Automatic measurement

Measurement starts from the first (lowest) frequency defined on the software.

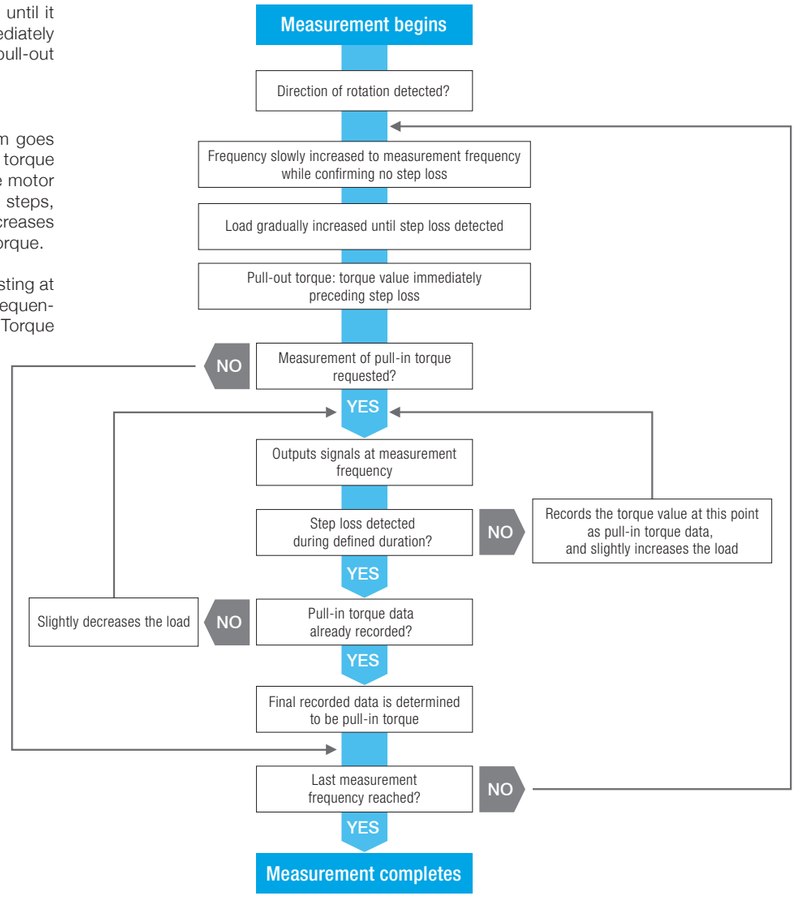
Pull-out torque

Rotating the motor at the speed of the defined frequency, the system gradually increases load until it detects step loss. The torque value immediately preceding the loss is determined to be the pull-out torque.

Pull-in torque

After measuring the pull-out torque, the system goes to the pull-in torque measurement. It reduces torque step by step to check at each step whether the motor can start from the holding state without losing steps, and according to the result, it decreases and increases the torque and checks until it finds the pull-in torque.

When finishing the pull-out and pull-in torque testing at the first frequency, it goes to the next higher frequencies one by one, to obtain the full Frequency-Torque curves of the test motor automatically.



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SUGAWARA

Stepper Motor Torque Tester

Micro Stepper Motor Tester **SMT-2**
Controller **SMC-2**
Sensor Set **SS** series

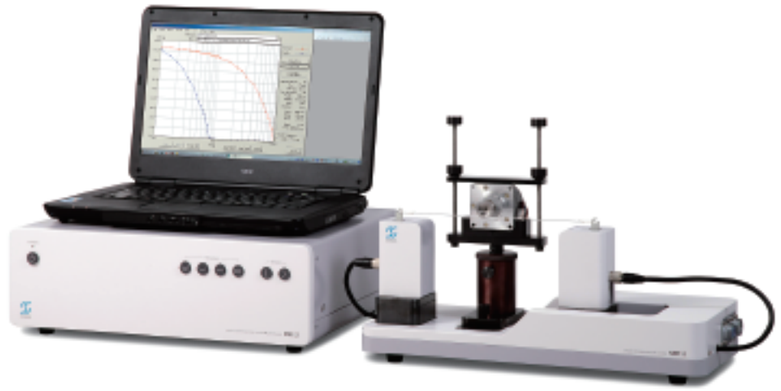
SUGAWARA Laboratories Inc.

Frequency-Torque Testing of Micro Stepper Motors

With the unique application of Prony (winding) braking, which is the most proven method for torque testing of small/micro stepper motors, it automatically obtains the full pull-in and pull-out torque curves with high accuracy.

Pull-in torque The maximum torque at which the motor can start from holding state without losing steps for a given speed

Pull-out torque The maximum torque at which the motor can operate without losing steps for a given speed



Advantages

Minimal moment of inertia of the tester

By adopting Prony braking, the system provides stable measurement unaffected by moment of inertia of the tester and coupling loss, which is unavoidable in conventional torque testers. The advantage is obvious especially in pull-in torque testing. For micro motors, zero inertia testing is possible by winding the brake thread directly on the shaft.

Definition-based measurement

The pull-in torque is measured exactly according to its definition: the maximum torque at which the motor can start from the holding state without losing steps. The resulting data has a high correlation with the data by traditional double balance method.

Broad measurement range

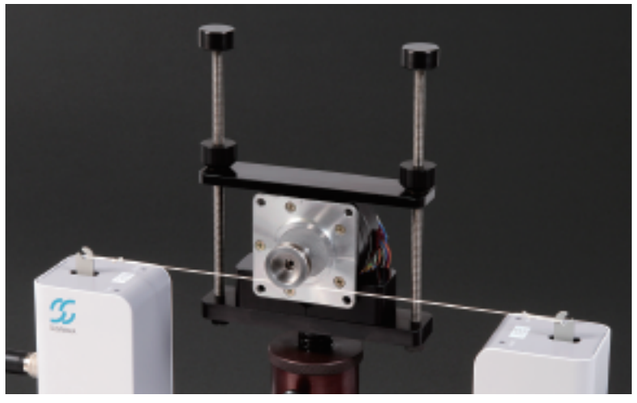
Six models of sensors, from 0.5 N to 20 N, allow wide range of high-precision measurement. By selecting Sensors and Pulleys, the system measures small/micro stepper motors of 0.1 to 400 mN·m.

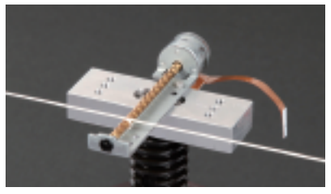
Easy-to-see presentation

Motor characteristics are easily seen on automatically plotted Frequency-Torque curves. Data can be overlaid on the graph up to four data sets.

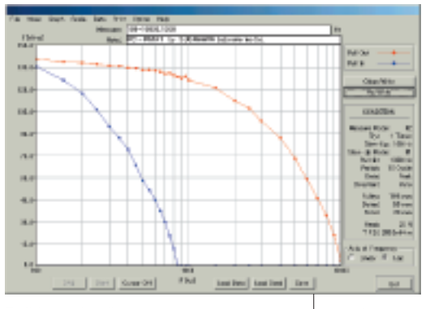
Can be controlled by standard personal computers

Allows control of measurement, display, and storage of data by standard personal computers running Windows®.



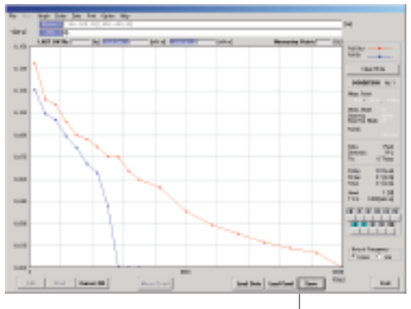


The Prony Brake enables torque testing of motors such as leadscrew type carriage control motors and micro stepper motors with maximum torque of 0.1 mNm in a 5 mm diameter case.



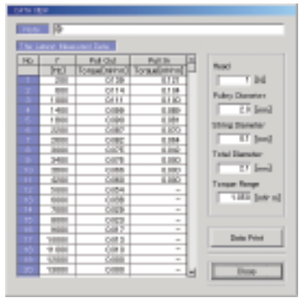
Pull-in and pull-out torque curve of a five-phase stepper motor. (Logarithmic scale)

X axis: frequency
Y axis: torque



Pull-in and pull-out torque curve of a low torque (0.2 mN·m or less) micro stepper motor. (Linear scale)

X axis: frequency
Y axis: torque



Numerical data display

System and Method

The Brake Thread is wound on the Pulley attached to the Test Motor shaft, and its both ends are attached to the hooks of the two Sensors. When the Moving Sensor moves to tighten the Brake Thread, the torque is loaded to the Test Motor via a Pulley.

In this way the motor torque **T** is detected as follows;

$$T=|F1-F2|\times(D1+D2)/2$$

T : motor torque [mNm]
F1: force detected by Fixed Sensor [N]
F2: force detected by Moving Sensor [N]
D1: diameter of the Pulley [mm]
D2: diameter of the Brake Thread [mm]

Measurement range

The torque measurement range of each Sensor is defined according to the formula below (thread diameter is ignored for convenience sake).

$$T=\text{Sensor Rating}\times\text{Pulley Diameter}/2$$

The torque range table defined by combination of the Sensor and the Pulley is as follows;

Torque measurement range table [mNm]

Sensor Model	Sensor Rating [N]	Pulley Diameter [mm]				
		1*1	5	10	20	40
SS-R5N	0.5	0.25	1.25	2.5	5	10
SS-1N	1	0.5	2.5	5	10	20
SS-2N	2	1	5	10	20	40
SS-5N	5	2.5	12.5	25	50	100
SS-10N	10	5	25	50	100	200
SS-20N	20	10	50	100	200	400

*1: when the thread is wound directly on the motor shaft.

Specifications

Brake	Prony braking
Sensor rating	Six types: 0.5 N, 1 N, 2 N, 5 N, 10 N, 20 N
Sensor sensitivity	DC 2 V/rating
Torque measurement precision	Within ±1% of torque range
Maximum allowable load	200% of Sensor rating
Torque measurement range	T=Sensor Rating × Pulley Diameter/2 (Refer to the torque measurement range table on the left.)
Torque analog output from SMC-2	DC 2 V/torque rating
Drive frequency range	16 - 50,000 Hz
Drive signals	Square wave (duty 1:1), TTL-level voltage signal or open-collector signal
Dimensions and weight	
Micro Stepper Motor Tester SMT-2	450 (W) × 200 (H) × 370 (D) mm, Approximately 14 kg
Controller SMC-2	430 (W) × 148 (H) × 360 (D) mm, Approximately 9 kg
Sensor Set SS-*N	80 (W) × 122 (H) × 66 (D) mm, Approximately 0.9 kg (EA)
Compatible personal computer	IBM PC/AT-compatible
Operating system	Microsoft Windows®2000, XP, 7
Interface	RS-232C serial port
Power supply	Single-phase AC 100 - 120 V ±10%, 50/60 Hz Single-phase AC 200 - 240 V ±10%, 50/60 Hz
Power consumption	50 VA or less