ROTARY STAGES **APR SERIES**

APR stages are perfect for rotary testing, pointing, optical calibration systems and metrology systems.

Aerotech's APR series direct-drive rotary stage is excellent for high-accuracy rotary positioning. The precision-machined and ground stage parts coupled with high-precision angular contact bearings result in exceptionally low error motions, accuracy errors, and repeatability errors. In addition, high resolution optical encoders provide excellent pointing capability with low-jitter velocity tracking.

Applications

The APR stages are perfect for rotary testing, pointing, optical calibration systems, and metrology systems. Several more specific applications include single and multi-axis electro-optic sensor testing, resolver or optical encoder accuracy testing, missile seeker testing, antenna testing, inertial navigation device testing, photonic component alignment, high-accuracy laser machining, and precision wafer inspection. Multiple APR stages can be combined for high-accuracy azimuth/elevation or azimuth/roll systems. Vacuum-prepared and other customized versions are also available for specialized applications.

Accurate Positioning with Incremental or Absolute Encoders

The APR provides the flexibility of using high-resolution absolute or incremental optical encoders. The absolute encoder option allows instant initialization at the time of power up and eliminates the need for a home cycle. Incremental encoders are available for a cost-effective, accurate, high resolution, high dynamic performance stage. Both incremental and absolute encoders provide exceptional accuracy and fine stepping capability. The APR stages are available with high-accuracy encoder options. In addition, calibration can be employed to further improve the accuracy of all APR stages.

Superior Mechanical Design

The motor and high-performance encoder are directly coupled to a common shaft, and the absence of gears, belts, or other drive-train mechanisms results in elimination of position error caused by hysteresis, windup, or backlash. Precision machining and grinding techniques used on the stage parts, along with precision angular contact bearings, ensure that tilt (wobble), axial, and radial error motions are minimized. An optional tabletop provides a larger surface area and an expanded hole pattern for payload mounting and allows for configurable limited travel options up to 270°. The tabletop options also include angular graduation marks for easy visual recognition of the stage position.

Low Total Indicator Runout (TIR) Mounting Surfaces

On standard APR stages, the payload is mounted directly to the precision-ground stage shaft via an eight-bolt hole pattern on the top of the shaft. The top surface and the aperture of the shaft are precision–machined for minimal surface runout with respect to stage motion. Precision-ground tabletop options provide more traditional metric or English hole-patterns while maintaining low surface runout of the tabletop mounting surface and aperture.

High Speed, High Bandwidth

Rapid acceleration and high velocity are key features of the APR stages. Customers can command rapid incremental or continuous rotary motion with the high-torque brushless motors in the APRs. Due to the direct-drive motor and the stage's high stiffness, the APR can provide high-bandwidth motion for oscillations, motion profiling, and rapid position or velocity tracking.

Brushless Direct-Drive

To maximize positioning performance, the APR series utilizes Aerotech's brushless, slotless motors. Various winding options and motor stack heights are available for applications ranging

PRODUCT HIGHLIGHTS

- Accuracies to 1.5 arc second
- Axial load capacity up to 250 kg
- Incremental or absolute encoders
- Large bearings provide high payload and moment load capacity
- 375-800 rpm continuous rotation speed
- Seven models are available, each with either 50, 75, or 100 mm clear apertureFollows the 2011/65/EU RoHS 2 Directive

from high-speed at a low input voltage or low current to high torque at a higher voltage. The motors are noncontact, so there are no brushes or gears to maintain. This allows the APR stages to provide many years of high performance operation with low cost of ownership. The motor's slotless, ironless construction features almost zero cogging (torque ripple). This makes the APR ideal for applications requiring outstanding contoured motion, smooth scan velocity, and precision motion profiling.

High Load Capacity and Large Moment Stiffness

Sturdy stage construction and separated angular contact bearings result in large load capacity and high moment stiffness for the APR stages. The APRs can excel in applications where the rotation axis is parallel or perpendicular to gravity and the payload center of gravity is cantilevered away from the stage.

Flexible Controller Configurations

Aerotech designs and manufactures a wide range of servo amplifiers and advanced controllers to provide a complete, integrated electro-mechanical package. Aerotech linear amplifiers provide the most precise positioning for demanding accuracy and in-position stability. Aerotech PWM digital drives provide high power for rapid acceleration and high torque applications. Whatever your application, Aerotech can provide a complete motion system solution to perfectly match your requirements.

APR Series **Specifications**

Model	APR150DR-115	APR150DR-135	APR150DR-180
Drive System	Slotless, brushless, direct-drive rotary motor		
Fundamental Resolution (Lines/Rev)	16384		
-E1 Resolution	0.020/0.005 arc seconds		
-E4 Resolution	0.000301 arc seconds		
-E5 Resolution	0.079 arc seconds		
-E6 Resolution	0.0079 arc seconds		
Maximum Bus Voltage	340 VDC		
Limit Switches	Optional – specified at time of order; 5 VDC, Normally Closed		
Home Switch	5 VDC, Normally Closed		

Model	APR200DR-115	APR150DR-135	APR150DR-180
Drive System	Slotless, brushless, direct-drive rotary motor		
Fundamental Resolution (Lines/Rev)	23600		32768
-E1 Resolution	0.014/0.0034 arc seconds		0.010/0.0025 arc seconds
-E4 Resolution	0.000301 arc seconds		0.000301 arc seconds
-E5 Resolution	0.055 arc seconds		0.04 arc seconds
-E6 Resolution	0.0055 arc seconds		0.004 arc seconds
Maximum Bus Voltage	340 VDC		
Limit Switches	Optional – specified at time of order; 5 VDC, Normally Closed		
Home Switch	5 VDC, Normally Closed		

APR Series **Specifications**

Specifications			APR150DR-115	APR150DR-135	APR150DR-180
Travel			Brush, brushless, voice coil, stepper		
Accuracy	**-E1, -E2, -E3, -E4 Feedback Options**	**Uncalibrated**	45 arc sec		
		Calibrated	4 arc sec		
	-E5, -E6 Feedback Options	**Uncalibrated**	N/A	4 arc sec	
		Calibrated	N/A	2 arc sec	
Resolution (Minimum Incremental Motion)			0.08 arc sec		
Repeatability (Bi-Directional)[1]			1.50 arc sec		
Repeatability (Uni-Directional)			0.75 arc sec		
Total Tilt Error Motion[2]			2.00 arc sec		
Total Axial Error Motion[2]			1.50 µm		
Total Radial Error Motion[2]			1.50 µm		
Maximum Speed[3]	**With -M1 Motor Option**		600 rpm		
	With -M2 Motor Option		800 rpm		
Maximum Acceleration			450 rad/s^2	625 rad/s^2	805 rad/s^2
Aperture			50 mm		
Maximum Torque (Continuous)			2.85 Nm	5.06 Nm	9.29 Nm
Load Capacity	**Axial**		45 kg		
	Radial		32 kg		
Rotor Inertia (Unloaded)			0.0047 kg-m^2	0.0060 kg-m^2	0.0086 kg-m^2
Stage Mass[4]			6.5 kg	8.5 kg	12.3 kg
Material			Aluminum; Hardcoat/Anodize Finish		
MTBF (Mean Time Between Failure)			20,000 hours		

1 Certified with each stage.
2 All error motion specifications are measured at 60 rpm.
3 Maximum speed listed is stage and motor dependent (assuming a 340 V bus). Actual speed may be lower due to motor back emf or encoder bandwidth (see Encoder Bandwidth table). Consult an Aerotech Applications Engineer for more details.
4 Mass listed is for the standard stage option (no brake and no tabletop). Consult Aerotech if brake and tabletop masses are desired.

APR Series **Specifications**

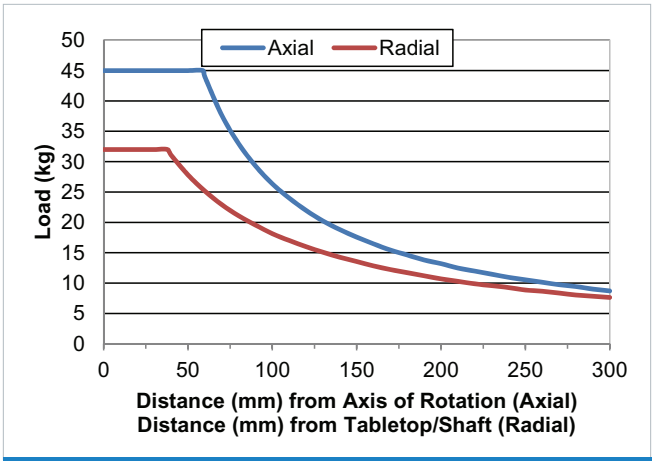
Specifications			APR150DR-115	APR150DR-135	APR150DR-180	APR260DR-180
Travel			Continuous (Optional 270° Max Limited)			
Accuracy	**-E1, -E2, -E3, -E4 Feedback Options**	**Uncalibrated**	33 arc sec		25 arc sec	
		Calibrated	3 arc sec		2 arc sec	
	-E5, -E6 Feedback Options	**Uncalibrated**	3 arc sec		2 arc sec	
		Calibrated	1.75 arc sec		1.50 arc sec	
Resolution (Minimum Incremental Motion)			0.06 arc sec		0.04 arc sec	
Repeatability (Bi-Directional)[1]			1.00 arc sec		0.75 arc sec	
Repeatability (Uni-Directional)			0.50 arc sec		0.50 arc sec	
Total Tilt Error Motion[2]			2.00 arc sec			
Total Axial Error Motion[2]			1.50 µm			
Total Radial Error Motion[2]			1.50 µm			
Maximum Speed[3]	**With -M1 Motor Option**		600 rpm		375 rmp	
	With -M2 Motor Option		800 rpm		N/A	
Maximum Acceleration			380 rad/s²	440 rad/s²	175 rad/s²	215 rad/s²
Aperture			75 mm		100 mm	
Maximum Torque (Continuous)			11.12 Nm	15.93 Nm	19.71 Nm	29.09 Nm
Load Capacity	**Axial**		205 kg		250 kg	
	Radial		100 kg		135 kg	
Rotor Inertia (Unloaded)			0.026 kg-m²	0.032 kg-m²	0.10 kg-m²	0.12 kg-m²
Stage Mass[4]			17.8 kg	22 kg	29.8 kg	35.4 kg
Material			Aluminum; Hardcoat/Anodize Finish			
MTBF (Mean Time Between Failure)			20,000 hours			

1 Certified with each stage.
2 All error motion specifications are measured at 60 rpm.
3 Maximum speed listed is stage and motor dependent (assuming a 340 V bus). Actual speed may be lower due to motor back emf or encoder bandwidth (see Encoder Bandwidth table). Consult an Aerotech Applications Engineer for more details.
4 Mass listed is for the standard stage option (no brake and no tabletop). Consult Aerotech if brake and tabletop masses are desired.

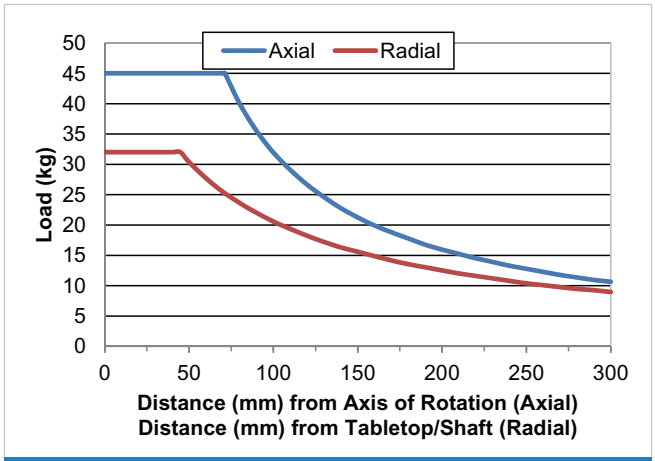
Recommended Controller		
Multi-Axis	**A3200**	Ndrive HLe/Ndrive HPe/Ndrive MP10/Ndrive CP10/Npaq
	Ensemble	Ensemble HLe/Ensemble HPe/Ensemble MP10/Ensemble CP10/Epaq
Single Axis	**Soloist**	Soloist HLe/Soloist HPe/Soloist MP10/Soloist CP10

Model	Max Speed (rpm) Per Encoder Bandwidth			
	-E1	**-E4**	**-E2, -E5**	**-E3, -E6**
APR150DR	Motor Limited	Motor Limited	118	11
APR200DR	Motor Limited	Motor Limited	82	8
APR260DR	375	375	59	5

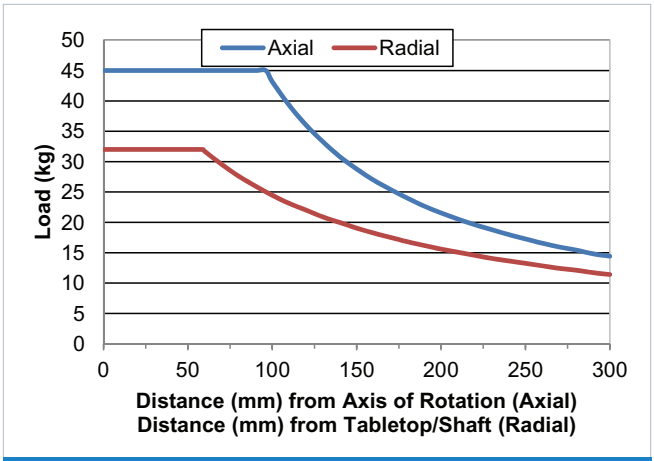
APR Series **Specifications**



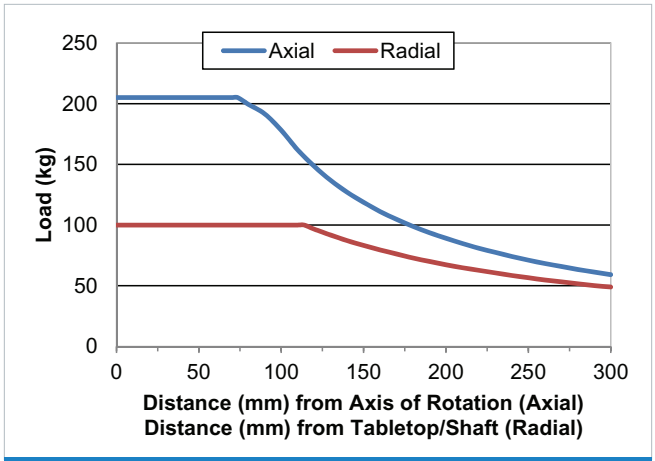
Axial and Radial Cantilevered Load Capability (APR150DR-115)



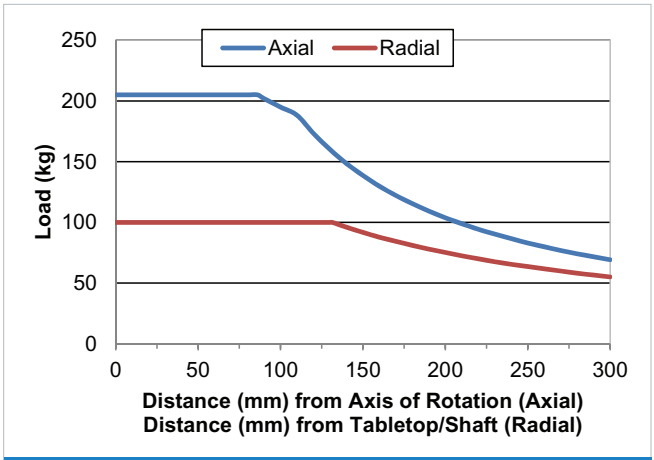
Axial and Radial Cantilevered Load Capability (APR150DR-135)



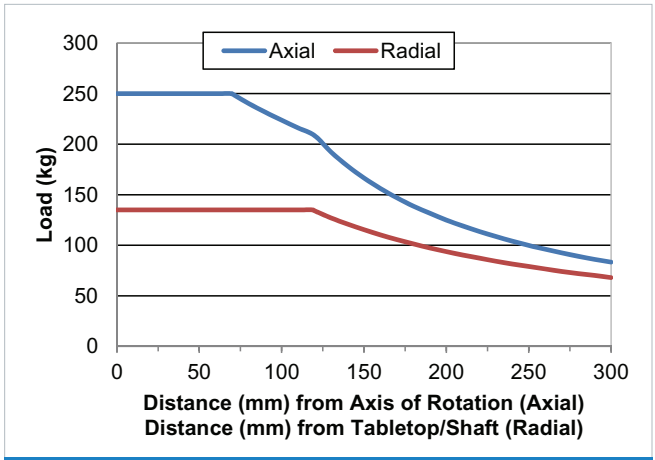
Axial and Radial Cantilevered Load Capability (APR150DR-180)



Axial and Radial Cantilevered Load Capability (APR200DR-155)

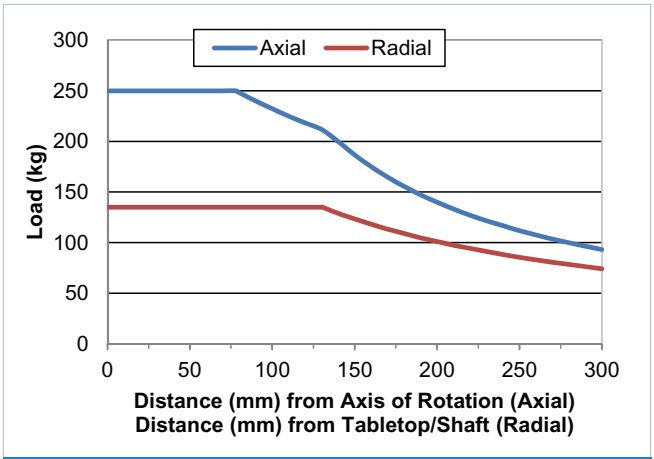


Axial and Radial Cantilevered Load Capability (APR200DR-185)



Axial and Radial Cantilevered Load Capability (APR260DR-160)

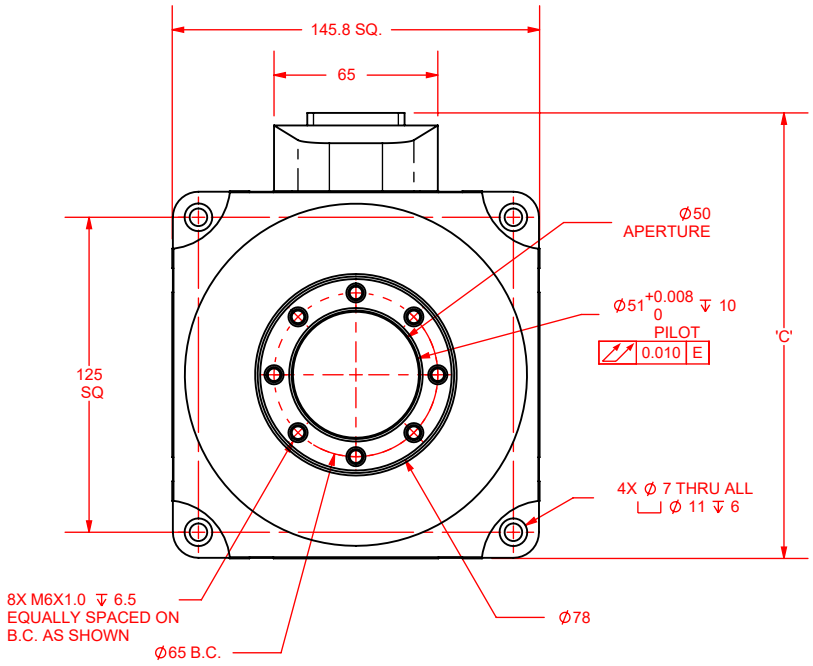
APR Series **Specifications**

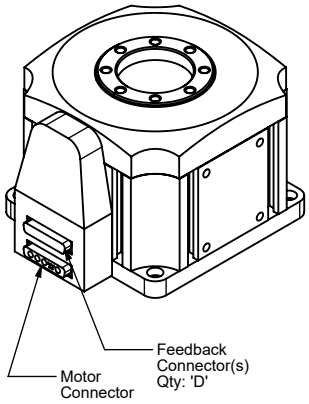


Axial and Radial Cantilevered Load Capability (APR260DR-180)

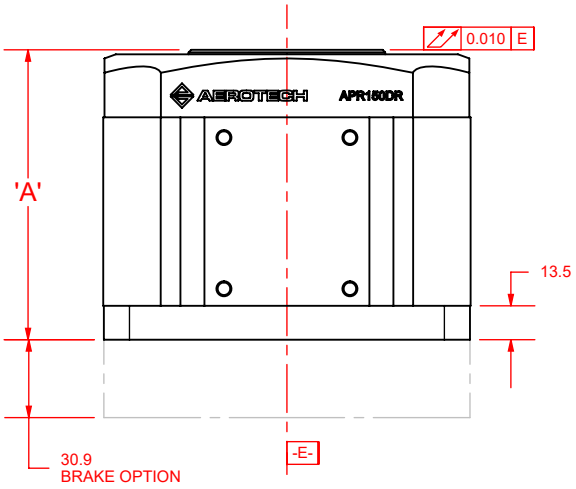
APR Series **Dimensions**

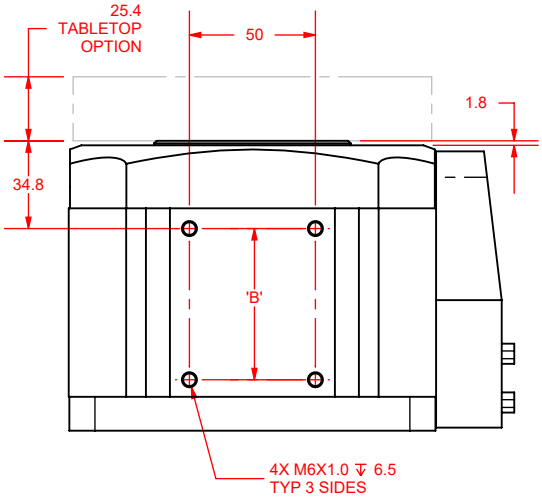
APR-150





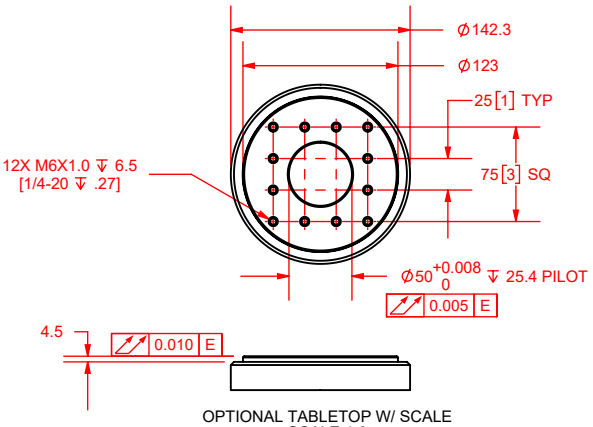
ISOMETRIC VIEW
Not to Scale





APR150DR DIMENSIONS		
Stage Height	'A'	'B'
-115	115.1	60
-135	136.1	80
-180	178.1	120

APR150DR DIMENSIONS		
Feedback	'C'	'D'
-E1, -E2, -E3, -E4	177	1
-E5, -E6	193	2

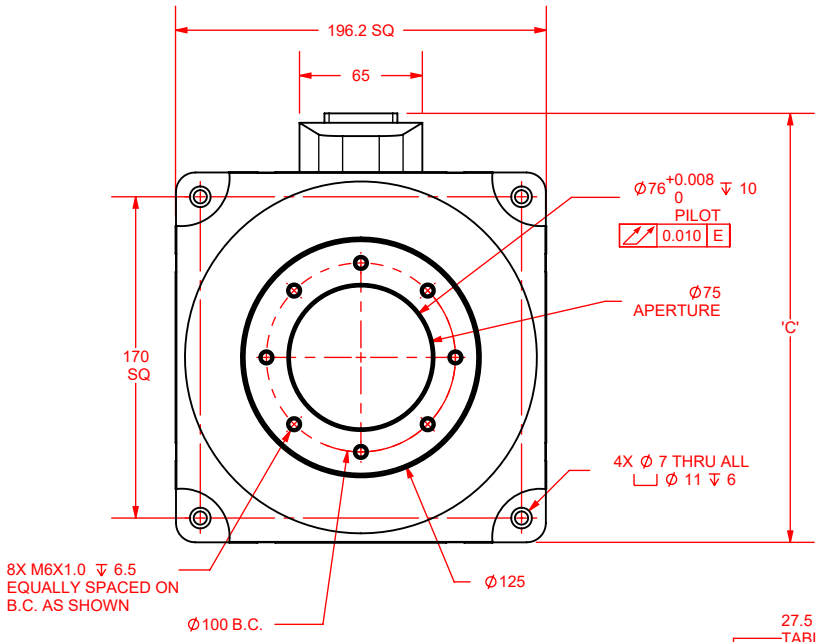


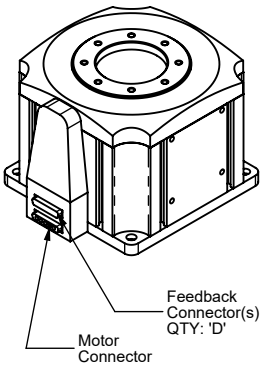
OPTIONAL TABLETOP W/ SCALE
SCALE 1:6

DIMENSIONS: MILLIMETERS [INCHES]

APR Series **Dimensions**

APR-200





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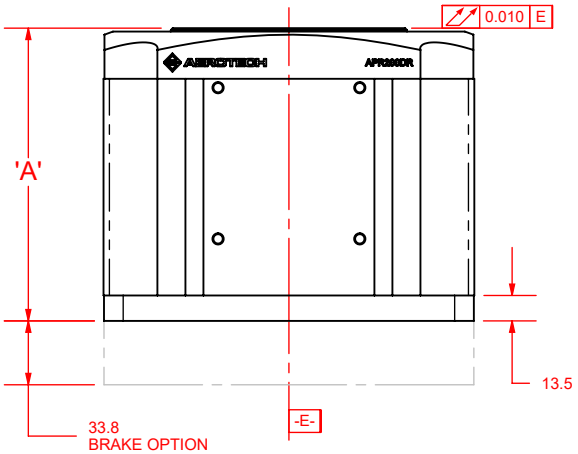
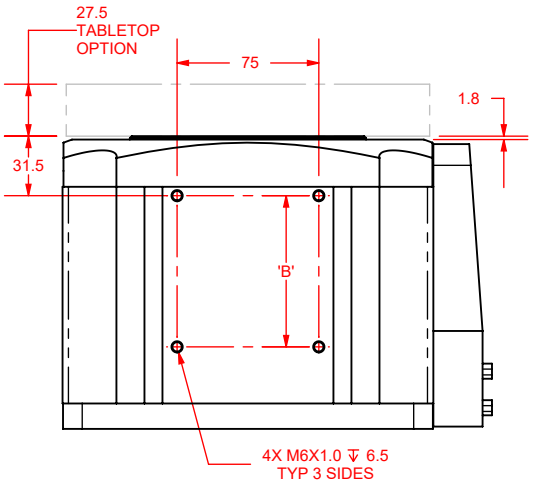
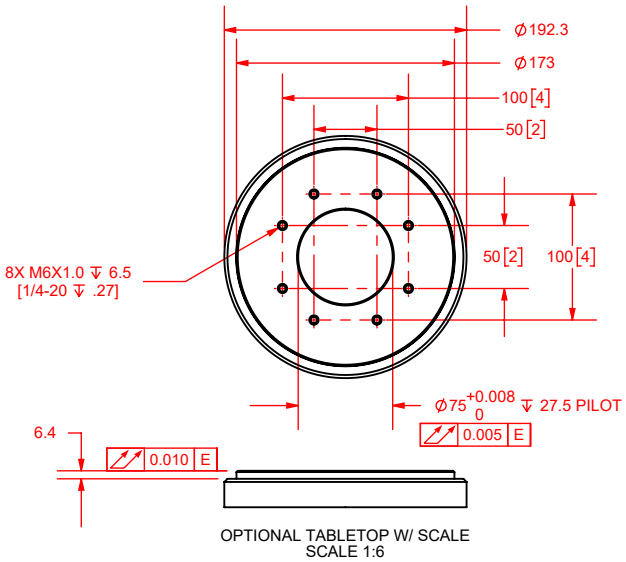
Not to Scale





APR200DR DIMENSIONS		
Stage Size	'A'	'B'
-155	154.9	80
-185	179.9	100

APR200DR DIMENSIONS		
Feedback	'C'	'D'
-E1, -E2, -E3, -E4	227	1
-E5, -E6	244	2

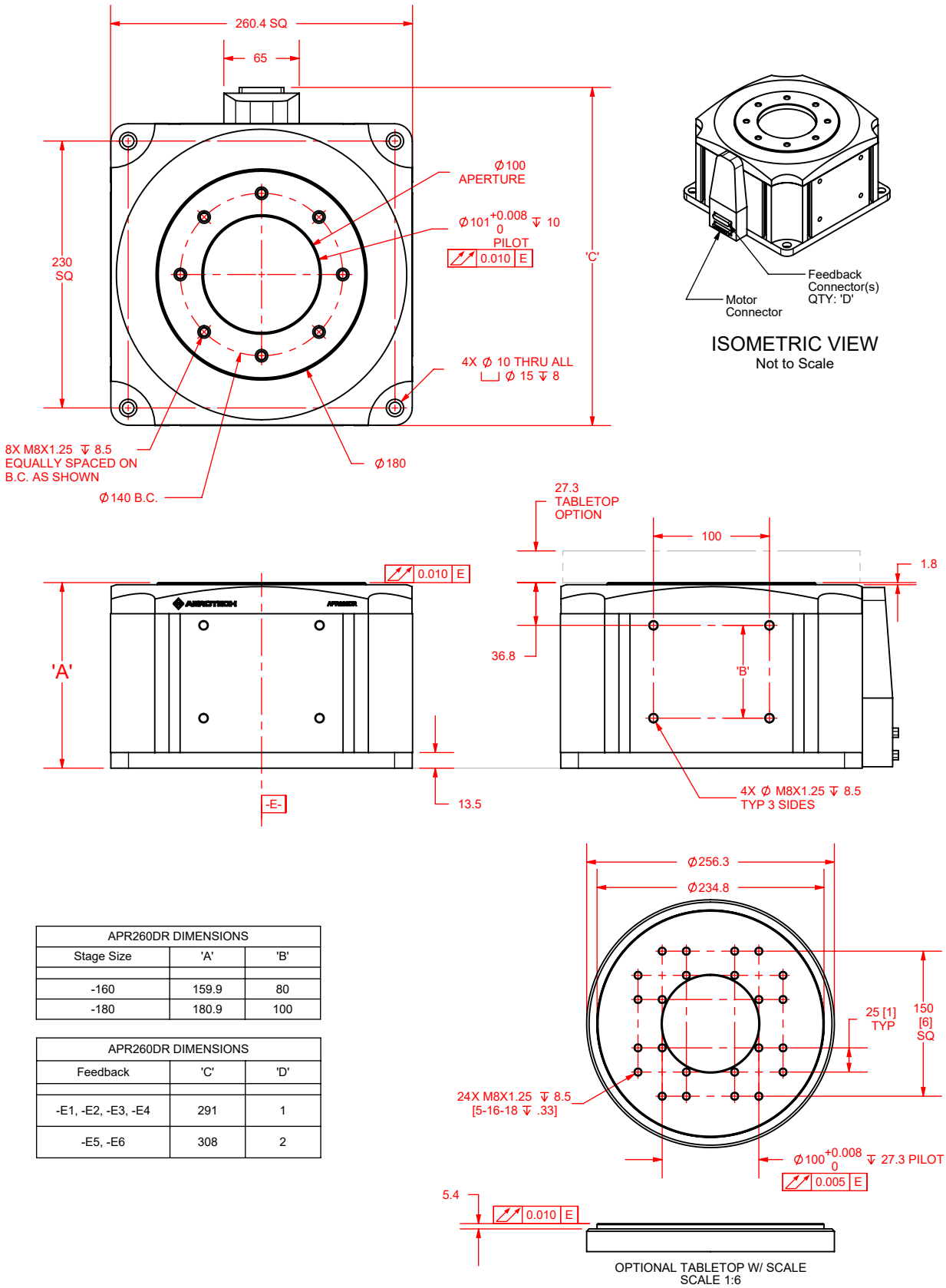


OPTIONAL TABLETOP W/ SCALE
SCALE 1:6

DIMENSIONS: MILLIMETERS [INCHES]

APR Series **Dimensions**

APR-260



APR260DR DIMENSIONS		
Stage Size	'A'	'B'
-160	159.9	80
-180	180.9	100

APR260DR DIMENSIONS		
Feedback	'C'	'D'
-E1, -E2, -E3, -E4	291	1
-E5, -E6	308	2

DIMENSIONS: MILLIMETERS [INCHES]

APR Series **Ordering Information**

APR High-Precision Mechanical Bearing Rotary Stage

APR150DR-115	APR150DR-115 high-precision mechanical bearing rotary stage
APR150DR-135	APR150DR-135 high-precision mechanical bearing rotary stage
APR150DR-180	APR150DR-180 high-precision mechanical bearing rotary stage
APR200DR-155	APR200DR-155 high-precision mechanical bearing rotary stage
APR200DR-185	APR200DR-185 high-precision mechanical bearing rotary stage
APR260DR-160	APR260DR-160 high-precision mechanical bearing rotary stage
APR260DR-180	APR260DR-180 high-precision mechanical bearing rotary stage

Feedback (Required)

-E1	Incremental encoder, 1 Vpp
-E2	Incremental encoder, Digital RS422, x1000 interpolation
-E3	Incremental encoder, Digital RS422, x10000 interpolation
-E4	Absolute encoder
-E5	High-accuracy incremental encoder, Digital RS422, x1000 interpolation
-E6	High-accuracy incremental encoder, Digital RS422, x10000 interpolation

Note: -E5 and -E6 options are not available with APR150DR-115.

Motor (Required)

-M1	Low current, -A winding
-M2	Low voltage, -B winding

Note: -M2 option not available with APR260DR models.

Tabletop (Optional)

-TT1	Metric graduated tabletop
-TT2	English graduated tabletop

Travel (Required)

	Continuous travel
-TR010	Limited travel, +/- 5 degrees
-TR020	Limited travel, +/- 10 degrees
-TR040	Limited travel, +/- 20 degrees
-TR060	Limited travel, +/- 30 degrees
-TR080	Limited travel, +/- 40 degrees
-TR100	Limited travel, +/- 50 degrees
-TR120	Limited travel, +/- 60 degrees
-TR140	Limited travel, +/- 70 degrees
-TR160	Limited travel, +/- 80 degrees
-TR180	Limited travel, +/- 90 degrees
-TR200	Limited travel, +/- 100 degrees
-TR220	Limited travel, +/- 110 degrees
-TR240	Limited travel, +/- 120 degrees
-TR270	Limited travel, +/- 135 degrees

Note: -TRxxx options contain an extra 1.5 degrees between the nominal travel and the electrical limit on each side.

(Ex: -TR270 contains +/- 135 degrees of nominal travel, with +/-136.5 degrees of travel between electrical limits.)

Hardstops (Optional)

-HS	Mechanical hard stops

Note: -HS option requires the selection of a Tabletop option (-TTx) and a Limited Travel option (-TRxxx).

Brake (Optional)

-BK	Holding brake

Note: -BK option not available with APR260DR models.

Metrology (Required)

-PL3	Metrology, uncalibrated with performance plots
-PL4	Metrology, calibrated (HALAR) with performance plots

APR Series **Ordering Information**

Integration (Required)

Aerotech offers both standard and custom integration services to help you get your system fully operational as quickly as possible. The following standard integration options are available for this system. Please consult Aerotech if you are unsure what level of integration is required, or if you desire custom integration support with your system.

-TAS	Integration - Test as system Testing, integration, and documentation of a group of components as a complete system that will be used together (ex: drive, controller, and stage). This includes parameter file generation, system tuning, and documentation of the system configuration.
-TAC	Integration - Test as components Testing and integration of individual items as discrete components. This is typically used for spare parts, replacement parts, or items that will not be used or shipped together (ex: stage only). These components may or may not be part of a larger system.