



## CASE STUDY

# ECM Highlights The Benefits of PCB Stator Tech in Haptic Feedback and Simulated Inertia Applications

## Overview

ECM has integrated its printed circuit board (PCB) stator technology into several haptic feedback and simulated inertia applications. Most recently, ECM was involved in two separate projects for very different haptic feedback industries, using PCB stator motors to create a realistic experience of touch and gravity. In the first instance, ECM partnered with NODO Film, an innovative film equipment company based in Los Angeles, to integrate PCB stator motor technology with their next generation cinematography inertia controller. ECM was also commissioned by a multinational leader in the gaming industry to replace a traditional motor and gear system, used in their high-demand simulated gaming device, with a PCB stator direct drive solution.

## Benefits

Motors developed with ECM's PCB Stator technology and PrintStator design software have many benefits for haptics and simulated inertia systems – in many cases enabling previously unseen capability and performance. In haptic feedback systems, the quality of a motor's motion can have a big impact on the effectiveness of the system to mimic real world gravity and inertia conditions. PCB Stator motors are air-core machines which means they contain no iron in their stator – just FR4 and copper. This eliminates any tendency for the rotors to have preferred alignments with the stator and enables perfectly smooth rotational motion. With zero cogging, ECM motors can provide exceptional precision but also deliver torque with a remarkably authentic feel.

The axially thin and lightweight nature of these motors can also increase the portability of integrated haptic systems while high energy efficiencies increase battery lifespan. The high level of customizability with the PrintStator software can also ensure a simple and innovative integration.



“The result of this collaboration is a major step forward for both the film industry and high torque, high precision haptics. The combination of torque, precision, flexible form factor, and ease of manufacturing did not exist before these motors. It's an inspiring and revolutionary combination of technology”

**Boyd Hobbs,**  
CEO and Founder  
NODO Film Systems



## Results

ECM developed a unique PCB Stator motor solution for NODO Film’s next generation camera-stabilization controller. The NODO device uses inertia wheels to provide realistic digital drag. This gives cinematographers better remote control over their camera motion. ECM enhanced NODO’s system with a compact PCB Stator design that creates 6x the current limit, 4x the max torque, and 4x the encoder resolution. Further, NODO was able to use the PrintStator software to design the PCB Stator motor as a fully integrated motor solution, tying the motor directly to their inertia wheel to reduce manufacturing costs and create a comfortable handheld device.

For another partner, ECM also designed a PCB Stator motor for a simulated gaming device, which offered an exceptional quality of motion and torque density. This 18cm diameter motor weighs only 1.8kg and delivers over 7Nm of force, allowing this system to eliminate gearing and incorporate ECM’s solution as a direct-drive. According to this partner, there is no other comparable motor that is able to achieve such high torque values while offering a perfect quality of motion. The resulting 200W solution combines remarkable precision with high torque capability to give the gaming system an extremely sensitive feel in a compact package.

<p><b>NODO Inertia Motor</b>          Speed [RPM] : 400</p> <p>Torque [Nm] : 1.0  <b>Kt [Nm/A] : 0.051</b></p> <p>Diameter [cm] : 10.0          Length [cm] : 1.19</p> <p><b>Motor Mass [g] : 491g</b></p>	<p><b>Example Encoder Revolutions</b></p> <table border="0"> <tr><td>16 Bit Encoder</td><td>65,356</td></tr> <tr><td>20 Bit Encoder</td><td>1,048,576</td></tr> <tr><td>21 Bit Encoder</td><td>2,097,152</td></tr> <tr><td>22 Bit Encoder</td><td>4,194,304</td></tr> <tr><td><b>24 Bit Encoder</b></td><td><b>16,777,216</b></td></tr> </table>	16 Bit Encoder	65,356	20 Bit Encoder	1,048,576	21 Bit Encoder	2,097,152	22 Bit Encoder	4,194,304	<b>24 Bit Encoder</b>	<b>16,777,216</b>
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## Next Steps

ECM’s advanced motor technology is powered by PrintStator – its proprietary, software-based design platform. PrintStator enables the swift design of optimized PCB Stator motor solutions based on user specifications. Capitalizing on the perfect quality of motion, high torque densities and compact systems made possible with ECM motors, innovators across numerous industries are employing PrintStator to design solutions for their haptic feedback and simulated inertia applications.

To discuss the benefits of ECM’s PCB stator technology within your product line, please email [info@pcbstator.com](mailto:info@pcbstator.com) or visit [pcbstator.com/design-your-own](http://pcbstator.com/design-your-own) to learn more about our 5-step integration process.

