Understanding Part Numbers

Animatics Class 5 SmartMotor™ Part Numbering Guidelines

- **SM**
- **23**
- **16**
- **5**
- **D**
- **DE**
- **AD1**

**Frame Size**
- **17**
- **23**
- **34**

**Motor**
- **NEMA 17 Frame**
  - **17**
- **NEMA 23 Frame**
  - **23**
- **NEMA 34 Frame**
  - **34**

**Class 5**
- **D**
- **DT**

**Connector Style**
- **D**
- **D-Sub**
- **DT**
- **D-Sub High Torque**

**Options**
- **DE**
  - Drive enable*
- **BRK**
  - Internal brake
- **SH**
  - Internal shunt (select models only)**
- **-C**
  - CANopen™ option
- **-DN**
  - DeviceNet™
- **-PB**
  - Profibus®
- **-AD1**
  - 24V Expansion I/O
- **-F1**
  - 1 Flat on shaft
- **-F2**
  - 2 Flats on shaft
- **-K**
  - Machined keyway on motor shaft
- **-S**
  - Complete sealed option
- **-SL**
  - Reduced shaft length
- **-S3**
  - Sealed without shaft seal

* Separate drive & control power
** Profibus option only available on SM23165D & SM23165DT and SM34165D & DT products and without brake or 24V I/O

SM34165D & SM34165DT are the only models that can have an internal shunt.

Animatics Class 5 SmartMotor™ Available Option Combinations

**NEMA 17 FRAME**

<table>
<thead>
<tr>
<th>NEMA 17 FRAME</th>
<th>BRAKE</th>
<th>24V I/O</th>
<th>CAN bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM17205D</td>
<td>-BRK</td>
<td>-AD1</td>
<td>-C or -DN</td>
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**NEMA 23 FRAME**

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<th>BRAKE</th>
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<th>CAN bus</th>
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<td>SM23165D</td>
<td>-BRK</td>
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<tr>
<td>SM23165DT</td>
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<td>SM23375D</td>
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<td>SM23375DT</td>
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<td>SM23105D</td>
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<tr>
<td>SM23205D</td>
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<tr>
<td>SM23305D</td>
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<td>SM23405D</td>
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**NEMA 34 FRAME**

<table>
<thead>
<tr>
<th>NEMA 34 FRAME</th>
<th>BRAKE</th>
<th>24V I/O</th>
<th>CAN bus</th>
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<tbody>
<tr>
<td>SM34165D**</td>
<td>-BRK</td>
<td>-AD1</td>
<td>-C or -DN</td>
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<td>SM34165DT**</td>
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<tr>
<td>SM34105D</td>
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<tr>
<td>SM34205D</td>
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<tr>
<td>SM34305D</td>
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<tr>
<td>SM34405D</td>
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**SM34165D & SM34165DT are the only models that can have an internal shunt.**

For an overview of all our products, visit: www.animatics.com
### Animatics CANopen SmartMotor™

**Features Include:**
- All basic Motion commands available via CiA V4.02 specification
- Ability to read/write all SmartMotor variables
- Use of onboard I/O via CANopen Gateway, SmartMotor program, or RS232 commands
- Ability to run 1000 SmartMotor subroutines via CANopen
- Online diagnostics of the SmartMotor™ via SMI2 software and RS232 connection
- Up to 127 nodes
- 250 micro second interrupt driven subroutine
- Baud Rates: 20K, 50K, 125K, 250K, 500K, 1Mpbs default 125Kbps

**Note:** This option DOES NOT apply to all Models, please see comparison chart on center foldout for availability.

### Animatics DeviceNet SmartMotor™

**Features Include:**
- Polled I/O and Explicit Messages from your PLC to control all SmartMotor™ operation
- Read/Write control over all ODVA Position Controller parameters
- Use of onboard I/O via DeviceNet, SmartMotor™ program, or RS232 commands
- Ability to run 1000 SmartMotor subroutines via DeviceNet and read/write four 32-bit user variables
- Online diagnostics of the SmartMotors via SMI2 software and RS232 connection
- Up to 64 DeviceNet nodes
- 250 micro second interrupt driven subroutine
- Baud Rates: 125K, 250K, 500K, 1Mpbs default 125Kbps

**Note:** This option DOES NOT apply to all Models, please see comparison chart on center foldout for availability.
Fieldbus Protocol / DE Options

Animatics ProfiBus SmartMotor™

Features Include:
- Command/Response Codes for all Class 5 SmartMotor commands
- Use of onboard I/O via ProfiBus, SmartMotor program, or RS232 commands
- Ability to run 1000 SmartMotor™ subroutines via ProfiBus
- Ability to read/write all SmartMotor variables
- Online diagnostics of the SmartMotors via SMI2 software and RS232 connection
- Up to 127 ProfiBus nodes
- 250 micro second interrupt driven subroutine
- Baud Rates: default 1.5Mbps
  9.6, 19.2, 31.25, 45.45, 93.75, 187.5, 500 kbps,
  1.5, 3, 6, 12 Mbps

Note: ProfiBus baud rates are achievable only with proper cable length and termination connectors. The minimum cable length when operating >=1MBaud is 1 meter (3 feet). If the cable is too short, reflected impedance can cause loss of communications data packets and spurious node errors.

HIGHLY RECOMMENDED OPTION. PLEASE READ!

Hardware "DE" Option:
The DE option allows the controller and drive-amplifier to be powered from separate 24-48 VDC power supplies.
- Controller can be powered from a standard 24 VDC supply
- Position will not be lost on loss-of-drive-power
- No need to re-home
- Load surges will not cause power surge on controller
- Standard battery options are made simpler

Note: All IP sealed SmartMotors are designed to always have separate drive and control power. As a result, no DE designation is available for IP sealed SmartMotors. Control power on IP sealed SmartMotors is rated for 24VDC, maximum of 32VDC.
Understanding Animatics Torque Curves

Each set of torque curves depicts limits of both continuous and peak torque for the given SmartMotor™ over their full range speed.

**Peak Torque Curve:**
The peak torque curve is derived from dyno testing and is the point at which peak current limit hardware settings of the drive prevent further torque in an effort to protect drive stage components.

**Continuous Torque Curve:**
The continuous torque curve is also derived from dyno testing, but is instead the point at which the temperature rises from an ambient of 25°C to the designed thermal limit.

For example, the motor will be placed on the dyno tester and set to operate at 1000 RPM continuously with the load slowly increased until the controller reaches its maximum sustained thermal limit. This limit is either 70°C or 85°C depending on the model number. All Class 5 SmartMotor Servos are set to 85°C.

The far lower right side of the curve is limited by supply voltage. This is the point at which Back EMF suppresses any further speed increase. Higher supply voltages will shift the zero torque point of the curves further to the right.

**Ambient Temperature Effects on Torque Curves and Motor Response:**

If the motor is operated in an environment greater than 25°C, then it will reach its thermal limit faster for the same given load thereby further limiting continuous torque.

Therefore; any given motor torque curve MUST BE linearly de-rated for a given ambient temperature from 25°C to 85°C for all Class 5 SmartMotor Servos.

**Supply Voltage Effects on Torque Curves and Motor Response:**

Higher voltages have two-fold effects on torque curves. As mentioned above, raising voltage will shift the curve to the right. It will also allow higher current into the drive. However, Torque curves depict Torque at a given velocity.

If you double supply voltage, the motor can sustain twice the original velocity. But since acceleration is the differential of velocity, it can achieve 4 times the original acceleration. This is useful for high speed indexing and fast start/stop motion.

All Torque Curves in this catalog also have SHAFT OUTPUT Power Curves overlaid on them as well.

Power can be found by the following equation:

\[ \text{Power (kW)} = \frac{\text{Torque (N.m)} \times \text{Speed (RPM)}}{9.5488} \]

For any given mechanical system being moved by a SmartMotor™, it is ideal to ensure the motor is running within its optimum performance range. This can be achieved via proper mechanical system design by adjusting one of the following as it may apply:

- Gear Reduction
- Belt Reduction
- Lead Screw Pitch
- Pinion Gear diameter

**Example 1: (Rotary Application)**

Suppose you have a load that requires 300 RPM at the output of a gear head. Suppose the optimum speed range for the motor is 2100 RPM.

Divide the optimum operating speed by the load speed to get the ideal gear reduction. In this case : 2100 RPM / 300 RPM = 7. So a 7:1 gear reduction would allow the motor to operate in its most efficient range.

**Example 2 (Linear Application)**

Suppose you need to run at 100mm/second via a ball screw and the motor has an ideal range of 3000 RPM. 3000 RPM/60 = 50 Rotations per second. 100mm/sec divided by 50RPS is 2mm per rotation.

So an ideal pitch would be 2mm.
Considerations when using torque curves for motor sizing:

For any given product model number, there may be variations of as much as +/-10%.

The following diagram depicts data points collected from dyno testing of a given model motor. A best-fit torque curve is created from these data points and is then de-rated to at least 5% below the worst case data points. The de-rated curve is what is advertised. This means that within any given model number, EVERY motor sold will perform at or better than the advertised torque. Theoretically, ALL motors should be no less than 5% better than advertised and may be better than 20% higher.

The diagram shows motor loading in 4 areas.

1. This is ideal and depicts a load within the normal operating range of the motor. The motor should operate well and have no problems for many years.
2. The load is very close to the operating limit. The motor will run quite warm as compared to Point 1.
3. The load exceeds the advertised level and exceeds +10% expected range of possible torque capabilities. In this case, the motor will most likely either overheat quickly and fault out or immediately get a position error because it simply does not have enough power to support the load demand.
4. The load exceeds the advertised operating limit of the motor. However, due to data scatter and de-rating, there may be some motors that will work and others that do not. Why? Because it is in the area of +/-10% variation expected in motors for a given size. This can become a major problem. Imagine designing a machine that operates in this range. Then you replicate that machine with many of them running on a production floor. One day, a motor at the lower end of the +/-10% expected variation would be placed on a new machine and that motor would get spurious drive faults. It would appear as though the motor is malfunctioning because... “all the other motors work just fine”. This is unfortunate because, in reality, all motors were undersized and operating outside of their advertised limits. This is why it is important to properly calculate load torque to ensure the correct motor is designed into the application. Never assume that without proper load calculation and motor sizing, that testing of one motor means all of that size may work. This is simply not the case. Try to keep operating conditions below the advertised limits to ensure reliable long-life operation.
<table>
<thead>
<tr>
<th>SM23165DT</th>
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<tbody>
<tr>
<td><strong>Continuous Torque</strong></td>
<td>4.61 in-lb</td>
</tr>
<tr>
<td></td>
<td>74 oz-in</td>
</tr>
<tr>
<td></td>
<td>0.52 N-m</td>
</tr>
<tr>
<td><strong>Peak Torque</strong></td>
<td>7.40 in-lb</td>
</tr>
<tr>
<td></td>
<td>118 oz-in</td>
</tr>
<tr>
<td></td>
<td>0.84 N-m</td>
</tr>
<tr>
<td><strong>Nominal Continuous Power</strong></td>
<td>204 Watt</td>
</tr>
<tr>
<td><strong>No Load Speed</strong></td>
<td>5,200 RPM</td>
</tr>
<tr>
<td><strong>Continuous Current @ Nominal Power</strong></td>
<td>6.1 Amps</td>
</tr>
<tr>
<td><strong>Voltage Constant</strong></td>
<td>9.08 V/kRPM</td>
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<tr>
<td><strong>Winding Resistance</strong></td>
<td>0.7 ohms</td>
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<tr>
<td><strong>Encoder Resolution</strong></td>
<td>4,000 Counts/Rev</td>
</tr>
<tr>
<td><strong>Rotor Inertia</strong></td>
<td>0.001 oz-in-sec²</td>
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<tr>
<td></td>
<td>0.706 10⁻⁶ Kg-m²</td>
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<tr>
<td><strong>Weight</strong></td>
<td>1.3 lb</td>
</tr>
<tr>
<td></td>
<td>0.59 kg</td>
</tr>
<tr>
<td><strong>Shaft Diameter</strong></td>
<td>0.250 in</td>
</tr>
<tr>
<td></td>
<td>6.35 mm</td>
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<tr>
<td><strong>Shaft, Radial Load</strong></td>
<td>7 lb</td>
</tr>
<tr>
<td></td>
<td>3.18 kg</td>
</tr>
<tr>
<td><strong>Shaft, Axial Thrust Load</strong></td>
<td>3 lb</td>
</tr>
<tr>
<td></td>
<td>1.36 kg</td>
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<tr>
<td><strong>DeviceNet Available</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>ProfiBus Available</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>CANopen Available</strong></td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Animatics SmartMotor™ SM23165DT (No Options) CAD Drawing**
SM23165DT Torque Curves

SM23165DT at 48 VDC at rise to 85°C

SM23165DT at 42 VDC at rise to 85°C

SM23165DT at 24 VDC at rise to 85°C

All Torque curves based on 25°C ambient. Motors were operated in Trap-Commutation Mode. Please consult factory for Sine-Commutation Torque Curves.
Animatics SmartMotor™ SM23165D/DT-AD1

in [mm]

Animatics SmartMotor™ SM23165D/DT-C

in [mm]
Animatics SmartMotor™ SM23165D/DT-BRK

**CAD Drawings**

Animatics SmartMotor™ SM23165D/DT-C-AD1

**CAD Drawings**

Animatics SmartMotor™ SM23165D/DT-BRK