

Class 4 vs Class 5 SmartMotor FAQs

How can I identify my SmartMotor's "class"?

There are several ways to identify if a motor is Class 4 or Class 5.

1. Examine the part number (PN) printed on the motor's label. All Class 5 products have a "5" as the seventh digit in the PN. For example, SM23165D, SM17205D-AD1, SM34405D-DE, SM23165MT-IP.
2. Examine the firmware version printed on the motor's label. The firmware version is typically printed just below the part number. If the firmware version is 4.xx, then it is a Class 4 motor; if it is 5.x.x.x, then it is a Class 5 motor.
3. Examine the firmware version using SMI. The firmware version is stored in the motor's .adb file, which can be viewed using SMI. To view the .adb file, open SMI, connect to the motor, open the Motor View and select the "Info" tab.

NOTE: Class 5 and Class 6 SmartMotors are the current classes of SmartMotors.

Is there a Class 5 replacement for my Class 4 motor?

There are Class 5 versions of nearly every Class 4 motor. The motors (rotor + stator) themselves have not changed, only the control electronics have. That means you can expect similar performance and exact mechanical matches. In general, to find the Class 5 equivalent of a Class 4 PN, add a "5" after the sixth digit into the PN. The following table shows some Class 4 motors and their Class 5 equivalent.

Class 4 Part Number	Class 5 Equivalent Part Number
SM1720D	SM17205D
SM2316D/SM2315D	SM23165D
SM3440D	SM34405D
SM2337D-DE	SM23375D-DE

What are the differences between Class 4 and Class 5 motors?

From a mechanical aspect, Class 5 motors are drop-in replacements for Class 4 motors. They have the same mechanical footprint, shaft size, pinouts and cable options. The primary difference affecting the end user is the syntax of the programming language. Most of the commands have changed and this means programs will have to be updated (as well as any master/host devices that send SmartMotor commands).

Moog Animatics provides a tool in the SMI software that automatically converts Class 4 programs to Class 5. The tool works for roughly 90 percent of the commands. To use this tool, open a Class 4 program and from the SMI menu select Tools > Convert File > Class 4 to Class 5. Refer to the following example.

Class 4 Program	(Converted) Class 5 Equivalent Program	
8 UDI	8 EIGN (3)	
9 UCI	9 EIGN (2)	
10 SLD	10 SLD	
11 ZS	11 ZS	
12 WHILE 1	12 WHILE 1	
13	13	
14 MP	14 MP	
15 A=79	15 ADT =79	'ATTENTION
16 V=53687	16 VT =53687	'ATTENTION
17 D=d	17 PRT =d	
18 G	18 G	

NOTE: After conversion, the tool reports any commands that did not directly translate. Refer to the ATTENTION comment(s) displayed by the conversion tool.

For a written comparison of Class 4 and Class 5 commands, see the Class 5 Command Comparison link in the Useful Links section of this document.

What are the differences in Acceleration, Velocity and Position commands?

The other important thing to note between Class 4 and Class 5 SmartMotors are the values used for the acceleration, velocity and position commands.

Position Units

Position units are measured in terms of encoder counts on both Class 4 and Class 5 SmartMotors. However, the size of the encoder (counts) has changed, which means position moves must be scaled accordingly. Refer to the following information.

Class 4 Pre 4.76 FW

NEMA 17 Size motors = 2000 counts per rev (RES=2000)

NEMA 23 Size motors = 2000 counts per rev (RES=2000)

NEMA 34 Size motors = 4000 counts per rev (RES=4000)

Class 4 Post 4.76FW (including 4.76) and Class 5

NEMA 17 Size motors = 4000 counts per rev (RES=4000)

NEMA 23 Size motors = 4000 counts per rev (RES=4000)

NEMA 34 Size motors = 8000 counts per rev (RES=8000)

Velocity Units

Native velocity units (VT, VA) are: (Encoder Counts/PID sample rate) * 65536

One can convert between velocity units and revolutions per second using the following equation.

$$VT = \frac{RPS \times RES \times 65536}{SAMP}$$

Acceleration Units

Native acceleration units (ADT) are: (Encoder Counts/PID sample rate²) *65536

One can convert between acceleration units and revolutions per second² using the following equation.

$$AT = \frac{RPSS \times RES \times 65536}{SAMP^2}$$

RES: resolution or encoder counts per rev

SAMP: PID sampling rate. On Class 4 this value is 4096. On Class 5, this value is configurable but the default value is 8000. On Class 6, this value is 16,000 and not configurable.

What about converting PID Gain values?

In all applications, the default tuning parameters typically work “as is” unless the application has special requirements or a large inertial mismatch. Therefore, when switching from Class 4 to Class 5, it is recommend to start with the default tuning values and then adjust accordingly.

NOTE: There is not a good metric for converting Class 4 gain values to Class 5.

What about converting WAIT values?

WAIT=x – this command is used to pause program execution for a specified amount of time. The amount of time is determined by the variable “x”. On Class 4, “x” is in units of PID samples; on Class 5, “x” is in units of milliseconds. This is also true for the command CLK=formula.

To convert Class 4 WAIT values to Class 5, use the following formula:

$$(\text{Class 4 WAIT value}/\text{Class 4 PID sample rate})*1000 = \text{Class 5 WAIT value}$$

Useful Links

Refer to the following links for more information.

- Class 5 install guide: www.animatics.com/cl-5-install-startup-guide
- Developer’s guide: www.animatics.com/smartmotor-developers-guide
- Class 5 Command Comparison:
www.animatics.com/download/product_info/Class%204%20to%20Class%205%20Command%20Comparison.pdf
- Tools and Sample Programs: www.animatics.com/tools
- System Best Practices: www.animatics.com/system-best-practices-application-note
- Product Catalog:
www.animatics.com/downloads/Catalog/MoogAnimatics_2016_ProductCatalog.pdf