Torque Dynamometers

Products: Stroboscopes, torque dynamometers, bearing inspection systems, etc.

SUGAWARA Laboratories Inc.

Address inquiries to:

Damage to or scattering of couplings or other components during measurement may cause injury.
Always use the safety cover.

*Premium data measurement services using Sugawara Laboratories’ torque dynamometers are available. Please visit the Sugawara Laboratories website for more information.
The contents of this pamphlet are subject to change without notice to permit improvements.

Speed-torque characteristics, pull-in/pull-out torque
Angle-torque characteristics, cogging torque, torque ripple

SUGAWARA Laboratories Inc.
Speed-torque measurements

**Hysteresis brake principles**

For measurements of an electric motor’s speed-torque performance, the most important thing is determining which braking method (e.g., hysteresis braking, eddy current braking, powder braking, Prony braking, or motor braking) suits the nature and objectives of the measurement. The hysteresis brakes used in Sugawara Laboratories’ speed-torque measurement equipment are superior in several aspects, including their capacity for stable measurement and strong data reproducibility.

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**Uses hysteresis brakes**

A hysteresis brake incorporates a structure in which a rotor made of magnetic material with hysteresis characteristics is turned by a gear-shaped stator in a magnetic field aperture. Through coupling to the motor subject to measurement, the hysteresis brake functions as a brake by absorbing as hysteresis loss energy seeking to rotate this rotor. Since this energy absorption through hysteresis loss is proportional to the rate of rotation of the rotor, the brake torque generated does not depend on RPM. Rather, it functions as a stable brake from the stopped state through the high-RPM zone. Brake torque, which can be controlled using the exciting current flowing through the stator coil, has the characteristics shown in Figure 3. The solid line represents performance when increasing and decreasing the exciting current while rotating the rotor. Brake torque is zero when the exciting current is zero.

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**Methods of detecting load torque and RPM**

Using a bearing in their casing frames, Sugawara Laboratories’ TA/TB series of torque measurement components provide support for hysteresis brakes. In this structure, the force seeking to rotate the brake stator through operation of the motor subject to measurement is detected by a load cell using a strain gauge. When the rotor is turned by adding rotational force when brake torque is generated, the brake torque generated can be transmitted to the stator and detected by the load cell. Since this torque detection method can detect in a very static way only the force attempting to rotate the brake stator, it is more durable than detecting the torque of the axle of rotation. This can be regarded as a stable detection method suited to high-speed rotation. Although detection response can be somewhat slow, this method offers adequate response for detecting motor load characteristics. In addition, to increase the precision of detection, losses from the bearing supporting the brake must be low. Air bearings are generally used for equipment with low rated torque. The speed of rotation is detected through measurements with an optical encoder at 60 pulses per rotation. This encoder can also be used to detect the direction of rotation using phase relationships.

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**Confirming the performance of Sugawara Laboratories torque dynamometers**

Performance is confirmed through benchmark tasks using Sugawara Laboratories’ work upon delivery. For this reason, we meet with clients concerning work and measurement conditions before concluding order contracts. In addition, if a client wants actual measurements using its own work, the work must be provided to Sugawara Laboratories before delivery inspections.
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### PC-SAA2 Motor Analyzer

This model allows Windows®-based measurements of the speed and torque characteristics of a wide range of motors, from DC motors to three-phase motors. It can be configured to use any measurement point and provides identical measurement values in automatic and manual modes. Users can select from 14 TA/TB-series torque measurement components, with ratings from 5 mN·m to 50 N·m. Adding optional components allows for use with applications including voltage and current measurements and evaluations of high-frequency drive efficiency.

#### Measurements

<table>
<thead>
<tr>
<th>Basic configuration</th>
<th>Basic configuration</th>
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<tbody>
<tr>
<td>Motor analyzer</td>
<td>Voltage/current measurement components</td>
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<td></td>
<td>(1) Voltage</td>
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<td>(2) Current</td>
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<td>(4) Efficiency</td>
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<td>Digital power meter</td>
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<td>A. Voltage E1–E4</td>
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<td>B. Current I1–I6</td>
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<td>D. Input power A</td>
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<td>E. Power B</td>
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<td>F. Efficiency A</td>
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<td>G. Efficiency B</td>
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<td>H. Power factor ω</td>
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<td>Voltage/current measurement units</td>
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<td>(5) Voltage</td>
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<td>(6) Current</td>
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<td>(7) Input</td>
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<td>(8) Efficiency</td>
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</tbody>
</table>

#### Primary specifications

**Load characteristics and voltage/current measurement**

**Load control method**

- **Torque control**: controls motor lead torque to configured value within ±1% of full scale
- **Speed control**: controls motor RPM to configured value within ±2% of full scale

**Measurement modes**

- **Automatic mode**: load can be configured to up to 400 points
- **Manual mode**: load configured and measured in increments of one point
- **Calibration mode**: calibrates detected torque values of torque detection components

**Torque measurement**

- Torque measurement precision: within ±0.5% of range (full scale)
- Measurement range: displays value of root mean square of 64 items of data sampled at intervals of 2 msec
- Sample display of numerical data

**PWM measurement**

- PWM measurement precision: within ±2 V (full scale)
- Measurement range: displays average value for up to 64 items of data sampled over 128 msec

**Measurement range**

<table>
<thead>
<tr>
<th>Voltage measurement precision:</th>
<th>within ±0.5% of range (full scale)</th>
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<tbody>
<tr>
<td>Current measurement precision:</td>
<td>within ±0.7% of range (full scale)</td>
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<tr>
<td>RPM measurement precision:</td>
<td>within ±0.5 of range (full scale)</td>
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<tr>
<td>Efficiency measurement precision:</td>
<td>within ±0.4% of range (full scale)</td>
</tr>
</tbody>
</table>

**Power measurement**

- Power measurement range: within ±0.5% of range (full scale)
- Power measurement precision: within ±0.4% of range (full scale)

**Efficiency measurement**

- Efficiency measurement range: 1.5 V–1,000 V
- Efficiency measurement precision: calculated using output power x 100

**Common specifications: PC-SAA2, PC-PM2**

- Input sensitivity: ±2 V (range ± full scale)
- Input range: ±2 V (range ± full scale)
- Measurement range: ±2 V (range ± full scale)

**Efficiency measurement**

- Efficiency measurement range: ±0.15%
- Efficiency measurement precision: ±0.15%

**Voltage measurement**

- Voltage measurement range: ±1500 V
- Voltage measurement precision: ±0.7% of range (full scale)

**Current measurement**

- Current measurement range: ±1500 A
- Current measurement precision: ±0.7% of range (full scale)

**Power measurement**

- Power measurement range: up to six elements — 5 A elements for measurement of minor currents and 50 A elements for measurement of major currents — can be implemented randomly. A range can also be configured for each element.
- Power measurement range: ±1500 A
- Power measurement precision: ±0.7% of range (full scale)

**Efficiency measurement**

- Efficiency measurement range: ±0.15%
- Efficiency measurement precision: ±0.15%

**Voltage measurement**

- Voltage measurement range: ±1500 V
- Voltage measurement precision: ±0.7% of range (full scale)

**Current measurement**

- Current measurement range: ±1500 A
- Current measurement precision: ±0.7% of range (full scale)

**Power measurement**

- Power measurement range: within ±0.15% of range (full scale)
- Power measurement precision: within ±0.15% of range (full scale)

**Efficiency measurement**

- Efficiency measurement range: 1.5 V–1,000 V
- Efficiency measurement precision: ±0.15%

**Voltage measurement**

- Voltage measurement range: ±1500 V
- Voltage measurement precision: ±0.7% of range (full scale)

**Current measurement**

- Current measurement range: ±1500 A
- Current measurement precision: ±0.7% of range (full scale)

**Power measurement**

- Power measurement range: within ±0.15% of range (full scale)
- Power measurement precision: within ±0.15% of range (full scale)

**Efficiency measurement**

- Efficiency measurement range: 1.5 V–1,000 V
- Efficiency measurement precision: ±0.15%

**Voltage measurement**

- Voltage measurement range: ±1500 V
- Voltage measurement precision: ±0.7% of range (full scale)

**Current measurement**

- Current measurement range: ±1500 A
- Current measurement precision: ±0.7% of range (full scale)

**Power measurement**

- Power measurement range: within ±0.15% of range (full scale)
- Power measurement precision: within ±0.15% of range (full scale)

**Efficiency measurement**

- Efficiency measurement range: 1.5 V–1,000 V
- Efficiency measurement precision: ±0.15%

**Voltage measurement**

- Voltage measurement range: ±1500 V
- Voltage measurement precision: ±0.7% of range (full scale)

**Current measurement**

- Current measurement range: ±1500 A
- Current measurement precision: ±0.7% of range (full scale)

**Power measurement**

- Power measurement range: within ±0.15% of range (full scale)
- Power measurement precision: within ±0.15% of range (full scale)

**Efficiency measurement**

- Efficiency measurement range: 1.5 V–1,000 V
- Efficiency measurement precision: ±0.15%
**Load characteristics and voltage/current measurement**

**Torque measurement components**
- (1) RPM
- (2) Torque
- (3) Output Po [W]

**Measurement modes**
- **Basic configuration**
  - Voltage/current measurement components:
    - Voltage
    - Current
    - Efficiency
  - Digital power meter:
    - A. Voltage (E)
    - B. Current (I)
    - C. Power (P)
    - D. Energy (E)
    - E. Load (L)
    - F. Efficiency (F)
    - G. Energy (G)
    - H. Power factor (PF)

**Voltage measurement**
- within ±0.5% of range
- ±0.7% of range

**Current measurement**
- within ±0.5% of range
- ±0.7% of range

**Measurement range**
- 1/25000/50/100/500/1000 V

**Frequencies at which measurement is possible**
- ±1 kHz (full scale)
- ±5 kHz (full scale)

**Voltage measurement**
- ±5% of range
- ±0.5% of range

**Current measurement**
- ±5% of range
- ±0.5% of range

**Efficiency measurement**
- ±0.1% of range
- ±0.5% of range

**Common specifications: PC-SAA2, PC-PMA2**

**WT1600 Digital Power Meter**
- Adding the WT1600 digital power meter from Yokogawa Electric Corp.
- Allows measurements of aspects such as driver input/output, including high-frequency specifications, and driver circuit evaluations.

**WT1600 measurement precision**
- ±0.15%

**Frequency power range**
- DC, 0.5 Hz–1 MHz

**Voltage measurement**
- 1.5 V–1,000 V

**Current measurement**
- Up to six elements — 5 A elements for measurement of minor currents and 50 A elements for measurement of major currents — can be implemented randomly. A range can also be configured for each element.

**Direct 5-A implementation**
- 10 mA–5 A

**Direct 50-A implementation**
- 1 A–50 A

**CT implementation**
- 15 A–750 A

**Sensor voltage input range**
- 50 mV–10 V

**Conversion sensitivity setting range**
- 0.00–9999.99

**Description**
- Compatible personal computers: IBM PC/AT or compatible
- Operating system: Microsoft Windows®2000, XP
- Communication with personal computer and WT1600 digital power meter:
  - Interface: RS232C
  - Connector: D-9-pin
  - Communication rate: 19200bps

**Data storage and reading**
- Display of data:
  - graphics, values, and configuration menu displayed on personal computer monitor
  - measurement data can be stored in CSV format files; stored data can be displayed in graph and table format

**Printing**
- on-screen graphs and numerical data output to printer

**Sum total of configured power data calculated by personal computer**
- 0.00–9999.99

**TM-25 Torque Meter**
- Combining this with TA/TB-series torque measurement components allows measurements of speed and torque of AC and DC motors.
- It includes a function for measurement fluctuations in numbers of rotations through automatic load sweeping. Measurement results can be output as analog signals.

**Description**
- Brake control: open-loop control using power supply

**Control methods**
- Torque control: fixed-torque servo control using torque value as feedback to power supply
- Speed control: fixed-speed servo control using RPM as feedback to power supply

**Basic configuration**
- Torque meter (control component): TM-25
- Torque measurement component: TA/TB-series (fourteen models)
## Speed-torque measurement

### Advantages of TA/TB torque measurement components
- **Hysteresis brake for measurement devices**
  - Sugawara Laboratories boasts many years of brake development and manufacturing experience. In addition to minimizing the magnetic field aperture in which the hysteresis cup rotates, this component minimizes the cup’s moment of inertia, enabling improved torque-control precision and controlling vibrations at high RPMs.
- **Enables stable measurements from low through high RPMs**
  - Torque is detected by the brake exerted by the brake rotor, enabling stable torque measurements from low through high RPM ranges. This component features a maximum speed of 30,000 rpm (depending on torque rating). In addition, optional components can be used to improve speed resolution for use with low-speed motors of 100 rpm or less.
- **Compatible with broad range of torque ratings from 5 mNm through 50 Nm**
  - Measurement components can be selected to suit motor power to ensure high-precision measurements. Users can select from 14 models of TA/TB torque measurement components offering differing torque ratings.
- **Long-lasting noncontact brake**
  - Hysteresis brakes are noncontact devices and offer long service life. Except for bearings, hysteresis brakes have virtually no maintenance requirements.
- **Superior heat resistance**
  - Another hysteresis brake advantage is its resistance to changes in torque values due to increases in brake temperature or surrounding temperature.
- **Features air bearings for low-torque use**
  - Air bearings support the brake for low-torque use.
- **Input absorption performance**
  - The continuous measurement time of the torque measurement component varies with input power. For this reason, the component must be used correctly, as shown in the following performance graphs. Sustained use beyond the limits indicated in these performance graphs will make it difficult to obtain correct measurements and pose risk of equipment damage.

### Overall torque specifications

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<tbody>
<tr>
<td>Torque rating</td>
<td>5 mNm</td>
<td>10 mNm</td>
<td>20 mNm</td>
<td>50 mNm</td>
<td>100 mNm</td>
<td>200 mNm</td>
<td>500 mNm</td>
<td>1 KNm</td>
<td>2 KNm</td>
<td>5 KNm</td>
<td>10 KNm</td>
<td>20 KNm</td>
<td>50 KNm</td>
<td>100 KNm</td>
<td>200 KNm</td>
<td>500 KNm</td>
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<tr>
<td>Torque measurement range</td>
<td>0.15–5 mNm</td>
<td>0.3–10 mNm</td>
<td>0.3–20 mNm</td>
<td>1.5–50 mNm</td>
<td>0.05–1 KNm</td>
<td>0.05–2 KNm</td>
<td>0.05–3 KNm</td>
<td>0.6–20 KNm</td>
<td>0.6–30 KNm</td>
<td>1.5–50 KNm</td>
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<tr>
<td>Torque measurement precision</td>
<td>±0.5% of torque rating (with control component values determined during calibration)</td>
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<td>Brake support methods</td>
<td>Air bearings</td>
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<td>Brake temperature protection</td>
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<tr>
<td>Brake rotor material of inertia</td>
<td>0.8 x 10^-6 kg·m²</td>
<td>0.8 x 10^-6 kg·m²</td>
<td>2 x 10^-6 kg·m²</td>
<td>3 x 10^-6 kg·m²</td>
<td>9 x 10^-6 kg·m²</td>
<td>9 x 10^-6 kg·m²</td>
<td>28 x 10^-6 kg·m²</td>
<td>180 x 10^-6 kg·m²</td>
<td>540 x 10^-6 kg·m²</td>
<td>1.8 x 10^-5 kg·m²</td>
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<td>Brake rotor material of inertia</td>
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<td>Shaft diameter (mm)</td>
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<td>Shaft height (mm)</td>
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<td>Shaft length (mm)</td>
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<td>Dimensions (W x H x D)</td>
<td>200 x 240 x 350 mm</td>
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<td>Weight (kg)</td>
<td>Approx. 15 kg</td>
<td>Approx. 19 kg</td>
<td>Approx. 26 kg</td>
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<td>Approx. 56 kg</td>
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<td>Approx. 210 kg</td>
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<td>Motor attachment hardware</td>
<td>MM–18</td>
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<td>Coupling moment of inertia</td>
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<td>Coupling component</td>
<td>PC-type rubber coupling</td>
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<td>Coupling motor</td>
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<td>Power supply</td>
<td>A2 / 100 V ±10%, 50/60 Hz</td>
<td>PC–EM1–U*</td>
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## Torque meter measurement components

### Torque-value calibration method

In accordance with physical moment principles, calibration can be performed using a calibration bar attached to the shaft of the torque measurement component and a weight suspended from the bar. The torque rating is displayed when the included weight is suspended from the notches at the end of the calibration bar. Volume is adjusted to allow display of the torque rating.

### Air filter

A TA-A2 regulator with an air filter to eliminate fine dust and particulate matter is provided standard with model TA torque measurement components for brakes supported by air bearings.

### Input absorption performance

The continuous measurement time of the torque measurement component varies with input power. For this reason, the component must be used correctly, as shown in the following performance graphs. Sustained use beyond the limits indicated in these performance graphs will make it difficult to obtain correct measurements and pose risk of equipment damage.

For models TB-20KS through TB-500KS, the automatic current cutoff operation operates when the continuous-use allowance is exceeded, setting brake torque to zero.
**Overall torque specifications**

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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque rating (N·m)</td>
<td>5 x 10^{-3}</td>
<td>10 x 10^{-3}</td>
<td>20 x 10^{-3}</td>
<td>50 x 10^{-3}</td>
<td>100 x 10^{-3}</td>
<td>200 x 10^{-3}</td>
<td>500 x 10^{-3}</td>
<td>1 N·m</td>
<td>2 N·m</td>
<td>5 N·m</td>
<td>10 N·m</td>
<td>20 N·m</td>
<td>30 N·m</td>
<td>50 N·m</td>
<td>100 N·m</td>
<td>200 N·m</td>
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<tr>
<td>Torque measurement range (°)</td>
<td>0.15–5°</td>
<td>0.3–10°</td>
<td>1.5–20°</td>
<td>3–100°</td>
<td>6–200°</td>
<td>15–500°</td>
<td>3–100°</td>
<td>0.5–2 N·m</td>
<td>1 N·m</td>
<td>2 N·m</td>
<td>5 N·m</td>
<td>10 N·m</td>
<td>20 N·m</td>
<td>30 N·m</td>
<td>50 N·m</td>
<td></td>
</tr>
<tr>
<td>Torque measurement accuracy</td>
<td>±0.01% of range ± 1°</td>
<td>±0.02% of range ± 1°</td>
<td>±0.03% of range ± 1°</td>
<td>±0.05% of range ± 1°</td>
<td>±0.07% of range ± 1°</td>
<td>±0.1% of range ± 1°</td>
<td>±0.15% of range ± 1°</td>
<td>±0.2% of range ± 1°</td>
<td>±0.2% of range ± 1°</td>
<td>±0.2% of range ± 1°</td>
<td>±0.2% of range ± 1°</td>
<td>±0.2% of range ± 1°</td>
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<td>±0.2% of range ± 1°</td>
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<td>Brake support methods</td>
<td>Air bearings</td>
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<td>Air bearings</td>
<td>Ball bearings</td>
<td>Air bearings</td>
<td>Ball bearings</td>
<td>Air bearings</td>
<td>Ball bearings</td>
</tr>
<tr>
<td>Brake temperature protection</td>
<td>Air filter</td>
<td>Hysteresis brake</td>
<td>Air filter</td>
<td>Hysteresis brake</td>
<td>Air filter</td>
<td>Hysteresis brake</td>
<td>Air filter</td>
<td>Hysteresis brake</td>
<td>Air filter</td>
<td>Hysteresis brake</td>
<td>Air filter</td>
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<td>Air filter</td>
<td>Hysteresis brake</td>
<td>Air filter</td>
<td>Hysteresis brake</td>
</tr>
<tr>
<td>Brake temperature protection</td>
<td>100–30,000 rpm</td>
<td>100–20,000 rpm</td>
<td>100–10,000 rpm</td>
<td>100–7,000 rpm</td>
<td>100–5,000 rpm</td>
<td>100–3,000 rpm</td>
<td>100–2,000 rpm</td>
<td>100–1,000 rpm</td>
<td>100–500 rpm</td>
<td>100–200 rpm</td>
<td>100–100 rpm</td>
<td>100–50 rpm</td>
<td>100–20 rpm</td>
<td>100–10 rpm</td>
<td>100–5 rpm</td>
<td>100–2 rpm</td>
</tr>
<tr>
<td>Brake diameter (mm)</td>
<td>MMJ-7B</td>
<td>MMJ-9B</td>
<td>MMJ-10B</td>
<td>MMJ-12B</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Brake diameter (mm)</td>
<td>130 mm</td>
<td>160 mm</td>
<td>200 mm</td>
<td>230 mm</td>
<td>300 mm</td>
<td>330 mm</td>
<td>360 mm</td>
<td>390 mm</td>
<td>420 mm</td>
<td>450 mm</td>
<td>480 mm</td>
<td>510 mm</td>
<td>540 mm</td>
<td>570 mm</td>
<td>600 mm</td>
<td>630 mm</td>
</tr>
<tr>
<td>Brake weight (kg)</td>
<td>Approx. 15 kg</td>
<td>Approx. 19 kg</td>
<td>Approx. 26 kg</td>
<td>Approx. 29 kg</td>
<td>Approx. 56 kg</td>
<td>Approx. 63 kg</td>
<td>Approx. 180 kg</td>
<td>Approx. 210 kg</td>
<td>Approx. 400 kg</td>
<td>Approx. 450 kg</td>
<td>Approx. 500 kg</td>
<td>Approx. 550 kg</td>
<td>Approx. 600 kg</td>
<td>Approx. 650 kg</td>
<td>Approx. 700 kg</td>
<td>Approx. 750 kg</td>
</tr>
<tr>
<td>Motor attachment hardware</td>
<td>MM-A5</td>
<td>MM-A10</td>
<td>MM-A15</td>
<td>MM-A20</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Motor attachment hardware</td>
<td>Subject to separate consultation</td>
<td>Subject to separate consultation</td>
<td>Subject to separate consultation</td>
<td>Subject to separate consultation</td>
<td>Subject to separate consultation</td>
<td>Subject to separate consultation</td>
<td>Subject to separate consultation</td>
<td>Subject to separate consultation</td>
<td>Subject to separate consultation</td>
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<td>Subject to separate consultation</td>
<td>Subject to separate consultation</td>
<td>Subject to separate consultation</td>
<td>Subject to separate consultation</td>
<td>Subject to separate consultation</td>
</tr>
</tbody>
</table>

**Advantages of TA/TB torque measurement components**

- Uses hysteresis brake for measurement devices
- Sugawara Laboratories boasts many years of brake development and manufacturing experience.
- In addition to minimizing the magnetic field aperture in which the hysteresis cup rotates, this component minimizes the cup’s moment of inertia, enabling improved torque-control precision and controlling vibrations at high RPMs.
- Enables stable measurements from low through high RPMs.
- Torque is detected by the force exerted by the brake stator, enabling stable torque measurements from low through high RPM ranges. This component features a maximum speed of 30,000 rpm (depending on torque rating).
- In addition, optional components can be used to improve speed resolution for use with low-speed motors of 100 rpm or less.
- Compatible with broad range of torque ratings from 5 mN·m through 50 N·m.
- Measurement components can be selected to suit motor power to ensure high-precision measurements. Users can select from 14 models of TA/TB torque measurement components offering differing torque ratings.
- Long-lasting noncontact brake
- Hysteresis brakes are noncontact devices and offer long service life. Except for bearings, hysteresis brakes have virtually no maintenance requirements.
- Superior heat resistance
- Another hysteresis brake advantage is its resistance to changes in torque values due to increases in brake temperature or surrounding temperature.
- Features air bearings for low-torque use
- Allows measurements even in the unstable ranges of AC motors
- More compact than motor brakes or other brake types

**Torque-value calibration method**

In accordance with physical moment principles, calibration can be performed using a calibration bar attached to the shaft of the torque measurement component and a weight suspended from this bar. The torque rating is displayed when the included weight is suspended from the notches at the end of the calibration bar. Volume is adjusted to allow display of the torque rating.

**Air filter**

A TA-A2 regulator with air filter to eliminate fine dust and particulate matter is provided standard with model TA torque measurement components for brakes supported by air bearings.

**Input absorption performance**

The continuous measurement time of the torque measurement component varies with input power. For this reason, the component must be used correctly, as shown in the following performance graphs. Sustained use beyond the limits indicated in these performance graphs will make it difficult to obtain correct measurements and pose risk of equipment damage.

For models TB-20KS through TB-500KS, the automatic current cutoff equipment operates when the continuous-use allowance is exceeded, setting brake torque to zero.
Options

Safety cover
In certain cases — for example, when coupling core removal is performed incorrectly — the coupling may be damaged during measurement, causing it to fly off in random directions and leading to injury. Always implement adequate safety measures (e.g., attaching a safety cover).

Motor attachment hardware
The standard hardware consists of models MMJ-7B through MMJ-12B. Sugawara Laboratories can also design and manufacture special hardware for use in production and inspection lines in addition to specialized couplings and other equipment, in accordance with client needs.

Indication of coupling dimensions
Using model BC-6-8-14 as an example, “BC” indicates the material used (RC: rubber; BC: beryllium; SC: steel). The following “6” indicates the external diameter of the torque meter axle, “8” the external diameter of the axle of the motor subject to measurement and the internal diameter when connecting attachments, and “14” the external diameter of the coupling.

Indication of attachment dimensions
Using model BA-10-10-D as an example, “BA” or “SA” indicates the type of attachment, the first “10” the internal diameter of the coupling, the next “10” the external diameter of the motor subject to measurement, and “D” the shape.

Modifications for use with low-speed motors
For measurements of low-speed motors, modifications (pattern-600 modifications) can be made to enable measurement in units of 0.1 r/min, thereby improving resolution. Note that the maximum RPM will be 4000 r/min.

Hysteresis brake unit

A high-performance brake for use with motor measurement devices; ideal for use with specialized measurement tools and similar equipment

A hysteresis brake enables a fixed level of braking at all times depending on the electric current supplied, regardless of changes in RPM. The HB series is a compact, easy-to-use high-performance unit of load equipment used in Sugawara Laboratories speed and torque measurement equipment.

Advantages
- Enables high-precision braking through improvements to internal and external teeth.
- Has a structure that keeps the moment of inertia as low as possible.
- Maximum RPM: 30,000 r/min
- Can handle low-speed through high-speed RPM
- Note: Maximum RPM varies with rating and by model.
- Long-lasting noncontact brake
- A brake resistant to effects of changes in surrounding temperature
- More compact in size than other brakes
- Offers a choice of 14 models, with ratings ranging from 5 mN·m to 50 N·m depending on torque rating

Specifications and external dimensions (mm)

<table>
<thead>
<tr>
<th>Model</th>
<th>HB-50BS-U*</th>
<th>HB-10S-U*</th>
<th>HB-10KS-U*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque</td>
<td>50 mN·m</td>
<td>100 mN·m</td>
<td>500 mN·m</td>
</tr>
<tr>
<td>Maximum RPM</td>
<td>30,000 r/min</td>
<td>30,000 r/min</td>
<td>30,000 r/min</td>
</tr>
<tr>
<td>Moment of inertia</td>
<td>2 x 10⁻⁶ kg·m²</td>
<td>3 x 10⁻⁶ kg·m²</td>
<td>2 x 10⁻⁶ kg·m²</td>
</tr>
<tr>
<td>Electric current rating</td>
<td>330 mA</td>
<td>330 mA</td>
<td>330 mA</td>
</tr>
<tr>
<td>Cell resistance</td>
<td>15.5 Ω</td>
<td>16.5 Ω</td>
<td>35 Ω</td>
</tr>
<tr>
<td>Continuous input</td>
<td>75 W</td>
<td>120 W</td>
<td>450 W</td>
</tr>
<tr>
<td>Weight</td>
<td>630 g</td>
<td>640 g</td>
<td>450 g</td>
</tr>
<tr>
<td>a</td>
<td>ø 3.8</td>
<td>ø 3.5</td>
<td>ø 4.3</td>
</tr>
<tr>
<td>b</td>
<td>ø 5.0</td>
<td>ø 5.3</td>
<td>ø 7.1A</td>
</tr>
<tr>
<td>c</td>
<td>ø 6.5</td>
<td>ø 6.8</td>
<td>ø 12B</td>
</tr>
<tr>
<td>d</td>
<td>ø 10.0</td>
<td>ø 10.4</td>
<td>ø 164</td>
</tr>
<tr>
<td>e</td>
<td>ø 4</td>
<td>ø 6</td>
<td>ø 10</td>
</tr>
<tr>
<td>f</td>
<td>35</td>
<td>40</td>
<td>42</td>
</tr>
<tr>
<td>g</td>
<td>5</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>h</td>
<td>6</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>i</td>
<td>40</td>
<td>40</td>
<td>71</td>
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<tr>
<td>j</td>
<td>ø 40</td>
<td>ø 40</td>
<td>ø 96</td>
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<tr>
<td>k</td>
<td>112</td>
<td>118</td>
<td>161</td>
</tr>
<tr>
<td>l</td>
<td>ø 4</td>
<td>ø 5</td>
<td>ø 8</td>
</tr>
</tbody>
</table>

External diagram of model-TA/TB measurement component
Options

Safety cover
In certain cases — for example, when coupling core removal is performed incorrectly — the coupling may be damaged during measurement, causing it to fly off in random directions and leading to injury. Always implement adequate safety measures (e.g., attaching a safety cover).

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Using model BC-6-8-14 as an example, “BC” indicates the material used (RC: rubber; BC: beryllium; SC: steel). The following “6” indicates the external diameter of the torque meter shaft. “8” the external diameter of the axle of the motor subject to measurement, and the internal diameter when connecting attachments, and “14” the external diameter of the coupling.

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Using model BA-10-10-D as an example, “BA” or “SA” indicates the type of attachment, the first “10” the internal diameter of the coupling, the next “10” the external diameter of the motor subject to measurement, and “D” the shape.

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- Note: Maximum RPM varies with rating and by model.
- Long-lasting noncontact brake
- A brake resistant to effects of changes in surrounding temperature
- More compact in size than other brakes
- Offers a choice of 14 models, with ratings ranging from 5 mN·m to 50 N·m depending on torque rating

Specifications and external dimensions (mm)

<table>
<thead>
<tr>
<th>Model</th>
<th>HS-1025-U*</th>
<th>HS-154-U*</th>
<th>HS-1545-U*</th>
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</thead>
<tbody>
<tr>
<td>Torque rating</td>
<td>50 mN·m</td>
<td>100 mN·m</td>
<td>500 mN·m</td>
</tr>
<tr>
<td>Maximum RPM</td>
<td>30,000 r/min</td>
<td>30,000 r/min</td>
<td>30,000 r/min</td>
</tr>
<tr>
<td>Moment of inertia</td>
<td>2.4 x 10^-5 kg·m^2</td>
<td>3.3 x 10^-5 kg·m^2</td>
<td>50 x 10^-5 kg·m^2</td>
</tr>
<tr>
<td>Electric current rating</td>
<td>15 W</td>
<td>25 W</td>
<td>40 W</td>
</tr>
<tr>
<td>Motor resistance</td>
<td>15 W</td>
<td>25 W</td>
<td>40 W</td>
</tr>
<tr>
<td>Continuous input</td>
<td>15 W</td>
<td>25 W</td>
<td>40 W</td>
</tr>
<tr>
<td>Weight</td>
<td>630 g</td>
<td>640 g</td>
<td>4500 g</td>
</tr>
<tr>
<td>a</td>
<td>φ 8</td>
<td>φ 8</td>
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</tr>
<tr>
<td>b</td>
<td>φ 8</td>
<td>φ 8</td>
<td>φ 8</td>
</tr>
<tr>
<td>c</td>
<td>φ 8</td>
<td>φ 8</td>
<td>φ 8</td>
</tr>
<tr>
<td>d</td>
<td>φ 8</td>
<td>φ 8</td>
<td>φ 8</td>
</tr>
<tr>
<td>e</td>
<td>φ 8</td>
<td>φ 8</td>
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<td>40</td>
<td>40</td>
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</tr>
<tr>
<td>k</td>
<td>112</td>
<td>116</td>
<td>161</td>
</tr>
<tr>
<td>l</td>
<td>φ 8</td>
<td>φ 8</td>
<td>φ 8</td>
</tr>
</tbody>
</table>

Note: Maximum RPM varies with rating and by model.
Stepping motor measurement equipment

PC-PMA2 Pulse Motor Analyzer
This model uses Prony (winding) braking, the braking method with the strongest demonstrated performance for stepping motor measurements. Used with a personal computer, it provides precise automatic measurements of pull-in and pull-out torque.

Advantages
● Stable measurement
Since it uses Prony braking, this model provides stable measurement unaffected by moments of inertia and no coupling loss. In addition, the resulting measurements allow data correlation via the traditional double-balance method.

● Precision measurement method
This model’s judgment of synchronization loss achieves high stability using algorithms developed by Sugawara Laboratories. Measurement mode can be chosen based on step angle. For pull-in torque, startup can be measured consistently from the holding state. Allows measurement at 1-Hz resolution.

● Broad measurement range
This model offers a range of seven available measurement heads, from 0.5 N to 50 N, allowing use for high-precision measurements. Through selection and use of pulleys, this model can also be used to measure small motors of 0.1 mN·m or less or 500 mN·m motors. Pulley diameters and other settings are easily configured using a personal computer running Windows®.
Note: Any of the seven available heads may be attached to a single measurement component.

● High-visibility measurement data
Motor characteristics are easily ascertained on automatically plotted performance graphs. Measurement data can be overlaid up to four times. In addition, the cursor can be used to read accurate values from measurement points. Hard copies of data displayed on-screen can be printed from a personal computer.

Can be controlled using standard personal computers
Allows control of measurement operations and display and storage of data from a standard personal computer running Windows®. Data is stored in CSV-format files for compatibility with other software applications.

Measurement of pull-in and pull-out torque

Automatic measurement method
Following detection of motor rotation direction, frequency measurements are performed from low to high frequency.

● Pull-out torque
Gradually increase loads after slowly revving the motor to the measurement frequency. When loss of synchronization is detected, the value immediately preceding this loss is determined to be the pull-out torque value.

● Pull-in torque
Starting from the holding state following measurement of pull-out torque, the configured frequency is output to the motor and loss of synchronization detected. Based on these results, the motor is rotated at the measurement frequency while increasing and decreasing loads and loss of synchronization monitored once again. This process is repeated until the maximum load torque value at which synchronized rotation can be performed is detected. This value is determined to be the pull-in torque.

Load-torque detection method
Braking tension is detected using two heads; the differential is calculated by the computer. When the force detected by each head is represented as F1, F2 (N), and radius R (mm) to pulley brake, detected torque T (mN·m) is R x (F1 - F2) [mN·m].

Basic configuration
Pulse motor analyzer: PC-PMA2
Measurement component: PMM-1
Torque detection head: G-PMA-H-*S
Personal computer: Microsoft Windows® 2000, XP

Primary specifications
Load method: Prony braking
Force detection head rating: seven types: 0.5/1/2/5/10/20/50 N
Torque detection head output sensitivity: DC 2 kV-flating
Torque measurement precision: ±10% of torque range
Maximum allowable load input: 200% of rating
Torque range: 0 - Fh x Dp / 2 [mN·m]
Fh: detection-head rating [N]

Torque measurement accuracy: + configured brake diameter [mm]

Load-torque detection method
Pulses output at slowly increasing frequencies
Measurement begins
Pulses output at measurement frequency
Frequency slowly increased to measurement frequency
Gradually increase loads after slowly revving the motor to the measurement frequency
Load increased by very small amount
Torque value at this time recorded
Pull-out torque data already recorded?

Final configured measurement
Final recorded data determined
Load decreased by very small amount
Yes
Yes
No
Load increased by very small amount
Yes
Yes
No

Sample display of numerical data

Choose a linear scale when graphing measurements of pull-in and pull-out torque for a fine-phase stepping motor. X axis: frequency, Y axis: torque

Range of operating pulse frequency settings: 16 Hz - 50,000 Hz

Power consumption: approximately 50 VA

Dimensions, weight: Width 160 mm x 160 mm x 20 mm
Operating systems: Microsoft Windows® 2000, XP

Control component PC-PMA2: 430 (W) x 150 (H) x 360 (D) mm
Head PMA-H-*S: 80 (W) x 115 (H) x 60 (D) mm
Compatible personal computers: IBM PC/AT compatible
Operating systems: Microsoft Windows® 2000, XP
Interface: at least one RS-232C serial port
Power supply: single-phase AC 100 V ±10%, 50/60 Hz
Power consumption: approximately 50 VA
### Stepping motor measurement equipment

**PC-PMA2 Pulse Motor Analyzer**

This model uses Prony (winding) braking, the braking method with the strongest demonstrated performance for stepping motor measurements. Used with a personal computer, it provides precise automatic measurements of pull-in and pull-out torque.

#### Advantages

- **Stable measurement**
  - Since it uses Prony braking, this model provides stable measurement unaffected by moments of inertia and no coupling loss. In addition, the resulting measurements allow data correlation via the traditional double-balance method.

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Following detection of motor rotation direction, frequency measurements are performed from low to high frequency.

- **Pull-out torque**
  - Gradually increase loads after slowly revving the motor to the measurement frequency. When loss of synchronization is detected, the value immediately preceding this loss is determined to be the pull-out torque value.

- **Pull-in torque**
  - Starting from the holding state following measurement of pull-out torque, the configured frequency is output to the motor and loss of synchronization detected. Based on these results, the motor is rotated at the measurement frequency while increasing and decreasing loads and loss of synchronization monitored once again. This process is repeated until the maximum load torque value at which synchronized rotation can be performed is detected. This value is determined to be the pull-in torque.

<table>
<thead>
<tr>
<th>Load-torque detection method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braking tension is detected using two heads; the differential is calculated by the computer. When the force detected by each head is represented as F1, F2 (N), and radius R (mm) to pulley brake, detected torque T (mN·m) is R x (F1 - F2) [mN·m].</td>
</tr>
</tbody>
</table>

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**Basic configuration**

- **Pulse motor analyzer:** PC-PMA2
- **Measurement component:** PMM-1
- **Torque detection head:** G-PMA-H-*S
- **Personal computer:** Microsoft Windows® 2000, XP

**Primary specifications**

- **Load method:** Prony braking
- **Force detection head rating:** seven types: 0.5/1/2/5/10/20/50 N
- **Torque measurement precision:** within ±1% of torque range
- **Maximum allowable load input:** 200% of rating
- **Torque range:**
  - B = Fr x Dp / 2 (mN·m)
  - Fr: detection-head rating (N)
  - Dp: configured pulley diameter
  - + configured brake diameter (mm)
- **Torque analog output:** D/2V torque rating
- **Range of operating pulse frequency settings:** 16 Hz - 50,000 Hz
- **Operating pulse output:** TTL-level voltage output, open-collector output, square wave, duty: 1:1

**Dimensions, weight**

- **Control component PC-PMA2:** 430 (W) x 150 (H) x 360 (D) mm
- **Approximately 9 kg**
- **Measurement component PMM-1:** 520 (W) x 220 (H) x 220 (D) mm
- **Approximately 15 kg**
- **Head PMA-H-*S:**
  - 80 (W) x 115 (H) x 60 (D) mm
  - Approximately 1 kg

**Compatible personal computers:** IBM PC/AT compatible

**Operating systems:**

- **Microsoft Windows® 2000, XP**
- **at least one RS-232C serial port**

**Power supply:**

- **Single-phase AC 100 V ± 10%, 50/60 Hz**
- **Power consumption:** approximately 50 VA
Cogging torque measurement equipment

ATM-MN Torque Meter

After securing the motor housing in place, this model measures torque per angle by rotating the rotor at 1 r/min, then uploads to a personal computer running Windows® angle-torque characteristics such as low levels of cogging torque for brushless DC motors and detent torque for stepping motors. Can also be used to measure torque of non-rotating pieces of machinery such as clutches and oil seals.

Advantages

- Achieves high detection sensitivity
  Incorporates Sugawara Laboratories’ exclusive high-sensitivity angle-torque detection component configured in a vertical structure to reduce torque-detection bearing size, enabling detection of low torque levels of 0.01 mN·m or less.
- Realizes measurements with low sensitivity to eccentricity
  Until now, the eccentricity resulting from coupling with the motor subject to measurement has significantly affected low-torque measurements and impeded high-precision measurement. Employing a vertical structure, ATM cogging torque measurement equipment resolves this problem by using a coupling suspended from the motor subject to measurement, allowing equipment to be fixed in place without rotating the motor’s stator. This also significantly reduces the time required to set the motor subject to measurement from that of previous models.
- Provides accurate peak-to-peak measurement of cogging torque
  The torque detector angle of torsion is very low, enabling accurate peak-to-peak measurement of cogging torque, including even the negative range. (See Figures 1.2.)
- Broad measurement range
  The model offers a wide range of five available measurement heads, with torque ratings ranging from 2 mN·m to 50 mN·m, allowing use for high-precision measurements. Note that measurement heads must be exchanged and inspected at the Sugawara Laboratories plant.
- High-visibility measurement data
  Motor characteristics are easily ascertained on automatically plotted performance graphs, and measurement data can be overlaid. In addition, the cursor can be used to read accurate values from measurement points. The data displayed on screen can be printed from a personal computer.
- Can be controlled using standard personal computers
  Allows control of measurements and display and storage of data with a standard personal computer running Windows®. Data is stored in CSV-format files for compatibility with other software applications.

Figure 1: Measurement when the rotating spring constant is high (i.e., when using a hard spring)

Torque characteristics for the measurement target and torque detection spring characteristics intersect at a single point in all zones, allowing stable measurement from valleys to peaks.

Figure 2: Measurement when the rotating spring constant is low (i.e., when using a loose spring)

In zones in which torque characteristics for the measurement target and torque detection spring characteristics intersect at multiple points, measurement points will rise at more stable points. i.e., torque increases at higher angles, preventing measurements in downward zones and amplitude measurements.

Measurement of angle-torque characteristics

■ Basic configuration
  Torque meter: PC-SAA2
  Torque measurement component: ATM-**MN
  Torque calibration tool: ATC3-**
  Personal computer: Microsoft Windows®2000, XP

■ Primary specifications
  Torque rating:
  - ATM-R5MN: 0.5 mN·m
  - ATM-2MN: 2 mN·m
  - ATM-10MN: 5 mN·m
  - ATM-10MN: 10 mN·m
  - ATM-20MN: 20 mN·m
  - ATM-50MN: 50 mN·m
  Torque detection precision: within ±1% of full scale
  Torque detection component tension angle: 1.5° or less at torque rating
  Angle detection component: 3600 pulse/resolution using pulse rotary encoder
  Angle measurement precision: ±1.5° or less
  Operating speed: approximately 1 r/min
  Operating direction: CW/CCW
  Operating modes:
  - Automatic: measurement between configured angles performed when the user presses the start key
  - Manual: measurement performed from current angle from the point at which the user presses the start key until the user presses the stop key
  DC voltage measurement:
  - Measurement range: 125/510/1020/50/100/200/300 V DC
  - Measurement precision: within ±1% of full scale for each range
  DC current measurement:
  - Measurement range: 0.05/0.1/0.2/0.5/1/2.5/10/20 A DC
  - Measurement precision: within ±1% of full scale for each range
  Attachable work shapes
  - External diameter, length including shaft: ø50 or less, 60 mm or less
  Accessories included
  - Power cable, connector cable, communication cable, Windows® software
  - Measurement component: X-Y-Z stage
  Torque calibration equipment (sold separately):
  - ATC3-RSMN/3SN/5SMN/10MN/20MN/50MN
  Dimensions, weight:
  - Control component (W x H x D): 430 x 161 x 400 mm Approximately 10 kg
  - Measurement component (W x H x D):
    - ATM-50MN: 330 x 636 x 350 mm Approximately 64 kg
  Compatible personal computers:
  - IBM/PC/AT-compatible
  Operating systems:
  - Microsoft Windows®2000, XP
  Interface:
  - at least one RS-232C serial port
  Power supply:
  - single-phase AC 100 V ±10%, 50/60 Hz
  Power consumption:
  - approximately 50 VA
Cogging torque measurement equipment

ATM-MN Torque Meter
After securing the motor housing in place, this model measures torque per angle by rotating the rotor at 1 rpm, then uploads to a personal computer running Windows® angle-torque characteristics such as low levels of cogging torque for brushless DC motors and detect torque for stepping motors. Can also be used to measure torque of non-rotating pieces of machinery such as clutches and oil seals.

Advantages
- Achieves high detection sensitivity
  Inclines Sugawara Laboratories’ exclusive high-rigidity torque detection component configured in a vertical structure to reduce torque detector bearing size, enabling detection of low torque levels of 0.01 mN·m or less.
- Realizes measurements with low sensitivity to eccentricity
  Until now, the eccentricity resulting from coupling with the motor subject to measurement has significantly affected low-torque measurements and impeded high-precision measurement. Employing a vertical structure, ATM cogging torque measurement equipment resolves this problem by using a coupling suspended from the motor subject to measurement, allowing equipment to be fixed in place without rotating the motor’s stator. This also significantly reduces the time required to set the motor subject to measurement from that of previous models.
- Provides accurate peak-to-peak measurement of cogging torque
  The torque detector angle of tension is very low, enabling accurate peak-to-peak measurement of cogging torque, including even the negative range. (See Figures 1.2.)
- Broad measurement range
  The model offers a wide range of five available measurement heads, with torque ratings ranging from 2 mN·m to 50 mN·m, allowing use for high-precision measurements. Note that measurement heads must be exchanged and inspected at the Sugawara Laboratories plant.
- High-visibility measurement data
  Motor characteristics are easily ascertained on automatically plotted performance graphs, and measurement data can be overlaid. In addition, the curve can be used to read accurate values from measurement points. The data displayed on screen can be printed from a personal computer.
- Can be controlled using standard personal computers
  Allows control of measurements and display and storage of data with a standard personal computer running Windows®. Data is stored in CSV-format files for compatibility with other software applications.

Figure 1: Measurement when the rotating spring constant is high (i.e., when using a hard spring)
Torque characteristics for the measurement target and torque detection spring characteristics intersect at a single point in all zones, allowing stable measurement from valley to peak.

Figure 2: Measurement when the rotating spring constant is low (i.e., when using a loose spring)
In zones in which torque characteristics for the measurement target and torque detection spring characteristics intersect at multiple points, measurement points will rise at more reliable points. i.e., torque increases at higher angles, preventing measurements in unmeasurable zones and amplitude measurements.

Measurement of angle-torque characteristics

Calibration equipment
AEC St® specialized calibration equipment is used to calibrate torque values in ATM cogging torque measurement devices. The ATM has a corrective measurement axis, configuring a structure for converting vertical weight force to a horizontal direction. This model uses two conversion structures, with calibration implemented by suspending equivalent weights from each and applying a coupling of forces to the measurement axis using the calibration bar.

Figure 3: Calibration equipment

Basic configuration
Torque meter: PG-SA2
Torque measurement component: ATM-MN
Torque calibration tool: AEC St`
Personal computer: Microsoft Windows® XP

Primary specifications
Torque rating:
ATM-R5MN: 0.5 mN·m
ATM-2MN: 2 mN·m
ATM-5MN: 5 mN·m
ATM-10MN: 10 mN·m
ATM-20MN: 20 mN·m
ATM-50MN: 50 mN·m
Torque detection precision: within ±1% of full scale
Torque detection component tension angle:
1.5° or less at torque rating

Angle detection component: 360° pulse/resolution
Using pulse rotary encoder
Angle measurement precision:
±1.5° or less

Operating speed:
approximately 1 r/min
Operating direction:
CW/CCW
Operating modes:
Automatic: measurement between configured angles performed when the user presses the start key
Manual: measurement performed from current angle from the point at which the user presses the start key until the user presses the stop key
DC voltage measurement:
Measurement range:
0.05/0.1/0.2/0.5/1.0/2.0/5.0/10/20/50/100/200/500/1000 V DC
Measurement precision:
within ±1% of full scale for each range
DC current measurement:
Measurement range:
0.05/0.1/0.2/0.5/1.0/2.0/5.0/10/20 A DC
Measurement precision:
within ±1% of full scale for each range

Attachable work shapes
External diameter, length including shaft:
ø50 or less, 60 mm or less

Accessories included
Control component:
power cable, connector cable, communication cable, Windows® software
Measurement component:
X-Y-Z stage
Torque calibration equipment (sold separately):
AEC St®-R5MN/2MN/5MN/10MN/20MN/50MN

Dimensions, weight:
Control component (W x H x D):
430 x 161 x 400 mm  Approximately 10 kg
Measurement component (W x H x D):
330 x 636 x 350 mm  Approximately 64 kg
Compatible personal computers:
IBM PC/AT-compatible
Operating systems:
Microsoft Windows®2000, XP
Interface:
at least one RS-232C serial port
Power supply:
single-phase AC 100 V ±10%, 50/60 Hz
Power consumption:
approximately 50 VA

Number of full scale for each range
±1% of full scale for each range

Calibration

Y axis: torque -25 - 25 mN·m
X axis: angle 0 - 360
(overlay display)

Calibration measurement

Calibration equipment

Calibration weight
Low torque-speed measurement

PC-MMA1 Torque Meter
This model measures speed and torque characteristics and power output up to 30,000 r/min in compact DC motors with starting torques of 1 mN·m or less. Uploading these measurements to a personal computer running Windows®3. Adding a voltage/current measurement component allows the model to measure voltage and current.

Sample measurement data
- Measurement of compact DC traction motor while controlling RPM (open load)
- Torque ripple T axis: RPM, voltage, current, power output, speed, power, efficiency

Primary specifications
- Braking method: eddy current braking
- Torque measurement: eddy current braking calculated from relative difference in RPM between motor subject to measurement and braking motor
- Torque measurement range: 0.1 mm·m, 1 mm·m, 2 mm·m
- Average over intervals of 128 μsec, derived by calculating optoelectric pulse frequency
- RPM measurement range: up to 30,000 r/min
- RPM measurement precision: ±0.7% of range (full scale)
- Voltage measurement range: 50, 100, 200, 500 V
- Voltage/current measurement: time-series average of 64 data points sampled at 2 μsec intervals
- Power measurement: ratio of power output to power measurement data calculated by computer
- Power measurement range: ±0.5% of range (full scale)
- Voltage/current measurement precision: ±0.2% of range (full scale)
- RPM measurement precision: ±0.2% of range (full scale)
- Efficiency measurement: ratio of power output to power measurement data calculated by computer
- Load control method: manual measurement in increments of 1 point
- Manual mode: manual measurement up to 400 points
- Dimensions, weight: single-phase AC 100 V ±10%, 50/60 Hz
- Control component: input power: 40 x 360 mm Approximately 9 kg
- Measurement component: input power: 40 x 360 mm Approximately 26 kg

Advantages
- Also measures high-speed motors
- The model uses an eddy-current brake for stable measurements from 30,000 r/min to the stopped state.
- High-precision measurements of low torque levels
- Precise axle matching

Fabrication of specialized hardware
Specialized motor-measurement hardware (e.g., work holders, coupling) can be fabricated to suit various applications for reliable, high-precision measurements.

Also measures voltage and current
Adding an EVA-I voltage/current measurement component allows the model to measure voltage and current and input power and efficiency derivations.

Basic configuration
- Torque meter: PC-MMA1
- Torque measurement component: MMT-1MN
- Personal computer: Microsoft Windows®2000, XP

Primary specifications
- Control component: IBM PC/AT-compatible
- Operating systems: Microsoft Windows®2000, ME, XP
- Interface: at least one RS-232C serial port
- Power supply: single-phase AC 100 V ±10%, 50/60 Hz
- Control component: input power: 40 x 360 mm Approximately 9 kg
- Measurement component: input power: 40 x 360 mm Approximately 26 kg

Torque ripple measurement, etc.

PC-MTS-01 General Motor Testing Equipment
This single system covers all aspects of motor torque measurement, such as speed-torque, cogging torque, and torque ripple. Combined with a power meter, it can be used to measure induced voltage. May be used in combination with environmental testing equipment.

Sample measurement data
- Measurement of torque ripple for the same DC motor in angle-torque mode RPM set to 10 r/min, torque range to 200 mN·m
- Data output in voltage displayed format
- X axis: range of rotation 0–360°
- Y axis: torque -30–270 mN·m

Advantages
- This model uses a simple structure with brake and various sensors configured on the main shaft for superior adherence at high speeds (up to 20,000 r/min).
- Easily converted to an operating structure for measuring speed and torque characteristics at high speeds and for measuring torque ripple and induced voltage.
- Uses time-hysteresis braking for load control and a weight-gauge torque detector designed by Suganumara Laboratories for torque detection.
- Allows easy core matching, with high precision using special motor-fixing hardware.
- Offers superior motor fixing, thermal insulation, and bearing structure for use with environmental testing equipment.

Basic configuration
- Torque measurement component: MMT-1MN
- Personal computer: Microsoft Windows®2000, XP
- Digital power meter: WT1600 (from Yokogawa Electric Corp.)

Primary specifications
- Measurement of load torque characteristics
- Load torque control range: 0.06 - 2 N m
- Load torque detection precision: ±0.5% of range (full scale)
- Allowable RPM: up to 20,000 r/min
- RPM measurement precision: ±0.2% of range (full scale)
- Maximum allowable power input: 600 W for five minutes
- Torque ripple (cogging torque) measurement
- Torque detection range: When measuring torque ripple: range (full scale) 2 N m
- When measuring cogging torque: range (full scale) 50 mN·m

Induced voltage measurement
- Work operating RPM: 1–20 r/min
- Work torque: ±0.5% of range (full scale)
- Work voltage: ±0.5% of range (full scale)

Sample measurement data
- Measurement of torque ripple for the same DC motor in angle-torque mode RPM set to 10 r/min, torque range to 200 mN·m
- Data output in voltage displayed format
- X axis: range of rotation 0–360°
- Y axis: torque -30–270 mN·m

Sample measurement data
- Measurement of DC motor cogging torque in single-torque mode RPM set to 1 r/min, torque range to 200 mN·m
- X axis: angle of rotation D–360°
- Y axis: torque -30–270 mN·m

Measurement of DC motor cogging torque in single-torque mode RPM set to 1 r/min, torque range to 200 mN·m
- X axis: angle of rotation D–360°
- Y axis: torque -30–270 mN·m
Low torque-speed measurement

PC-MMA1 Torque Meter
This model measures speed and torque characteristics and power output up to 30,000 rpm in compact DC motors with starting torques of 1 mN·m or less, uploading these measurements to a personal computer running Windows®. Adding a voltage/current measurement component allows the model to measure voltage and current.

Sample measurement data

Primary specifications
Braking method: eddy current braking
Torque measurement: calculated from relative difference in RPM between motor subject to measurement and braking motor
Torque measurement range: 0.1 mm/m, 1 mm/m, 2 mm/m
RPM measurement: average over intervals of 120 sec, derived by calculating optoelectric pulse frequency
RPM measurement range: upper limit is 30,000 rpm
RPM measurement precision: ±0.7% of range (full scale)
Voltage/current measurement: time-series average of 64 data points sampled at 2 sec intervals
Power measurement: ratio of power output to power measurement data calculated by personal computer
Load-control method: serves control using fixed load torque
Open loop sweep: RPM of load-control motor controlled automatically
Manual mode: manual measurement up to 400 points
Manual mode: manual measurement in increments of one point
Compatible personal computers: IBM PC/AT-compatible
Operating systems: Microsoft Windows® 2000, ME, XP
Power supply: single-phase AC 100 V ±5% (50/60 Hz)
Dimensions, weight: approximately 19 x 18 x 31 cm, 2.5 kg

Advantages
- Also measures high-speed motors
- Also measures voltage and current
- Also measures voltage and current
- Also measures high-speed motors
- Also measures low torque levels
- High-precision measurements of low torque levels
- Precise axle matching
- Fabrication of specialized hardware
- Specialized motor-measurement hardware (e.g., work holders, coupling)
- Adding an EV A-1 voltage/current measurement component allows the model to measure voltage and current.

Basic configuration
- Torque meter: PC-MMA1
- Torque measurement component: MM3-1WN
- Personal computer: Microsoft Windows® 2000, XP

Torque ripple measurement, etc.

PC-MTS-01 General Motor Testing Equipment
This single system covers all aspects of motor torque measurement, such as speed-torque, cogging torque, and torque ripple. Combined with a power meter, it can be used to measure induced voltage. May be used in combination with environmental testing equipment.

Sample measurement data

Basic configuration
- Torque measurement component: MTS-2N01
- Control component: PC-MTS-01
- Personal computer: Microsoft Windows® 2000, XP
- Digital power meter: WT1600 (from Yokogawa Electric Corp.)
- Environmental testing equipment: subject to separate consultation

Primary specifications
- Measurement of DC motor torque ripple in single torque mode RPM set to 1 r/min, torque range to 200 mN·m
- Angle of rotation ±360°
- Torque range: 200–2,000 mN·m

Advantages
- This model uses a simple structure with brake and various sensors configured on the main shaft for superior adherence at high speeds (up to 20,000 rpm).
- Easily converted to an operating structure for measuring speed and torque characteristics at high speeds and for measuring torque ripple and induced voltage.
- Uses time-hysteresis braking for load control and a weight-gauge torque detector designed by Sugawara Laboratories for torque detection.
- Allows easy core matching, with high precision using special motor-fixing hardware.
- Offers superior motor fixing, thermal insulation, and bearing structure for use with environmental testing equipment.

Basic configuration
- Torque measurement component: MTS-2N01
- Control component: PC-MTS-01
- Digital power meter: WT1600 (from Yokogawa Electric Corp.)
- Environmental testing equipment: subject to separate consultation

Primary specifications
- Measurement of load torque characteristics
  - Load torque control range: 0.06 – 2 Nm
  - Load torque detection precision: ±0.5% of range (full scale)
  - Allowable RPM: up to 20,000 rpm
  - RPM measurement precision: ±0.2% of range (full scale)
  - Maximum allowable input power: 600 W for five minutes
  - Torque ripple (pump/cogging torque measurement)
  - Torque detection range
    - When measuring torque ripple: range (full scale) 2 Nm
    - When measuring cogging torque: range (full scale) 50 mN·m

Advantages
- This model uses a simple structure with brake and various sensors configured on the main shaft for superior adherence at high speeds (up to 20,000 rpm).
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- Torque measurement component: MTS-2N01
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- Environmental testing equipment: subject to separate consultation

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    - When measuring torque ripple: range (full scale) 2 Nm
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- Offers superior motor fixing, thermal insulation, and bearing structure for use with environmental testing equipment.
Torque Dynamometers

Speed-torque characteristics, pull-in/pull-out torque
Angle-torque characteristics, cogging torque, torque ripple

Products: Stroboscopes, torque dynamometers, bearing inspection systems, etc.

Danger

Damage to or scattering of couplings or other components during measurement may cause injury.
Always use the safety cover.

*Sensitive data measurement services using Sugawara Laboratories’ torque dynamometers are available. Please visit the Sugawara Laboratories website for more information.

The contents of this pamphlet are subject to change without notice to permit improvements.

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