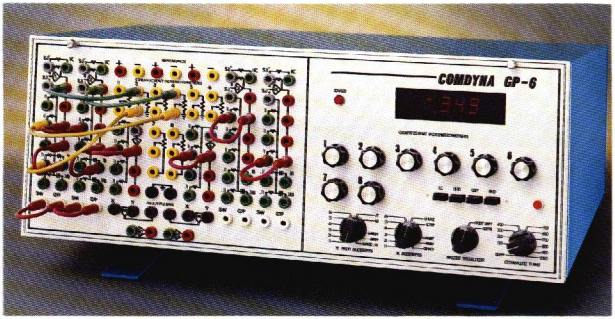
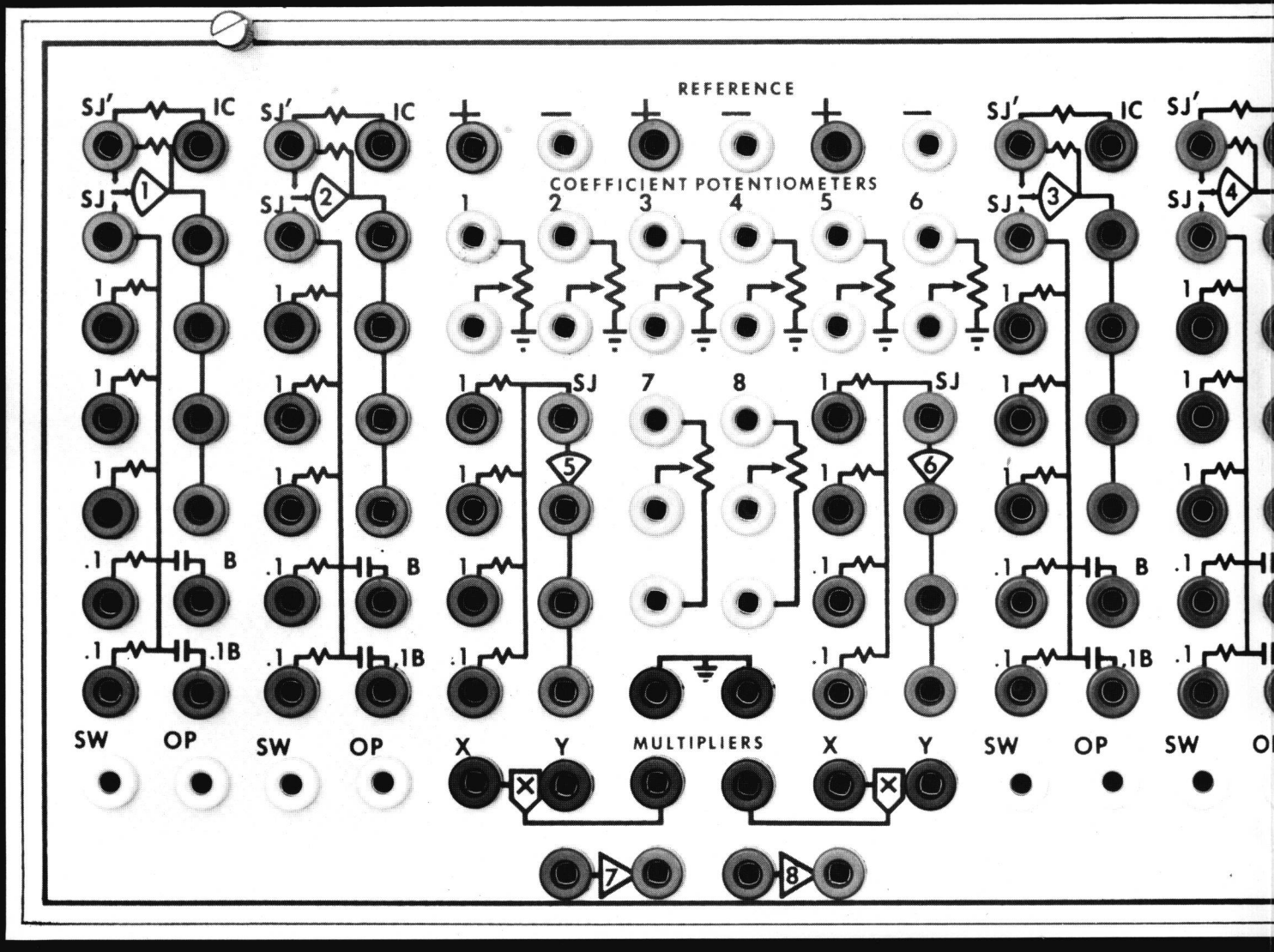
GP-6

ANALOG COMPUTER



COMDYNA, Inc.

COMPUTERS FOR DYNAMIC ANALYSIS



THE COMDYNA GP-6 IS THE ANALOG COMPUTE

CHECK THE MANY FEATURES THAT AID TE

ANALOG SIMULATION

Each GP-6 can simulate mathmatical models of up to four state variables.

Internal Components

- 8 ea. Operational Amplifiers
- 6 ea. Summer Resistor Networks
- 2 ea. Inverter Networks
- 4 ea. Electronic Switch Networks
- 4 ea. Integrator Capacitor Sets
- 8 ea. Coefficient Potentiometers
- 2 ea. Multiplier/Divider Boards

External Accessories

Function Generators, fixed and variable; Banana Plug Modules; Three Mode Controller; Transfer Function Simulator; Microcomputer AD/DA Interface.

PATCH PANEL

The traditional analog computer patch panel is the only means to program linear circuit devices, the alternatives are bread-boarding or PC board fabrication.

Patch panel programs can be custom controllers, filters, scaling amplifiers, simultation loops, etc., ready to use in minutes--no circuit board check out and debugging, component selection and purchase, etc.

The color coded panel is large and readily understood. Analog programming symbols clearly indicate the active devices and associcated networks. Internal summing resistors, integrating capacitors, and active auxilliary circuits reduce patching connections without sacrificing flexibility. Standard banana jacks and plugs allow easy connection of external accessories, amplifiers, readout instrumentation, etc.

EASE OF OPERATION

Straight forward operator functions make the GP-6 easy to use. Some features to aid program set-up, parameter adjustments and run organiztion are:

Digital Readout... An internal DVM digitally displays coefficient potentiometer settings and amplifier outputs.

Two Axis Address... Computed variables are easily selected as X and Y inputs to an oscilloscope or plotter.

Manual and Repetitive Operation Mode Control...A choice of time scales enables a program to be run in slow or fast time, response curves plotted or displayed.

Visual Overload Indicator... An alarm indicates when a variable exceeds a maximum allowable output.

ER FOR THE INSTRUMENTATION/CONTROLS LAB

TEACHING AND CONTROL SYSTEM DESIGN

INTECONNECTIONS

The GP-6 directly interconnects with all forms of analog, analog/digital and digital/analog instrumenation. Front panel banana jacks on standard 3/4 inch spacing encourage patch cord connections as inputs and outputs.

Rear panel terminal posts organize oscilloscope/recorder connections, mode control for external or slave operation, power for external devices and input to the internal digital voltmeter.

The system's positive/negative 10 volts offers a precision reference available for external transducers, position potentiometers, etc.

A three mode electronic integrator control and the standard selection of four integrating capacitors allows integration of practically any time varient signal

PERFORMANCE

The GP-6 analog computer is essentially a system of high quality, high accuracy, programmable active and passive devices.

The operational amplifier specifications feature stable roll-off characteristics, high FET input impediance, low drift and ample output current. Summing networks are high accuracy resistors. Integrating capacitors are matched sets of a stable, low leakage, dialectric composition. Integrator modes are electronically switched, compatible with digital logic and microcomputer control. A choice of multipliers offer high accuracies to meet a range of non-linear requirements.

The precision patch panel reference is a standard +/-10 volts to input constants, set internal and external parameters, scale factors, biases, threshholds and windows.

EXTRAS

Many extras aid operator convenience and laboratory useability.

4 Time Scales per Integrator... Each integrator has a choice of two high speed and two slow time integrating capacitors.

Time Base Ramp...A special, two time scale integrator provides a calibrated time base for either an oscilloscope or XY plotter. There is no need to sacrifice a patch panel integrator to generate time response curves.

Compute Time Readout...A second special amplifier allows for a direct digital voltmeter reading of the compute time period, the value of the full scale time base coordinate.

Slavability... Any GP-6 may easily be slaved to another GP-6, micrcomputer or digital logic system, laboratory instrumentation or apparatus..

THE GP-6 MEETS LABORATORY SIMULATION AND CIRCUIT NEEDS

CONTROLS EXPERIMENTS

The GP-6 offers hands-on analog experiments to introduce the concept of systems, mathematical modeling and simulation, the application of and programming of linear circuit devices, instrumentation/control circuitry, scaling of measured and control variables, testing for system/parameter dermination and closing the loop to run time and frequency response tests, the various types of classic analog controllers, comparing control of a simulation vs. hardware, to first test digital controllers with simulations then with the hardware, to assess digital control's strengths and limitations, comparing digital control of the simulation vs. hardware, digital control vs. analog control, and to ultimately combine the hardware with simulation loops to investigate systems with complexities and non-linearities beyond the availability or practicality of real apparatus.

Each GP-6 simulates up to four state variable, linear or non-linear models. Two or more GP-6's can be slaved together for larger simulations.

CLASSROOM DEMONSTRATIONS

Light weight and portable, the GP-6 is easily carried into a classroom for lecture presentations or demonstrations of controller performance.

SPECIAL PROJECTS

The GP-6 patch panel operations connect directly to analog instrumentation and actuators. A GP-6 may function as a controller of the hardware, the simulator of hardware to be controlled, or combined with the hardware as the plant to be controlled.

WITH AN EMPHASIS ON TEACHING

The GP-6 has a long and proven history in the teaching of control theory and control system design. Consider the following undergraduate laboratory, a design study conducted on a work station consisting of: GP-6 analog computer; Microcomputer; Comdyna 7905 AD/DA board; Dalvin DVH-10 Power Amplifier; Dalvin DVH-1000 Servo-Motor Module.

Introduction to Control Systems... Program and scale linear circuits to simulate first, second, fourth order and non-linear simulations. Apply linear circuits as instrumentation amplifiers, current/voltage transducers, complex filters, error amplifiers, proportional- rate-reset controllers, circuitry to test system time and frequency response.

Plant Model and Parameter Determination... Develop a math model for the power amplifier/servo-motor load. Measure and calculate parameters such as armature resistance, motor inductance, moment of inertia, etc. Close the loop to test the time and frequency response, comparing theoretical and measured step/Bode plots to determine/validate the model, then calculate both the continuous and discrete transfer functions and roots, state variable equations in matrix/vector form.

Continuous Control... Design a continuous controller. Program the controller circuit and the servo-motor simulation on the analog computer. Test the design on the simulator, then replace the simulation and directly control the hardware. Adjust the controller gains for optimum performance. Explain any differences between calculatad and empirically determined parameter values. Evaluate the response curves with respect to the mathematical model. Would a more accurate model (third order vs. second order, for example) produce a better design? Recalculate the parameters with the refined model and test the results.

Discrete Control... Design a discrete controller to replace its its continuous counterpart. Conduct the design with the original model then the model refined by running the continuous controller. First test and debug the discrete controller on the analog simulator, then control the hardware. Compare the performance of the discrete vs. continuous control of the simulator, then the hardware. Alter the sampling rates and explain the effects of sampling time. Evaluate the effect of AD/DA converter discontinuities and resolution errors. Assess the limitations of discrete control and suggest how to improve performance.

AND FEATURES FOR ADVANCED WORK

Non-linear Operation... Hysteresis/backlash, coulomb friction, viscous damping, dead space, rigid stops, white noise, etc. may be introduced by analog circuit techniques.

Ease of Interface to Other Instrumentation and Control Devices... The GP-6 signal compatibility with all forms of analog instruments enables external apparatus to be easily added as work station accessories.

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