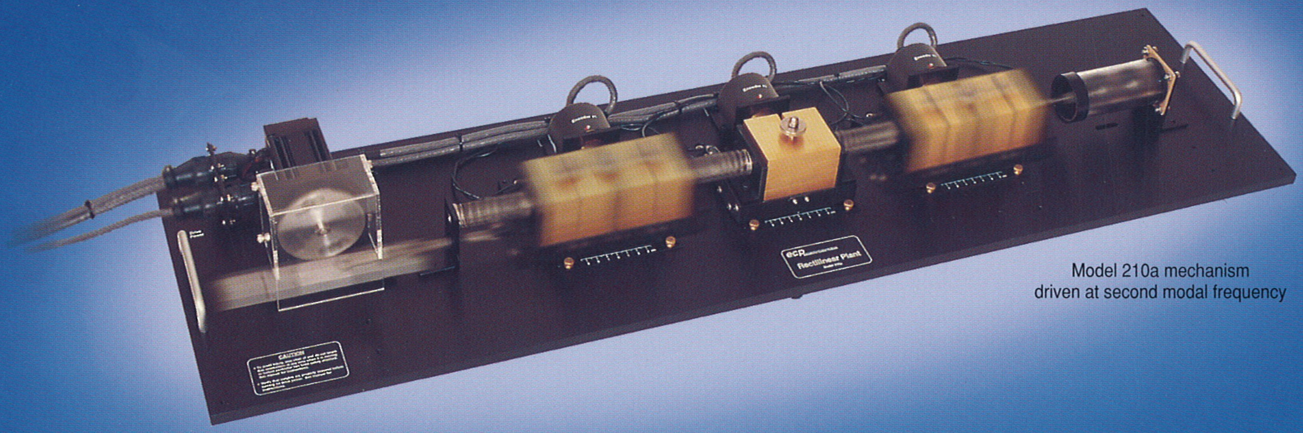
Visit our new Website @ www.ecpsystems.com

The Most Effective Way To Teach Dynamics & Vibrations

Accelerates student grasp of physical principles

Saves instructor time



Model 210a mechanism driven at second modal frequency

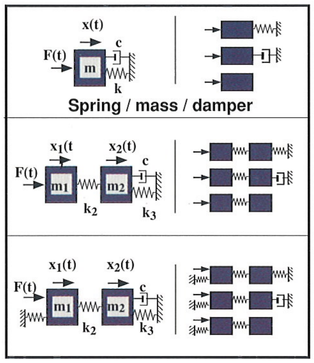
Turn-key workstations for the laboratory and classroom

- Durable, precise mechanisms
- User-friendly interface software
- Comprehensive, step-by-step experiments
- Flexible data acquisition and plotting features
- State-of-the-art control & drive electronics

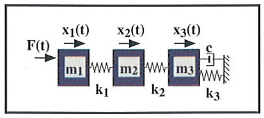
ecp Educational Control Products

Model 210 Rectilinear System

Transforms To 16 Distinct Configurations Including:

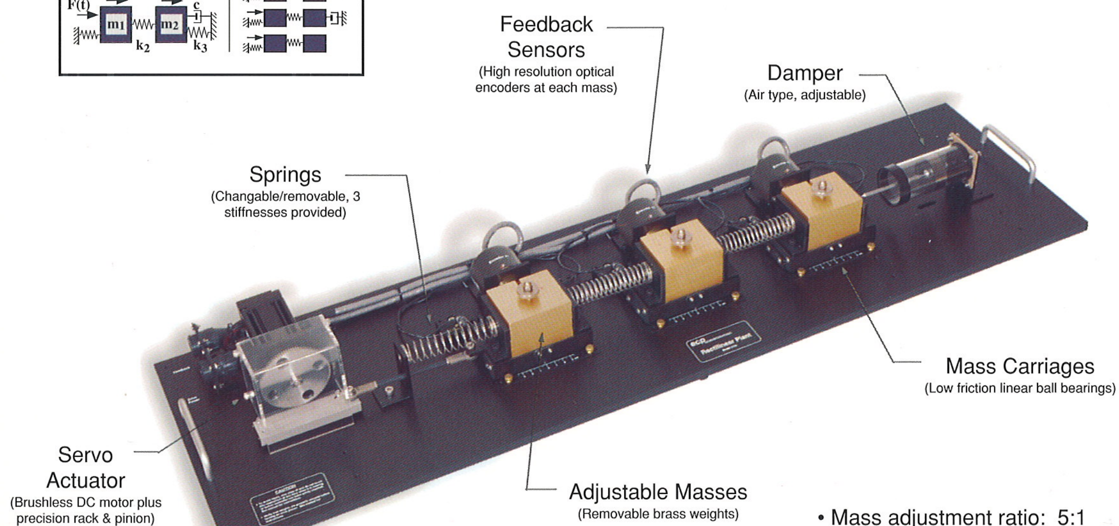


Optional 3rd Mass Provides 21 Forms That Include:



All ECP Mechanisms Feature . . .

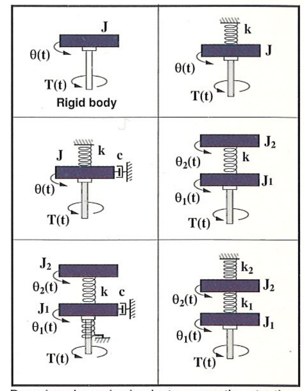
- Durable anodized aluminum-ball bearing construction – holds up to continual student use (& abuse!)
- Precision sensors and actuators for consistently acurate test results.
- Easily adjusted parameters for separate student work groups
- Rapidly changed configurations for basic or advanced experiments
- Bench-top size, transportable, quickly connects to rest of system



Three mass Model 210a shown. Basic Model 210 has 2 masses

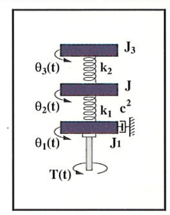
- Mass adjustment ratio: 5:1
- Spring adjustment ratio: 4:1
- Resonant frequencies and zeros from 1.5 to 7 Hz.
- Precision 1700 count/cm optical encoder sensors
- Bench top sized: 30x86x16 cm (12x34x6 in)
- Low inertia 2.0 N-m brushless DC servo motor

Model 205 Transforms To 10 Configurations Including:



Damping shown is via electromagnetic actuation

Optional 3rd Disk Provides 15 Forms That Include:



Ideal For Introductory Lessons . . .

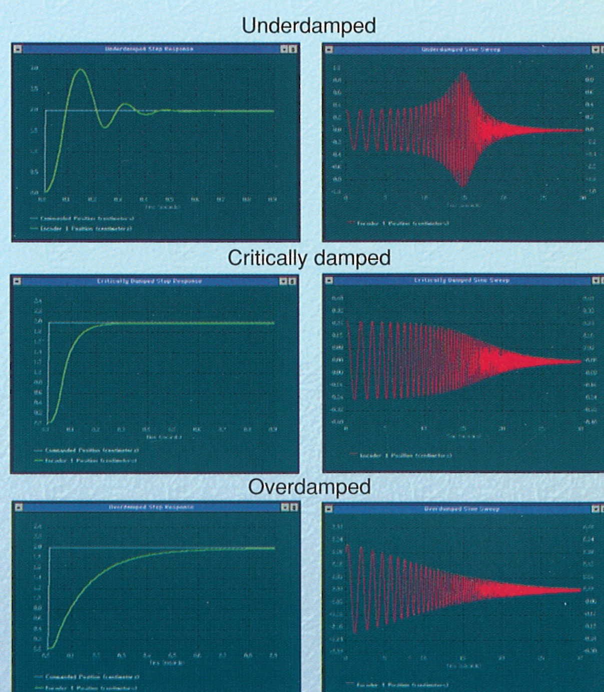
Whether in the laboratory or the classroom, ECP systems vividly demonstrate to students introductory principles. Step-by-step experiments include

- **Second order systems:** Show basic harmonic motion; effect of mass (m), damping (c), and stiffness (k) on natural frequency and damping ratio; and under-, over-, and critically damped systems.

- **Forced harmonic vibration:** Measure resonant frequency and amplitude; phase change with frequency; phase vector dependence on m, c, & k; and high frequency attenuation.

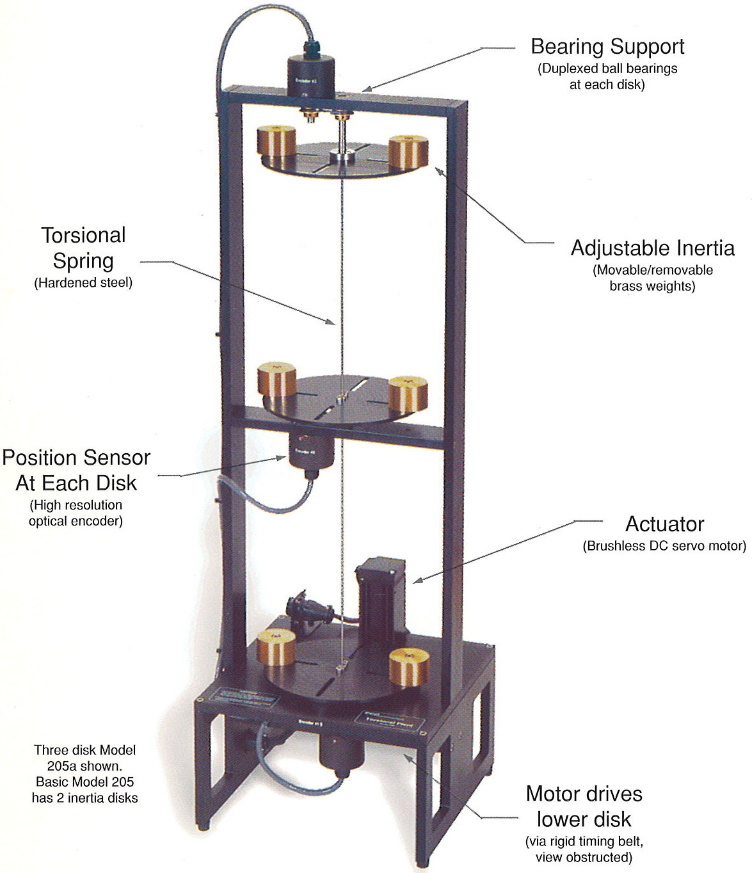
- **Transient response:** Investigate step rise time, percent overshoot; logarithmic decrement; response to impulse, step, ramp, and parabolic inputs; force & base motion excitation, response spectrum, and convolution integral.

- **System type:** Show effect of changing boundary parameters and forcing function on transient & frequency response characteristics.



These experiments show students the effects of m, c, and k on classical step and harmonic ("sine sweep") responses and help correlate time and frequency domain characteristics.

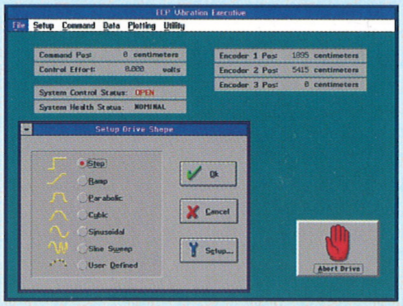
Model 205 Torsional System



Three disk Model 205a shown. Basic Model 205 has 2 inertia disks

- Inertia adjustment ratio: 10:1
- Resonant frequencies and zeros adjustable from 0.8 to 7 Hz.
- Precision 16,000 count/rev optical encoder sensors
- Bench top sized: 30x30x96 cm (12x12x38 in)
- Low inertia 2.0 N-m brushless DC servo motor

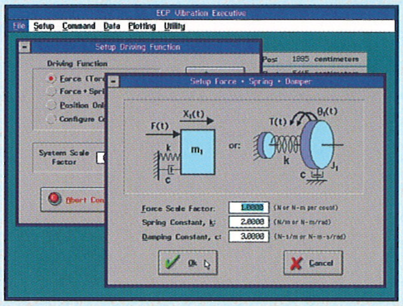
With Our Easy-to-use Interface Software You Can . . .



Efficiently Operate The System

using a rich array of available functions, arranged in an intuitive menu structure.

The background screen gives on-line system status, real-time variable values, and rapid safety abort.



Quickly Setup And Execute A Forcing Function

Options include force (torque) and controlled base motion which may be combined with spring and damper constants effected via the actuator. A full library of input shapes (e.g. step, sinusoidal) provides rapid system characterization

Easily Acquire And Plot Data

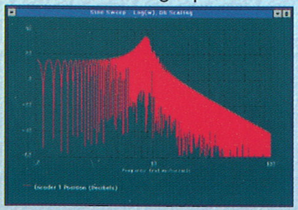
including drive force, inertia positions, velocities, and accelerations. View data in real-time or plot from saved data files. Zoom, log & linear scaling, multi-plotting, tiling, and more!

. . . And More Advanced Study

By configuring the mechanisms in higher order forms and using the versatile features of ECP's interface software, advanced concepts are readily shown and physically visualized.

- **Modal analysis (Eigenvalue problem):** Demonstrate multi degree-of freedom systems, effect of m, and k on modal frequencies and shapes, mode shape measurement at resonant frequencies, mode shape orthogonality, Rayleigh's quotient, Holzer method, transfer matrices.

Data Scaling Options

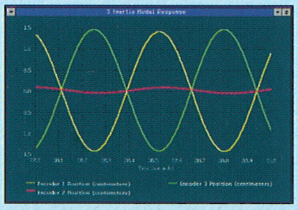


Underdamped frequency response data at left plotted using log(ω) & Db scalings. By witnessing the actual system motion, and use of a variety of data scaling options, students are given a clear physical interpretation of fundamental magnitude & phase characteristics

- **Frequency response characteristics:** Show phase/magnitude relationships, resonant poles and zeros, pole/zero cancellation, high frequency attenuation and dependence on ordered mass number (pole excess).

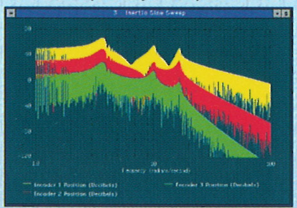
- **Nonlinear systems:** Introduce nonlinear effects (e.g. nonlinear spring) via optional user-written algorithm or include friction and drive nonlinearities in dynamic model. Then apply techniques such as phase plane analysis, Runge-Kutta, perturbation, and iteration methods and compare with actual test data.

Mode Shape



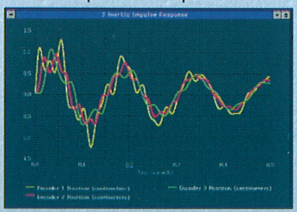
Outputs under modal frequency excitation for a 3-DOF system, with second eigenvector approx. [1,0,-1] (see front cover). The mode shape is clearly seen from the data and witnessed visually during the exercise.

Frequency Response



Frequency response of 3 DOF system shows classical properties. I.e. 3 resonant poles and 2, 1, & 0 zeros for inertias 1, 2, & 3 respectively with characteristic 40, 80, & 120 Db/dec rolloff. (Plots biased by 20 Db successively for display clarity)

Impulse Response



Impulse response gives time domain interpretation of frequency response plot. All 3 inertias strongly transmit first mode; inertia 2 transmits little second mode due to nearby zero; inertia 3 transmits little third mode due to rolloff.

A Wealth Of Features To Save You Time And Enhance Student Learning

ECP's systems are unparalleled in their broad curriculum flexibility, versatile data processing, rugged construction, and ease of use. Whether you're teaching fundamental topics such as second order step and frequency responses or more advanced topics such as modal analysis, transfer matrices, or random force response, a wealth of unique features and clear instructions ensure that you and your students can efficiently demonstrate the desired principles. Our systems let you:

- Simplify lesson planning using our comprehensive set of ready-to-use experiments
- Quickly set up each mechanism for a wide range of 1, 2, and (optionally) 3 degree of freedom configurations
- Rapidly specify and execute force or controlled base motion driving functions with programmable parameters
- Efficiently demonstrate system dynamics with our library of driving function shapes (impulse, step, ramp,linear & logarithmic sine sweep, and more)
- Precisely measure system behavior by acquiring up to nine variables in real time.
- Vividly show system characteristics with advanced, easy-to-use, data plotting features: linear and logarithmic scaling, time & frequency response, auto-differentiation, zooming, tiling, and more
- Easily change parameters (m, J, c, & k as appropriate) both to demonstrate their dynamic effect and to provide for distinct student work group assignments
- Readily import/export data to other software applications including Matlab® and Matrix X®
- Monitor real-time analog signals (via built-in DAC's) with an oscilloscope, plotter, or spectrum analyzer
- Save and reload all working parameters – ideal for multiple work groups
- Print plots directly to virtually any laser or dot matrix printer
- Maintain a safe working environment with automatic safety limit monitoring
- Expand system utility to include a complete control system workstation using optional software & experiments
- And much more!

Turn-key Systems That Set Up In Minutes

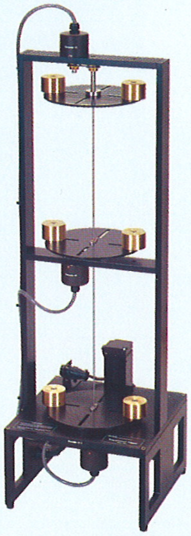
Our state-of-the-art systems come complete with all the hardware and software you need to perform a broad range of meaningful experiments. Setup requires only three simple steps:

1. Install DSP board in standard PC slot*
2. Load software on PC hard drive
3. Plug in cables and begin.

Each system is provided with step-by-step exercises that graphically bring home to students the physical meaning of dynamics & vibrations principles. Our user-friendly interface software and plug-in hardware connections let you operate the system in minutes and perform thought-provoking experiments the same day!

* or connect via RS-232 for external installation

Rugged, Versatile Mechanism



• *See inside & above*

User-friendly Interface Software

• *See inside & above*

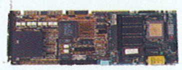
Thought-provoking Experiments

- *Detailed experiments & solutions*
- *Step-by-step system operation*
- *Applied dynamics theory*
- *Useful analytical software routines*

Industrial Grade I/O Electronics

- *PWM servo amplifier(s)*
- *Real-time analog signals out*
- *Safety relays/circuit protection*

Advanced Control / Data Acquisition



- *High speed, DSP-based*
- *Versatile real-time control*
- *Precision data acquisition*