

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	CVCA1			
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.						