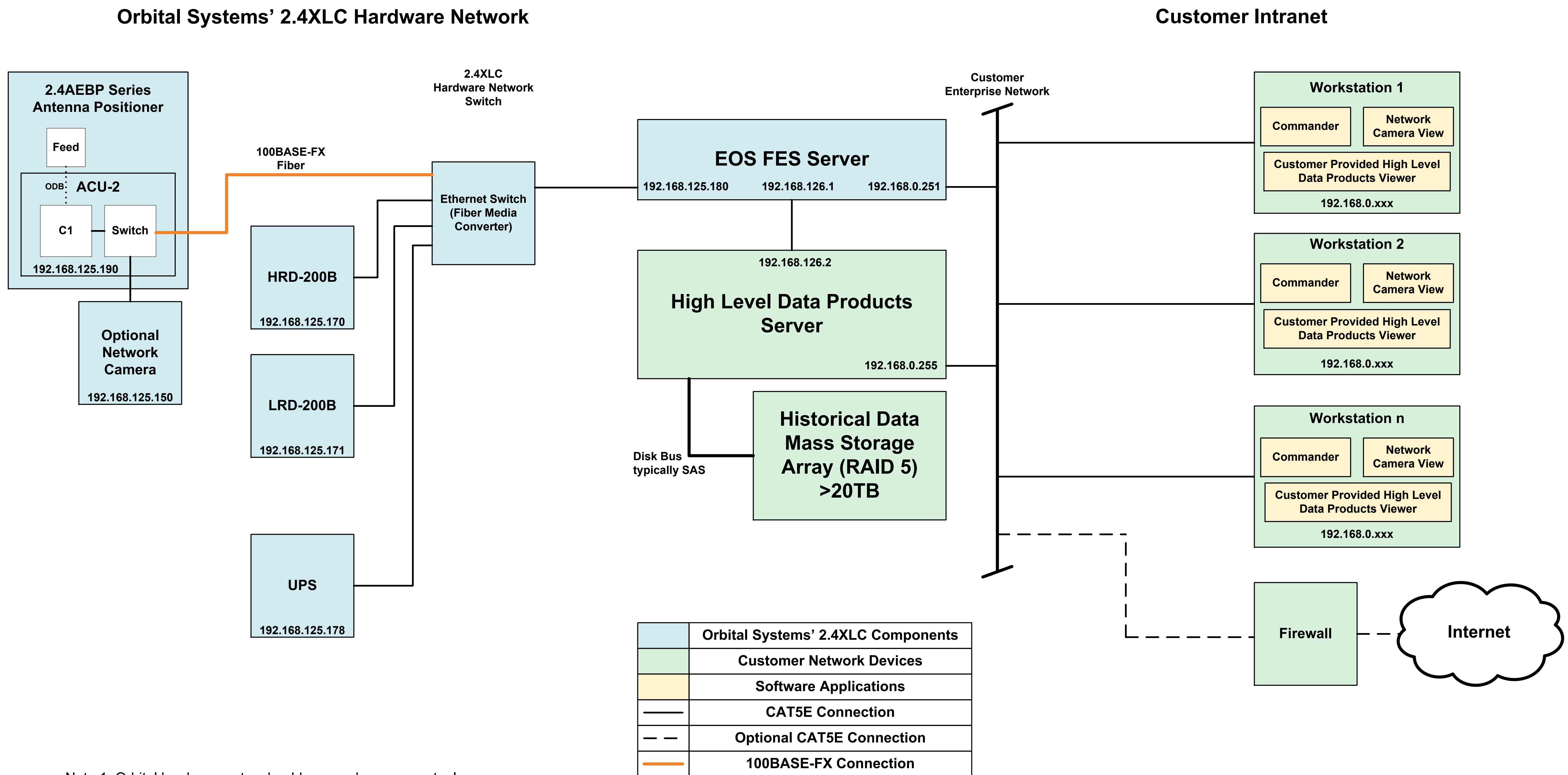
3-Phase Power Installation Diagram

Orbital Systems LLC, Irving TX, USA

Proprietary Information

2021-04-28 ver A.1

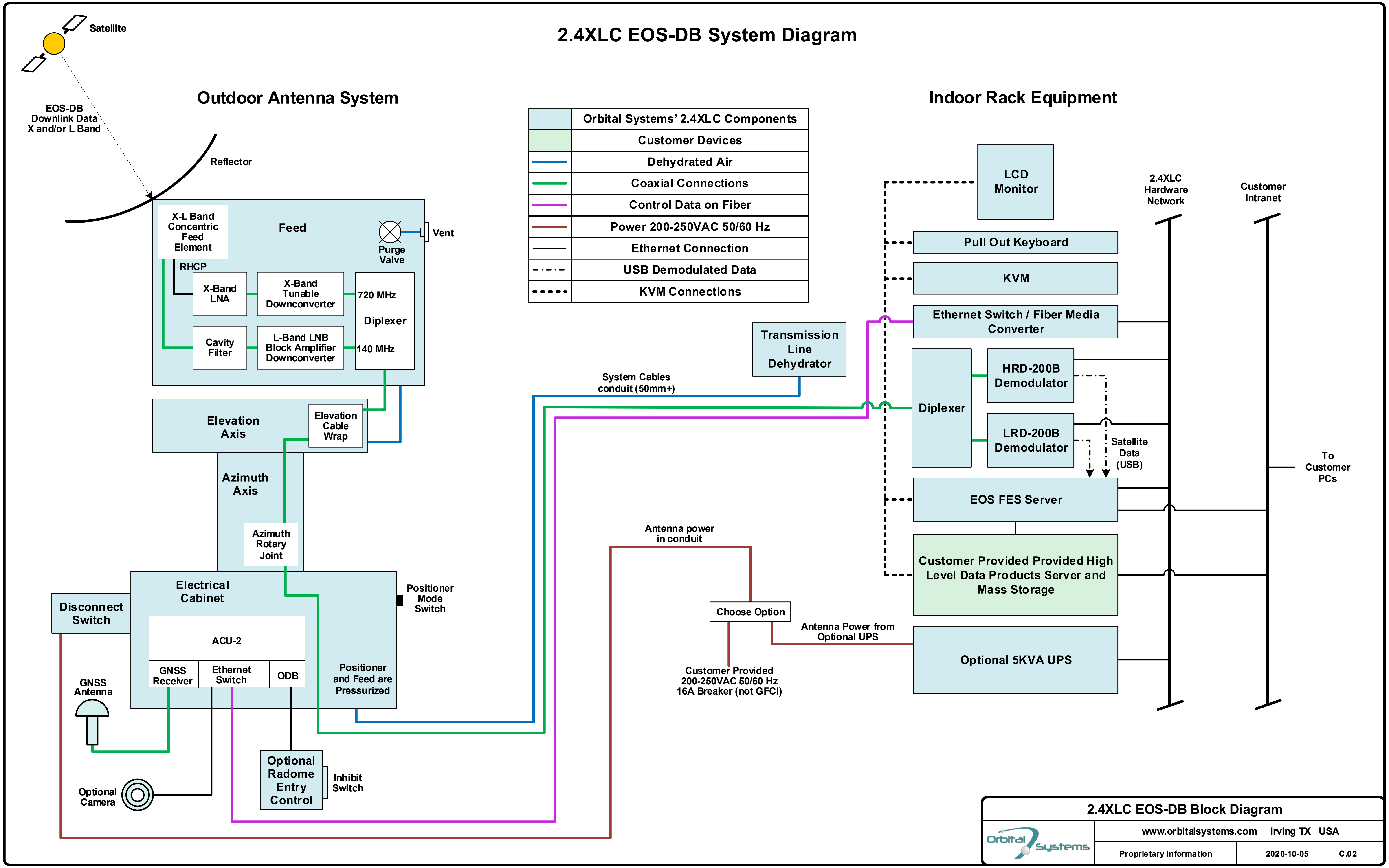
2.4XLC Typical EOS-DB Data Network Configuration



Note 1: Orbital hardware network addresses shown are actual, customer network addresses shown are typical
Note 2: The Hardware Network must not be exposed to the Internet
Note 3: Optional network Camera is port forwarded through the EOS-FES Accessible by URL: http://192.168.0.201:15080

2.4XLC EOS-DB Typical Network Configuration

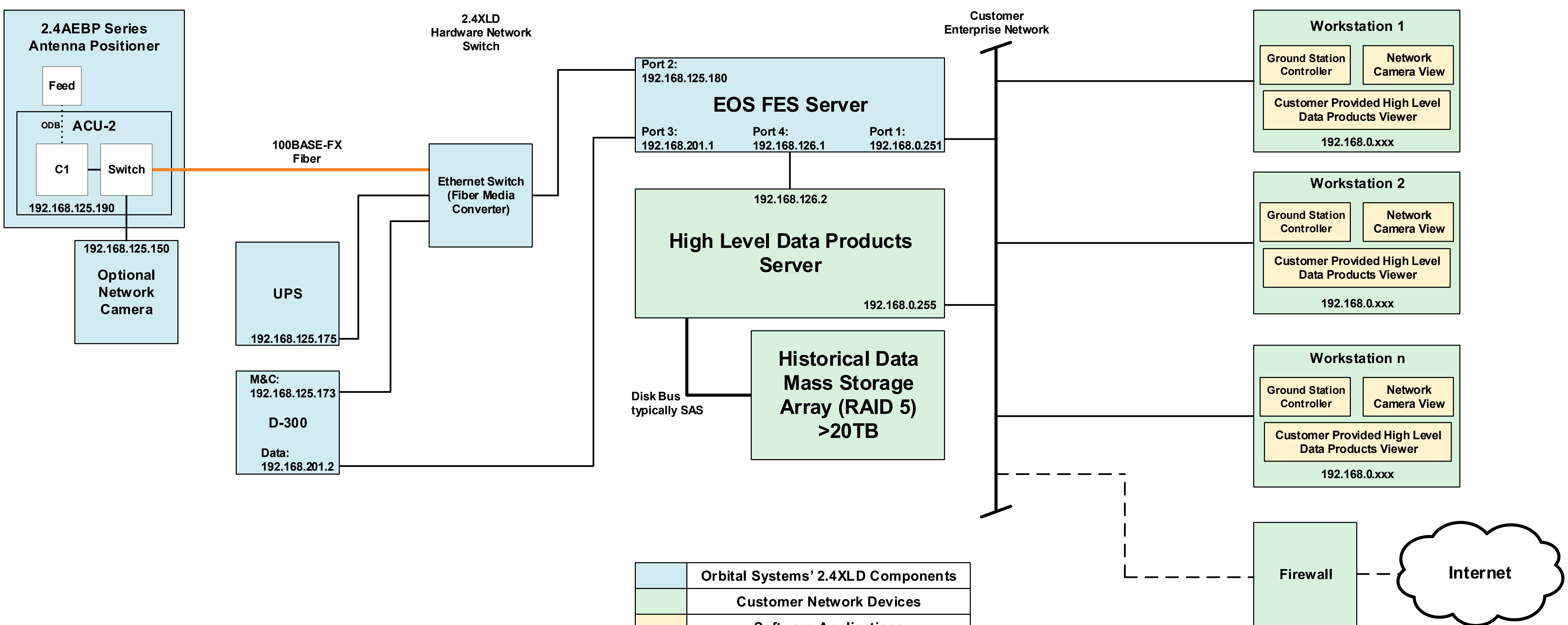
Orbital Systems, Ltd., Irving TX, USA
Proprietary Information
6/21/14 ver B.2


2.4XLC EOS-DB System Diagram
Satellite
EOS-DB Downlink Data X and/or L Band
Outdoor Antenna System
Reflector
X-L Band Concentric Feed Element
Feed
Purge Valve
Vent
RHCP
X-Band LNA
X-Band Tunable Downconverter
720 MHz
Diplexer
140 MHz
Cavity Filter
L-Band LNB Block Amplifier Downconverter
Elevation Axis
Elevation Cable Wrap
Azimuth Axis
Azimuth Rotary Joint
Disconnect Switch
Electrical Cabinet
ACU-2
GNSS Receiver
Ethernet Switch
ODB
Positioner Mode Switch
Positioner and Feed are Pressurized
GNSS Antenna
Optional Camera
Optional Radome Entry Control
Inhibit Switch
Orbital Systems' 2.4XLC Components
Customer Devices
Dehydrated Air
Coaxial Connections
Control Data on Fiber
Power 200-250VAC 50/60 Hz
Ethernet Connection
USB Demodulated Data
KVM Connections
System Cables conduit (50mm+)
Transmission Line Dehydrator
Antenna power in conduit
Choose Option
Antenna Power from Optional UPS
Customer Provided 200-250VAC 50/60 Hz 16A Breaker (not GFCI)
Indoor Rack Equipment
LCD Monitor
Pull Out Keyboard
KVM
Ethernet Switch / Fiber Media Converter
Diplexer
HRD-200B Demodulator
LRD-200B Demodulator
Satellite Data (USB)
EOS FES Server
Customer Provided Provided High Level Data Products Server and Mass Storage
Optional 5KVA UPS
2.4XLC Hardware Network
Customer Intranet
To Customer PCs
2.4XLC EOS-DB Block Diagram
www.orbitalsystems.com Irving TX USA
Proprietary Information
2020-10-05
C.02

2.4XLD Typical EOS-DB Data Network Configuration

Orbital Systems' 2.4XLD Hardware Network

Customer Intranet

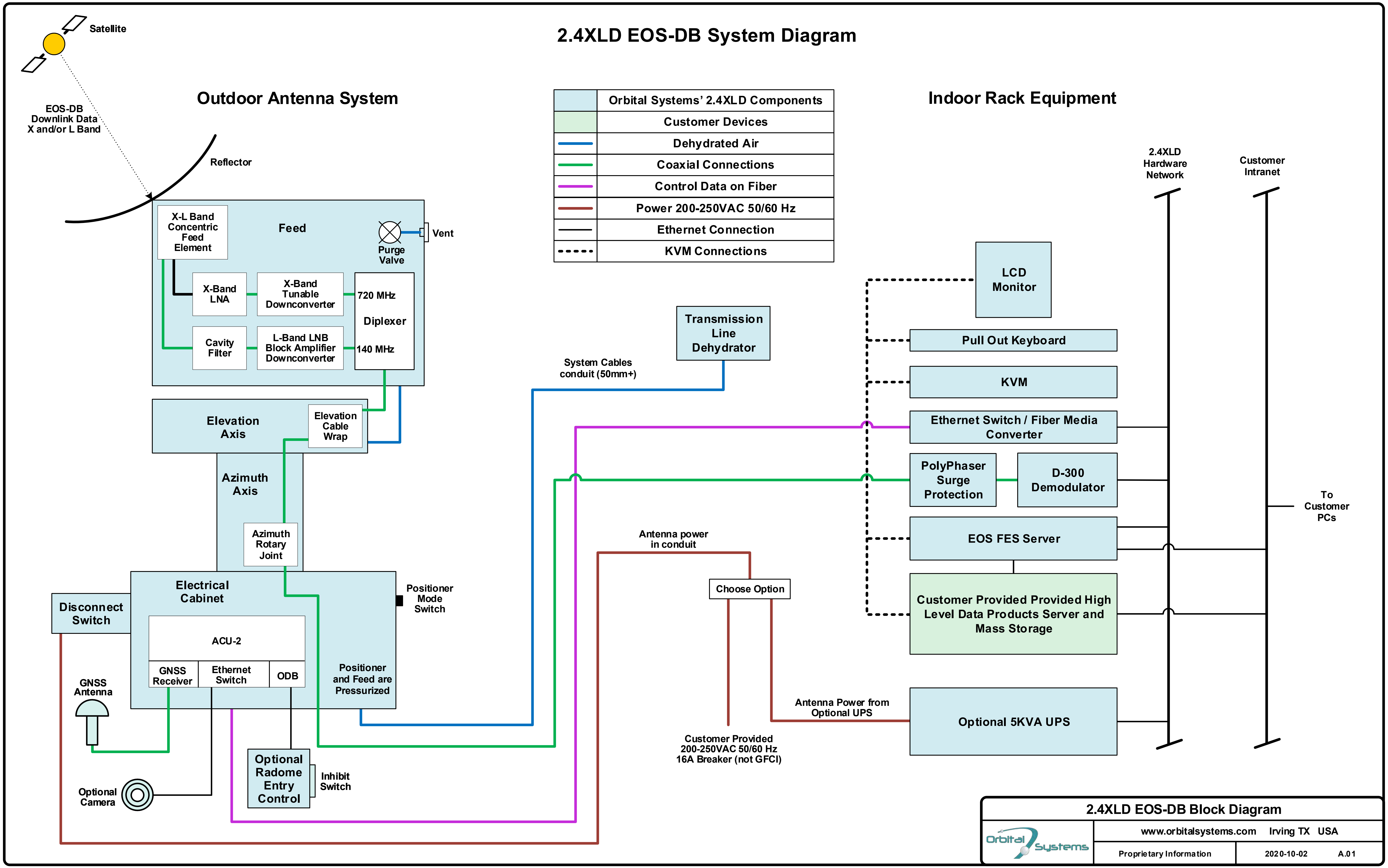


(light blue)	Orbital Systems' 2.4XLD Components
(light green)	Customer Network Devices
(light yellow)	Software Applications
(solid line)	CAT5E Connection
(dashed line)	Optional CAT5E Connection
(orange line)	100BASE-FX Connection

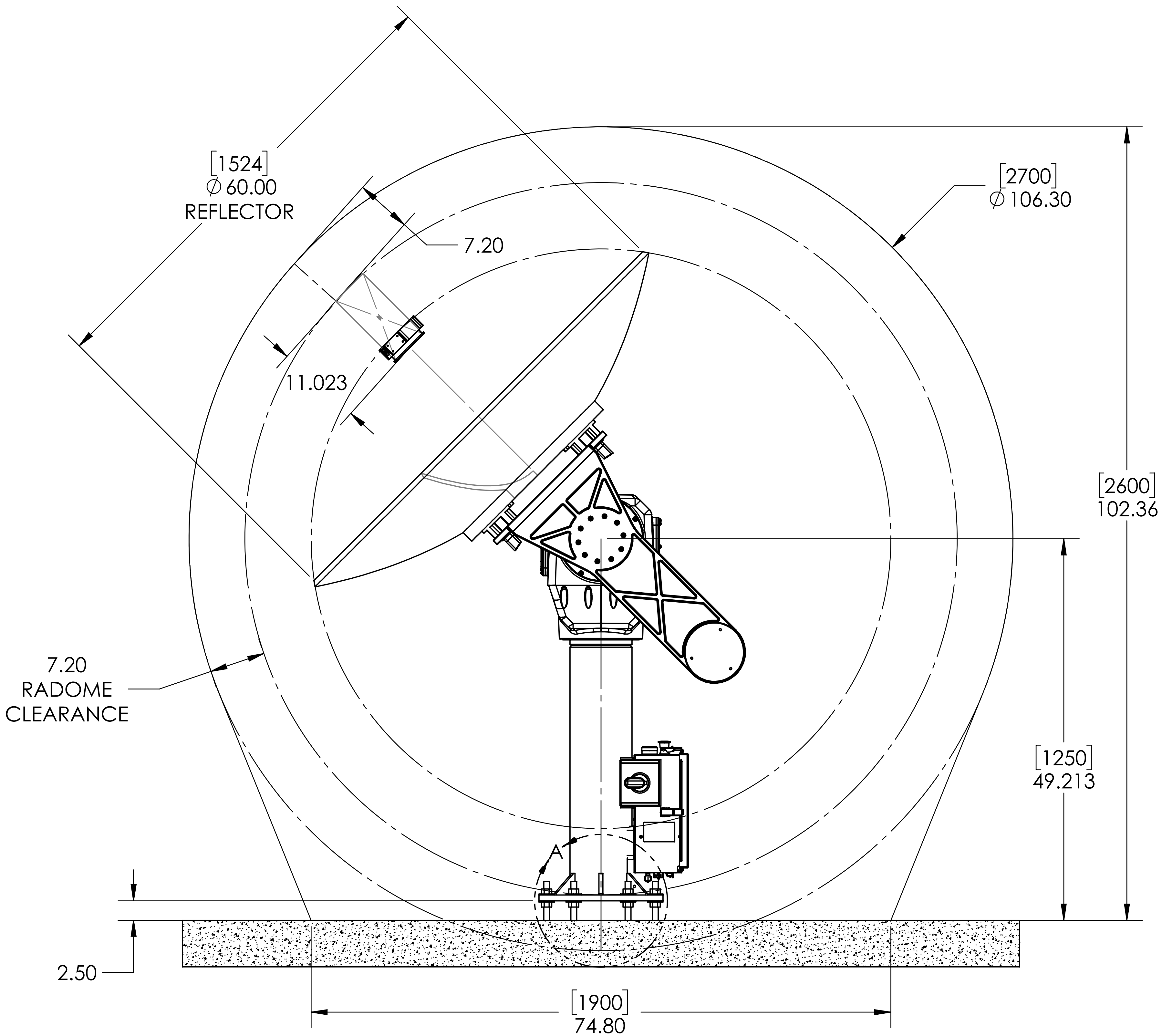
Note 1: Orbital hardware network addresses shown are actual, customer network addresses shown are typical
Note 2: The Hardware Network must not be exposed to the Internet
Note 3: Optional network Camera is port forwarded through the EOS-FES Accessible by URL: http://192.168.0.201:15080

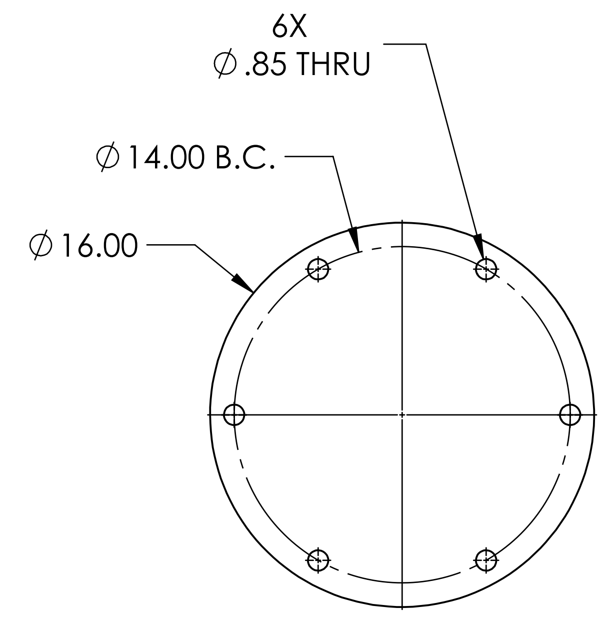
2.4XLD EOS-DB Typical Network Configuration

Orbital Systems LLC, Irving TX, USA
Proprietary Information
2020-12-16 ver A.2


2.4XLD EOS-DB System Diagram
Satellite
EOS-DB Downlink Data X and/or L Band
Outdoor Antenna System
Reflector
X-L Band Concentric Feed Element
Feed
Purge Valve
Vent
X-Band LNA
X-Band Tunable Downconverter
720 MHz
Diplexer
140 MHz
Cavity Filter
L-Band LNB Block Amplifier Downconverter
Elevation Axis
Elevation Cable Wrap
Azimuth Axis
Azimuth Rotary Joint
Electrical Cabinet
Disconnect Switch
ACU-2
GNSS Receiver
Ethernet Switch
ODB
Positioner Mode Switch
Positioner and Feed are Pressurized
GNSS Antenna
Optional Camera
Optional Radome Entry Control
Inhibit Switch
Orbital Systems' 2.4XLD Components
Customer Devices
Dehydrated Air
Coaxial Connections
Control Data on Fiber
Power 200-250VAC 50/60 Hz
Ethernet Connection
KVM Connections
System Cables conduit (50mm+)
Transmission Line Dehydrator
Antenna power in conduit
Choose Option
Customer Provided 200-250VAC 50/60 Hz 16A Breaker (not GFCI)
Antenna Power from Optional UPS
Indoor Rack Equipment
LCD Monitor
Pull Out Keyboard
KVM
Ethernet Switch / Fiber Media Converter
PolyPhaser Surge Protection
D-300 Demodulator
EOS FES Server
Customer Provided Provided High Level Data Products Server and Mass Storage
Optional 5KVA UPS
2.4XLD Hardware Network
Customer Intranet
To Customer PCs
2.4XLD EOS-DB Block Diagram
Orbital Systems
www.orbitalsystems.com Irving TX USA
Proprietary Information
2020-10-02
A.01

NOTES: FOR REFERENCE ONLY





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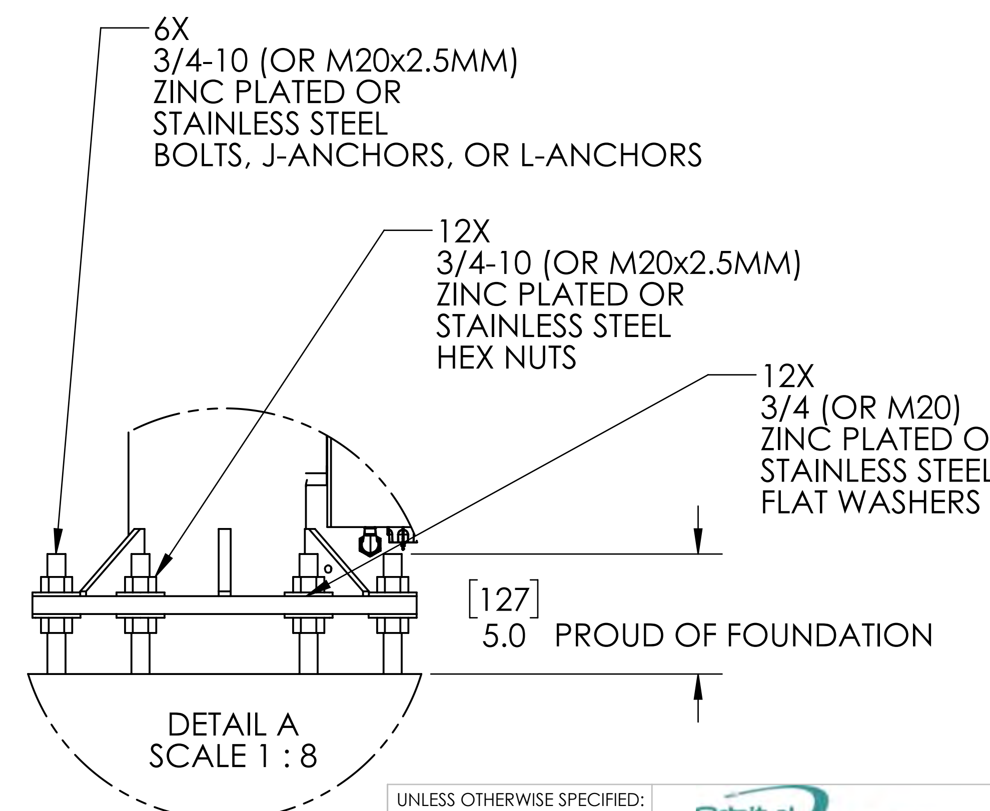

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ANGULAR: MACH ± .5 BEND ± .5
TWO PLACE DECIMAL ± .01
THREE PLACE DECIMAL ± .005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5

MATERIAL

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Orbital Systems

TITLE:
1.5M POSITIONER RADOME LAYOUT

SIZE **B** DWG. NO. REV

SCALE: 1:16 WEIGHT: 6147.40 SHEET 1 OF 1

NOTES: Unless Otherwise Specified

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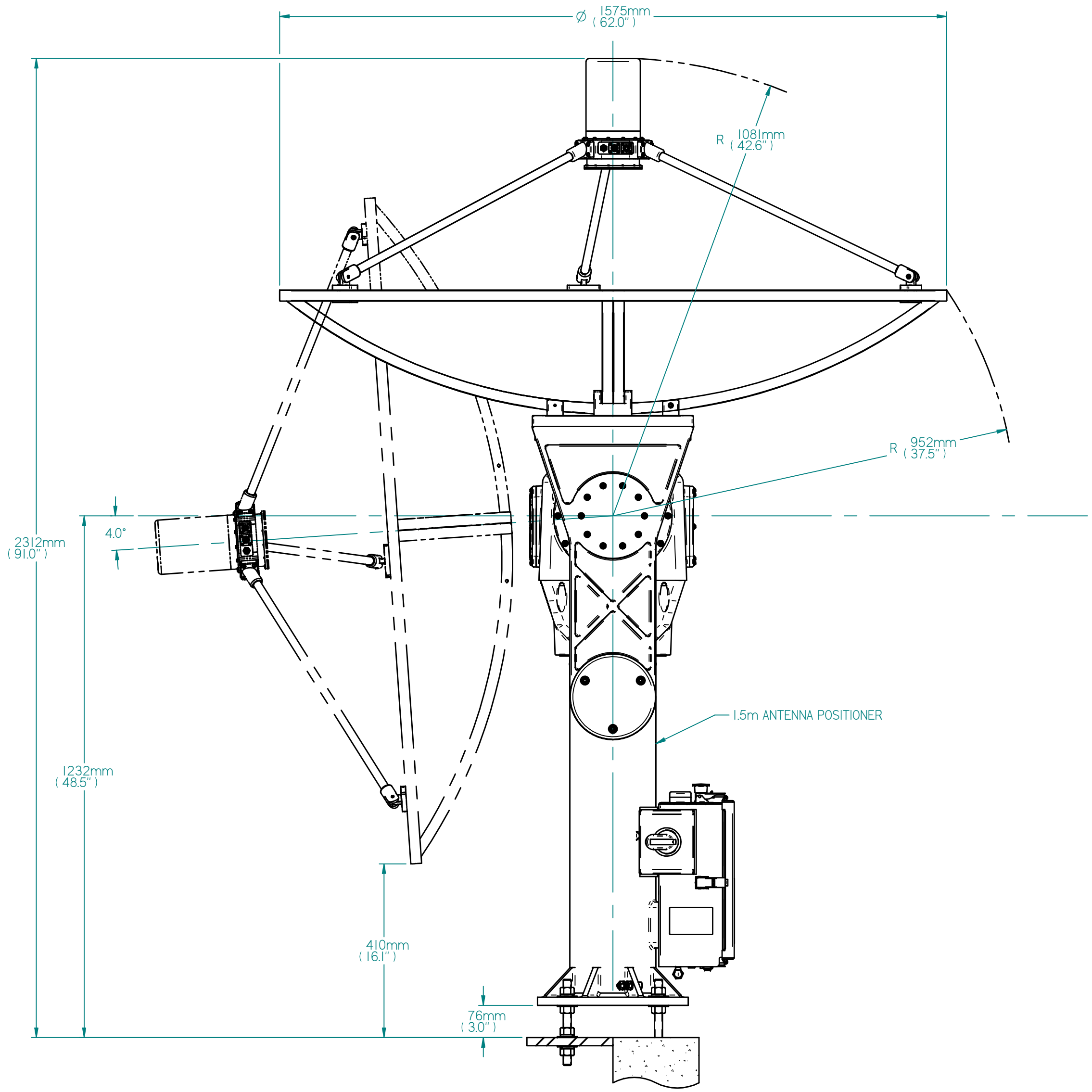

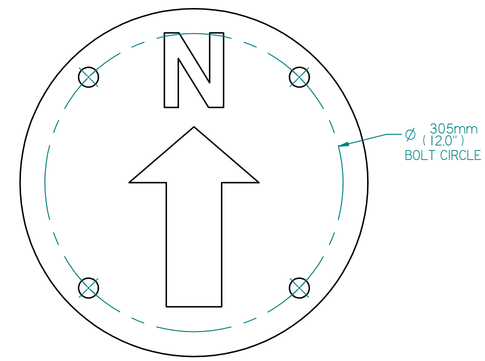

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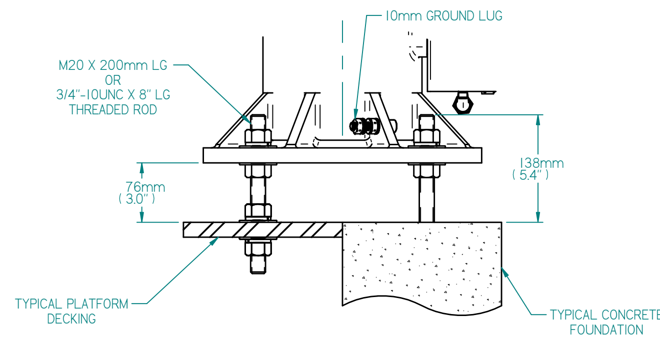

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XXX	± .005	
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DRAWN BY	S. OXLEY
DATE	
SCALE	NONE
SHEET	1 OF 1
SIZE	B
TITLE	1.8AEHT-1.5m ANTENNA POSITIONER
DRAWING NO.	AM 901-186
REV	C.1

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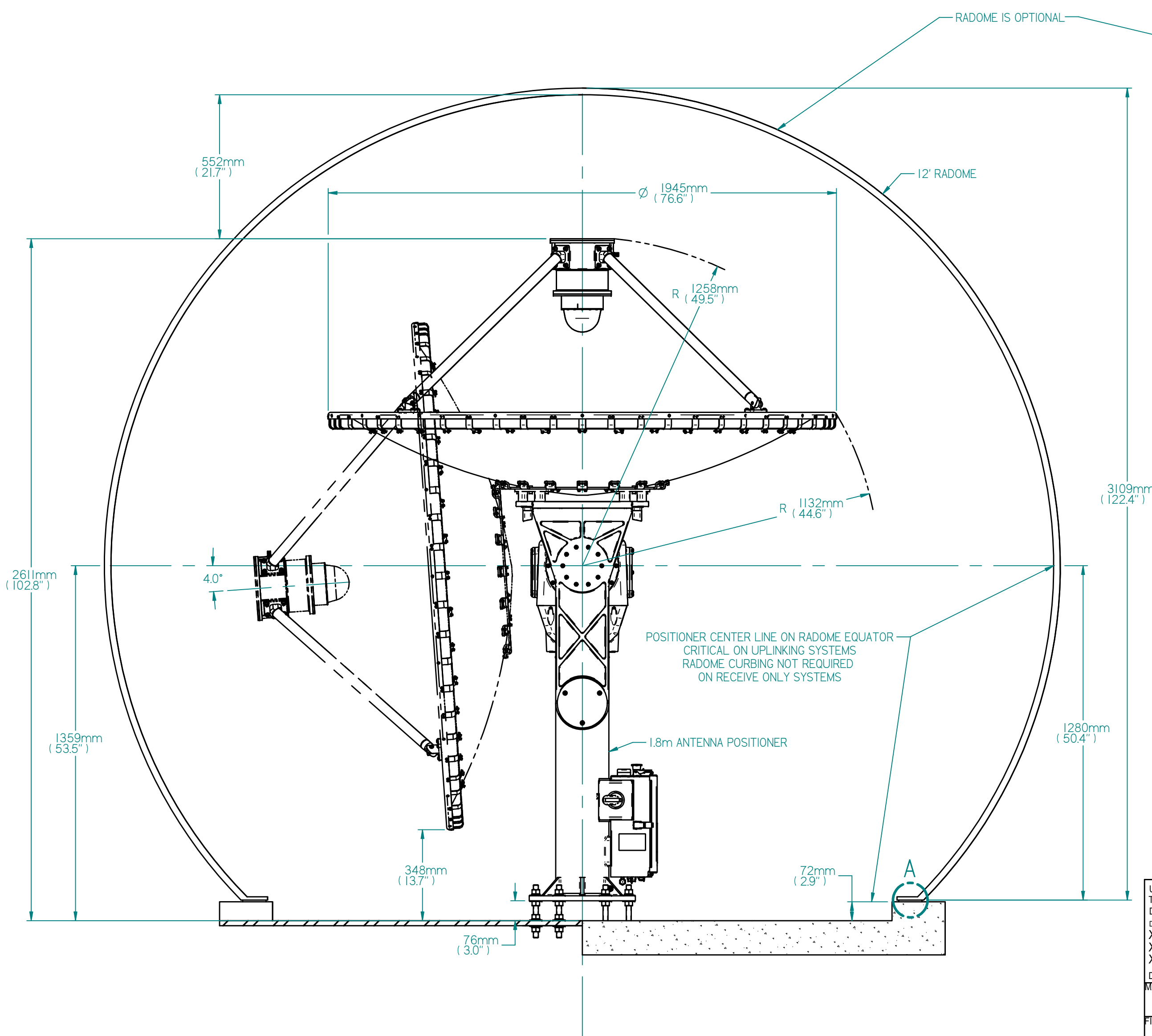

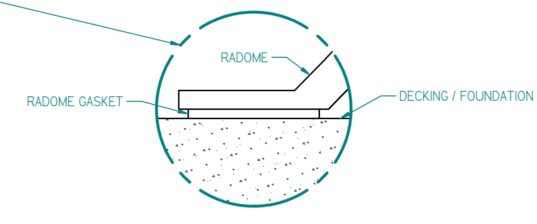

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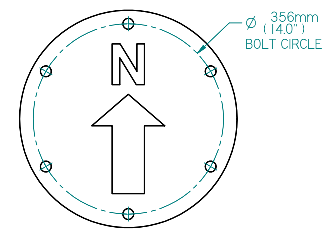

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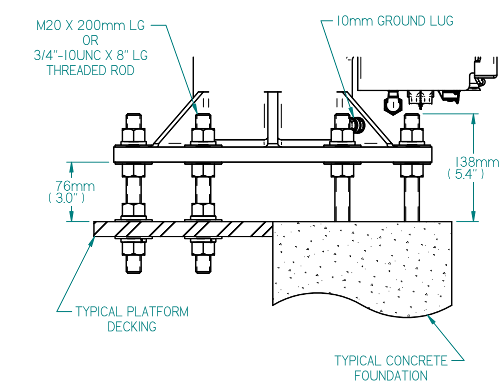

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SCALE NONE

SHEET 1 OF 1 | SIZE B

TITLE 1.8AEHT-1.8m ANTENNA POSITIONER

DRAWING NO. AM 901-187 | REV C.1

NOTES: Unless Otherwise Specified

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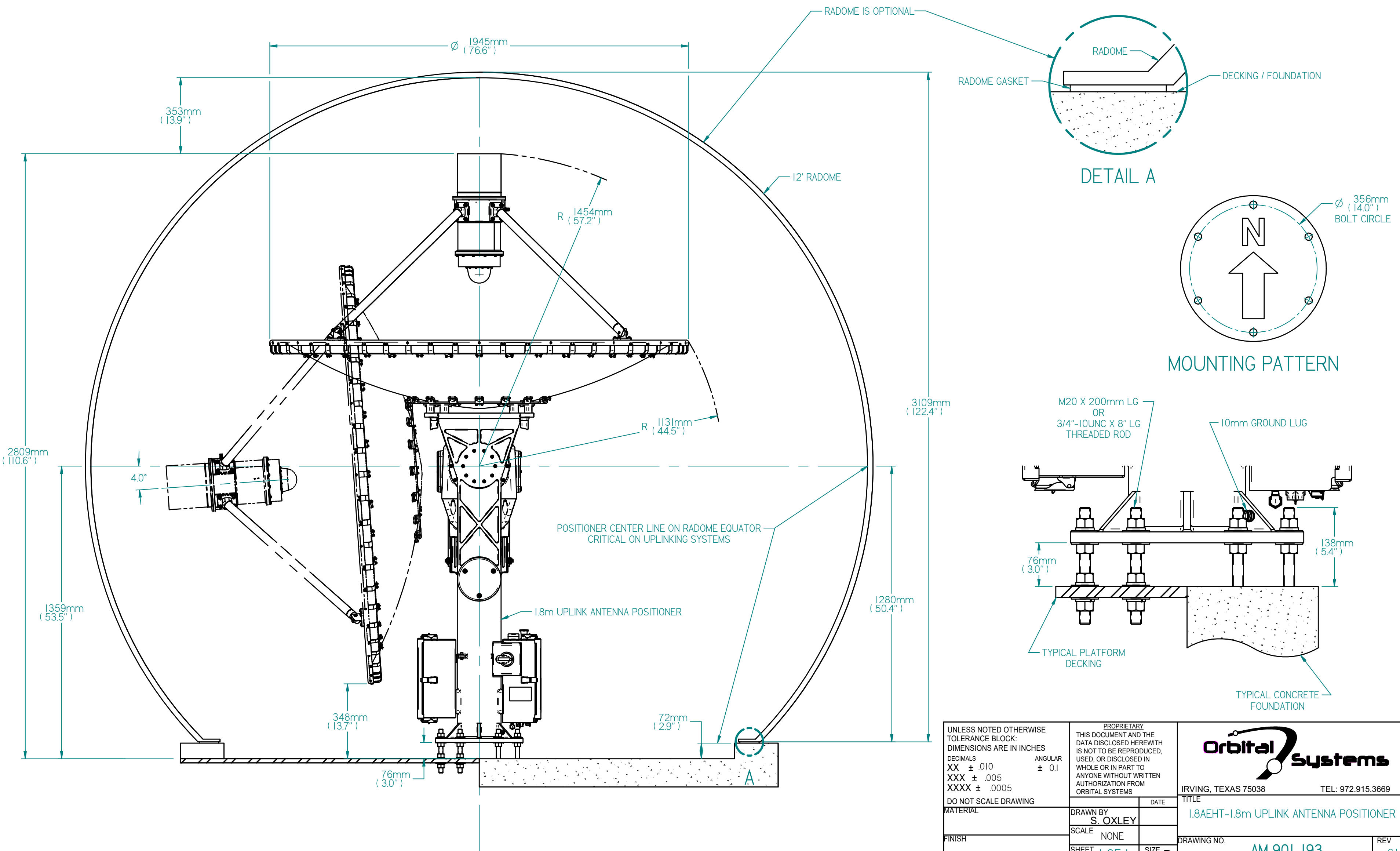

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MATERIAL	DATE DRAWN BY S. OXLEY	TITLE 1.8AEHT-1.8m UPLINK ANTENNA POSITIONER
FINISH	SCALE NONE SHEET 1 OF 1 SIZE B	DRAWING NO. AM 901-193 REV C.1

NOTES: Unless Otherwise Specified

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2. TUMBLE FINISH BEFORE PLATING, ANODIZING OR POWDER COATING
3. MASK ALL TAPED HOLES BEFORE ANODIZING OR POWDER COAT

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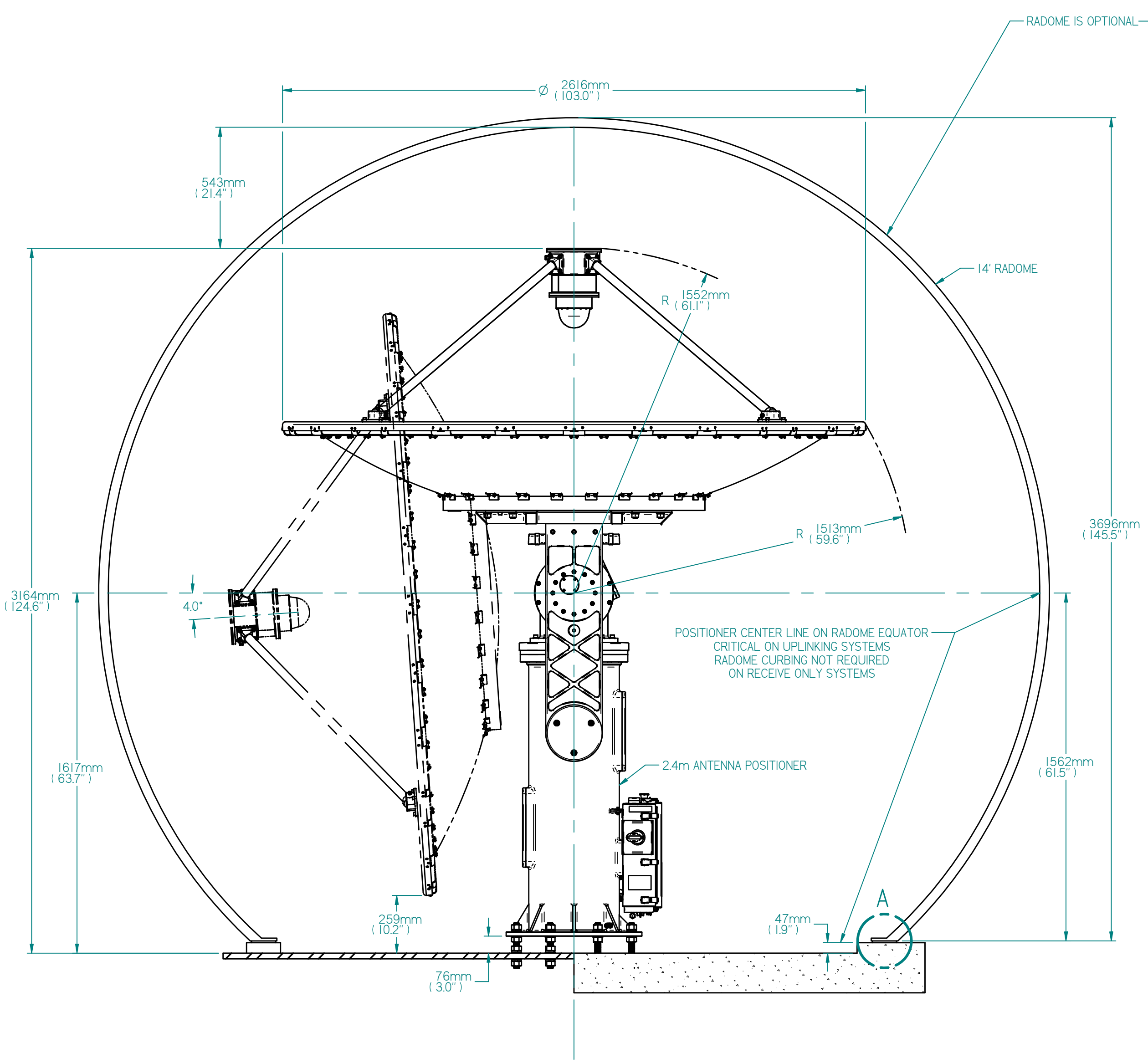

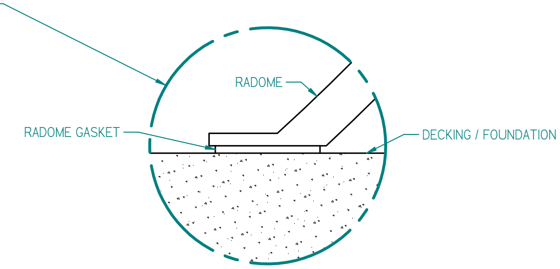

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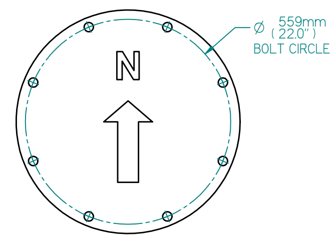

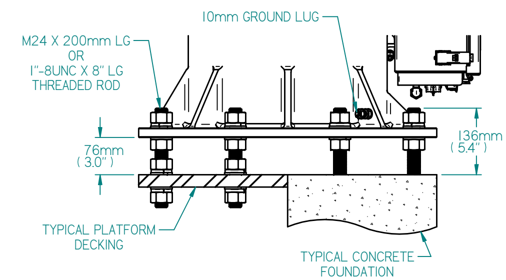

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MATERIAL

FINISH

DRAWN BY: S. OXLEY
DATE

SCALE: NONE

SHEET: 1 OF 1

SIZE: B

TITLE: 2.4AEBP-2.4m ANTENNA POSITIONER

DRAWING NO.: AM 901-190

REV: C.1

NOTES: Unless Otherwise Specified

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2. TUMBLE FINISH BEFORE PLATING, ANODIZING OR POWDER COATING
3. MASK ALL TAPED HOLES BEFORE ANODIZING OR POWDER COAT

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REV	ECO #	ZONE	DESCRIPTION OF CHANGE(S)	DATE	CHANGED / APPROVED

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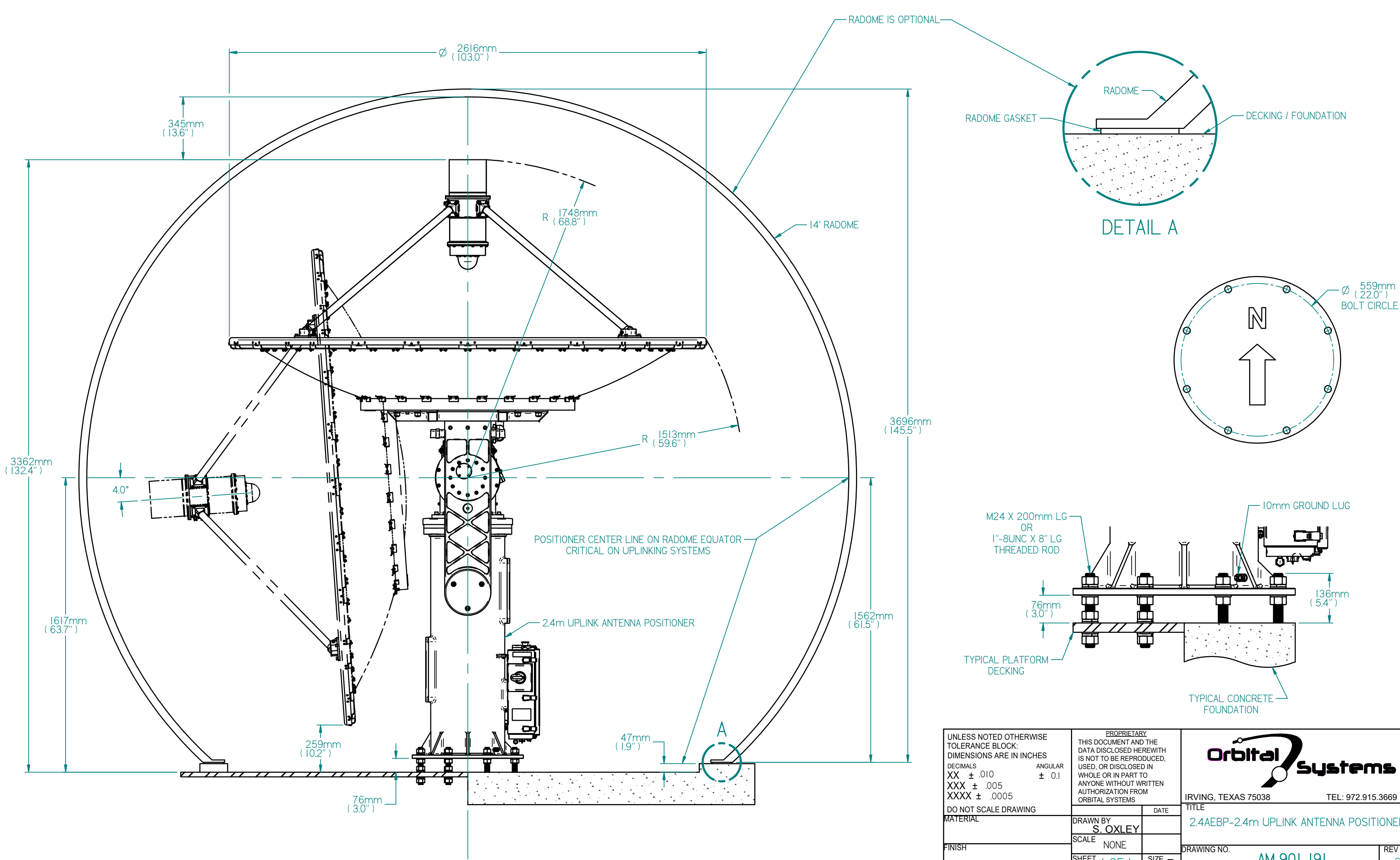

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DO NOT SCALE DRAWING

MATERIAL

FINISH

DATE

DRAWN BY S. OXLEY

SCALE NONE

SHEET 1 OF 1 SIZE B

Orbital Systems
IRVING, TEXAS 75038 TEL: 972.915.3669

TITLE 2.4AEBP-2.4m UPLINK ANTENNA POSITIONER

DRAWING NO. AM 901-191 REV C.1

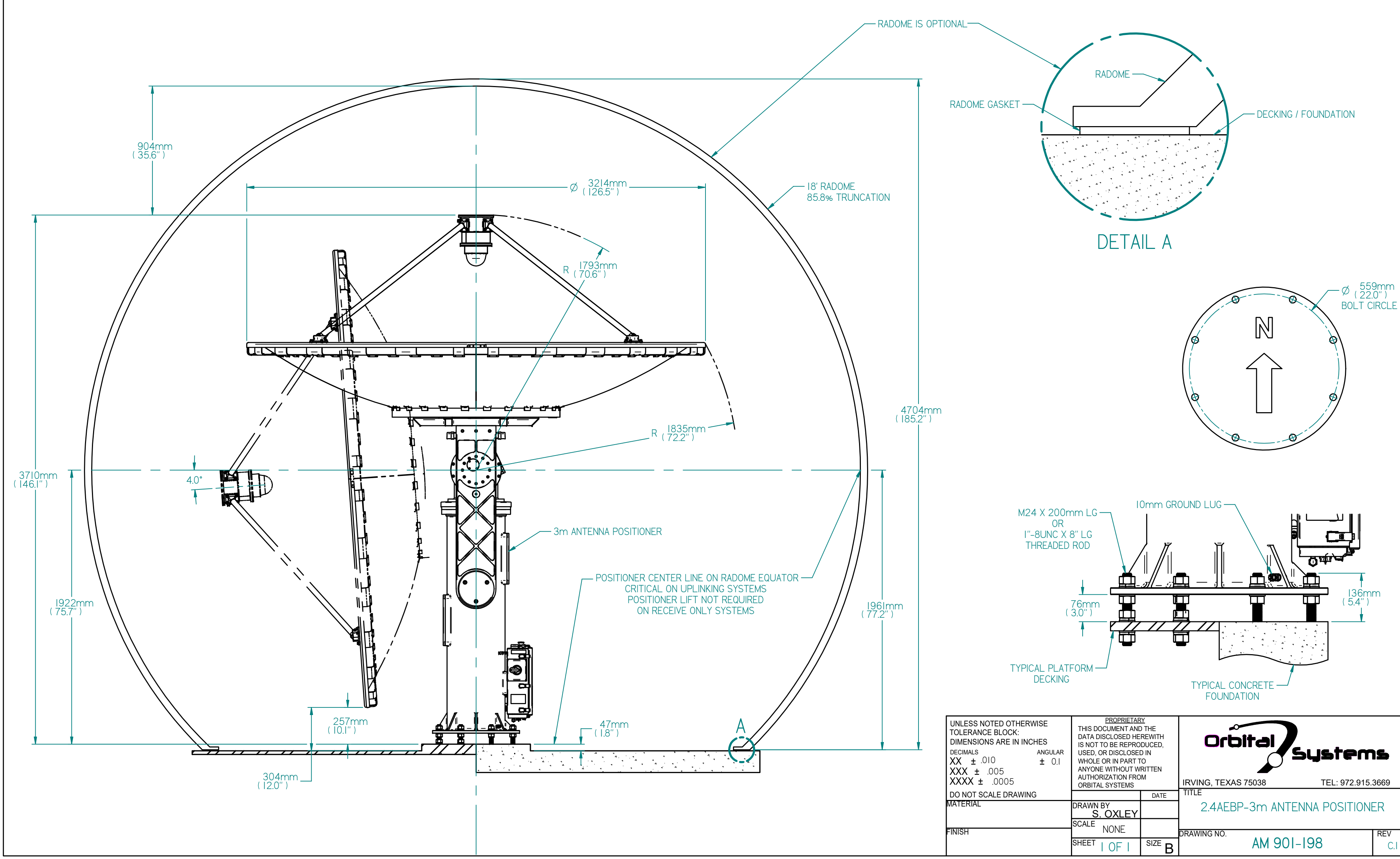
NOTES: Unless Otherwise Specified

1. DEBURR AND REMOVE ALL SHARP EDGES .02 AS REQD.
2. TUMBLE FINISH BEFORE PLATING, ANODIZING OR POWDER COATING
3. MASK ALL TAPED HOLES BEFORE ANODIZING OR POWDER COAT

REVISION BLOCK

REV	ECO #	ZONE	DESCRIPTION OF CHANGE(S)	DATE	CHANGED / APPROVED

DWG NO. AM 901-198 REV C.1



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MATERIAL	DRAWN BY S. OXLEY / DATE	TITLE 2.4AEBP-3m ANTENNA POSITIONER	
FINISH	SCALE NONE		
	SHEET 1 OF 1 / SIZE B	DRAWING NO. AM 901-198	REV C.1

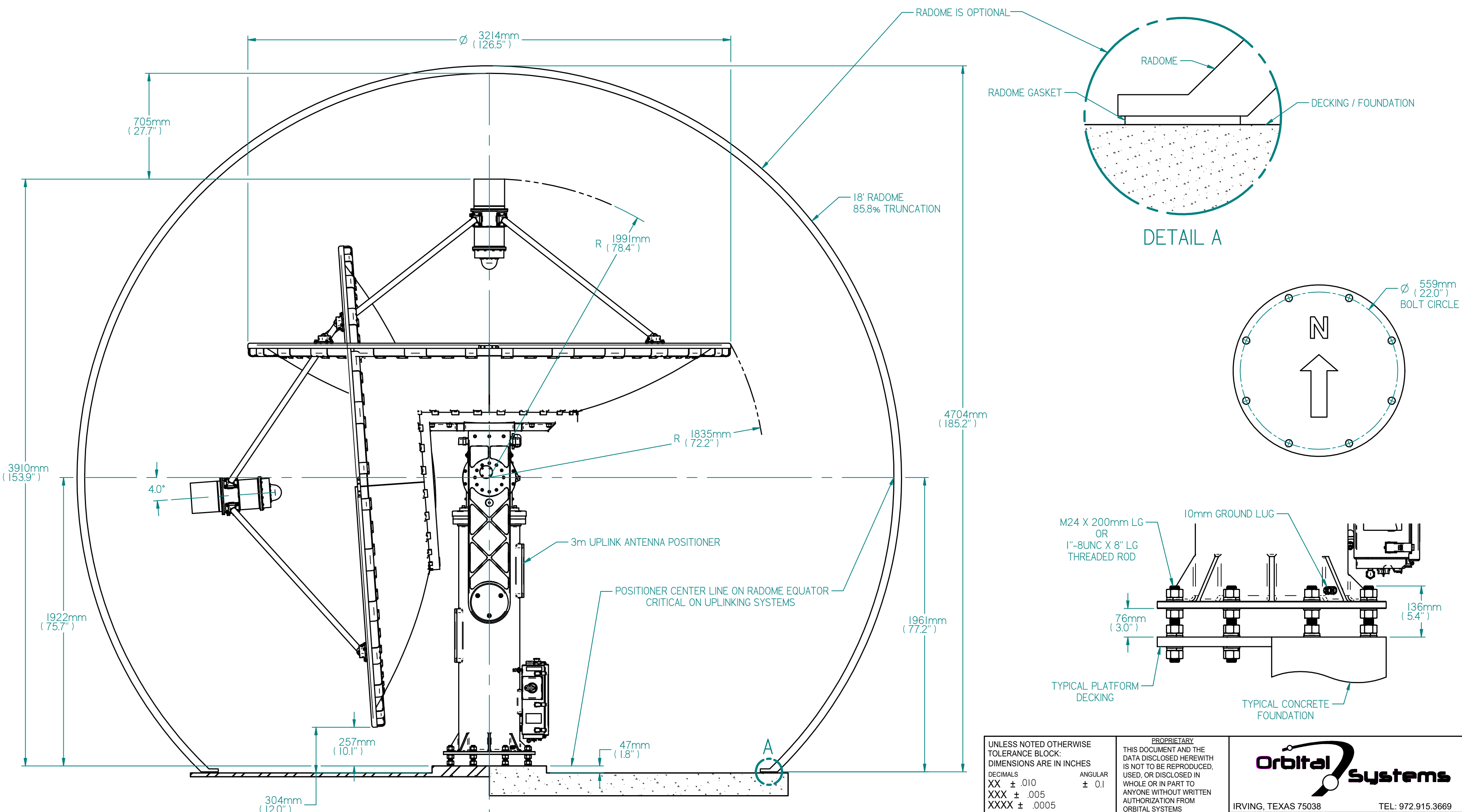
NOTES: Unless Otherwise Specified

1. DEBURR AND REMOVE ALL SHARP EDGES .02 AS REQD.
2. TUMBLE FINISH BEFORE PLATING, ANODIZING OR POWDER COATING
3. MASK ALL TAPED HOLES BEFORE ANODIZING OR POWDER COAT

REVISION BLOCK

REV	ECO #	ZONE	DESCRIPTION OF CHANGE(S)	DATE	CHANGED / APPROVED

DWG NO AM 901-195 REV C.1



UNLESS NOTED OTHERWISE TOLERANCE BLOCK: DIMENSIONS ARE IN INCHES DECIMALS: XX ± .010, XXX ± .005, XXXX ± .0005 ANGULAR: ± 0.1 DO NOT SCALE DRAWING	PROPRIETARY THIS DOCUMENT AND THE DATA DISCLOSED HEREWITH IS NOT TO BE REPRODUCED, USED, OR DISCLOSED IN WHOLE OR IN PART TO ANYONE WITHOUT WRITTEN AUTHORIZATION FROM ORBITAL SYSTEMS	Orbital Systems IRVING, TEXAS 75038 TEL: 972.915.3669
MATERIAL	DRAWN BY S. OXLEY DATE	TITLE 2.4AEBP-3m UPLINK ANTENNA POSITIONER
FINISH	SCALE NONE SHEET 1 OF 1 SIZE B	DRAWING NO. AM 901-195 REV C.1

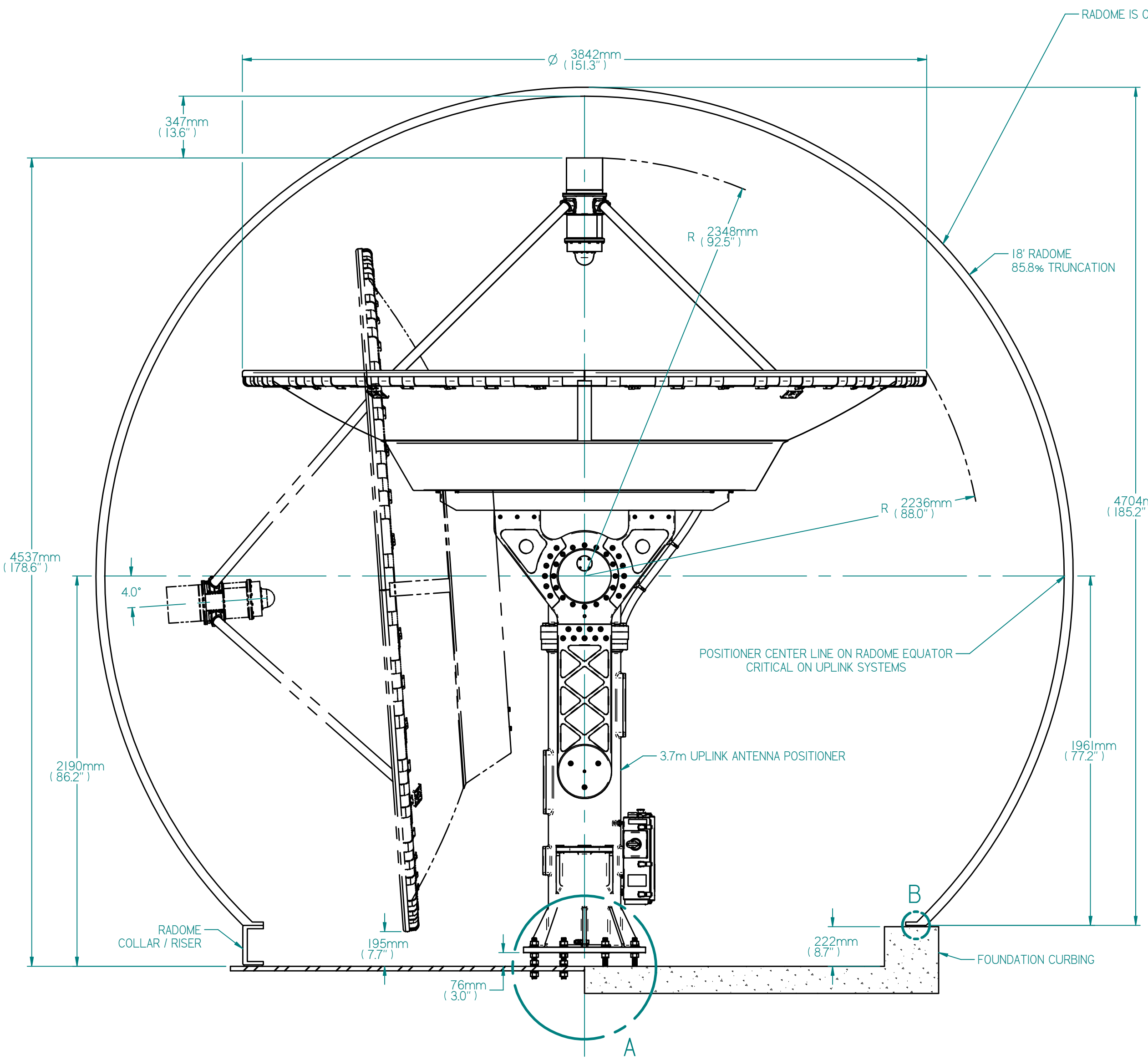
NOTES: Unless Otherwise Specified

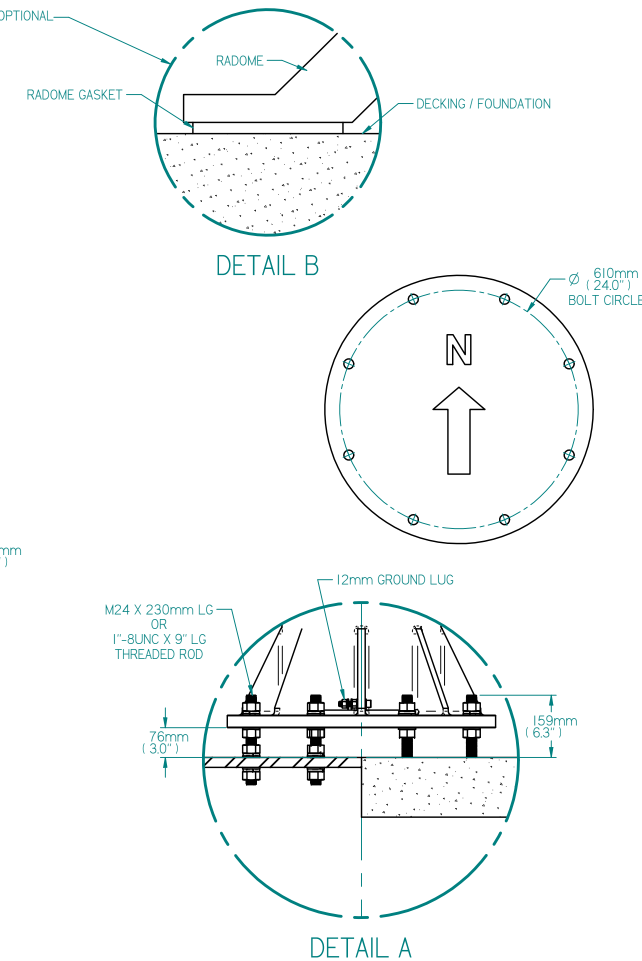
1. DEBURR AND REMOVE ALL SHARP EDGES .02 AS REQD.
2. TUMBLE FINISH BEFORE PLATING, ANODIZING OR POWDER COATING
3. MASK ALL TAPED HOLES BEFORE ANODIZING OR POWDER COAT

REVISION BLOCK

REV	ECO #	ZONE	DESCRIPTION OF CHANGE(S)	DATE	CHANGED / APPROVED

DWG NO AM 901-196 REV C.1





UNLESS NOTED OTHERWISE
TOLERANCE BLOCK:
DIMENSIONS ARE IN INCHES

DECIMALS		ANGULAR
XX	± .010	± 0.1
XXX	± .005	
XXXX	± .0005	

DO NOT SCALE DRAWING

PROPRIETARY
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Orbital Systems
IRVING, TEXAS 75038 TEL: 972.915.3669

MATERIAL	DRAWN BY S. OXLEY	DATE
FINISH	SCALE NONE	
	SHEET 1 OF 1	SIZE B

TITLE: 3.0AEBP-3.7m UPLINK ANTENNA POSITIONER

DRAWING NO. AM 901-196 REV C.1

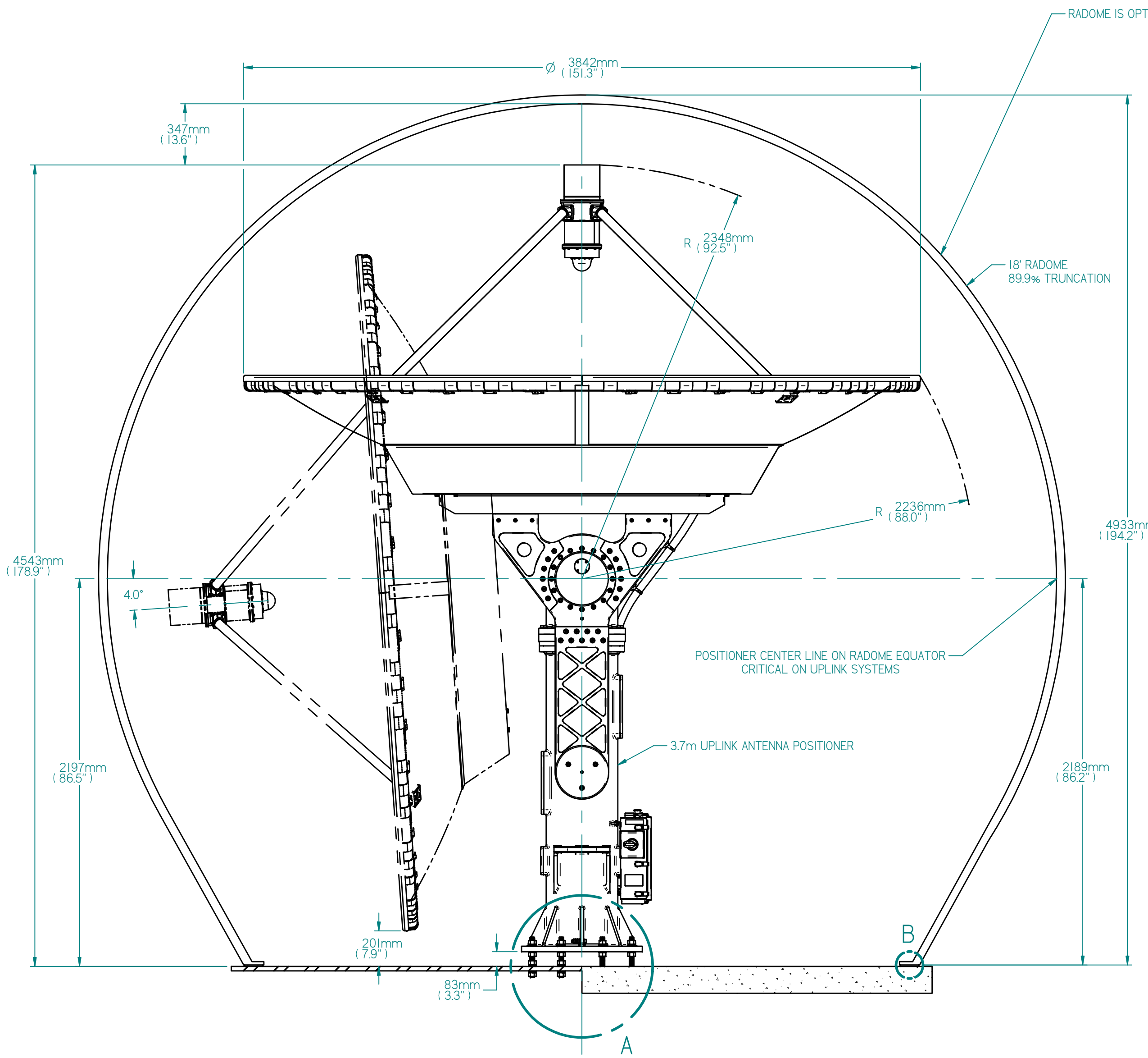
NOTES: Unless Otherwise Specified

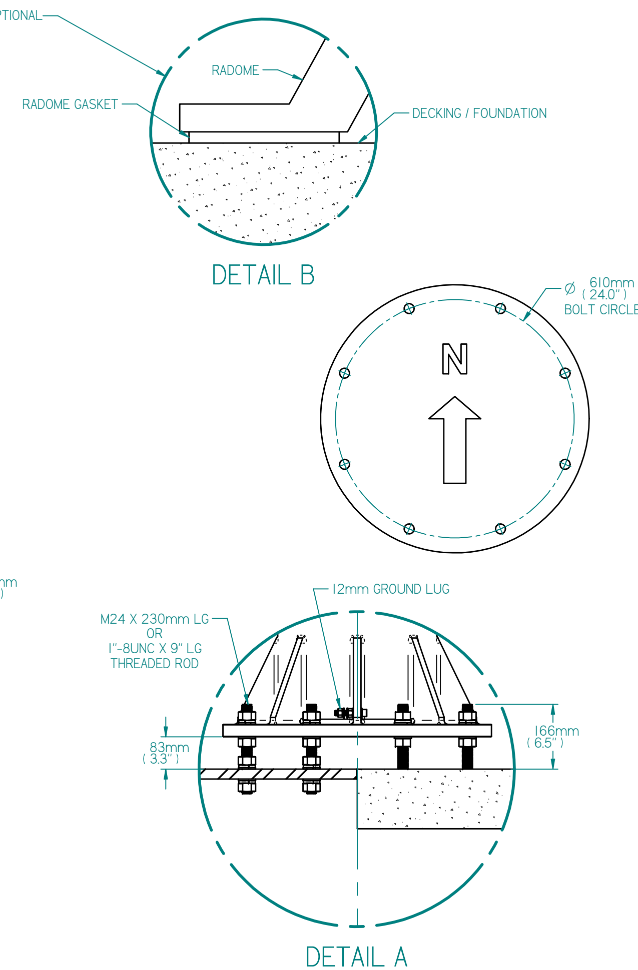
1. DEBURR AND REMOVE ALL SHARP EDGES .02 AS REQD.
2. TUMBLE FINISH BEFORE PLATING, ANODIZING OR POWDER COATING
3. MASK ALL TAPED HOLES BEFORE ANODIZING OR POWDER COAT

REVISION BLOCK

REV	ECO #	ZONE	DESCRIPTION OF CHANGE(S)	DATE	CHANGED / APPROVED

DWG NO AM 901-196 REV C.1





UNLESS NOTED OTHERWISE TOLERANCE BLOCK: DIMENSIONS ARE IN INCHES

DECIMALS: XX ± .010; XXX ± .005; XXXX ± .0005
ANGULAR: ± 0.1

DO NOT SCALE DRAWING

MATERIAL

FINISH

PROPRIETARY
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DATE

DRAWN BY S. OXLEY

SCALE NONE

SHEET 1 OF 1 SIZE B

Orbital Systems

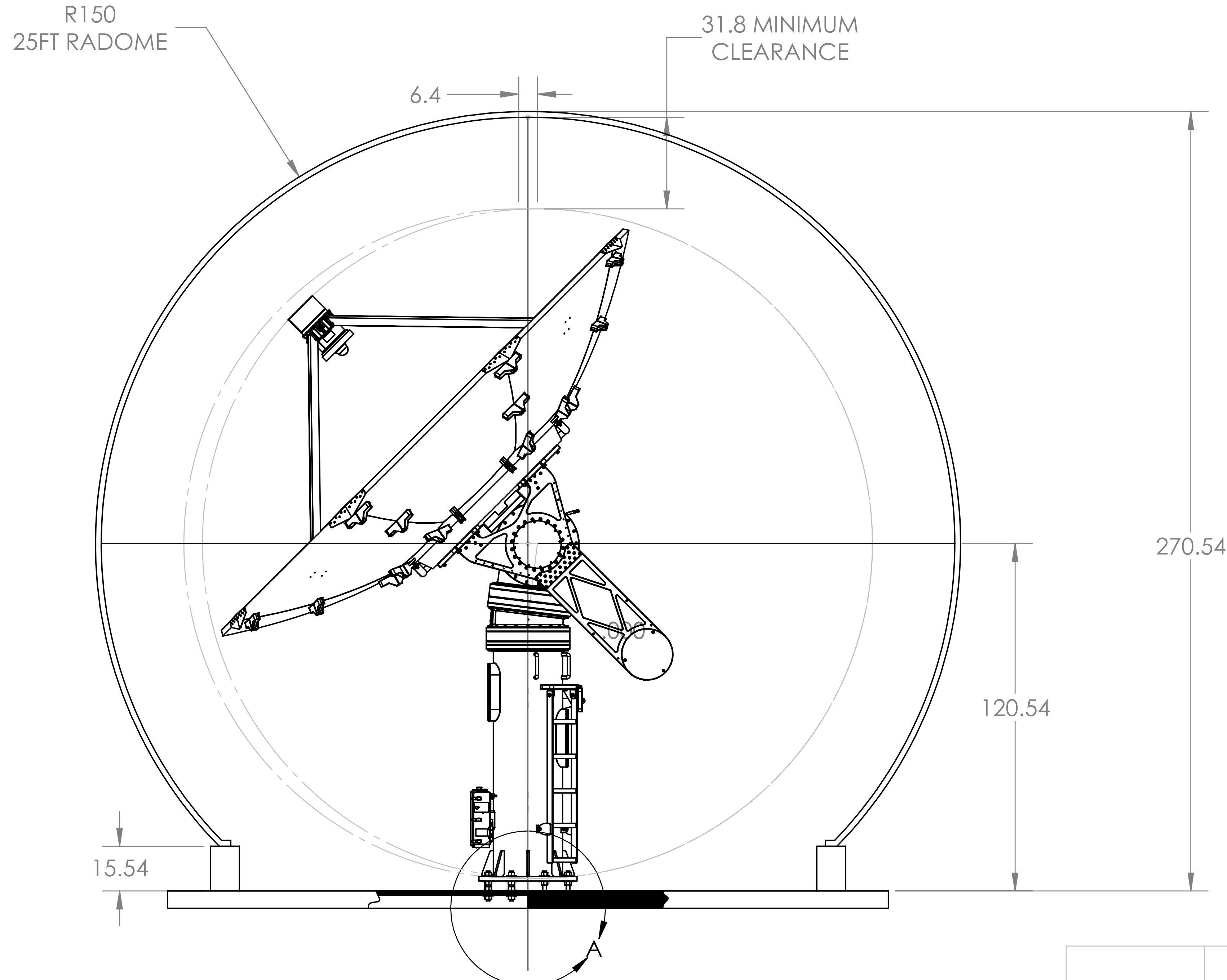
IRVING, TEXAS 75038 TEL: 972.915.3669

TITLE 3.0AEBP-3.7m UPLINK ANTENNA POSITIONER

DRAWING NO. AM 901-196 REV C.1

NOTES: FOR REFERENCE ONLY

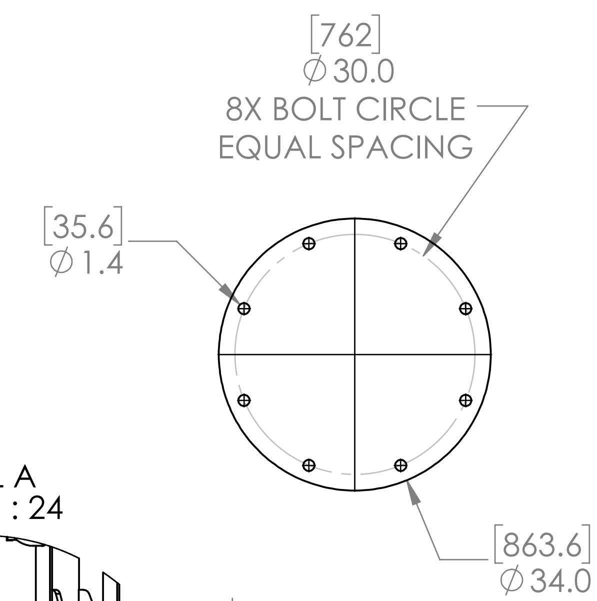
REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED



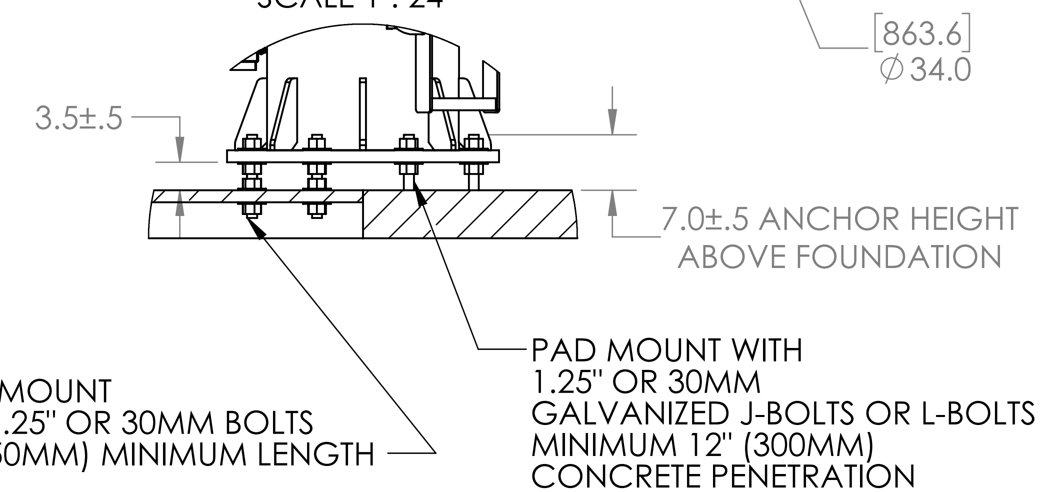
5.0M POSITIONER APPROXIMATE MASS

POSITIONER WITH COMPOSITE REFLECTOR AND FEED:
5400 LBM (2449 KG)

POSITIONER WTIHOUT REFLECTOR OR FEED:
4750 LBM (2155 KG)



DETAIL A
SCALE 1 : 24



NEXT ASSY	USED ON	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL±1/16 ANGULAR: MACH± .5 BEND ±.5 TWO PLACE DECIMAL ±.01 THREE PLACE DECIMAL ±.005	
APPLICATION		INTERPRET GEOMETRIC TOLERANCING PER:	
		MATERIAL	
		FINISH	
		DO NOT SCALE DRAWING	

	NAME	DATE
DRAWN	MM	20161003
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
COMMENTS:		

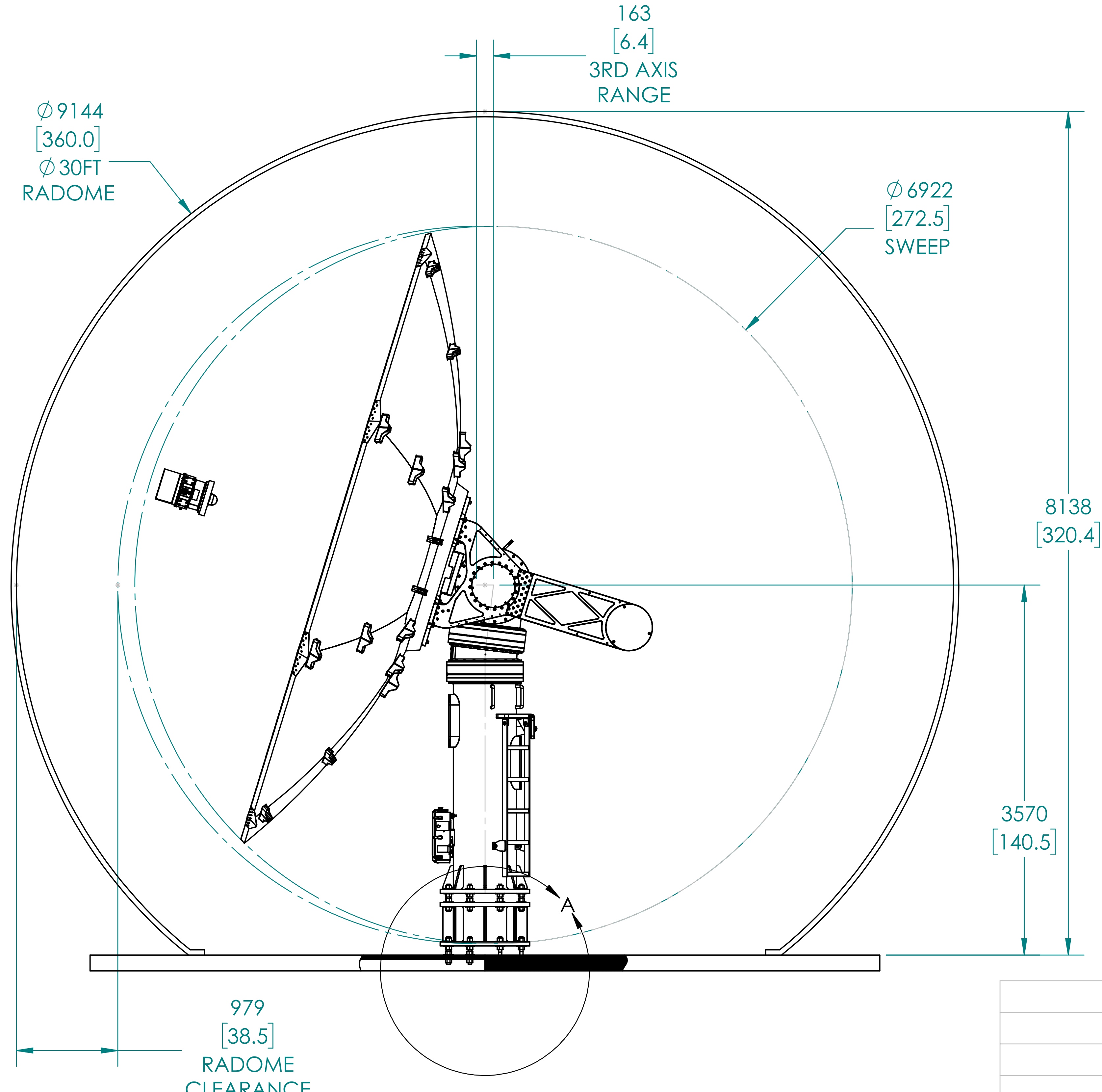
Orbital Systems

TITLE:
5.0M POSITIONER LAYOUT

SIZE	DWG. NO.	REV
B	885-000	0

SCALE: 1:48 WEIGHT: SHEET 1 OF 1

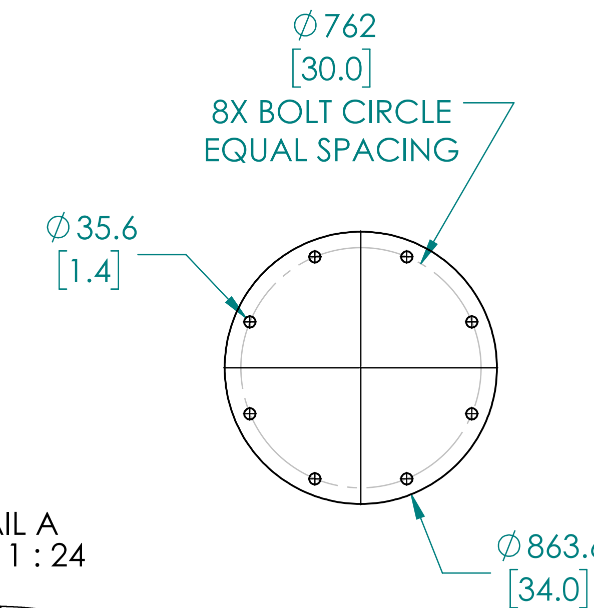
NOTES: FOR REFERENCE ONLY



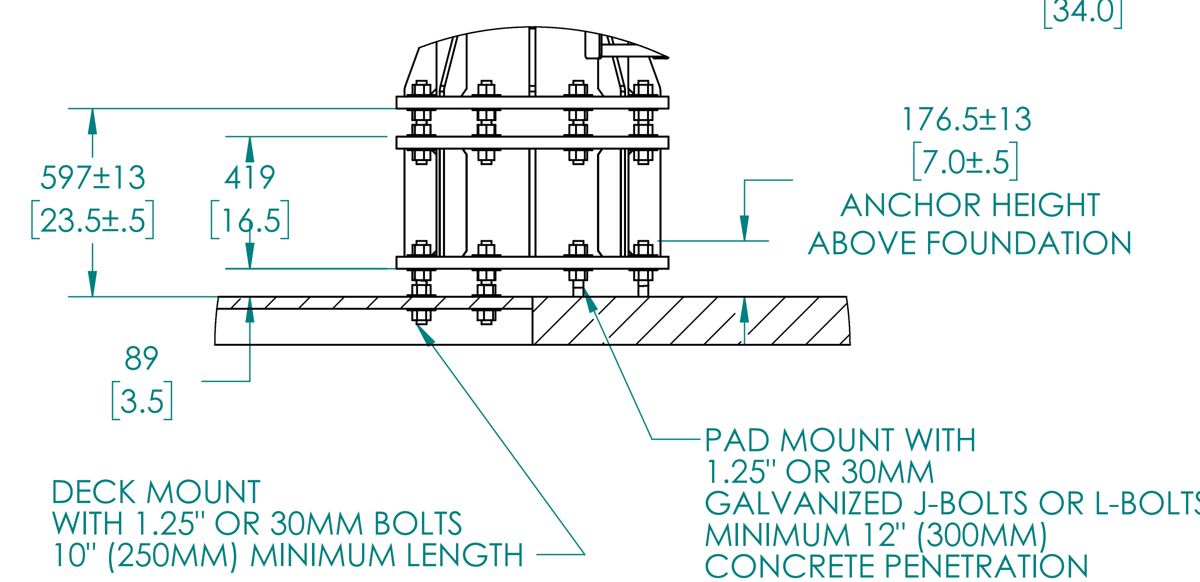
5.0AE3BP-6.1M POSITIONER APPROXIMATE MASS

POSITIONER WITH COMPOSITE REFLECTOR AND FEED:
5600 LBM (2540 KG)

POSITIONER WTIHOUT REFLECTOR OR FEED:
4950 LBM (2245 KG)



DETAIL A
SCALE 1 : 24



PROPRIETARY AND CONFIDENTIAL

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NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN MM [IN]
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± .5 BEND ± .5
TWO PLACE DECIMAL ± .01
THREE PLACE DECIMAL ± .005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	MM	20180208
CHECKED	-	
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

Orbital Systems

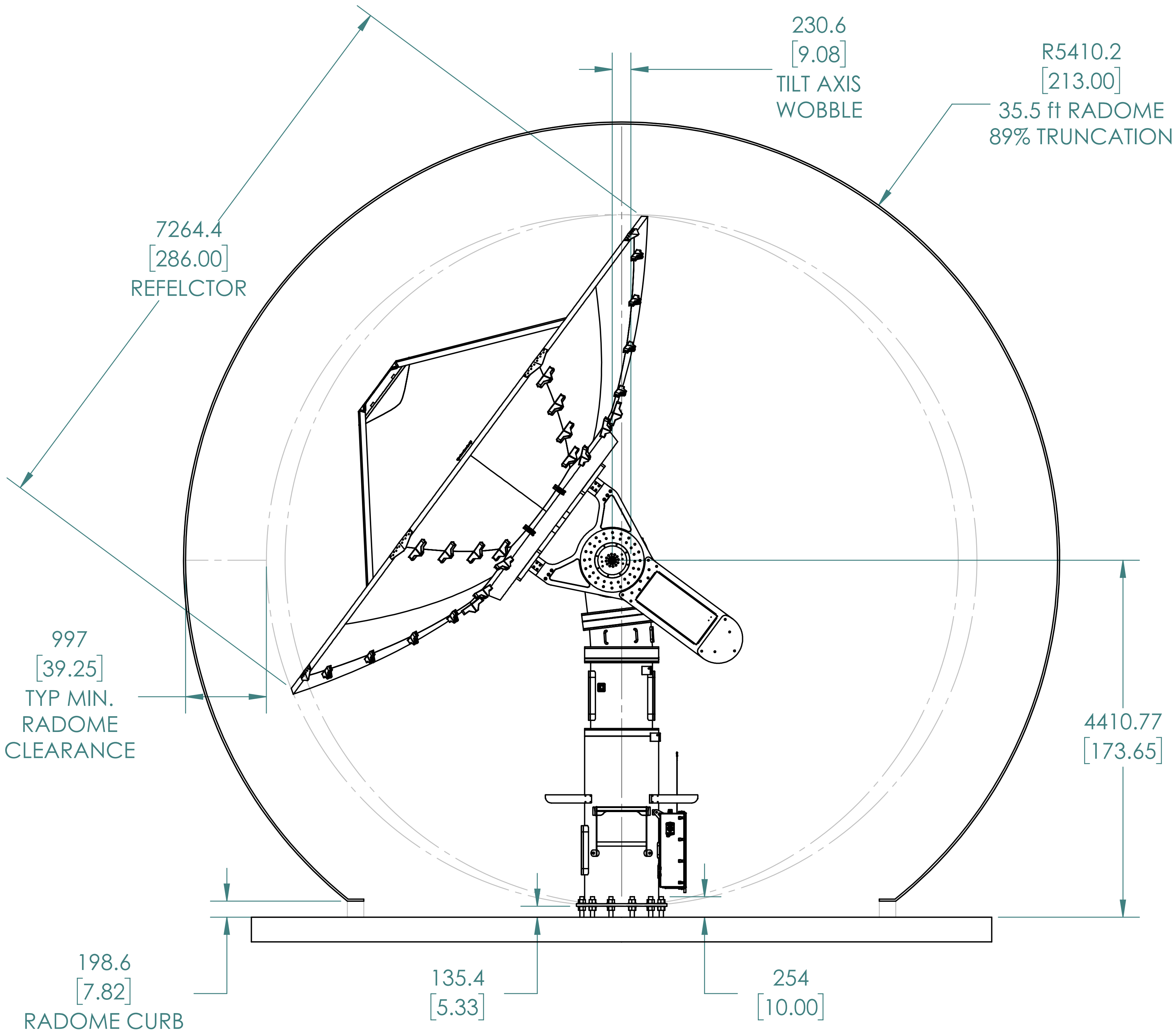
TITLE:
5.0AE3BP-6.1M POSITIONER LAYOUT

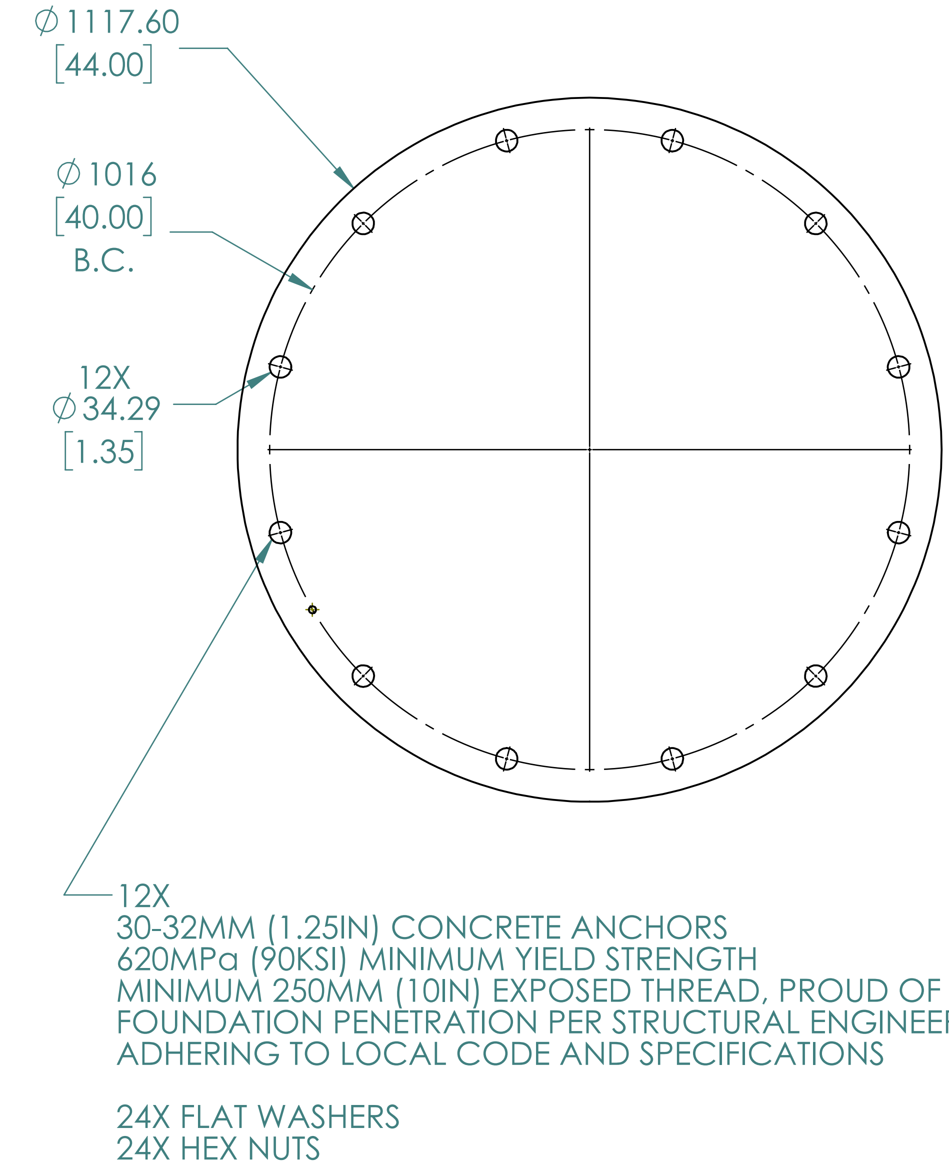
SIZE	DWG. NO.	REV
B	AM 886-001	3

SCALE: 1:48 WEIGHT: SHEET 1 OF 1

NOTES:
FOR REFERENCE ONLY

REVISIONS					
ZONE	REV.	DESCRIPTION	DATE	DRAWN BY	APPROVED BY
	A.01	UPDATED BASE BOLT CIRCLE	20210504	MM	-
	A.02	UPDATED MODEL	20211026	MM	-





12X
30-32MM (1.25IN) CONCRETE ANCHORS
620MPa (90KSI) MINIMUM YIELD STRENGTH
MINIMUM 250MM (10IN) EXPOSED THREAD, PROUD OF FOUNDATION
FOUNDATION PENETRATION PER STRUCTURAL ENGINEER,
ADHERING TO LOCAL CODE AND SPECIFICATIONS

24X FLAT WASHERS
24X HEX NUTS

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN MM [IN]
TOLERANCES:
FRACTIONAL ±1/16
ANGULAR: MACH± .5 BEND ±.5
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5

MATERIAL

FINISH

DO NOT SCALE DRAWING

Orbital Systems

TITLE: 7.3AE3BP-7.3M Positioner Layout with Radome

SIZE **B** | DWG. NO. | REV A.02

SCALE: 1:64 | WEIGHT: | SHEET 1 of 1

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