NIPPON PULSE FAQ

Nippon Pulse

Your partner in motion control

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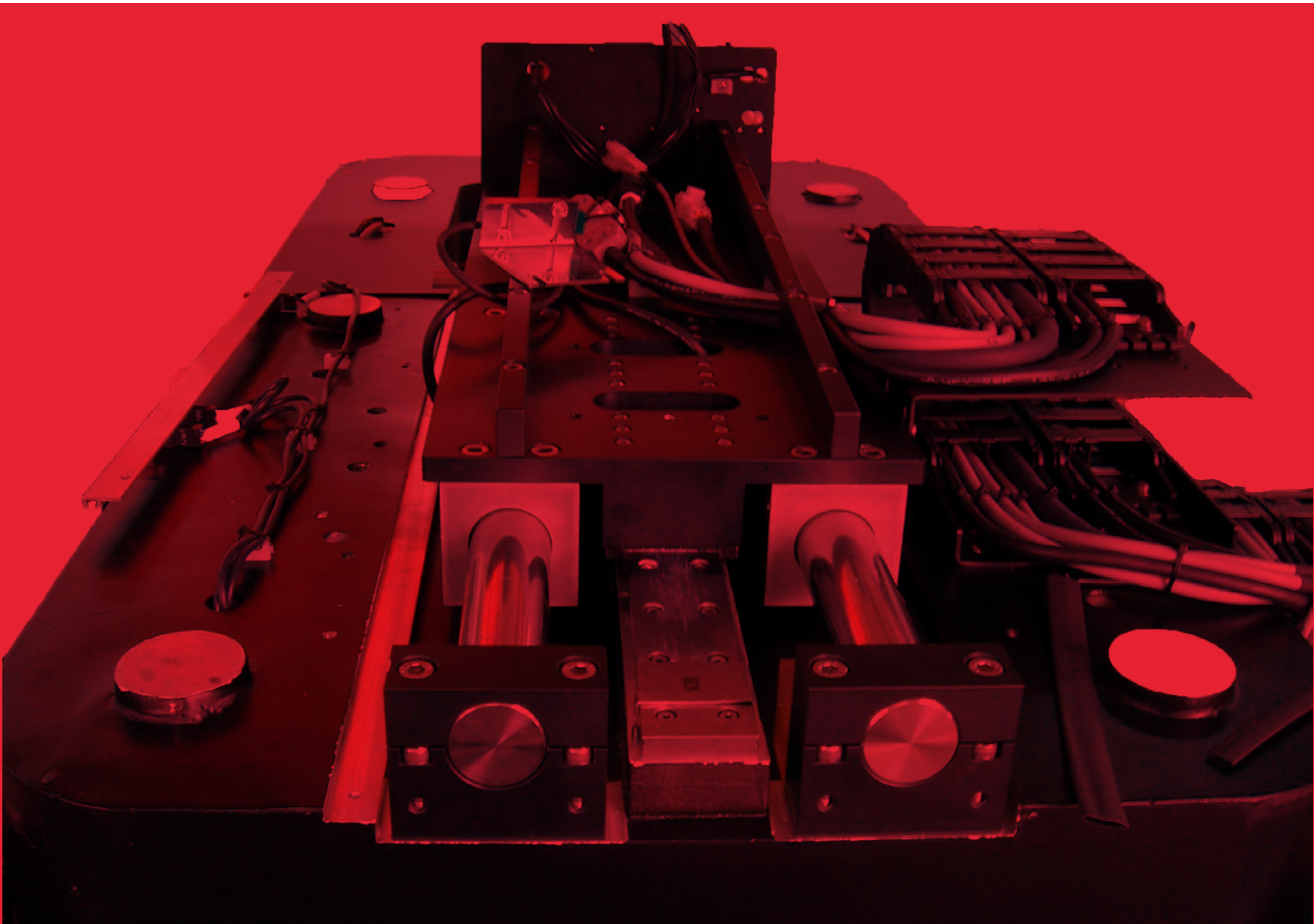
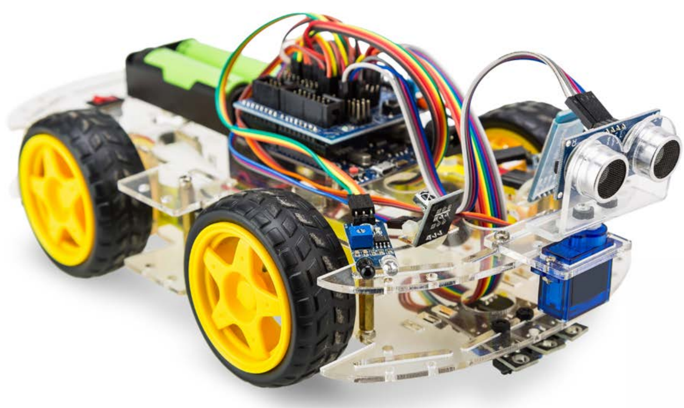


SERVO-MOTOR TERMINOLOGY FAQ:

What's the difference between an industrial servo motor and a hobbyist-quality servo motor?

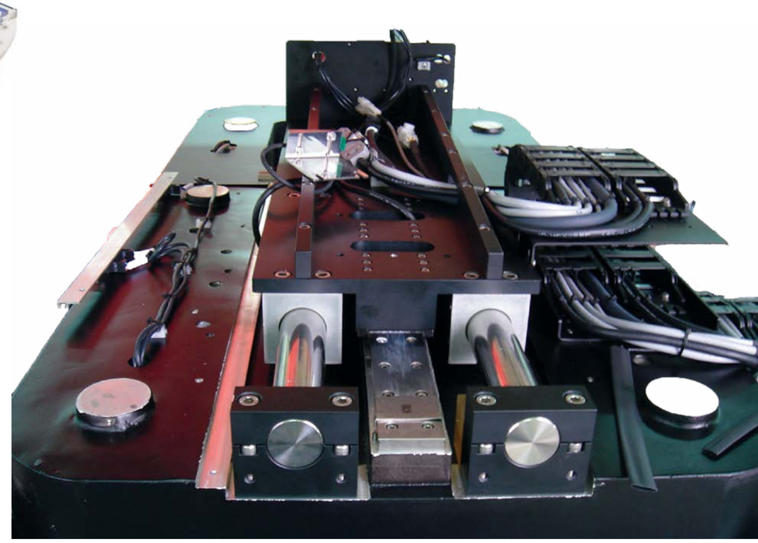
Nippon Pulse engineers are regularly approached by hobbyists and educators looking for servo motors. But there is a big difference between wshat these novice engineers are usually seeking — two-lead dc motors — and precision industrial servo motors run off ac power with an encoder for feedback. One example of the latter is Nippon Pulse's Linear Shaft Motor, an ac brushless servo for exacting linear actuation.

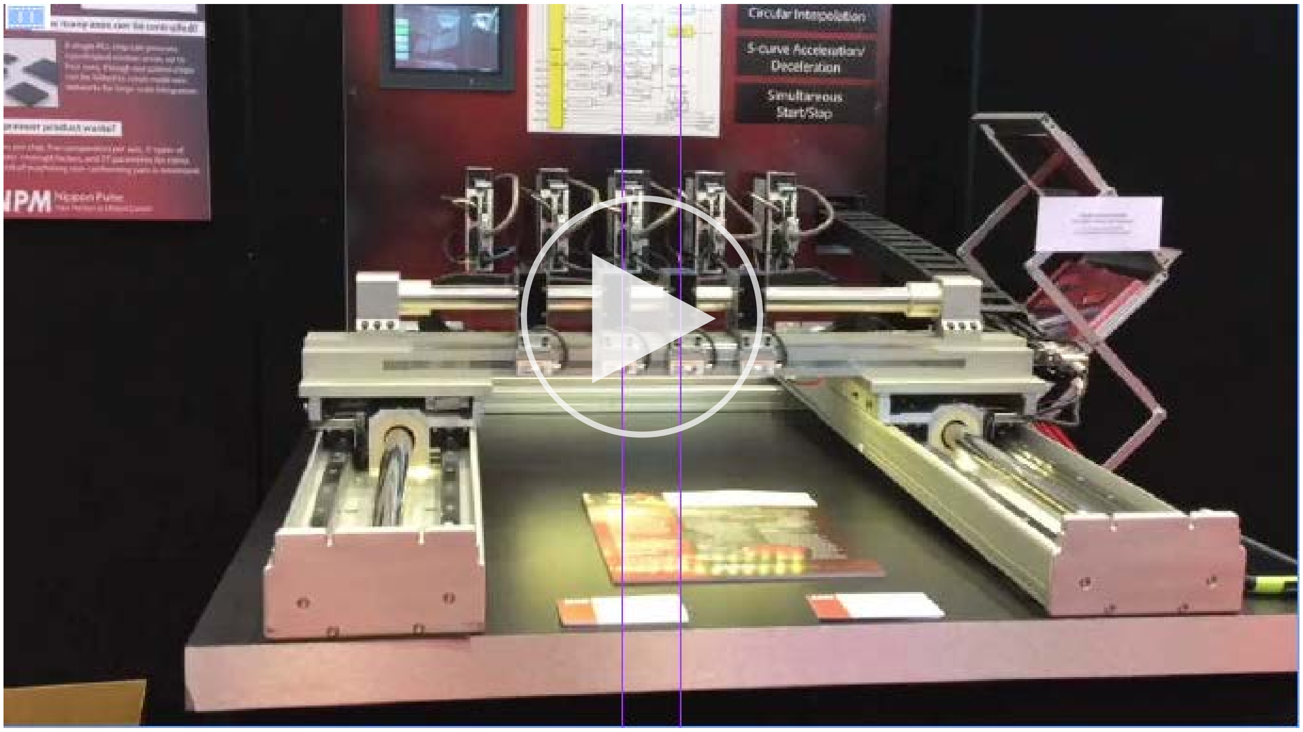
Spurring the uptick in maker-market requests (and divergent uses of the term servo motor) is the rise of STEM programs in the U.S. aimed at motivating students and exposing them to engineering tools, concepts, and components. Coaches and mentors for these programs are occasionally engineers themselves ... though most are self-taught novices on the specific field of motion control. Robotic kits for these programs (incorporating LEGO elements or other standardized components and subsystems) prompt school volunteers and students to familiarize themselves with (among other things) motors for model kits and remote-control (RC) models. Such motors are often brush dc motors with small gearheads (in many instances, made of plastic) for some reciprocating motion ... perhaps with a potentiometer tracking motor position. Unfortunately, manufacturers of these components often call them servo motors. So that's also what educators and students call these simple motors.



The so-called servo motors in hobbyist and maker-grade designs are entirely different and much simpler than the servo motors employed in industrial applications.

Linear shaft servo motors find use in industrial applications requiring efficient and precise motion sans cogging of other options.





This H-bridge includes two linear shaft motor stages and a multi-head linear shaft motor.

To address this issue and inform new engineers, Nippon Pulse regularly holds sessions at tradeshows on the basics of stepper motors, servo motors, and how to control both. Upon completion of the session, Nippon Pulse then supplies visitors with small development kits to facilitate small machine builds and education on motion-design basics.

Common among educators is the misconception that any motor that's not a stepper motor must be a servo motor. Online resources on servo motors are unfortunately peppered with copious references to ultra-inexpensive hobby-grade motors with gearheads ... so Google and Amazon search results for "servo motors" include those detailing maker-grade motors and options from robot shops along with those detailing true industrial servo motors. A related issue is the way in which STEM programs (especially those that base robotic kits on Arduinos) can inadvertently teach students to mistakenly call anything with command over the motor a controller — even when the device in question happens to be a drive.

In other cases, builders of custom RC vehicles occasionally request ac servo motors but will indicate that they cannot use a linear three-phase servo motor, even when cursory review of parameters might suggest that as an option. When presented with a true servo motor, such a hobbyist may ask, "Why does this motor have three wires? Which one is ground? Where do I put the dc voltage?" This is when Nippon Pulse engineers set the record straight — that in fact, servo motors don't work at all how motors in RC designs work. In some cases, hobbyists use the term "brushless motor" to refer to any industrial-grade servo motor. An additional indication that a true industrial servomotor may not be appropriate is if the RC hobbyist or designer indicates a preference for using potentiometer feedback.

Even the industrial space has issues with inconsistent and inexact terminology on this front — with confusing terms such as brushless dc motor for electronically commutated motors. There is also crossover between technologies for hobby-level designs and true industrial-grade designs — especially for the DIY CNC market. Some industrial-grade motors can connect to Raspberry Pi for motion control ... and some manufacturers of highly sophisticated motors also sell can-stack stepper motors so ubiquitous in simpler automation and consumer designs requiring straightforward motion.

Ultimately, use of proper terminology supports good specmanship — for accurate information about a machine build that accounts for how U.S. component suppliers may supply overly aggressive values ... and German and Japanese suppliers often list conservative values.

Case in point: Design engineers who execute many machine builds may encounter three different definitions of the value of continuous current for a motor. Nippon Pulse defines a motor's continuous current as that which a motor can sustain in free space indefinitely — set as 24 hours. Yet another expression of continuous current is the amount of current through the motor for indefinite period of time when attached to a heat sink. A third definition is the current that can be applied for a 30% duty cycle when attached to a heatsink for a set period of time. These three values of continuous current are not the same — and motors described with these disparate measures are of vastly different quality ... even if the numbers match. Unfortunately, the details of how the motor manufacturer calculates continuous current is often in small print at the bottom of published data sheets and catalogs. If the design engineer or purchasing agent isn't paying attention to the fine print, it may result in the specification of inadequate motors.

Nippon Pulse America Inc. linear shaft servo motors come in an array of sizes.

Here are some clues to quickly differentiate hobby-level motor applications and true industrial-grade servo motors: Hobby-grade designs can often tolerate simple brush motors on critical axes; include axes run off straight dc input; and incorporate low-cost gearheads on the motor in some cases. In addition, many hobby-grade (so-called) linear servo axes including feedback and bearings may cost only $50 or so.

In contrast, industrial-grade linear servo designs are much costlier due to the inclusion of precision-manufactured subcomponents and advanced electronics to exact accurate positioning and axis coordination, among other things.

Another design parameter of focus for hobbyists is motor resistance — because it's often touted as a key design parameter for getting battery-operated builds to run longer. There are three things to remember here:

- 0.5 A of current draw is 0.5 A of current draw no matter what the motor type ... even if it's a servo motor.
- In the context of industrial applications, motor resistance is a measure that requires nuanced and educated consideration.
- Most motors used in industrial applications today differ from dc brush motors for which powering is as simple as applying dc voltage across the winding.

Scaleless (SL) tubular linear motors from Nippon Pulse America Inc. include a built-in linear encoder. The noncontact design includes a stainless-steel shaft (containing magnets) and forcer (containing motor coils). The encoder and Hall sensors are also inside this forcer — for a contained linear-motion solution that is suitable for medical devices, laboratory equipment, robotics, and factory automation.

In summary, hobbyists, amateur CNC designers, and engineering students often don't work in motion control as their primary profession. They become versed in motion control from their maker-market build work and exposure to online educational references such as YouTube videos, design forums, and manufacturer data sheets. As mentioned, terminology used in these communities (particularly online), as well as maker spaces and educational STEM programs, conflicts with that used in the industrial motion-control market. Another complicating factor is occasionally there's commonality and overlap between what's used in industrial settings and these maker-grade builds. For example, small standalone industrial motion controllers are often suitable for maker robotics ... and some automation-grade servo motors take commands from BeagleBone Black and Raspberry Pi boards via C++ libraries that run on Linux hosts. The latter are sometimes offered by component manufacturers as a way to satisfy motion-component demand from the maker community while freeing application engineers from involvement with one-off projects.

Further blurring the lines between maker and OEM-grade designs is the fact that some high-volume engineering teams have begun integrating open-source board computers in their machine builds — mostly to leverage these boards' lower cost and higher availability than traditional PLCs for motion control. In fact, Nippon Pulse will soon release a low-cost hybridized motion controller for the maker market.

Educate yourself on motion controls at ***nipponpulse.com/learning***.
Access details on the full range of Nippon Pulse industrial-grade motors and controllers at ***nipponpulse.com/products***.