



RC700-f/12

Observatory-class
Observation System



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Why PlaneWave?

Company Overview

PlaneWave Instruments is a leading manufacturer of commercial off-the-shelf (COTS) tracking systems and ground based telescopes from 300mm to 1,000mm. When combined with emerging sensor technologies, our systems can provide sensitivities that meet or exceed mission requirements for most astronomy, SSA and optical communication applications.

Many of our telescopes are based on the revolutionary Corrected Dall-Kirkham (CDK) optical design developed by PlaneWave Chief Technical Officer David Rowe. The CDK design is coma free, has no off-axis astigmatism, and provides a wide flat imaging field. The CDK outperforms the older RC design in many ways; it is a lower cost telescope to manufacture and has a proven, field-tested track record.

Our telescope mountings are agile direct-drive tracking systems. They are highly reliable and allow slew speeds in excess of 50°/second. Our mounts are designed to meet requirements of >1,000,000 slews/year to affordably track orbital or deep-space objects.

PlaneWave telescopes and mounts have been designed to simplify both remote-control and autonomous operation. This facilitates creation of affordable and affordably operable world-wide SSA and optical-communication networks. The high tracking and slewing speeds and precision pointing of our mounts make them ideal for quickly transitioning between multiple types of targets (LEO, GEO, GPS, astronomy, etc.)

PlaneWave Instruments is a small privately-owned business and is proud to design and manufacture our products in the United States.

Core Capabilities

- The PlaneWave management team has decades of experience in the astronomy and manufacturing industries and has a proven track record of delivering products on time and on budget.
- PlaneWave is a leader in developing products that are innovative, high quality and designed to be scalable for volume manufacturing.
- Our facilities use SolidWorks, custom software tools, state-of-the-art CNC and 3D printing to design and realize our products.
- PlaneWave employs a pool of talented and innovative mechanical, electrical and software engineers. From new product development to custom design, our team is well suited to meet the rapidly evolving requirements of our customers.

Key Technologies

- PlaneWave has developed extensive motion control algorithms, astrometric analysis software, pointing analysis and correction software, and control system architectures that significantly enhance performance of our gimbal systems.
- PlaneWave's vertical integration includes inhouse design and manufacture of our gimbals, motors, optics and OTAs. This allows for minimized cost and maximized performance through design optimization of each system component.
- PlaneWave has developed state-of-the-art optical manufacturing and testing facilities. From individual mirrors to complete optical systems, we are able to ensure that each of our products are of the highest quality.

Company History

PlaneWave Instruments is a privately held company headquartered in Adrian, MI and was founded in 2006 by Richard Hedrick and Joseph Haberman. It operates design and manufacturing facilities in California and Michigan. Through the leadership of its founders and CTO David Rowe, the company developed and championed the CDK (Corrected Dall-Kirkham) telescope, a revolutionary new optical system.

In addition to consumer products, PlaneWave makes a full line of observatory class telescope mounts, and the CDK and Ritchey-Chrétien (RC) telescope line from 12.5" to 1 meter apertures. The company produces high-quality off-the-shelf products at unprecedented value. The products are used by universities, research centers and aerospace companies, with 60 CDK700s (0.7 meter aperture) and 16 PW1000 (1 meter aperture) telescopes produced as of 2020.

Most recently, PlaneWave has begun offering standalone, direct-drive tracking-systems, compatible with both our CDK optical-systems and many third-party manufactured telescopes and instrument packages. Building upon the technology, manufacturing knowledge, and software that were developed for the CDK700 and CDK1000 observatory telescopes, our L-Series mounts offer the same exceptional performance, robust reliability, and comfortable ease of use. With 8Mhz encoders and direct-drive actuation, resulting in slewing speeds in excess of 100 degrees/second, motion speeds of the system will typically be limited by the telescope or instrument mechanics. We expect these capabilities, at our mounts respective price-points, will be game-changing for a wide variety of researchers and commercial users.

PlaneWave Instruments is also prepared to offer our engineering services and manufacturing expertise to the most demanding clientele needs for innovative and custom solutions.

RC700 Features

Optimized Central Obscuration

The PlaneWave RC700-f/12 was designed to offer a central obscuration of less than 30% to improve both image contrast and the efficiency of optical fiber coupling.

Optional GPS/PTP Encoder Synchronization

For applications requiring the most accurate knowledge of position and time, PlaneWave offers optional electronics that allow UTC timestamping of encoder feedback.

Dual Nasmyth Foci

The RC700 offers two Nasmyth focus ports to simplify use of multiple instrument packages. The systems tertiary mirror (M3) is robotic and remotely controllable through PlaneWave Interface Software and the PWI API, allowing even remote users to change between ports with the click of a button.

Space-Frame Design & Optional Coudé Path

Like our PW1000 system, the PlaneWave RC700 incorporates the Space-Frame Fork design. This design approach not only reduces weight while increasing rigidity, but also simplifies Coudé path routing. Contact your PlaneWave representative to discuss requirements for your desired Coudé solution.

Optional Carbon-Fiber Hard-Shroud

For installations where stray, ambient light is a concern, the RC700 has an optional hard-shroud available. This 2-panel, carbon-fiber shroud mounts between the optical tube front-ring and mid-ring and is easily removable for maintenance.

Additional Payload Capacity

The RC700 has been designed with large payloads in mind. Each Nasmyth port is capable of supporting 300+ pounds of instrumentation. Additionally, the optical tube structure has been designed to accommodate optical windows, with mass of up to 100 pounds (including mount) and piggyback instrumentation of up to 300 pounds.



Direct-Drive Motors

Like each of PlaneWave Instruments existing tracking mounts, the RC700 system features high-performance, in-house designed and manufactured direct-drive motors. We use an axial-flux motor design that prevents motor cogging and ensures consistent torque. Our vertical integration also allows us to use a high magnetic-volume density, achieving higher torque with modest power requirements. Specifications and benefits include:

- On-Axis 26-Bit Absolute Encoders
- Stable Satellite Tracking for LEO and Beyond
- Slew Speeds > up to 50 degrees/second
- 115VAC 20A input: No need for 3-phase power or generators

RC700 Specifications

EXPECTED SYSTEM PERFORMANCE

(Tracking notes based on mount axis encoder feedback)

SLEWING SPEED APPLICATION

	Astronomy	Satellite Tracking	
Axis Rate:	Sidereal	1-deg/sec	5-deg/sec
Pointing accuracy (All-Sky, RMS)	10 arc-seconds	20 arc-seconds	30 arc-seconds
Pointing accuracy with local offset/re-sync (within 5 degrees of target)	1-2 arc-seconds	10 arc-seconds	20 arc-seconds
Closed Loop Tracking Accuracy (assumes > 0.25 Hz correction rate)	< 0.1 arc-seconds	< 1 arc-second	< 2 arc-seconds
Open Loop Tracking accuracy RMS (over 10 seconds)	< 0.2 arc-seconds	< 2 arc-seconds	< 5 arc-seconds
Open Loop Tracking accuracy RMS (over 10 minutes)	< 1 arc-seconds	N/A	N/A
Jitter (1-200hz)	0.1 arc-seconds	< 0.5 arc-seconds	< 2 arc-seconds
Internal Servo-Loop (Drive-Motor)	16 KHz		
Software Command Round-Trip	20 ms		
Azimuth Travel	660 degrees		
Elevation Travel	15 - 90 degrees		

GENERAL SPECIFICATIONS

Weight	2500 lbs
Dimensions and Power Requirement	92.25" (H) x 52" (W) x 36" (D) and 120 VAC 30A (220V upon request)
Swing Radius	50"
Base-Flange to Alt-Axis	46"
Operating Temperature Range	-20C to +50C
Storage Temperature Range	-30C to +70C

MECHANICAL STRUCTURE

Fork Assembly	Space-frame steel truss
Fork Base	Welded stainless-steel torsion box
Azimuth Bearing	22.7 inch diameter slew-ring bearing
Altitude Bearing	Four 6.5 inch 4-way loaded ball bearings (two pre-loaded on motor side and two on non-motor side)
Optical Tube	Dual carbon-fiber truss structure with dual Nasmyth foci
Instrument Payload	300 lbs, mounted to each Nasmyth interface (Focuser & De-rotator specs TBD)
Optical Window Mounting	Mounting pattern on OTA front-ring will support customer/integrator provided optical window
System Natural Frequency	10 Hz or greater

RC700 Specifications

OPTICAL SPECIFICATIONS

Optical Design	Ritchey-Chrétien
Aperture	700 mm (27.56 inch)
Focal Length	8410 mm
Focal ratio	$f/12$
Central Obstruction	< 30% of the primary mirror diameter
Image Scale	40.8 microns per arcsecond
Back Focus	317 mm (12.5 inch) from instrument mounting surface
Field Diameter	16.35 arcminutes
Fully Baffled Field	40 mm
Optical Performance	RMS spot-sizes of < 1 micron on-axis, 8.2 microns at 11 mm off-axis, 27.5 microns at 20.5 mm off-axis
Mirror Material	Fused Silica (Quartz)
Mirror Coating	Enhanced aluminum, protected gold and custom options available
Focus Position	Nasmyth focus

CONTROL SYSTEM

Motor Controller (includes ICD)	Industrial grade Elmo brushless motor control system and built inelectronics
Azimuth Motor	Direct-drive 3 phase axial-flux torque motor
Altitude Motor	Direct-drive 3 phase axial-flux torque motor
Encoder(s)	255 mm stainless steel encoder ring with read-head yields 67.1 million counts per revolution of the telescope. This translates to about 0.019 arc-second resolution.
Motor Torque	Approximately 170 ft-lbs continuous (azimuth motor)
Drive Electronics	Elmo Motion Control Systems drives
Telescope Control Software	PWI4 (provided by PlaneWave)
Recommended Time Source	GPS time card or PTP server