



Advanced Manufacturing Division

6405-1610 Heavy Duty Stepper Motor



FRAEN 6405-16XX
Heavy Duty Stepper Motor

PARAMETER	MINIMUM	TYPICAL	MAXIMUM	UNITS
Pointer mass		5	8	g
Pointer Load inertia, Iyy		6,500		g.mm ²
Pointer Load inertia, Izz		5,500		g.mm ²
Pointer imbalance		1	2.5	g.mm
Distance from the bottom of the pointer hub to motor housing		23		mm
Start speed (Pull-in speed)				
Start/Stop speed @ 5v, no vibration		>150	>140	°/sec
Start/Stop speed, no vibration @ coil voltage = 4.7v		>135	>130	°/sec
Start/Stop speed, no vibration @ 4.7v, T=95°C		>105	>100	°/sec
Start/Stop speed, 10g accel vibration, @ 4.7v, & T=95°C		>90	>65	°/sec
Max Speed @ 5v, no vibration, accel at 4000 °/sec ²			>800	°/sec
Acceleration (up to 400° /sec) @ 5v, no vibration	6000			°/sec ²
Speed @ 5v, no vibration	600			°/sec
Operating Temperature	-40		105	°C
Storage Temperature	-40		105	°C
Coil Resistance ¹	214	227	240	Ohms
Operating Voltage	2.5	5	7.5	Volts
Operating Current @ 4v		18		mA
Magnetic Saturation Voltage		12		Volts
Coil Inductance	45	55	65	mH
Rotor magnetic pole pairs		5		pair
Gear ratio		1:36		
Rotor rotation per magnetic cycle (North pole to North pole)		72		Degrees
Output shaft rotation per magnetic cycle		2		Degrees

FRAEN HEAVY DUTY SERIES STEPPER MOTOR				
Output shaft rotation in full step mode		0.5		Degrees
Output shaft rotation in half-step mode		0.25		Degrees
Output shaft rotation in microstep mode @ 12steps/degree		0.083		Degrees
Sweep Span	300			Degrees
Equivalent motor inertia @ output		6.50E-06		Kg*m ²
Dynamic (Pull-out) Torque				
@ 200°/sec	1.2			mNm
@ 400°/sec	0.6			mNm
Static (Holding) Torque	3.6			mNm
Detent Torque @ 22°C	0.3	0.4		mNm
Motor Torque - Automatic Assembly	1.2			mNm
Hysteresis		0.6	1	Degrees
Linearity Error		0.3	0.5	Degrees
Noise Level				
@ 100°/sec		30	35	dB(A)
@ 200°/sec		35	40	dB(A)
@ 400°/sec		40		dB(A)
Permissible forces on output shaft ²				
Push/Pull Force (Axial)	150			N
Push/Pull Force (Radial @ 8mm)	12			N
Insertion Force ³		105		N
Internal Stop Break-out Torque	70			mNm
Permissible number of insertions of motor into PWB		1		
Motor Size				
Height		30		mm
Width		27		mm
Thickness		10		mm
Weight		7		g

Unless otherwise specified: $T_{dut} = 20^{\circ} C$
Full step 2-phase on

¹ The temperature conversion for copper wire used in the bobbins is: $RT=(1+(T-20)*(0.00393))*R20$

² Since the permissible pointer push-on/pull-off forces are 150N, the solder joints must not be damaged with these loads. The snaps are intended to carry much of the load when the pointer is pulled off, regardless of circuit board hole variations within permissible limits.

³ The insertion force is to be measured by applying a normal force to the motor housing while the snaps are resting above the circuit board holes. Board thickness and hole locations and tolerances are to be as specified on the drawing.

⁴ Other information:

Part Number	Output Shaft	Motor Orientation
6405-1610	18mm x 1.5mm	Rear Mount

HEAVY DUTY STEPPER MOTOR - ADDITIONAL SPECIFICATIONS

General

Product Qualification High & Low Temperature Exposure Product Durability & Endurance	All tests 72 hr soak, 200 hr cycling 1000 hrs @ 105 °C	Conformance to Tolerance < 18 Lost microsteps ¹
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Noise/Sound Measurement

Only 1 motor ON.
 Microphone placed 5cm above center of motor above bottom of board for Rear Mount
 Run at sweep speeds of 50°/sec, 200°/sec, and sweep=250°
 Detect RMS level using 0.05 sec time constant, A-weighting, sampling rate 12 KHz minimum.

Vibration

Test Profile - Sine	Sine	
Frequency Range 5-200-5 Hz	5-200-5 Hz	
Sweep	Logarithmic	
Sweep Period - 20min (Lo-Hi-Lo)	20 Min. (Lo-Hi-Lo)	
Duration	18 Sweeps (6 hours)/Plane	
Acceleration Level:		
Amplitude=10mm PtoP	5-15 hz	< 18 Lost microsteps ¹
4.5g	15-25 hz	
3g	25-100 hz	
3g	100-200 hz	
Shock Test	40g	

¹ Microstep=(1/24)*2 Degrees