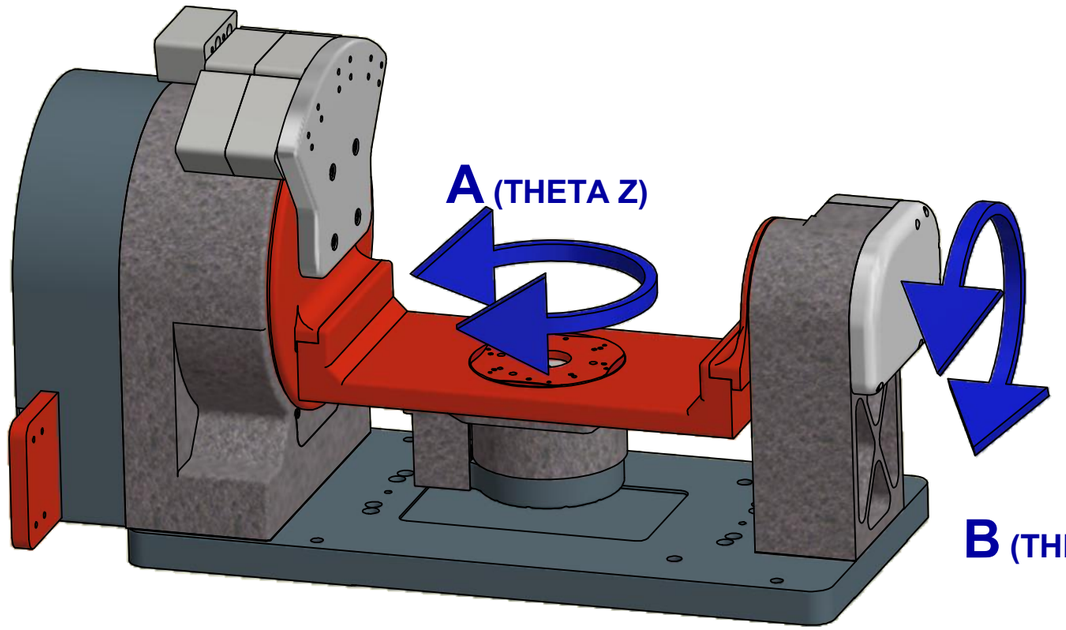
2 AXIS ROTARY GIMBAL



STANDARD FEATURES	
Stage	2 Axis Rotary Gimbal
Travel	2 Degrees of Freedom (Theta Y, Theta Z)
A Angular Travel	360 degrees continuous (Theta Z)
B Angular Travel	+/- 100 degrees (Theta Y) >> [Travel Expandable to +/- 172 deg]
Max Payload	12.0 kg (with Options for Higher Payload)
Motor	Frameless Torque Motor Optional: With Integrated Pneumatic Brakes
Feedback	Non-Contact Optical Encoder
Scale	Stainless Steel Ring
Angular Resolution	< 0.02 arc-sec
Sensors	Integrated Home
Bearings	Angular Contact
Hard Stops	Metal-on-Metal Hard Stop
Counterbalance	Counterweight Capability (Adjustable with Provided Weights)
Cables	High Flex, 10M Cycle, 3m Length
Vacuum Supply	Optional: Vacuum Line Plumbed to Center of Rotary Mounting Surface for Customer Supplied Vacuum Chuck
Pneumatic Purge	All Rotary Axes Have Air Purge Included Connect Supplied Hoses to CDA Air Supply
Transport	Reuseable Shippping Stop / Lift Eye Bolts Supplied
Structure	Anodized Aluminum 6061-T6
Environment	Standard
Temperature	0°C to 50°C
Humidity	10% to 80% Non-Condensing
Precision	6-D Nano Precision ™ Test Methods

DRAWN	NBROWN	4/24/2016
CHECKED	NBROWN	4/24/2016
Tolerances: x.x ± .05 in, x.xx ± .01 in, x.xxx ± .005 in, ANGLES ± 0.5°	Surface Roughness: √ RMS MAX.	
MATERIAL		
FINISH	SEE NOTES	

ALIO 6-D

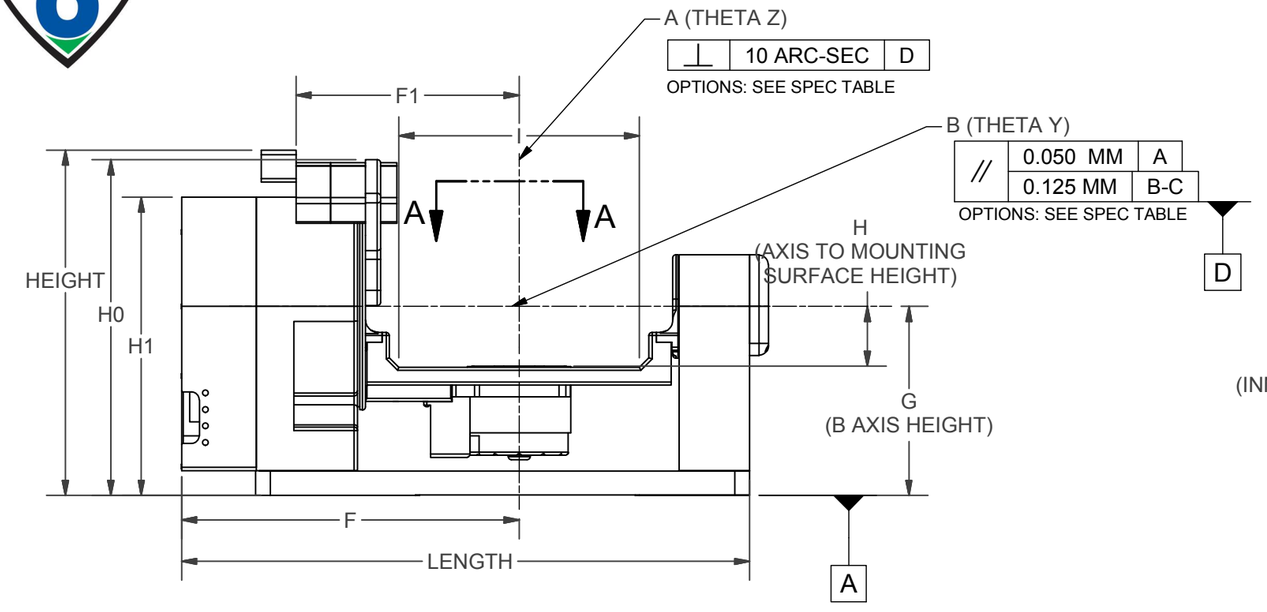
TITLE

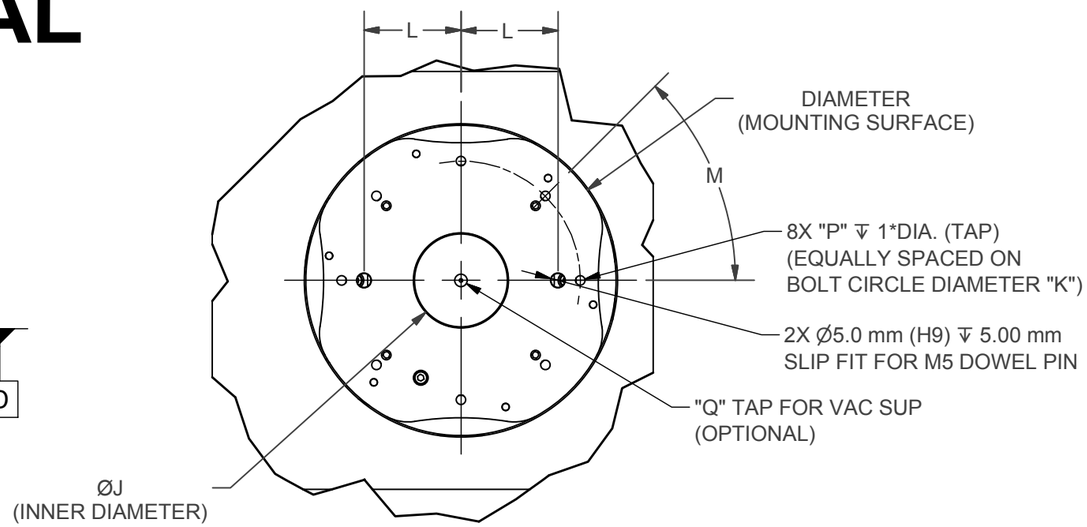
2 AXIS GIMBAL

SIZE	DWG NO	REV
B	0010-08069	001

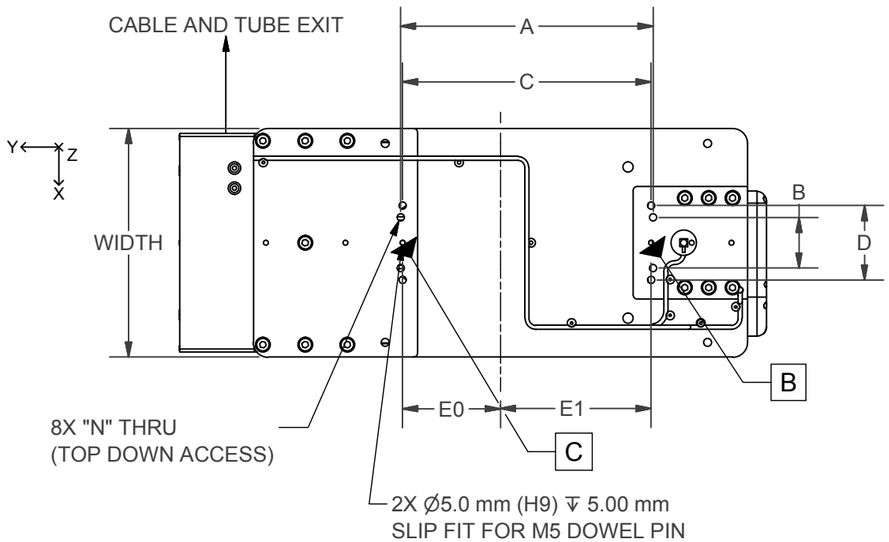
SCALE | ALIO STD TEMPLATE - REV 006 | SHEET 1 OF 8

2 AXIS ROTARY GIMBAL





DETAIL A
SCALE 1 / 2



LENGTH	WIDTH	HEIGHT	H0	H1	DIAMETER	A (inch)	B (inch)	C	D	E0	E1	F	F1	G	H	I	J	K	L	M (deg)	N	P	Q
571	230	362.5	337.5	300	104	10	2	250	75	98.5	151.5	339.5	225	190	60	242	32	80	32.5	45	M6	M4	M5
					154												88	100	40	45	M6	M5	G1/8

* All units millimeters unless otherwise noted.
* All hole patterns centered on M5 dowel pin holes or on rotary OD.
* All dimensions and visual represenatiaons reflect axes at mid-stroke or home position.

Green highlighted dimensions can be adjusted to match customer desired dimensional specifications (with some limitations.)
NRE required, Requested dimensions must be provided by customer in the quoting process.

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DRAWN	NBROWN	4/24/2016
CHECKED	NBROWN	4/24/2016
Tolerances: x.x ± .05 in, x.xx ± .01 in, x.xxx ± .005 in, ANGLES ± 0.5°	Surface Roughness: √ RMS MAX.	
MATERIAL		
FINISH	SEE NOTES	

ALIO 6-D

TITLE

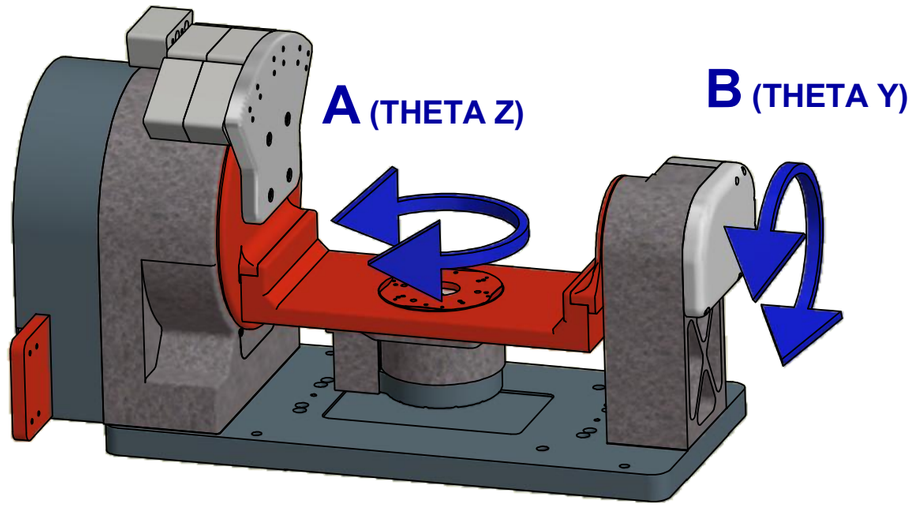
2 AXIS GIMBAL

SIZE	DWG NO	REV
B	0010-08069	001

SCALE | ALIO STD TEMPLATE - REV 006 | SHEET 2 OF 8

ROTARY SPECIFICATIONS

MODEL	UNITS	AI-TM-104RA			AI-TM-154RA			AI-TM-208RA-GMB-CB		
AXIS	--	A (THETA Z)			A (THETA Z)			B (THETA Y)		
TRAVEL DEFINED FROM HOME	deg	360 degrees continuous			360 degrees continuous			+/- 100		
TRAVEL BETWEEN HARD STOPS (+/- 0.5 deg)	deg	--			--			+/- 100.5		
TRAVEL BETWEEN LIMITS (+/- 0.5 deg)	deg	n/a			n/a			No Limits Included		
TRAVEL OPTIONS	--	LIMIT TO ANY +/- DEGREES			LIMIT TO ANY +/- DEGREES			TRAVEL UP TO +/- 172 DEGREES		
ENCODER INFORMATION	--									
MODEL	--	Renishaw Tonic with RESM Stainless Steel Ring								
TYPE	--	1Vp-p Analog Output Sin/Cos Encoder								
LINES PER REVOLUTION	lines/rev	15744			23600			31488		
PERFORMANCE SPECIFICATIONS [2]		STD	ULTRA	NANO	STD	ULTRA	NANO	STD	ULTRA	NANO
ANGULAR ACCURACY WITHOUT COMPENSATION	arc-sec	n/a			n/a			n/a		
ANGULAR ACCURACY WITH COMPENSATION	arc-sec	n/a		+/-3	n/a		+/-3	n/a		+/-3
BIDIRECTIONAL ANGULAR REPEATABILITY	arc-sec	+/- 0.5			+/- 0.5			+/- 0.4		
RESOLUTION (ANALOG - STANDARD)	arc-sec	0.02 arc-sec			0.01 arc-sec			0.01 arc-sec		
AXIAL RUNOUT (STANDARD)	um	10	4	2	10	4	2	10	5	3
RADIAL RUNOUT (STANDARD)	um	10	4	2	10	4	2	10	5	3
AXIS WOBBLE	arc-sec	12	8	6	16	10	8	10	7	5
WOBBLE AND RUNOUT OF PAYLOAD	--	Customer responsible for mounting and alignment of payload								
B PARALLELISM TO MOUNTING SURFACE	um/200mm	-			-			100	50	15
A PERPENDICULARITY TO MOUNTING SURFACE	um/100mm	25	10	4	25	10	4	-		
A - B AXIS INTERSECTION	um	-			-			25	10	3
B AXIS TO A MOUNT SURFACE DISTANCE	mm	60 mm +/- 0.5 mm Nominal (exact distance provided for each S/N at shipment)								
MOTION PROFILE SPECIFICATIONS										
MAX VELOCITY [3]	deg/sec	360 deg/sec (~6.28 rad/sec)			360 deg/sec (~6.28 rad/sec)			360 deg/sec (~6.28 rad/sec)		
MAX ACCELERATION [3]	deg/sec^2	1600 deg/sec (~28 rad/sec)			1600 deg/sec (~28 rad/sec)			2300 deg/sec (~40 rad/sec)		
ASSEMBLY MASS (WITH COUNTERWEIGHT)	kg	39								
MAX LOAD (AXIAL)	kg	12			12			40		
MAX LOAD (RADIAL)	kg	12			12			40		
CUSTOMER SPECIFIED PAYLOAD	kg	8 kg (+/- 4 kg or 12kg maximum)								
CUSTOMER PAYLOAD CENTER OF GRAVITY	mm	40mm (Above Theta Z Mounting Surface - Payload Independent)								
MOVING MASS (NO LOAD, NO COUNTERWEIGHT)	kg	1			1			8.9		
MOVING MASS (12KG LOAD AND COUNTERWEIGHT)	kg	13			13			26.3		
ROTATING MASS MOMENT OF INERTIA (NO LOAD, NO COUNTERWEIGHT)	kg*mm^2	1020			1020			60000		
ROTATING MASS MOMENT OF INERTIA (12KG LOAD AND COUNTERWEIGHT)	kg*mm^2	95000			95000			190000		
MOTOR INFORMATION										
MOTOR TYPE	--	FRAMELESS TORQUE MOTOR								
MOTOR MODEL	--	AI-TM-089-B9Y			AI-TM-133-CN			AI-TM-178-BEY		
MAGNETIC PITCH (N-N)	deg	60			26			40		
MAX VOLTAGE (LINE TO LINE) [4]	VDC	340			300			340		
MAX MOTOR TEMP	°C	155			100			155		
THERMAL SENSOR	--	NONE			PTC 1kO / KTY83-122			NONE		
MOTOR CONNECTION	--	WYE			WYE			WYE		
TORQUE CONSTANT	Nm/Arms	0.68			2.09			2.50		
PHASE RESISTANCE (@25° C) [5]	Ohm	3.9			4.2			3.1		
INDUCTANCE	mH	8.9			11.5			19.1		
CONTINUOUS TORQUE [6]	Nm	2.6			10.0			15.0		
CONTINUOUS CURRENT [6]	Arms	3.8			4.8			6.0		
PEAK TORQUE [4]	Nm	8.2			20.6			48.0		
PEAK CURRENT [4]	Arms	12.0			13.3			19.1		
BACK EMF CONSTANT	Vrms/krpm	41			126			152		



Notes:
1. Specifications on this page are specific to customer payload and this application.
2. Specifications measured on stage centerline, 25mm above mounting surface. ALIO provides NIST traceable proof for all options/spec per quote.
3. Stage limitations are for peak customer payload and specified mass moment of inertia with payload and counterweight. Does not account for drive or resolution limitations.
4. Maximum on time at peak operating limits is 10 seconds. Back EMF plus IR drop must not exceed maximum line to line bus voltage.
5. Resistance values do not include cable resistance. Cable resistance adds 0.3 ohm/m. All electrical specifications may vary by 12% from listed values.
6. Continuous operating limits are based on continuous operation at maximum temperature with aluminum heat sink (300mm x 300mm x 25mm).

DRAWN	NBROWN	4/24/2016
CHECKED	NBROWN	4/24/2016

Tolerances:
x.x ± .05 in
x.xx ± .01 in
x.xxx ± .005 in
ANGLES ± 0.5°

Surface Roughness: √ RMS MAX.

MATERIAL

FINISH SEE NOTES

ALIO 6-D

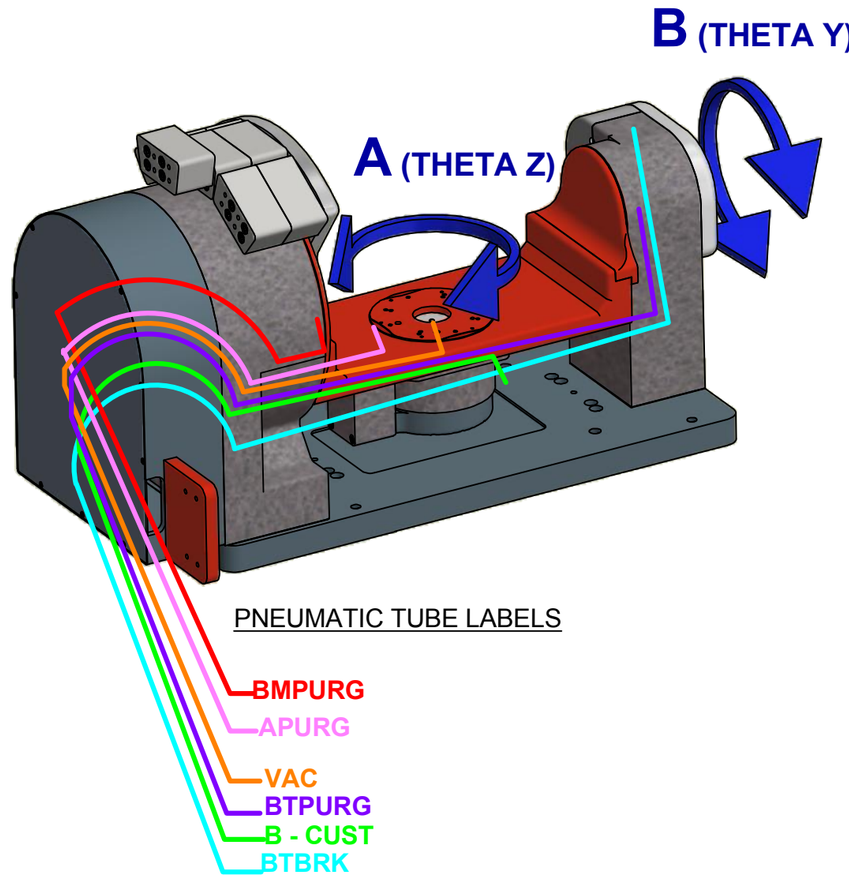
TITLE

2 AXIS GIMBAL

SIZE		DWG NO	REV
B		0010-08069	001

SCALE | ALIO STD TEMPLATE - REV 006 | SHEET 3 OF 8

AUXILIARY FEATURES



AUXILIARY FEATURES	
Pneumatic Features - Air Purge	All Rotary Axes Include Air Purge Option
	Connect Customer Supplied Clean Dry Air Source to "APURG,"
	"BTPURG," and "BMPURG" Labeled Tubes
	Includes Tight Tolerance Mechanical Labyrinth Protection Internal in Rotary Stages
Payload Air / Vacuum Supply (Optional)	Optional Rotary Union for Single Pneumatic Circuit for Payload / Chuck Air or Vacuum
	For Customer Supplied Air / Vacuum Source to "VAC" Labeled Tube
	M5 Tapped Port at ID of Rotary (or Use O-ring Seal of ID of Rotary)
	Bearing Supported, Maintenance Free, Pneumatic Rotary Union
	100 Million Cycle Life Rating
	1/4 Inch OD High Flex Poly Tube
Safety (Optional)	Brake Option on Theta Y axis ("BTBRK")

B AXIS BRAKE SPECIFICATIONS	
B AXIS BRAKE DESCRIPTION	
BRAKE LOCK (& FAILSAFE)	SPRING ACTIVATED
BRAKE RELEASE	PNEUMATIC ACTIVATED
BRAKE SUPPLY TUBE	4mm Outer Diameter High Flex
MINIMUM SUPPLY PRESSURE	~0.1 Mpa
MAXIMUM SUPPLY PRESSURE	1.0 MPa
MAXIMUM THEORETICAL DISPLACEMENT UPON BRAKE	0 DEGREES
CUSTOMER TO SUPPLY AIR SUPPLY AND DIGITAL OUTPUT CONTROL OF PNEUMATIC VALVE FOR BRAKE ACTIVATION	
ALIO TO SUPPLY PRESSURE REGULATOR AND DIGITIAL VALVE	
BRAKE ON/OFF VERIFICATION IS VIA INLINE PRESSURE SENSOR CONNECTED TO ONE DIGITAL INPUT	

DRAWN	NBROWN	4/24/2016
CHECKED	NBROWN	4/24/2016
Tolerances: x.x ± .05 in, x.xx ± .01 in, x.xxx ± .005 in, ANGLES ± 0.5˚	Surface Roughness: √ RMS MAX.	
MATERIAL		
FINISH	SEE NOTES	

ALIO 6-D

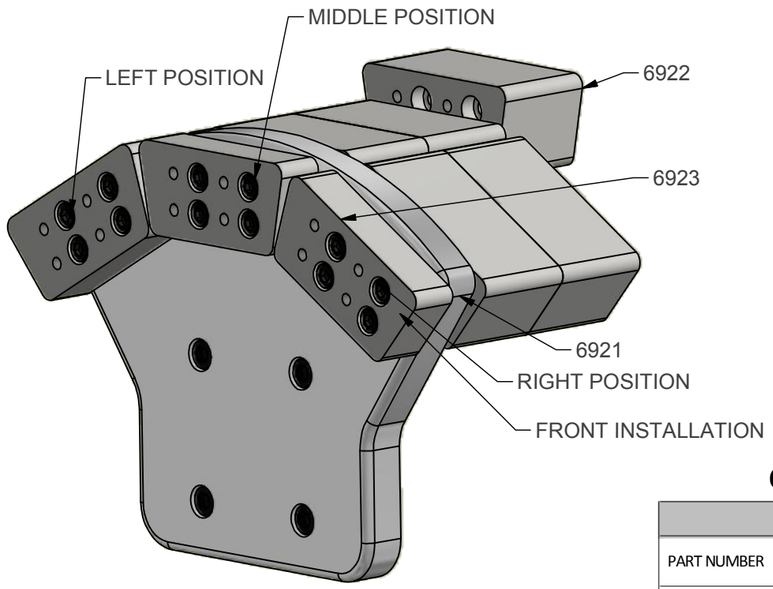
TITLE

2 AXIS GIMBAL

SIZE	DWG NO	REV
B	0010-08069	001

SCALE | ALIO STD TEMPLATE - REV 006 | SHEET 4 OF 8

COUNTERBALANCE SPECIFICATIONS



COUNTERBALANCING PROCEDURE:

1. INSTALL 6921 ONTO THE STAGE WITH 4X M6X20 SHCS.
2. INSTALL 6922 ONTO 6921 WITH 4X M5X35 SHCS EACH UNTIL IT IS "CLOSE"
   - THE GOAL IS FOR THE STAGE NOT TO SWING BACK QUICKLY WHEN RELEASED FROM REST FROM ANY NON-HOME POSITION.
3. INSTALL 6923 ONTO 6921 OR 6922 WITH 4X M5X16 SHCS EACH UNTIL THERE IS NO MOVEMENT WHEN RELEASED FROM REST FROM ANY NON-HOME POSITION.

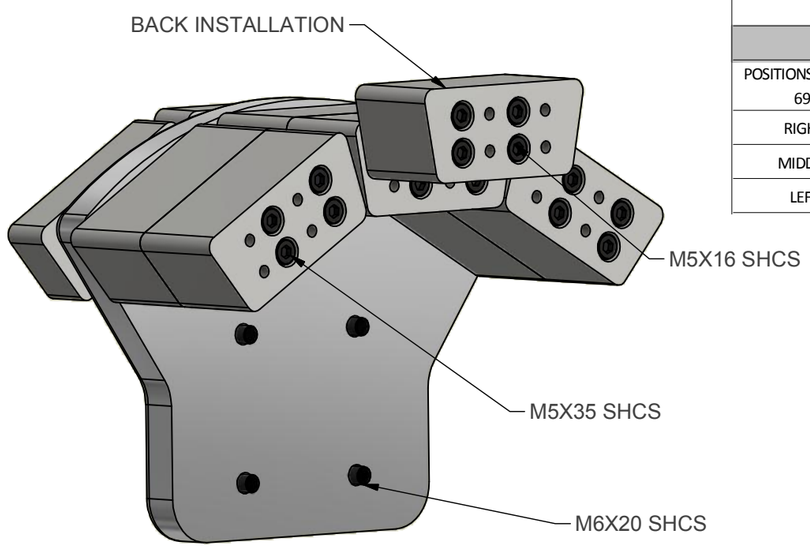
NOTE: 6922 AND 6923 MAY BE INSTALLED ON THE FRONT OF 6921 IF DESIRED.
IMPORTANT: RIGHT AND LEFT POSITIONS ON 6921 CANNOT SUPPORT MORE THAN 2X 6922. IF MORE COUNTERBALANCE IS REQUIRED, INSTALL ON FRONT OR IN MIDDLE POSITION.

SEE CONFIGURATION TABLE BELOW FOR PRE-DETERMINED COUNTERBALANCE ARRANGMENTS.
SHOWN: CONFIGURATION FOR 12 KG LOAD WITH LOAD CG @ 40MM ABOVE THETA Z MOUNT SURFACE.

COUNTERBALANCE CHARACTERISTICS

PHYSICAL CHARACTERISTICS				
PART NUMBER	MATERIAL	MASS	ROUGH DIMENSIONS (WXHXD) (MM)	MOUNTING HARDWARE (4X EACH)
6921	ALUMINUM	0.8 KG	193X147X15	M6X20 SHCS
6922	STEEL (ELECTOLESS NICKEL PLATED)	0.5 KG	70X32X35	M5X35 SHCS
6923	STEEL (ELECTOLESS NICKEL PLATED)	0.2 KG	70X32X17	M5X16 SHCS

CONFIGURATIONS			
POSITIONS ON 6921	NO LOAD	LOAD: 8 KG WITH CG @ 40 MM	LOAD: 12 KG WITH CG @ 40 MM
RIGHT	2X 6922	2X 6922	2X 6922 + 1X 6923
MIDDLE	1X 6922 + 1X 6923	3X 6922 + 1X 6923	3X 6922 + 1X 6923
LEFT	2X 6922	2X 6922	2X 6922 + 1X 6923



DRAWN	QWOLF	10-12-2016
CHECKED		
Tolerances: x.x ± .05 in, x.xx ± .01 in, x.xxx ± .005 in, ANGLES ± 0.5°	Surface Roughness: √ RMS MAX.	
MATERIAL		
FINISH	SEE NOTES	

ALIO 6-D

TITLE

2 AXIS GIMBAL

SIZE		DWG NO	REV
B		0010-08069	001

SCALE | ALIO STD TEMPLATE - REV 006 | SHEET 5 OF 8

CABLE SPECIFICATIONS

BRAKE VALVE CABLE CHARACTERISTICS

VALVE SPECIFICATIONS	
MANUFACTURER	SMC
MFR PART NUMBER	VT307Y-H1-02N-F
VOLTAGE	24 VDC
WATTAGE	1.8 W
DUTY CYCLE	CONTINUOUS
CURRENT	75 mA
MAX PRESSURE	0.7 Mpa
RESPONSE TIME	25 ms
TUBE SIZE	4MM INPUT, 4MM OUTPUT
LEAD CONNECTIONS	
RED	24V SUP / SIGNAL IN
BLACK	24V RTN
PRESSURE REGULATOR	
MANUFACTURER	SMC
MFR PART NUMBER	AR20-N02E-Z-B
TUBE SIZE	4MM INPUT, 4MM OUTPUT

PRESSURE LOSS SENSOR CHARACTERISTICS

SENSOR CHARACTERISTICS	
MANUFACTURER	SMC
MFR PART NUMBER	ISE30A-N01-N-LA1
OUTPUT	NPN
INPUT TUBE SIZE	4MM
MAX PRESSURE	1 MPa
LEAD CONNECTIONS	
BROWN	24V SUP
BLUE	24V RTN
BLACK	SIGNAL OUT

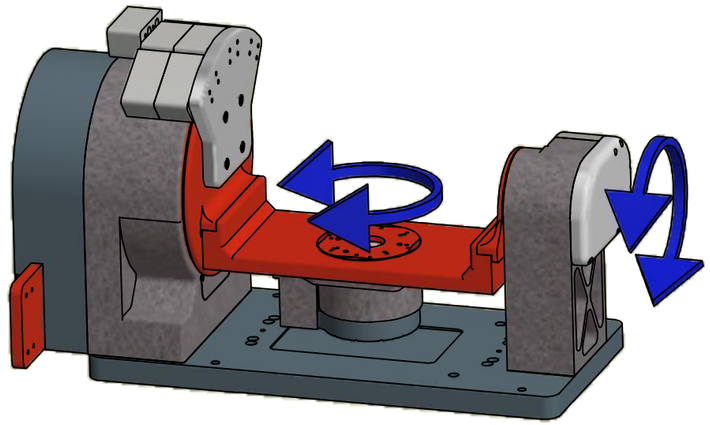
Setup settings of ISE sensor (P/N: ISE30A-N01-N-LA1) are F0 (uni = mpa);

F1 (oUt = hys)(lot = 1_p)(P_1 = 0.150)(H_1 = 0.025)(Col = 5or)

TORQUE MOTOR CABLE LEADS

LEAD CONNECTIONS	
WHITE	R PHASE
BLACK	S PHASE
RED	T PHASE
SHIELD	GROUND

*Motor cables are labeled "MA" and "MB" for the A and B axes respectively.



DRAWN	QWOLF	10/11/2016
CHECKED		
Tolerances: x.x ± .05 in, x.xx ± .01 in, x.xxx ± .005 in, ANGLES ± 0.5°	Surface Roughness: √ RMS MAX.	
MATERIAL		
FINISH	SEE NOTES	

ALIO 6-D

TITLE

2 AXIS GIMBAL

SIZE	DWG NO	REV
B	0010-08069	001

SCALE | ALIO STD TEMPLATE - REV 006 | SHEET 6 OF 8

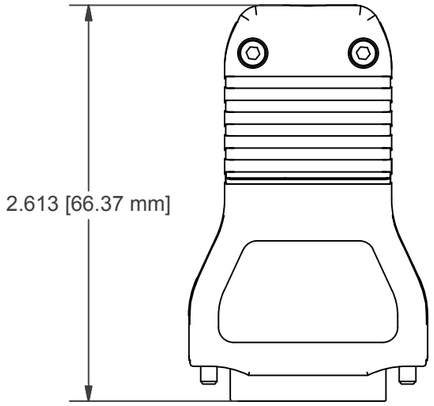
INTERFACE SPECIFICATIONS

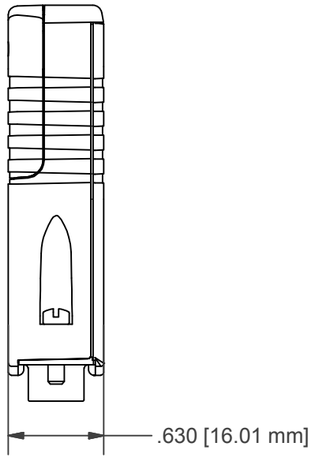
ENCODER INTERFACE PINOUT

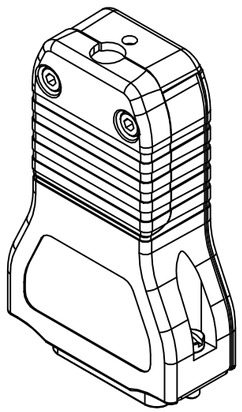
FUNCTION	SIGNAL	ANALOG ENCODER P/N: AI-TI-0000 ONLY
CABLE CONNECTOR	TYPE	D-SUB 15 PIN MALE
CUSTOMER MATING CONNECTOR	TYPE	D-SUB 15 PIN FEMALE
POWER	5V	4,5
	0V	12,13
SINE & COSINE INCREMENTAL SIGNALS	V1+	9
	V1-	1
	V2+	10
	V2-	2
REFERENCE MARK	R+	3
	R-	11
LIMITS	P	7
	Q	8
SHIELD	Inner Shield	nc
	Outer Shield	Case

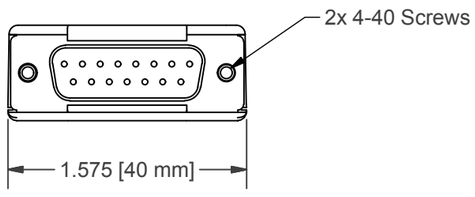
Notes:

1. Multiple 5V and 0V pins are redundant and only one pin is required to be connected.
2. Encoder cables are labeled "EA" and "EB" for the A and B axes respectively.









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DRAWN	QWOLF	2016-17-10
CHECKED		
Tolerances: x.x ± .05 in, x.xx ± .01 in, x.xxx ± .005 in, ANGLES ± 0.5°	Surface Roughness: √ RMS MAX.	
MATERIAL	Generic	
FINISH	SEE NOTES	

ALIO 6-D

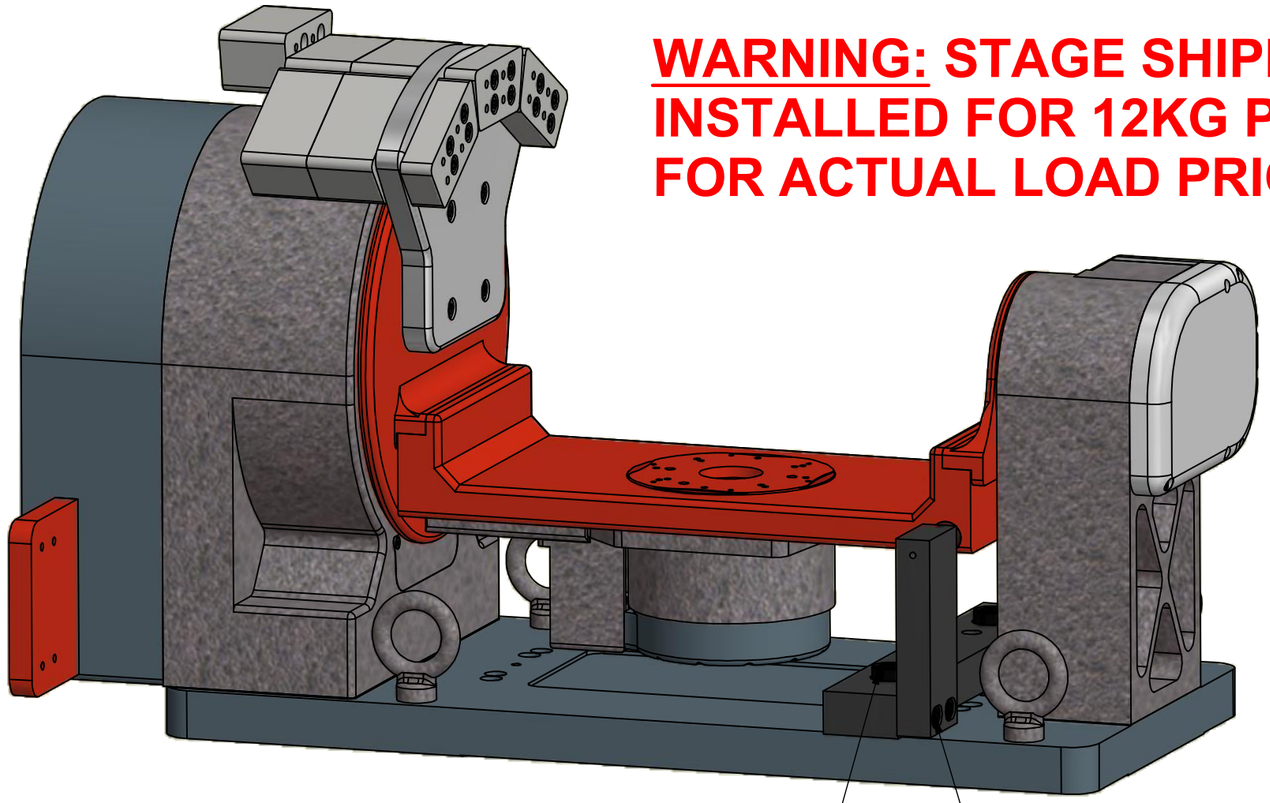
TITLE

TONIC INTERFACE

SIZE	DWG NO	REV
B	TONIC INTERF	

SCALE | ALIO STD TEMPLATE - REV 006 | SHEET 7 OF 8

WARNING: REMOVE SHIPPING STOPS PRIOR TO OPERATING.



WARNING: STAGE SHIPPED WITH COUNTERBALANCE INSTALLED FOR 12KG PAYLOAD. ADJUST COUNTERBALANCE FOR ACTUAL LOAD PRIOR TO OPERATING.

DRAWN	QWOLF	10-11-2016
CHECKED		
Tolerances: x.x ± .05 in, x.xx ± .01 in, x.xxx ± .005 in, ANGLES ± 0.5°	Surface Roughness: √ RMS MAX.	
MATERIAL		
FINISH	SEE NOTES	

ALIO 6-D

TITLE

2 AXIS GIMBAL

SIZE	DWG NO	REV
B	0010-08069	001

SCALE | ALIO STD TEMPLATE - REV 006 | SHEET 8 OF 8