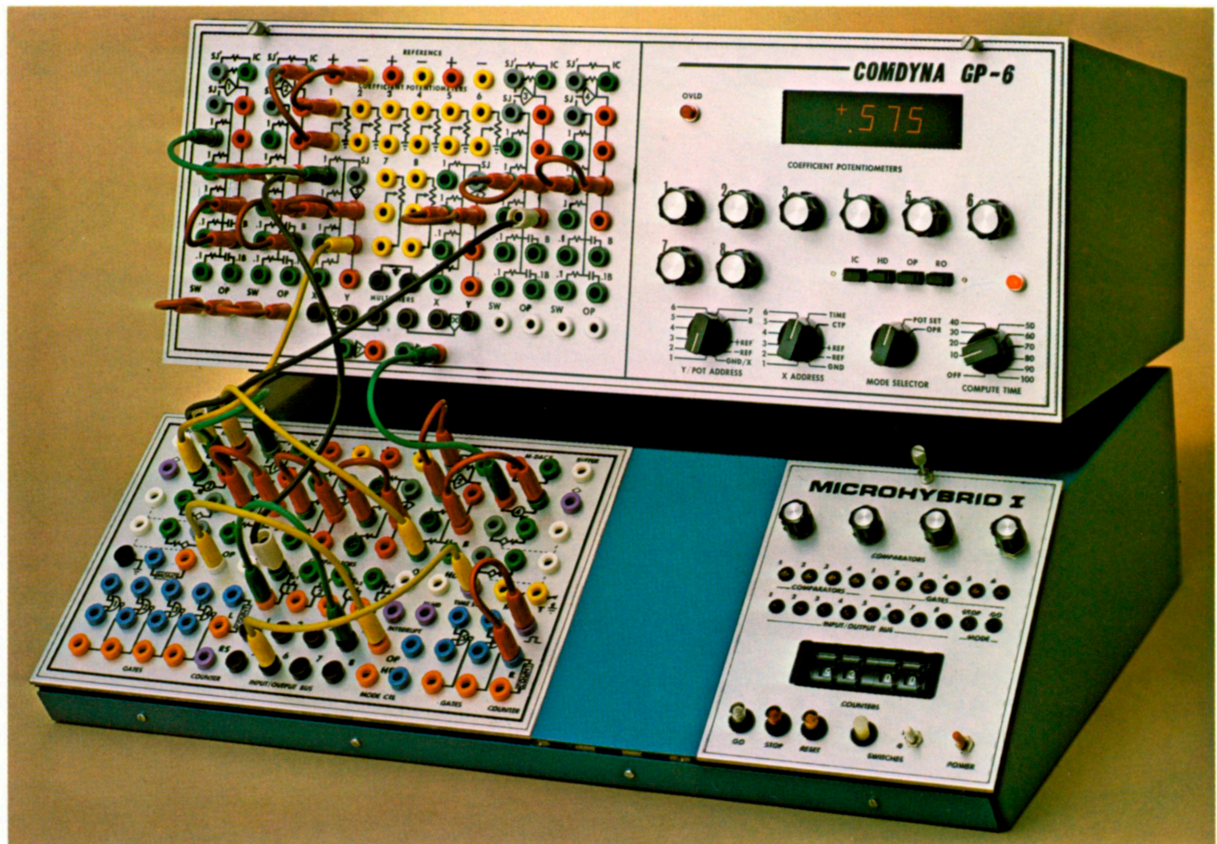


MICROHYBRID I

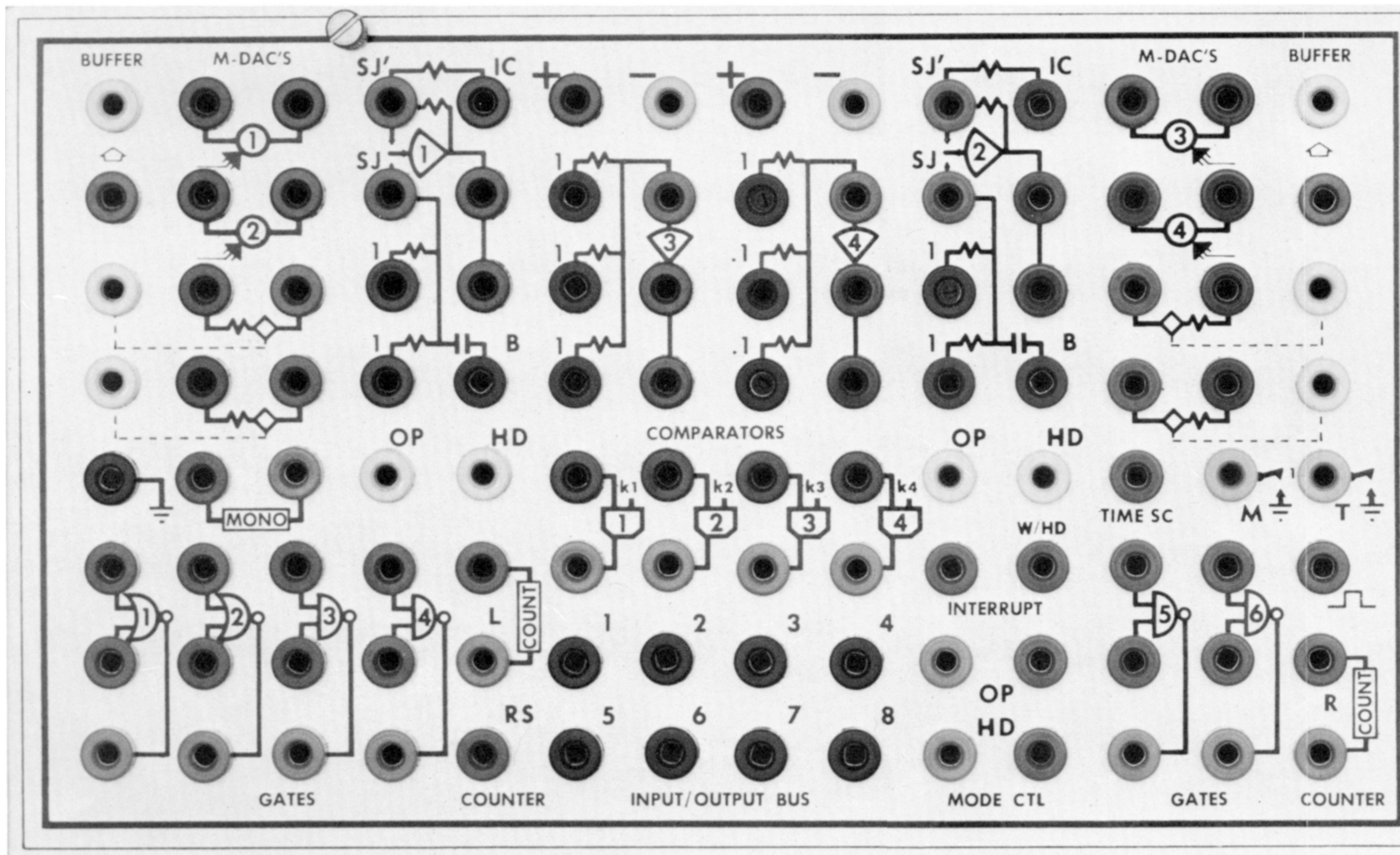
FOR APPLICATIONS IN . . .

EDUCATION
SIMULATION
DATA ACQUISITION
SIGNAL ANALYSIS
CONTROL



 **COMDYNA, Inc.**

COMPUTERS FOR DYNAMIC ANALYSIS



MICROHYBRID I IS A TOTAL ANALOG-DIGITAL INTERFACE SYSTEM

COMBINED ANALOG, INTERFACE AND DIGITAL METHODS PROVIDE A COMPLETE SET OF HYBRID COMPUTING OPERATIONS

DATA TRANSFER

Microhybrid I communicates with a digital computer through an input control word, a bidirectional data word and extra sense and status bits. Analog to digital transfer is initiated by the digital computer. Upon receiving a convert command, one of sixteen analog variables is selected, converted to digital data and placed on the data bus for use in a digital computer program. Digital to analog transfer occurs when the digital computer selects and sets one of four multiplying digital/analog converters. A patched analog variable is thereby attenuated by a digital data word.

LOGIC CONTROL

Digital/analog interface operations fall into two major categories ... data transfer and logic control. Logic control concerns off-on switching of analog variables and the control of integrator IC, HOLD and OP modes. All analog operations may be controlled with patch cord connections. Control is conducted either with patch panel logic or a digital computer program that is interfaced through the patch panel bidirectional I/O BUS. Control function inputs originate from interface components such as comparators, mode control indicators, the analog compute time clock, etc.

ASYNCHRONOUS LOGIC

Patch panel asynchronous logic components are furnished to handle events that occur independently of a synchronized clock. When criteria is based on the status of an analog variable or the analog computer's operational mode, it is often desirable to trigger the logic function by the event. Otherwise, the digital computer must monitor logic states, run a routine and return logic commands. Functions generated with patch panel gates, flip-flops, downcounters and delays can simplify digital computer software, increase overall operating speeds, reduce memory requirements and eliminate complex timing problems.

ANALOG FUNCTIONS

Some operations are better handled with analog techniques than a digital computer program. When properly applied, a few patched analog components will significantly reduce digital computing requirements. High speed arithmetic calculations, integrations, filtering, signal calibration/conditioning, analog control and continuous on-line data processing often are best performed by analog computing methods. Two patch panel summer/integrators with three mode electronic control, two highgain operational amplifiers and a precision reference give the Microhybrid I analog computing capabilities.

HYBRID FUNCTIONS

Hybrid components interface analog variables with control or status logic. Four comparators sense preset bias levels of analog variables and output high/low state indicators. Comparator outputs are used to trigger asynchronous logic and to start, interrupt or loop digital computer programs. Other hybrid components control analog operations with digital commands. Four digital/analog switches turn analog variables on or off with patched control inputs. Two amplifiers, each with a feedback switch, function as SPDT electronic switches, track/store units, peak pickers or logic controlled integrators.

HYBRID SIMULATION

Many system features are provided to aid hybrid computer simulation. There are two patch panel interrupts; one places the analog computer into the hold mode. A special clock synchronizes logic functions with the analog computer's time scale. Slow time or high speed operation is selected by the time scale relay driver. Patch panel terminations enable a digital program to either sense or control integrator modes. GO, STOP and RESET controls let a digital computer program be turned over to the Microhybrid operator for starting and stopping simulation runs.

DESCRIPTION OF PATCH PANEL FUNCTIONS

Gates... NAND and NOR gates operate as indicated on the patch panel by standard logic symbols. Outputs are open collector. Status of all gates are displayed by LED indicators.

Monostable ... Pulse duration is preset but can be internally altered.

Downcounters ... Input pulses are counted in a divide by "N" mode where "N" is preset by operator panel thumbwheel switches. Reset occurs at zero with both downcounters. One has an additional patch panel reset; the other resets during the analog computer's IC mode.

I/O BUS... Eight terminations provide bidirectional control logic from or to the digital computer. Outputs from the digital computer are set as a latched data word. All bits are terminated as open collectors. For input to the digital computer the states of patch panel terminations are read as a data word. States are also displayed by LED indicators.

Interrupt... A logic command controls one output bit designated for use as a digital computer interrupt.

Interrupt with Hold ... Same as above except that the analog computer is placed into the hold mode until released by the digital computer.

MDAC's ... Multiplying digital/analog converters attenuate analog signals by digital computer data words.

D/A Switches ... Each is a gain 1 input to a summer or integrator amplifier that is switched on or off by control logic.

Output Buffers... Interface between the Microhybrid and GP-6 patch panel control logic.

Mode Control Interface... Buffered inputs from the analog computer's IC, HD and OP modes and output override control of the analog computer's modes. Enables the Microhybrid to either sense the mode state when control is by the GP-6 or to perform the mode control function.

Analog Compute Time Clock... Provides clock pulses that are equivalent to .1 or 1 seconds as referred to the analog computer's slow or high speed time scales.

Time Scale Relay Driver... Provides a contact closure to energize the GP-6 time scale relay. Also controls the analog compute time clock's time scale.

Summer/Integrators ... Summer/Integrator amplifiers have individual three mode electronic control and may be used as integrators, summers, track/store amplifiers and single pole/double throw electronic switches. Each integrator has a time scale relay.

Summer/High Gain Operational Amplifiers... Single ended high gain operational amplifiers with summing resistor networks.

Signal Comparators... Each produces a logic 1 output when a patched analog variable exceeds a preset bias.. Comparator states are displayed by LED indicators.

Reference ... A precision positive and negative 10 volt reference.

Digital Momentary Switch ... Patch panel logic termination of the operator panel momentary switch.

Digital Toggle Switch ... Patch panel logic termination of the operator panel toggle switch.

DESCRIPTION OF OPERATOR PANEL FUNCTIONS

Comparator Bias Adjustments... Potentiometers with knob adjustments provide voltage bias levels for the patch panel comparators.

LED Indicators... Logic states of the COMPARATORS, GATES, I/O BUS and the STOP-GO operating modes are displayed.

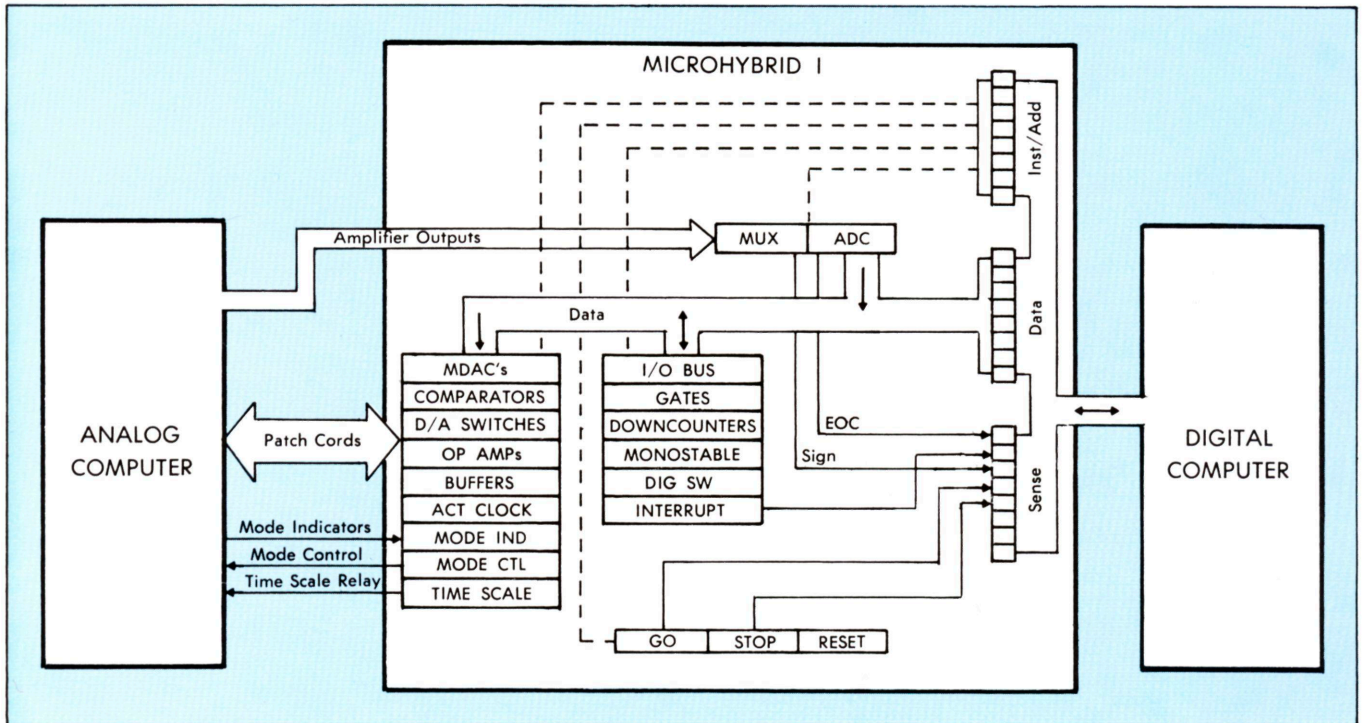
Counters... Two decade thumbwheel switches are provided for presetting the patch panel downcounters.

Mode Switches... Pushbutton switches activate the GO, STOP and RESET operational modes.

Digital Switches... A pushbutton momentary and a toggle switch provide manually controlled patch panel logic states.

Power... AC power switch.

MICROHYBRID I SYSTEM ORGANIZATION



The Microhybrid system is organized to meet a diversity of hybrid computing needs. Operators may choose between patch cord and central processor programming for the best possible computing approach.

Through the application of analog, interface and digital operational components, analog signals are combined with digital logic and data. A complete hybrid computing system is formed when the Microhybrid I, a GP-6 analog computer and a general purpose digital computer are joined into a single operating unit.

Analog signals and control logic are interfaced through patching connections and the Analog Signal/Control Connector. Trunk lines transport GP-6 amplifier outputs to a multiplexer for analog/digital data conversion. Trunks also interface integrator mode indicators, mode control and control of the time scale relay. Other interface connections are made by patching between the GP-6 and Microhybrid patch panels.

Communication with the digital computer is conducted through a data connector. The digital computer interface is performed through three parallel 8 bit bytes and is based on the use of the programmable, peripheral interface devices that are standard with most micro and mini computers. One byte is used as an instruction and address bus. One byte is a bidirectional data bus. The remaining byte is used for interrupt and sense lines to indicate the status of specific Microhybrid conditions.

Analog to Digital Conversion

- The MUX selects 1 of 16 analog outputs.
- ADC is started.
- The sign bit is set.
- When ADC is complete the EOC bit is set.
- The digital output is placed on the data bus.

Digital to Analog Conversion

- An input word is placed on the data bus.
- 1 of 4 MDAC's is addressed.
- The MDAC is set from the data bus.
- A patched analog variable is attenuated by the data word.

Patch Panel I/O BUS, Write

- Individual bits are transmitted as one data word.
- The 8 patch panel states are set from the data bus.

Patch Panel I/O Bus, Read

- The state of each bit is placed on a data bus line.
- All 8 bits are read as one data word.

Interrupt

- Patch panel logic latches the interrupt bit.
- The interrupt bit is cleared by a READY control word.

Interrupt w/Hold

- Same as above except that a hold mode override is latched until the interrupt bit is cleared.

Operator Panel Controls

- GO ... Push button sets the GO bit that can be used to start a digital computer routine. The GO panel indicator is turned on.
- STOP ... Push button sets the interrupt and clears the GO bits. READY control word clears the interrupt and turns on the STOP panel indicator.
- RESET ... Push button sets the interrupt and reset bits, clears the GO bit. READY control word clears the interrupt bit and turns on the STOP panel indicator.

* Note — A modular internal construction enables the above instruction set to be altered or expanded to meet special user requirements.



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