

UNIVERSAL CONTROL FOR STEPPER MOTORS

With good-quality stepper motors widely available at reasonable cost, this flexible, computer-driven, control board will make it rather hard to hold on to the belief that stepper motors are the exclusive realm of industrial electronics. If you are suspicious about "universal", just glance at the specifications table below; if you are into industrial electronics, well...

Stepper motors come in an astounding variety of types and sizes, and they are frequently spotted these in electronic machine tools and on hobby robots. Steve Conroy has suggested using a home construction to produce one at a fraction of its original price. However the number of steps coming from the device, and the fact that it is often found to be more difficult to get going than a simple servo motor, more often than not causes the perplexed owner to carefully put his poor possession in the junkbox, together with other "possibly useful" materials.

In *Stepping Motors*, Cliveur Electronics (April 1980), the general methods were described for the design of stepper motors. Also that article provides a useful discussion of stepper motor terminology used further on in this article.

The main specifications of the proposed control board are contained in the shaded table on this page. The board is readily tailored to suit the user's requirements, but it should be made quite clear at the onset that each of the following sections is to be read closely to be able to decide on the most desirable circuit configuration for a specific application. A detailed discussion of each of the technical features is, therefore, indispensable for a good understanding of the operation of this fully reconfigurable lower-level board between computer and, for instance, robot limbs, a photograph, or a glider.



Stepper motors: some problems

The following is a necessarily brief discussion of the main difficulties to be overcome when using stepper motors.

Limited speed range: The motor windings constitute an inductive load, which limits the maximum speed of the coil current. Also, the winding's permanent magnet rotor causes an inductive voltage which further worsens the commutation. These effects limit the maximum attainable step rate (also *pull-in rate*), but can be overcome by utilizing system drive control.

Resonance: the undamped character of a stepper motor operating at a relatively low step rate causes its movement to be rather halting. The upper waveforms here in Fig.1 show the considerable overshoot after each step. Should the step frequency equal that of the undamped oscillations, resonant oscillatory motion, resulting in a powerful, jerky movement of the spindle. Mechanical damping devices have been developed to ensure a smoother spindle movement, but these permanent loads typically cause the already low efficiency of the stepper motor to fall below the acceptable level.

The lower waveforms here shown in Fig.1, provide evidence for the proposition that micro-step operation can provide a marked improvement in linear spindle movement,

Technical specifications

Driver capacity: Net motor types:	one 6 phase bipolar type, two 3 phase bipolar type, and 2 phase unipolar type, two 4 phase unipolar type.
Max. output current:	1.2500 Amps 1 A bipolar, 0.2500 Amps 2 A 4-phase, buckminsterfullerene pattern and 200 mA current flow direction.
Driver type:	Brushless, brushless current amplifier.
Output I/O:	4 bit data input and 2 bit handshaking or Centronics standard.
Speed:	10 - 25.5° with 1.2500 Amps 10 - 40° with 0.2500 Amps. Regulation not required.

Elektor Stepper Motor Control

Judd E. Hollander



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Table of Contents Elektor Stepper Motor Control

1. Understanding the eBook Elektor Stepper Motor Control
 - The Rise of Digital Reading Elektor Stepper Motor Control
 - Advantages of eBooks Over Traditional Books
2. Identifying Elektor Stepper Motor Control
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Elektor Stepper Motor Control
 - User-Friendly Interface
4. Exploring eBook Recommendations from Elektor Stepper Motor Control
 - Personalized Recommendations
 - Elektor Stepper Motor Control User Reviews and Ratings

- Elektor Stepper Motor Control and Bestseller Lists
- 5. Accessing Elektor Stepper Motor Control Free and Paid eBooks
 - Elektor Stepper Motor Control Public Domain eBooks
 - Elektor Stepper Motor Control eBook Subscription Services
 - Elektor Stepper Motor Control Budget-Friendly Options
- 6. Navigating Elektor Stepper Motor Control eBook Formats
 - ePub, PDF, MOBI, and More
 - Elektor Stepper Motor Control Compatibility with Devices
 - Elektor Stepper Motor Control Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Elektor Stepper Motor Control
 - Highlighting and Note-Taking Elektor Stepper Motor Control
 - Interactive Elements Elektor Stepper Motor Control
- 8. Staying Engaged with Elektor Stepper Motor Control
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Elektor Stepper Motor Control
- 9. Balancing eBooks and Physical Books Elektor Stepper Motor Control
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Elektor Stepper Motor Control
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Elektor Stepper Motor Control
 - Setting Reading Goals Elektor Stepper Motor Control
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Elektor Stepper Motor Control
 - Fact-Checking eBook Content of Elektor Stepper Motor Control
 - Distinguishing Credible Sources

13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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