MODEL:
DI3M-2.4T-FM

Max continuous power dissipation: 2.0 HP (1.5 kW)
Max continuous brake torque: 134 in-oz. (95 N-cm)
Max brake speed: 15,000 RPM
# TABLE OF CONTENTS

1. OVERVIEW ................................................................................................................................................. 4
2. SPEED vs. TORQUE CURVE – MB-2.4 BRAKE (FOR ONE BRAKE) ......................................................... 6
3. TORQUE & SPEED OUTPUT TO MOTOR ........................................................................................................ 7
   Table 1: Torque, Speed and Power (English Units) ...................................................................................... 7
   Table 2: Torque, Speed and Power (SI Units) ................................................................................................. 7
4. LOAD CELL (DI3M-2.4T-FM, Measure Motor Torque) .................................................................................. 7
   4.1 Load Cell Accuracy Plot (in-oz.) .............................................................................................................. 8
   4.2 Load Cell Accuracy Plot (N-cm) .............................................................................................................. 9
5. SPEED MEASUREMENT ................................................................................................................................. 10
6. DATA SAMPLING ........................................................................................................................................... 10
7. LAPTOP COMPUTER ..................................................................................................................................... 10
8. POWER REQUIREMENTS .............................................................................................................................. 10
9. DC VOLTAGE TRANSDUCERS ...................................................................................................................... 11
   9.1 Input .......................................................................................................................................................... 11
   9.2 Output ...................................................................................................................................................... 11
   9.3 Environmental and Physical Characteristics .......................................................................................... 11
10. AC VOLTAGE TRANSDUCERS – SINGLE PHASE ..................................................................................... 11
   10.1 Input ...................................................................................................................................................... 11
   10.2 Output .................................................................................................................................................... 11
   10.3 Environmental and Physical Characteristics ........................................................................................ 11
11. DC CURRENT TRANSDUCERS (Split Core) .............................................................................................. 12
   11.1 Input ...................................................................................................................................................... 12
   11.2 Output .................................................................................................................................................... 12
   11.3 Environmental and Physical Characteristics ........................................................................................ 12
12. AC CURRENT TRANSDUCERS – SINGLE PHASE (Split Core) ............................................................... 12
   12.1 Input ...................................................................................................................................................... 12
   12.2 Output .................................................................................................................................................... 12
   12.3 Environmental and Physical Characteristics ........................................................................................ 12
13. DYNAMOMETER LAYOUT – DB3M-2.4T-FM, LOAD CELL ON MOTOR........ 13
14. MOTOR MOUNTING PLATE ........................................................................ 14
15. DYNAMOMETER CONTROLLER.................................................................. 15
16. NOMENCLATURE OF DYNAMOMETER PART NUMBER ......................... 16
1. OVERVIEW

This data sheet is a reference for the performance specifications of the dynamometer models listed on the cover page.

The MBS dynamometers may be used to test just about any type of motor (i.e. electric, hydraulic, pneumatic, reciprocating). Types of testing include: endurance testing, speed versus torque curves, measure stall torque, efficiency, temperature rise, performance verification, etc. MBS dynamometers are sold as complete systems (shown in image below) that include: the dynamometer, controller, computer with software, calibration weight, manual and all cables. Our systems do not require annual fees, licenses or permits. The software is user friendly, is very configurable (i.e. changing units, display scale limits, data acquisition rate, etc.) and has some safety precautions build in to prevent damage to the motor under test and/or the system (i.e. brake temperature sensor, setting current limit, setting power limit, trigger input signals).

The nomenclature of the dynamometer part number is described at the end of this document. The power dissipation rating for this system is located on the bottom of the cover page. This data sheet may also be used to determine the best configuration for a system.

Dynamometers, or more specifically the size of the brakes for the dynamometers, are selected based on the required power dissipation and required torque.
The DI3M-2.4T-FM is a direct drive system where one of the brakes may be un-coupled to test smaller motors; the load cell measures the motor torque.

Dynamometers, or more specifically the brakes for the dynamometers, are sized based on the required power dissipation and required torque. The benefit of this dynamometer as an inline system is the ability to test much higher speeds than an off the shelf transmission can handle.

The torque, speed, voltage and current ranges (and types; i.e. DC, AC) need to be specified when purchasing a dynamometer in order to select the limits for the instrumentation. The following performance specifications for load cells, transducers, etc. are based on vendor specifications.
2. SPEED vs. TORQUE CURVE – MB-2.4 BRAKE (FOR ONE BRAKE)
3. TORQUE & SPEED OUTPUT TO MOTOR

<table>
<thead>
<tr>
<th>Motor_Spd (RPM)</th>
<th>Motor Torque (in-oz.)</th>
<th>Power (HP)</th>
<th>Pulley Ratio (motor/brake)</th>
<th>Qty. Brakes</th>
<th>Brake Torque (in-oz./qty.)</th>
<th>Brake_Spd (RPM)</th>
<th>Time (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>36</td>
<td>0</td>
<td>Direct drive</td>
<td>1</td>
<td>36</td>
<td>0</td>
<td>cont.</td>
</tr>
<tr>
<td>0</td>
<td>72</td>
<td>0</td>
<td>Direct drive</td>
<td>2</td>
<td>72</td>
<td>0</td>
<td>cont.</td>
</tr>
<tr>
<td>8,500</td>
<td>60</td>
<td>0.5</td>
<td>Direct drive</td>
<td>1</td>
<td>60</td>
<td>8,500</td>
<td>cont.</td>
</tr>
<tr>
<td>8,500</td>
<td>120</td>
<td>1.0</td>
<td>Direct drive</td>
<td>2</td>
<td>120</td>
<td>8,500</td>
<td>cont.</td>
</tr>
<tr>
<td>15,000</td>
<td>67</td>
<td>1.0</td>
<td>Direct drive</td>
<td>1</td>
<td>67</td>
<td>15,000</td>
<td>cont.</td>
</tr>
<tr>
<td>15,000</td>
<td>134</td>
<td>2.0</td>
<td>Direct drive</td>
<td>2</td>
<td>134</td>
<td>15,000</td>
<td>cont.</td>
</tr>
</tbody>
</table>

Table 1: Torque, Speed and Power (English Units)

<table>
<thead>
<tr>
<th>Motor_Spd (RPM)</th>
<th>Motor Torque (N-cm)</th>
<th>Power (Watts)</th>
<th>Pulley Ratio (motor/brake)</th>
<th>Qty. Brakes</th>
<th>Brake Torque (N-cm/qty.)</th>
<th>Brake_Spd (RPM)</th>
<th>Time (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>25.4</td>
<td>0</td>
<td>Direct drive</td>
<td>1</td>
<td>25.4</td>
<td>0</td>
<td>cont.</td>
</tr>
<tr>
<td>0</td>
<td>50.8</td>
<td>0</td>
<td>Direct drive</td>
<td>2</td>
<td>50.8</td>
<td>0</td>
<td>cont.</td>
</tr>
<tr>
<td>8,500</td>
<td>42.4</td>
<td>373</td>
<td>Direct drive</td>
<td>1</td>
<td>42.4</td>
<td>8,500</td>
<td>cont.</td>
</tr>
<tr>
<td>8,500</td>
<td>84.7</td>
<td>746</td>
<td>Direct drive</td>
<td>2</td>
<td>84.7</td>
<td>8,500</td>
<td>cont.</td>
</tr>
<tr>
<td>15,000</td>
<td>47.3</td>
<td>746</td>
<td>Direct drive</td>
<td>1</td>
<td>47.3</td>
<td>15,000</td>
<td>cont.</td>
</tr>
<tr>
<td>15,000</td>
<td>94.6</td>
<td>1,492</td>
<td>Direct drive</td>
<td>2</td>
<td>94.6</td>
<td>15,000</td>
<td>cont.</td>
</tr>
</tbody>
</table>

Table 2: Torque, Speed and Power (SI Units)

The tables are based on the performance graph for the MBZ-2.4 Brake, shown in Figure 1. The 2.4 model brake has been known to operate up to 20,000 RPM but no data is available above 15,000 RPM.

4. LOAD CELL (DI3M-2.4T-FM, Measure Motor Torque)

- Load Cell Load Rating: 212 oz. (6 kg)
- Arm Length: 1.0 inches (2.54 cm)
- Max Brake Torque: 134 in-oz. (94.6 N-cm)
- Max Torque to L.C: 212 in-oz. (150 N-cm)
- Non-Linearity: 0.02% of R.O.
- Hysteresis: 0.02% of R.O.
- Non-Repeatability: 0.02% of R.O.
- Zero Balance: ±1% of R.O.
- Compensated Temperature Range: 14°F to 104°F
- Safe Temperature Range: 14°F to 140°F
- Temperature Effect on Output: 0.002% of Load/°F
- Temperature Effect on Zero: 0.002% of Load/°F
- Safe Overload: 150% of R.O.*

* Hard stops are in place to help prevent damage from over-load.
4.1 Load Cell Accuracy Plot (in-oz.)

The Torque Error plot shows the percentage error as a function of measured torque. These plots show the range that a load cell will accurately measure. The maximum torque to the motor is based on the maximum torque from the brake. The error plot is based on published data from the load cell vendor.
4.2 Load Cell Accuracy Plot (N-cm)

The Torque Error plot shows the percentage error as a function of measured torque. These plots show the range that a load cell will accurately measure. The maximum torque to the motor is based on maximum torque from the brake. The error plot is based on published data from the load cell vendor.
5. SPEED MEASUREMENT
A standard brake has five magnets (alternative quantity are optional) which trigger a hall effect sensor. The speed is averaged over one revolution of the brake. A 48-MHZ clock is used to measure the time between magnets.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock Error</td>
<td>~25°C</td>
<td>±30</td>
<td></td>
<td></td>
<td>PPM</td>
</tr>
<tr>
<td></td>
<td>-10°C to 60°C</td>
<td>±50</td>
<td></td>
<td></td>
<td>PPM</td>
</tr>
<tr>
<td></td>
<td>-40°C to 85°C</td>
<td>±100</td>
<td></td>
<td></td>
<td>PPM</td>
</tr>
<tr>
<td>Brake Speed</td>
<td>5 magnets</td>
<td>12</td>
<td></td>
<td>180</td>
<td>KPM</td>
</tr>
<tr>
<td></td>
<td>30 magnets</td>
<td>2</td>
<td></td>
<td>30*</td>
<td>KPM</td>
</tr>
</tbody>
</table>

* Theoretical speed; actual maximum speed is limited to the speed of the brake.

6. DATA SAMPLING
Sampling is the frequency of measuring and recording data; this rate is adjustable by the operator.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling Rate</td>
<td>2.3 GHz Proc.</td>
<td>20</td>
<td>50</td>
<td></td>
<td>ms</td>
</tr>
</tbody>
</table>

i.e. 50 ms = 20 samples (or readings) per second.

7. LAPTOP COMPUTER

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>2.3</td>
<td></td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>Memory</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td>GB</td>
</tr>
<tr>
<td>Display</td>
<td>LED LCD</td>
<td>15.6</td>
<td></td>
<td></td>
<td>inches</td>
</tr>
</tbody>
</table>

8. POWER REQUIREMENTS
The MBS Dynamometer requires two 115 or 230 VAC power outlets: one for the laptop computer and one for the controller. The brakes in the dynamometer structure receive power from the controller.

<table>
<thead>
<tr>
<th>Item</th>
<th>Voltage</th>
<th>Type</th>
<th>Current (amps)</th>
<th>Freq. (Hz)</th>
<th># Plugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controller</td>
<td>115/230</td>
<td>VAC</td>
<td>1.1/0.6</td>
<td>50/60</td>
<td>1</td>
</tr>
<tr>
<td>Laptop</td>
<td>110-240</td>
<td>VAC</td>
<td>1.2</td>
<td>50/60</td>
<td>1</td>
</tr>
<tr>
<td>Dynamometer</td>
<td>24</td>
<td>VDC</td>
<td>6.0</td>
<td>-</td>
<td>none</td>
</tr>
</tbody>
</table>
9. DC VOLTAGE TRANSDUCERS

9.1 Input
Range ........................................ 0 VDC to: 1, 5, 10, 50, 150, 200 up to 600 VDC
Overload .................................... 2x voltage range selected
Frequency Range .......................... DC only

9.2 Output
Basic Accuracy ................................ 1.0%
Linearity ..................................... 10% to 100% F.S.
Thermal Drift ............................... 500 PPM/°C
Response Time ............................. 250 ms

9.3 Environmental and Physical Characteristics
Operating Temperature .................... 0°C to +50°C
Insulation Category ....................... CAT II
Vibration Tested to ....................... IEC 60068-2-6, 1995
Pollution Degree .......................... 2
Altitude ...................................... 2000-meter max.
Insulation Voltage ....................... 2500 VDC
MTBF ........................................ Greater than 100K hours
Relative Humidity ....................... 5% to 95%, non-condensing
Weight ...................................... 0.5 lbs.

10. AC VOLTAGE TRANSDUCERS – SINGLE PHASE

10.1 Input
Range ........................................ 0 VAC to: 50, 150, 250, 500, 600 VAC
Overload ..................................... 2x voltage range selected
Frequency Range .......................... 20 Hz to 5 kHz

10.2 Output
Basic Accuracy ................................ 0.5%
Linearity ..................................... 10% to 100% F.S.
Calibration .................................... True RMS sensing
Thermal Drift ............................... 500 PPM/°C
Response Time ............................. 250 ms

10.3 Environmental and Physical Characteristics
Operating Temperature .................... 0°C to +60°C
Insulation Category ....................... CAT II
Vibration Tested to ....................... IEC 60068-2-6, 1995
Pollution Degree .......................... 2
Altitude ...................................... 2000-meter max.
Insulation Voltage ....................... 2500 VDC
MTBF ........................................ Greater than 100K hours
Relative Humidity ....................... 5% to 95%, non-condensing
Weight ...................................... 0.5 lbs.
11. DC CURRENT TRANSDUCERS (Split Core)

11.1 Input
Range ........................................... 0 ADC to: 2, 5, 10, 20, 30, 50, 75, 100
.................................................. up to 600 ADC
Overload ........................................ 4x current range selected
Frequency Range ............................... DC only

11.2 Output
Basic Accuracy ............................... 1.0%
Linearity ......................................... 0% to 100% F.S.
Thermal Drift .................................. 500 PPM/°C
Response Time ................................. 250 ms

11.3 Environmental and Physical Characteristics
Operating Temperature ..................... 0°C to +50°C
Insulation Category .......................... CAT II
Vibration Tested to ......................... IEC 60068-2-6, 1995
Pollution Degree .............................. 2
Altitude ......................................... 2000-meter max.
Insulation Voltage ............................ 2500 VDC
MTBF ........................................... Greater than 100K hours
Relative Humidity ........................... 5% to 95%, non-condensing
Weight .......................................... 0.5 lbs.

12. AC CURRENT TRANSDUCERS – SINGLE PHASE (Split Core)

12.1 Input
Range ........................................... 0 AAC to: 5, 10, 15, 20, 25, 30, 40, 50 up to
.................................................. 600 AAC
Overload ........................................ 4x current range selected
Frequency Range ............................... 20 Hz to 5 kHz

12.2 Output
Basic Accuracy ............................... 0.5%
Linearity ......................................... 10% to 100% F.S.
Calibration ...................................... True RMS sensing
Thermal Drift .................................. 500 PPM/°C
Response Time ................................. 250 ms

12.3 Environmental and Physical Characteristics
Operating Temperature ..................... 0°C to +60°C
Insulation Category .......................... CAT II
Vibration Tested to ......................... IEC 60068-2-6, 1995
Pollution Degree .............................. 2
Altitude ......................................... 2000-meter max.
Insulation Voltage ............................ 2500 VDC
MTBF ........................................... Greater than 100K hours
Relative Humidity ........................... 5% to 95%, non-condensing
Weight .......................................... 0.5 lbs.
13. DYNAMOMETER LAYOUT – DB3M-2.4T-FM, LOAD CELL ON MOTOR
14. MOTOR MOUNTING PLATE

**NOTES:**

1. PLATE TO BE MODIFIED TO SUIT CUSTOMER'S REQUIREMENTS.

2. N/A: CS54-0009, CS55-0008, CS57-0010.
15. DYNAMOMETER CONTROLLER
16. NOMENCLATURE OF DYNAMOMETER PART NUMBER

DB5M-8.7T-FM

- **Motor Mounting Style:**
  - FM = Face Mount
  - BM = Base Mount
  - CB = Carriage Base

- **Number of Brakes:**
  - T = Tandem System
  - Omitting T = single brake system

- **Brake Size:**
  - 17.5 = MBZ-17.5 brake
  - 8.7 = MBZ-8.7 brake
  - 5.7 = MBZ-5.7 brake
  - 3.7 = MBZ-3.75 brake
  - 2.4 = MBZ-2.4 brake

- **Load Cell Location:**
  - M = Measuring Motor Torque
  - B = Measuring Brake Torque

- **Centerline Distance:**
  - 3 = 3 inches from top of baseplate to centerline of motor shaft.
  - 5 = 5 inches from top of baseplate to centerline of motor shaft

- **System Type:**
  - B = Belt Coupled system
  - I = Inline system

  - D = Dynamometer

The load cell(s) size(s) and type(s) of voltage & Current transducers are to be specified individually.