

CRYO VOICE COIL ACTUATOR (CVCA)

Features

- Electromagnetic force actuator
- Contactless: no friction or wear
- Push-pull capacity
- Compact and robust design
- 5K to 375K operational range
- Fast dynamic operation
- UHV compatible (completely sealed by welding)
- Electrical connection via standard 1mm contacts
- Compatible with industrial motion controllers



Description / Applications

The Cryo Voice Coil Actuator (CVCA) is an electromagnetic linear force actuator for cryogenic operation. The all-welded titanium construction with integrated power feedthrough pins hermetically encapsulates the coil making it also UHV compatible. The contactless nature of a voice coil actuator makes it especially suited for applications requiring smooth accurate positioning over the full stroke or for high lifetime applications like wafer probing.

Specifications

specs	unit	symbol	CVCA ₁			
SYSTEM SPECIFICATIONS ¹						
Active axes	-	-	1			
Type of motion	-	-	Linear			
Actuator	-	-	Electromagnetic			
Stroke	mm	s	6 (-2,5 to +3,5)			
Operating temperature	K	T _{env}	≈5 - 375 (lower limit set by superconductivity of titanium)			
Main construction material	-	-	Titanium, nickel plated magnetically soft steel			
Mass coil assembly (stator)	grams	m _{stator}	41			
Mass magnet assembly (mover)	grams	m _{mover}	48			
Radial clearance	mm	-	0,35, both directions			
Max. allowable coil temperature	°C	T _{coil_max}	140 (180 wire specification)			
Benchmark coil temperatures ²	-	-	10K	50K	77K	300K (air)
Coil resistance	Ohm	R	0,0043	0,18	0,43	3,58
Voltage at peak force	V	V _{FP}	0,009	0,35	0,81	7,06
Current at peak force	A	I _{FP}	2,08	1,92	1,88	1,5
Back EMF constant	V/m/s	k _{BEMF}	3,83	4,17	4,26	4
Coil inductance	mH	L	0,62 @ 100Hz			
Force sensitivity	N/A	k _f	3,83	4,17	4,26	4
Actuator constant	N/W	k _a	58,2	9,81	6,43	2,07
Max continuous force ³	N	F _{ss}	8	5	4,5	3
Peak force ⁴	N	F _p	>8	>8	8	6
Power at peak force	W	P _p	0,019	0,67	1,55	8,4
Power at max. continuous force	W	P _{ss}	0,019	0,26	0,49	2,1
Power at 1N continuous force	W	-	0,0003	0,01	0,024	0,23
Electrical time constant ⁵	ms	τ _E	144	3,44	1,44	0,17
Mechanical time constant ⁶	ms	τ _M	0,014	0,5	1,14	10,7
Thermal resistance of coil assembly ⁷	K/W	R _{stator}	789	139	11	2,2
Thermal resistance of magnet assembly ⁷	K/W	R _{mover}	1,22	1,22	1,22	1,22
DRIVE ELECTRONICS						
Controller/driver	-	-	Current amplifier			
¹ At zero position. ² Actual initial coil temperature at 10K tests was approx. 50K because of thermal resistances, 10K values from analysis. ³ At 100K coil temperature rise.						
⁴ Allowed for 10 seconds. Values ≤50K limited by used current amplifier. ⁵ L/R. ⁶ (m _{mover} *R)/(k _f *k _{BEMF}).						
⁷ Theoretical from FEA. Coil assembly is based on radiation between windings and conduction through bobbin.						