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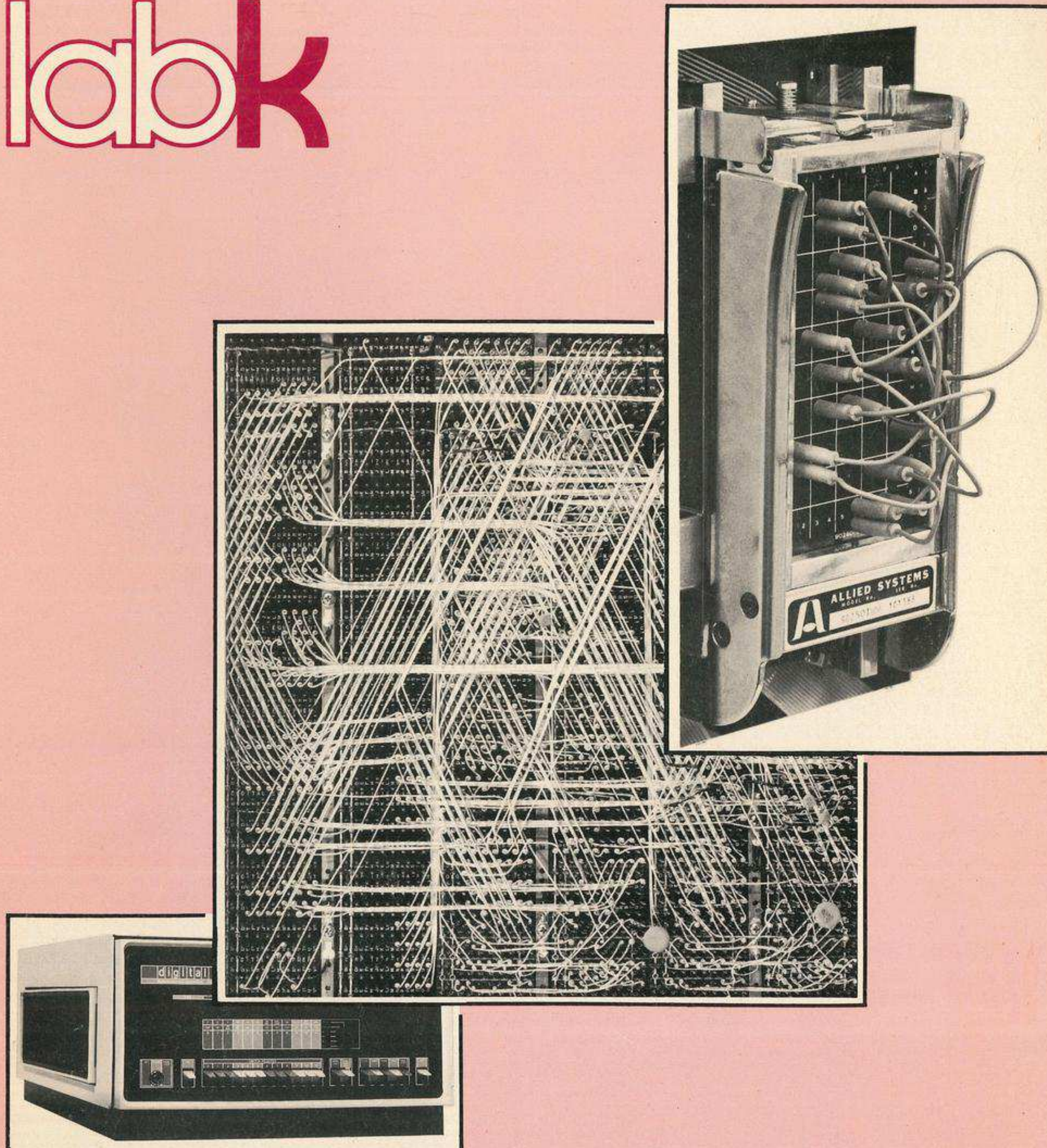

life sciences control system

labk

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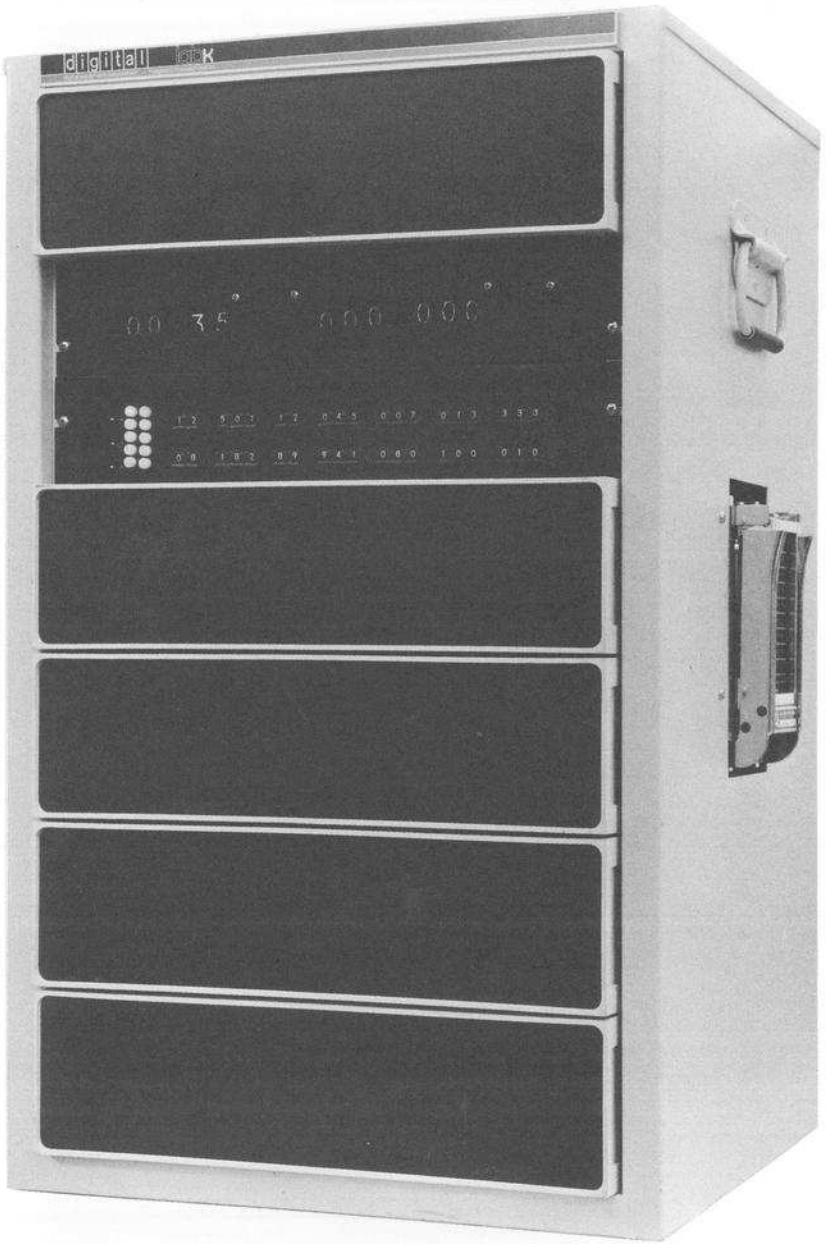
Biomedical Products Department
Digital Equipment Corporation



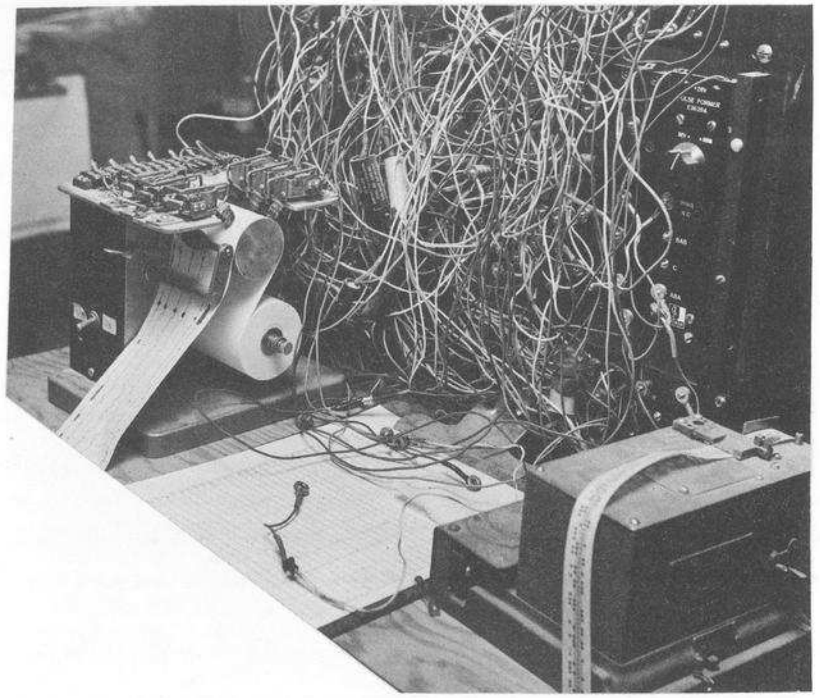
The Evolution of Psychology Instrumentation

Digital Equipment Corporation (DEC), a major contributor to solid-state technology for research with both computer and control system solutions, is concerned with helping the investigator maximize his investment for psychology instrumentation. Since the degree of sophistication has only recently caught up with the flexible research requirements of the psychologist, a brief review of the evolution of control systems for psychology will enable us to see the inherent benefits of solid-state technology.

During the early 1950's, relay modules, the first forms of psychology instrumentation, afforded the psychologist a means to gather his data. Working with very little money, most researchers were forced to obtain their relays from a local supplier and to build control systems by themselves. Configuring a relay-based control system through trial and error, the researcher often built his own power supply and wired his components into a makeshift control panel. Some investigators developed ac voltage systems, others worked with dc voltages. Standardization had not yet been achieved! Basic concepts which later forms of equipment employed, such as suppression of contacts and the effects of closure speeds on the logic, had not yet been developed. However primitive these early systems were, they did provide a starting point.

Soon, refinements were made in the use of relays. The "snap lead" was standardized and modules were interconnected by studs. The suppliers of the early relays were induced to design a degree of modular standardization into their equipment. Thus, 7-in. modules on power bars, designed for 24-28 Vac power supplies, became available. The psychologist guided the manufacturers in building control systems hardware. The "building block" concept, centering around easy-to-understand relay circuitry, had begun to evolve.

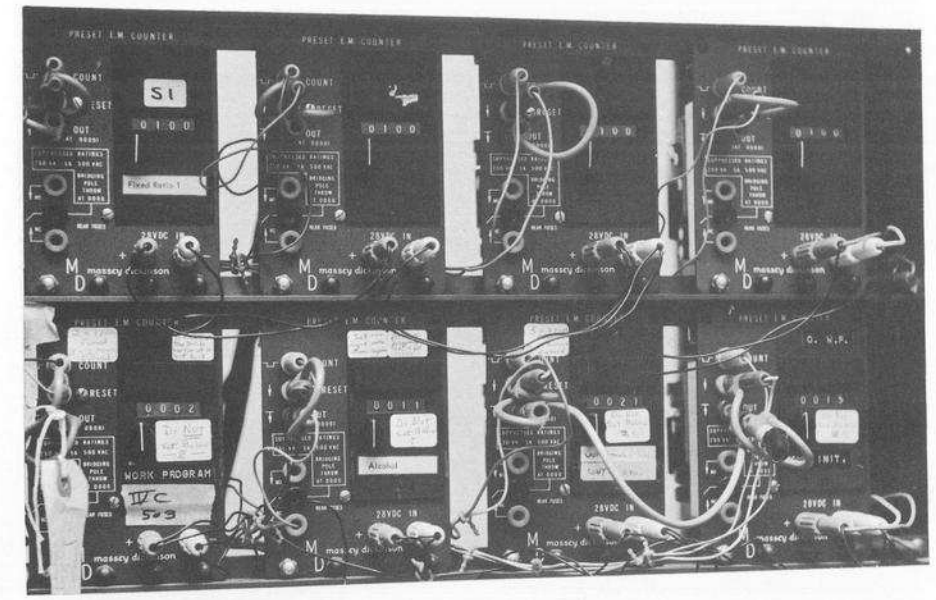
It is interesting to note that the timing requirements of relays were well suited to the instruments of the day: Skinner boxes, solenoids, shutters, pellet dispensers, electromechanical counters, and even cumulative recorders.



However, when an investigator attempted to do anything more complicated, he found that the limited speed of his relay equipment did not contribute to his ability to reduce and analyze the data he had acquired.

Around 1960, psychologists heard the early tremors of the new solid-state technology. The early solid-state logic, they soon found, was incapable of interacting with relays. The lack of suppression in relays adversely affected transistors in solid-state logic, erroneously triggering the logic. However, the problem was gradually resolved by changing the threshold (electronic filtering networks) to exclude this noise problem.

While waiting for solid-state control logic suitable to the psychology environment and flexible control systems he could afford, the researcher continued to design, with relay modules, a solution capable of interfacing to the slower input/output devices found in the laboratory. Until DEC began to manufacture K-Series, solid-state logic modules in 1965 to replace relays in industrial control applications, a life science investigator still could not effectively upgrade his relay logic system using DEC hardware unless he computerized.

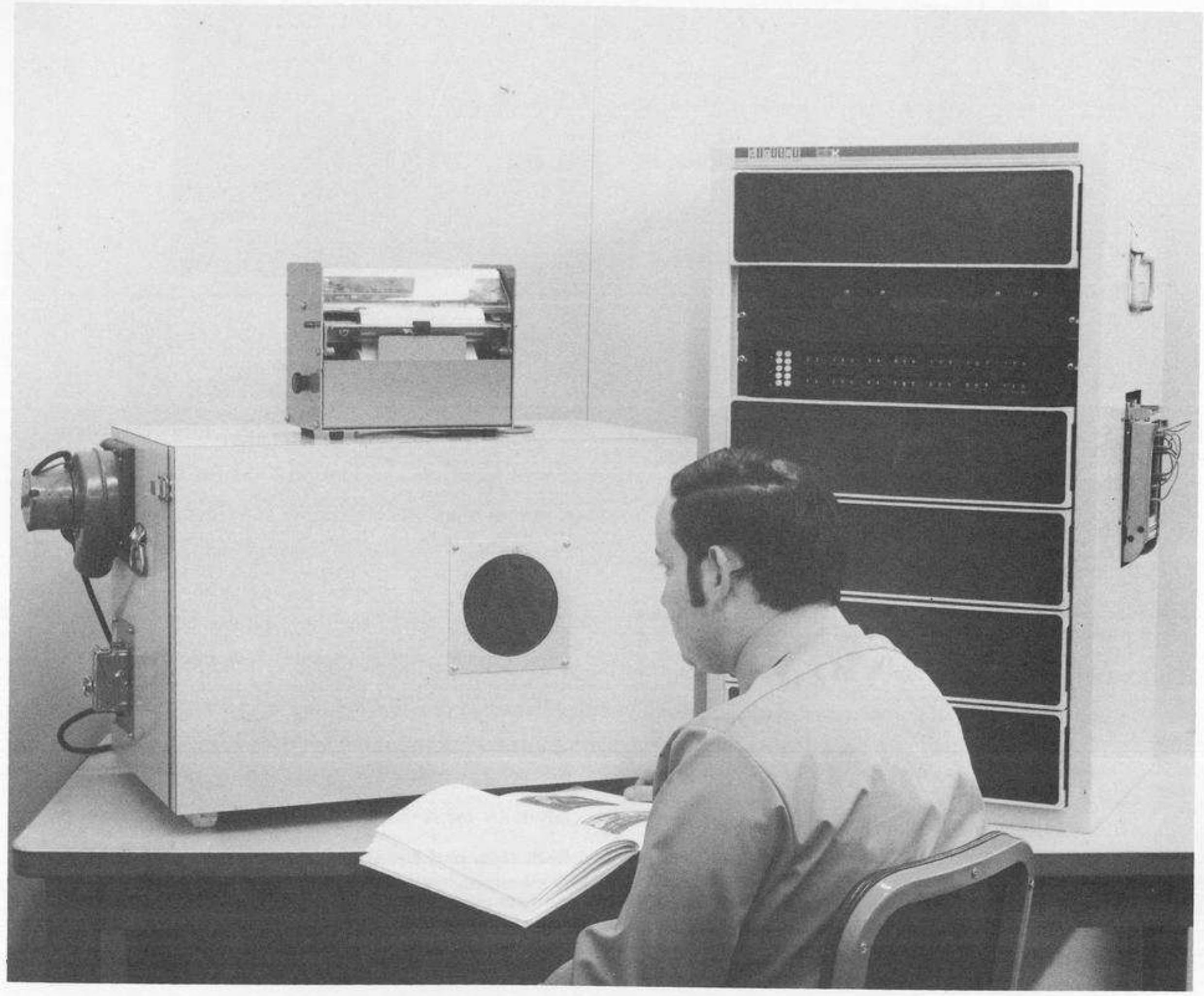


DEC saw a need for low-speed (100 kc) solid-state modules that provided high noise immunity, hardware programming versatility, and a wide range of manual control functions. Adapting K-Series control modules, which eliminated the electrical noise problem so prevalent in interfacing to relays, the "400" line of manual control modules was introduced.

Making use of Modular Level Design (MLD), a predesigned integration of smaller, quieter components enabling the researcher to configure his own control system with the lowest possible interfacing costs, a versatile 200-position programming plugboard was developed to provide the needed hardware programming flexibility while maximizing the efficiency of solid-state logic.

It is from the Modular Level Design concept that the LAB-K (K for K-Series) logic controller, a hardware system designed specifically to precisely control both time and events in experiments, evolved to offer researchers a new level of flexible research alternatives.

Seen as an advanced hardware program controller and as a tool for research by itself, a carefully planned interim stage in the process of upgrading to a computer and as an integral part of computer-based research, the LAB-K offers the researcher a number of flexible alternatives to meet his changing investigative goals.



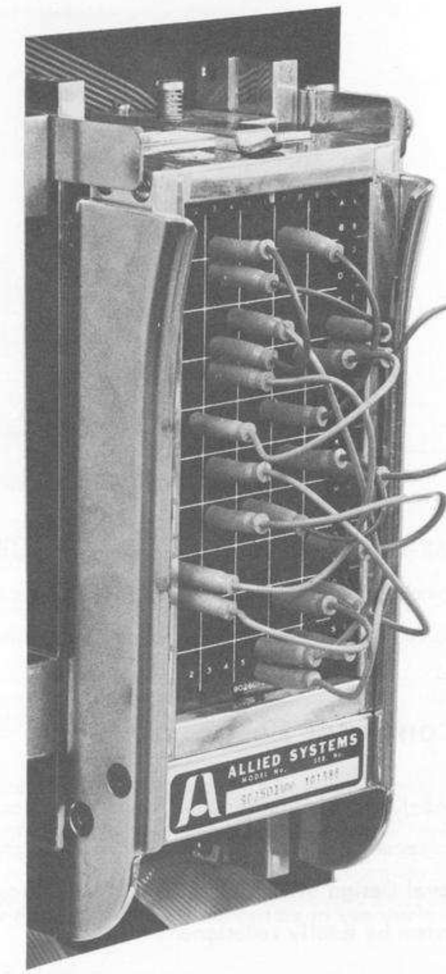
Features of the LAB-K Control System

Flexible Plugboard Programming

A 200-position programming plugboard provides efficient logic terminal points which enable the researcher to fully utilize LAB-K's solid-state logic.

Individual components of an experiment are quickly "programmed" by connecting plugwires on the plugboard, thus enabling the appropriate logic in LAB-K. Experimental components are chained together on the plugboard and stepped, component by component, through the entire schedule using the sequencer as an executive for the LAB-K logic. Only inputs, outputs, and reset operations must be controlled through the programming plugboard.

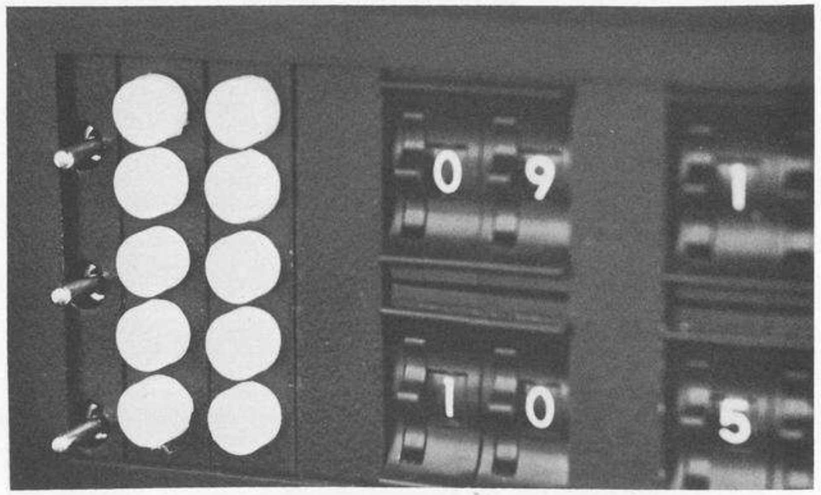
Thus, the plugboard is nearly five times as efficient as larger (440-, 660-position) hard-wired patchboards, each of which must be totally rewired each time a new experiment is to be run. For even greater input/output capability, a second 200-position programming plugboard, available as an option, can be added to the system.



Complete Experimental Control

LAB-K consists of both the hardware and the appropriate logic necessary to control the functional components (FI, FR, VI, VR, etc.) of experiments.

For subject-paced control, LAB-K steps schedule components, counts intervals, and provides the necessary signals to output devices (lamps, reinforcement devices, electromechanical counters, etc.). In experimenter-paced studies, LAB-K implements sequentially preselected stimuli needed to acquire test data within a timed interval.

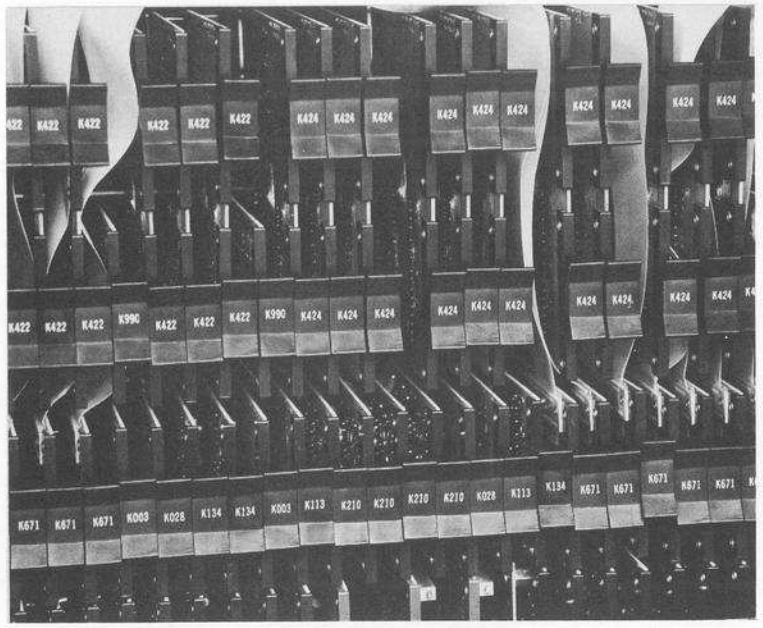


LAB-K controls both time and events for either subject or experimenter-paced research. Up to ten components of an experiment, once connected by plugwires on the plugboard, are executed sequentially without the assistance of the researcher.

Computer Level Logic

LAB-K already contains sufficient logic necessary to meet the experimental needs of most researchers. However, because LAB-K makes use of a predesigned integration of solid-state logic called Module Level Design (MLD), additions and modifications to the existing control logic do not require that the system be totally redesigned.

To help the researcher evolve his instrumentation to meet his expanding needs, DEC manufactures a wide range of logic modules. Most are available at the lowest cost offered by any manufacturer providing control systems for psychology. In fact, DEC is recognized worldwide as the largest manufacturing supplier of solid-state logic with more than a decade of experience in building compact (high density) logic systems using computerized "wire wrap" technology.



DEC manufactures the following:

a. K-Series, noise immune, solid-state modules for control applications and the "400" line of control modules specifically for the research psychologist's needs.

b. M-Series I/O (Input/Output) modules, available at the lowest cost anywhere for both control and computer applications.

c. A-Series A/D (Analog-to-Digital) modules. DEC is the only manufacturer of psychology control systems that makes A/D modules.

d. Power supplies with the best price/performance ratio available to the psychologist (7 amp/$200).

Computer Compatible Research

LAB-K was designed as an independent research station for computerized control of experiments and as a carefully planned interim logic solution in the process of acquiring a computer. Thus, data acquisition is computer compatible. In addition to control logic systems, DEC is a leading supplier of computers for real-time scientific applications with more than 9,000 of its computers in use worldwide.

The Computer Interface Block (X602) provides a means of connecting through cables to a standard computer interface for computerizing control of LAB-K. It enables the researcher to use LAB-K as an independent research station - but with a view towards computer control in the future.

Expandable

As research goals change, so do instrumentation needs. Because it is modular and can be updated at any time by selecting the functional Application kits needed by the researcher, LAB-K can be quickly expanded to meet a changing research need.

LAB-K Modular Application Kits include:

Application	Kit
Input Logic	A
0-9 Sequencer	B
Down Counter	C
1-, 10-, and 60-second Time Bases	D
Up Counter	E
Output Logic	F
Power Supply	G
I/O Connection Hardware	H
Mounting Panel	J
Cabinet and Hardware	K

Application Kits A-K represent a typical meaningful research configuration. Below are suggested "add on" logic functions:

Application	Kit
.001-, .01-, and .1 second Time Bases	L
Variable Interval and Variable Ratio Programmer	M
Session Timer	N
Second VI and VR Programmer	P
IRT Distributor	Q

Useful Accessory Options for LAB-K

Application	Kit
Two sets of 3-digit BCD thumbwheel switches for Down Counter	C1
Nixie Digital Readout for Down Counter	C2
Decimal Decoder and Nixie Display for Up Counter	E2
Nixie Tube Readout for 9 hour 57 minute Session Timer	N1
99 Hour and 59 Minute Counter (One BCD Counter Add On)	N2
One Decoder and Nixie Display Add On-4th Digit	N3

Automatic Wirewrap Frame

The Automatic Wirewrap Frame is wired to include all of the kits listed above, excluding the modules in each kit. The exceptions are the three basic hardware kits, G, H, and K.

Logic Training Courses and Aids

DEC offers a wide range of educational tests and training courses to assist a researcher in upgrading his working knowledge of solid-state control logic and control logic systems and their maintenance. Your local DEC sales engineer conducts training courses in K-Series logic and it's control applications to assist you in upgrading your application to solid-state logic. A new K-Series Correspondence Course is also available.

Some LAB-K-related texts available to users include:

a. Logic Lab Workbook
b. K-Series Logic Lab Workbook
c. Control Handbook
d. LAB-K Handbook
e. Logic Handbook

Many other texts and training courses are also available to assist the researcher in realizing his ultimate goal of upgrading to a DEC computer in the foreseeable future.

Corporate Commitment

Only DEC has the size, strength and technical background to help a researcher meet both current and future instrumentation needs. Each investigator can draw on this corporate strength and expertise in many ways:

More than 80 sales offices - one located near you!

More than 75 specialists servicing Psychology - five times more than all competitive support combined!!

Greatest diversity of high-density solid-state logic!

Only manufacturer of psychology instrumentation with extensive computer experience.
Only DEC is a leading manufacturer of computers for real-time scientific applications!

Lowest-cost solid-state logic for psychology applications!

Manual control features include central control over logic!

Only DEC offers quantity discounts to all its module customers.

All solid-state modules are guaranteed under a 10 year warranty!

LAB-K solid-state logic is computer compatible and computer interfacable!

Educational training in solid-state logic theory and application is available!

Free membership in DECUS (Digital Equipment Computer Users Society) is available to all DEC equipment users. DECUS is the world's second largest computer users society!!

Free module systems design services available!!

Complete computer interfacing and Computer Special Systems services available.

The LAB-K Logic

All LAB-K logic, even for the most complex applications, is built from four basic building blocks - AND gates, OR gates and their logical inversions, NAND gates and NOR gates. These building blocks, called operators, are the elements used to build both simple and complex systems. For this discussion, it is sufficient to recognize that Boole's postulates are powerful tools in designing modules to control the three functional logic groupings needed for life science applications:

Input Logic

Input logic facilitates the processing of signals emanating from outside a system. This logic usually consists of switches, contact closures, Schmitt triggers (threshold discriminators), etc. Basically, the input logic conditions the signals so that the electronic components of a system will respond to the signals. (Input logic is discussed in detail under Application A.)

Output Logic

Output logic is used to process a response signal of a system. These response signals are input to solid-state drivers which are, in turn, connected to external equipment, e.g., test cubicles, lights, data recorders, display devices, etc. (Output logic is fully explored under Application F.)

Application Logic

Application logic interprets external events, in the form of signals, and responds electronically depending on the nature of the event. The discriminatory sensitivity and response contingencies of the logic must be programmed. When this is done on the LAB-K, programming is accomplished on the patchboard - affording the user additional flexibility in his use of the application logic. The application logic is used to "remember" and to count time and events, using flip-flops and counters for these tasks. (Application logic is covered later in this presentation.)

With this brief logic overview in mind, let us look at the basic logic functions performed by the LAB-K control logic system. From there we shall evaluate this logic in the context of precisely controlling both time and events in experimentation.

Basic Logic Functions

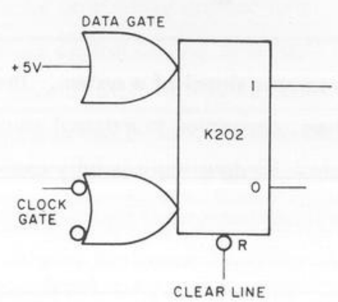
The logic operators (AND, OR, NAND, and NOR gates) provide the logic gates for LAB-K application logic. However, logic gates require a continuous input level to operate. If the input level is removed, the gate does not "remember" its previous input condition.

LAB-K, in addition to logic gates, utilizes devices which remember their condition after the input has been removed. This device, which has a memory, is called a flip-flop. A flip-flop is a logic element which always exists in one of two stable states - the high (+5V) condition or the low (0V) condition. This type of component is called a bistable device (a seesaw is a good physical analogy). If the flip-flop receives an instruction to go high at the "1" output, it does so and stays there until instructed to return to the low condition. The reverse is also true.

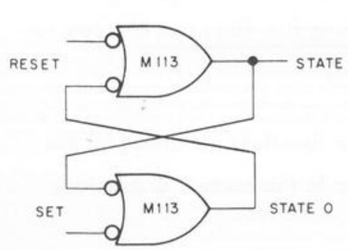
Flip-flops generally provide both "1" and "0" state outputs that are generated on separate lines. They do not always mean that the "1" line is always high and the "0" line is always low.

In the LAB-K, flip-flops are used for control, or they are combined and used as a BCD counter, up-down counter or divider. The modules in the LAB-K used for this function are the K202, or K124, or K113 and K220, K221, or K211.

A signal from high to low at the clock gate input provides a high at the "1" output. When the clear line goes low (ground), the "1" output is put in the low state. It then stays in the low state as long as the clear line is low, regardless of the input at the data and clock gates.



The flip-flop illustrated below consists of two M113 inverting gates. A truth table is also provided for this flip-flop.



Truth Table

Set	Reset	State 1 Output	State 0 Output
0	0	1	1
0	1	1	0
1	0	0	1
1*	1*	No Change	No Change

*Stays in its previous state.

The gates and the flip-flop discussed to this point are the basic components required to implement logic function on the LAB-K. Circuits, designed to perform more complex functions, utilize these basic components. However, regardless of how complex the configuration of any circuit might be, the operating principle of individual gates always remains the same.

Counters

Counters are used to establish the time or event periods, or the duration criteria of a schedule component. In the LAB-K there are three types of BCD counters. Let us look at each of these in depth.

A 4-bit binary or BCD counter such as the K210, consists of 4 bits (flip-flops), each flip-flop representing one bit. The 8, 4, 2, 1 numbering system (when used as a binary counter) can register and hold 15 pulses with the 16th pulse resulting in one high-to-low pulse out from the last state. Consequently, all flip-flops return to the 0 state. This counter counts up when the count gate steps from high to low. Every 16 pulses input to the first stage (flip-flop) produce 8 outputs from the first stage: four pulses from the second stage, two pulses from the third stage and one pulse from the last stage. Thus, each stage divides its output by two, a value assigned to each bit.

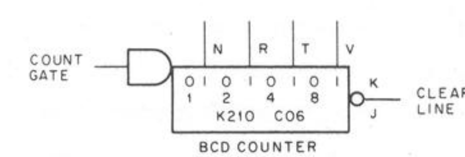
For a four stage counter, the values of each successive bit is obtained by multiplying each digit by its binary position coefficient and then adding all the products obtained: For example, if the input to a 4-bit counter is 1011, the value equals $11_{(2)}$ as shown below:

2_3 2_2 2_1 2_0

1 0 1 1

$$1 \times 2^0 = 1$$
$$1 \times 2^1 = 2$$
$$0 \times 2^2 = 0$$
$$1 \times 2^3 = \underline{8}$$
$$11$$

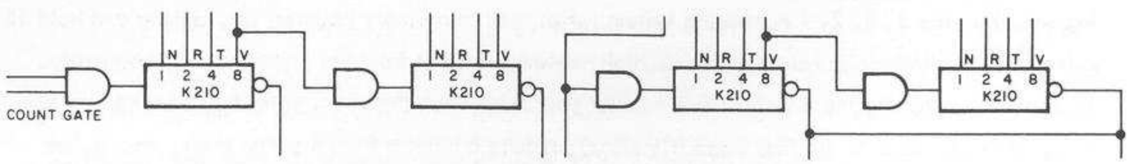
In the diagram below, 0 indicates an off condition while 1 indicates an on (or count) condition.



The counter stores a total of 15 pulses and acts as a binary counter when pin D (on the module) is grounded. The 16th pulse input, acting in a binary mode, results in a transfer pulse being output from the counter; thus, all bits reset to the 0 (lower) stage.

In the LAB-K, the K210 counters are Binary Coded Decimal (BCD) Counters with Pin D not grounded; the last stage output of each K210 puts a high-to-low pulse during the 10th input pulse to the counter.

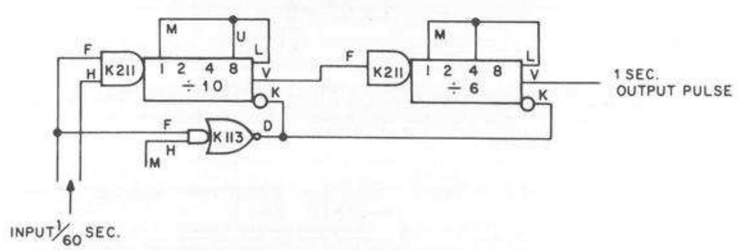
Additional 4-bit stages can be added to the first K210 in either the binary or BCD mode. Three stages (3-bit BCD Counter) function in the same manner as the flip-flops within a single K210. Each successive stage divides the signal present at the output of the previous stage by 10.



The Programmable Divider (K211) is a counter designed to function as a rate divider of a real-time clock. It operates in the same manner as the K210, but is prewired to a specific count. The specific count (10 or 6) divides the pulses generated from the clock frequency or a line sync source.

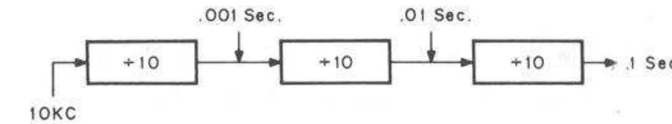
The output from the final stage provides a train of pulses that act as a pulse stream generator. The line frequency from a K731 module produces pulses at the input of the K211 countgate.

In the diagram below, a one pulse per second output is seen. Stage 1 (÷10) of the time generator divides the 60 pulses of the Stage 1 countgate by 10. The output of Stage 1 (Pin V) is six pulses per second. These pulses are divided again by Stage 2 (÷6) of the time generator. This results in a one pulse per second rate.



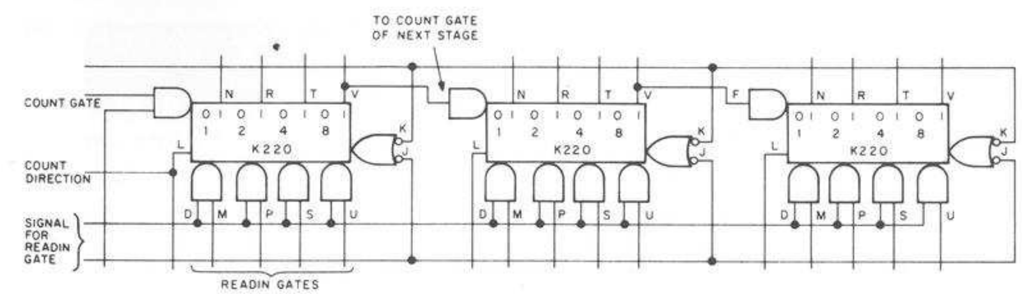
Application L, a LAB-K option, consists of three time generators. These provide time bases of: 0.1 sec., 0.01 sec., and 0.001 sec.

To obtain 1000 pulses per second (1 ms - 0.001 sec), the 10 kc line frequency is divided by 10 (÷10) and one pulse per millisecond is produced at the output line (v) of the K211 Programmable Divider. To modify this to a 0.01-sec time base, one adds a second stage to Stage 1 and wires it to divide by 10, producing a 0.01-sec time base. A three-stage time generator (see diagram below) in which all three stages divided by 10, produces a 0.1-sec time base.



The Up/Down Binary or BCD Counter (K220) is utilized as a down counter in most LAB-K applications and is used as a BCD counter only. Because the K220 module can have a number strobed into the counter, it can be used with encoding thumbwheel switches (in counting down to zero from the number in the switches) to determine the length of time or the number of events that remain until an output pulse is initiated.

By using the control line implemented through the programming patchboard, the researcher can count up or down with the K220; an important feature when performing titrations or threshold studies.



The count direction is determined by the voltage level at Pin L (high = Up; low = Down).

The read-in gates contain information (in BCD form) that has been set in the thumbwheel switches. For example, if six were to be set in the counter, gates S and P each have one leg high. At the appropriate time, the read-in signal, normally sitting low, goes high and the number is set into the counter.

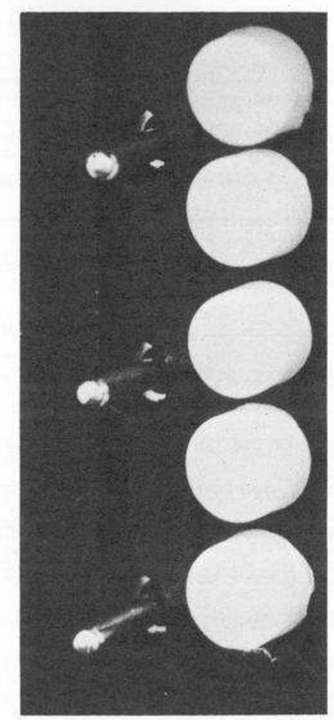
LAB-K Application Kits

Application A — Input Logic

LAB-K's input logic, controlled through three toggle switches on the front panel, contains dry contact switch closures for processing external signals coming into the LAB-K. As with all other Application Kits to be discussed, the input logic is both highly flexible and expandable.

Toggle Switches

When running an experiment, three toggle switches - MASTER RESET, SYSTEM ON, and EXTINCTION - are used in controlling experiments. These three switches manually turn the control logic "off" and "on" as well as automatically disabling subject reinforcement when desired.



At the beginning of every experiment, the MASTER RESET is momentarily depressed - resetting all of the counters and flip-flops in LAB-K back to the starting point.

The second toggle switch, SYSTEM ON, allows the event (input) signals to enter LAB-K. (The event signals are ANDed with SYSTEM ON.) This switch also enables the time generators (Kits D and/or L).

The EXTINCTION switch is used to manually disable subject reinforcement. When locked in the UP position, it prevents the subject from being reinforced.

Processing Input Signals

Of the eight external signal sources in the LAB-K, two are hard-wired into the system when the researcher purchases the system as a prewired frame, X602. These two external signals, referred to as the left and right events, are connected to two dry contact switches located in the Input Logic. Each dry contact switch is connected to a Schmitt trigger (threshold discriminator), which triggers a one-shot if the event occurs. Since the output signal of a one-shot is only on for a predetermined period, the subject's holding time has no effect on the duration of the event signal once it has been generated. The response lever must be released before another event signal can be generated - thus eliminating the "holding response" problem.

The six other contact switches in the Input Logic have not been hard-wired into the system. As required, they can be directly connected to the leg of the logic gate. The logic gates and one-shots for these six switches are not provided for on the X602, but are available through the new expansion I/O Kit LAB-K-200. If used with a one-shot as described above, then the signal must be connected by a Schmitt trigger.

One-shots can be bypassed if two wires are removed on the outputs of the flip-flops and a wire is connected between the dry contact filters and the gating structure. Further, it is possible to add another gate card to the system and to provide both the one-shot outputs and the voltage level outputs for the dry contact closures.

Application B — 0-9 Sequencer

The 0-9 Sequencer is a ten-position stepper which acts as the "Executive Director" of an experiment by sequentially enabling most of the functional components of the logic at intervals that are contingent on time and/or events. It controls simple one component or complex multiple component schedules. The sequencer is also used to synchronize the timing generators at the completion of each sequencer step.

Application B consists of logic gates, a BCD counter, a decoder, and a thumbwheel switch.

The sequencer is stepped by a signal from either the Down Counter or the Up Counter, both of which count time or events. The researcher determines which of these two components is going to step the sequencer at the termination of the preselected time or event through the patchboard. Two groups of logic gates are used to control the stepping of the sequencer when the Down Counter reaches zero, or when a count is decoded in the Up Counter. Both groups of logic gates are enabled by a sequencer step.

One logic gate (4 legs) is used to step the sequencer when the Down Counter reaches zero from a predetermined number.

The other logic gate (5 legs) steps the sequencer when a count is decoded in the Up Counter. The legs of this gate are called Up Counter control legs (1-5) and are connected to a step on the sequencer via the patchboard.

The sequencer thumbwheel switch is also used whenever it is necessary to repeat a schedule. If the schedule in question consists of five components (0, 1, 2, 3, 4), setting four on the sequencer thumbwheel switch causes the BCD Counter to reset to zero at the completion of the fifth component. As a result, all five components are implemented again.

Application C — The Down Counter

The Down Counter is used to count any timed interval or event required of a fixed value. Therefore, the Down Counter in LAB-K is used to control subject-paced components in operand conditioning such as a fixed interval or fixed ratio, threshold or titration studies, Sidman avoidance or an avoidance escape and experimenter-paced trials such as discrete trial research.

The Down Counter is also used to control the duration of variable schedules, i.e., a pseudo-random interval of time or events. During this type of experiment, the Down Counter times the duration of a component through the programming plugboard, stepping the sequencer at the end of component.

Up to four groups of BCD thumbwheel switches, each containing three digits, are connected to the encoder of the Down Counter. Each step on the sequencer then controls and determines through the patchboard which of the numbers from one of four encoder BCD switch groups will go into the Down Counter. Time and event inputs come into the Down Counter and count the number encoded back down to zero.

Logically, three types of contingencies of time and event can be met on the Down Counter - all of which can be controlled through the programming plugboard.

When the Down Counter reaches zero, events can be controlled - outside events -- such as: printout counters, electromechanical counters, shutters, reinforcement devices, or whatever needs to be controlled at the end of a given time period. When zero is reached, the Down Counter is reset to repeat its countdown. Thus, using the programming plugboard, it is possible to determine that, on any step of the sequencer, when the Down Counter is to be reset.

The three sets of programmable controls to reset the Down Counter are available on the plugboard:

a. Reset Down Counter on event (response) - Ex. DRL, avoidance in operant research.
b. Reset Down Counter on zero detection. EX. F.R., or time duration ended.
c. Reset Down Counter when detect zero followed by event. Ex. FI, DRL or Tone followed by heartbeat.

Application D and L — Timing Kits

Timing kits provide incremented time bases (pulse streams) used where time durations are needed in experiments. The pulses generated by two logic configurations of modules are used to generate time intervals from 1 millisecond to 16.5 hours when used with the various BCD Counters within LAB-K.

Application D

Application D provides three time bases: 1 sec, 10 sec, and 60 sec. It consists of 60 kc line sync generator and three sets of programmable dividers. The time bases are hard-wired to the various BCD Counters in the unit. The input gates are controlled and programmable from the plugboard. The control points originate from the sequencer outputs.

Application L

An option, Application L provides three time bases: 0.1 sec, .01 sec, and .001 sec. It consists of a 10 kc crystal clock and three sets of programmable dividers. These time generators are controlled and programmable in the same manner as in Application D.

Application E — The Up Counter

The Up Counter is simply a three digit BCD Counter that has two sets of three digit BCD thumbwheel switches connected to decode its output. It is used to count the durations of the fixed time or event components run on the Down Counter and will, therefore, decode a number set in the thumbwheel switches. The three digit BCD Counters that are a part of the Up Counter logic are also used as the upper limit section of the variable interval, variable ratio programmer.

The Up Counter can decode numbers set in its groups of thumbwheel switches and be programmed to step the Sequencer to end a phase component or section of an experiment. The decoded output from the Up Counter is available on the programming plugboard so that the output drivers can be connected. This enables the Up Counter to control devices from the outside world - electromechanical counters, printout counters, etc. On the input to the counter, there are six possible inputs hard-wired to one side of the AND gate. These are the six time bases coming into the Up Counter from the two timing

kits. Again the user can preprogram through the plugboard which increment of time will enter the Up Counter determined by a step of the sequencer which in turn represents a phase of an experiment.

Application M — VI/VR Programmer

The Variable Interval/Variable Ratio Programmer is used to run variable interval or variable ratio in a pseudo random mode; for example, experiments when the researcher wants to present a sequence of intervals based on a median within controllable limits.

The VI/VR Programmer enables the researcher determine:

a. The lower limit of a variable interval or variable ratio.
b. The percentile setting for a median variable interval or the variable ratio.
c. The upper limit of a variable ratio or variable interval.

There are only three time bases available for VI programs; 0.1 sec, 1 sec, and 10 sec. If a time base having a frequency higher than a tenth of a second is used, the VI/VR Programmer is not accurate. Either the left or right event input signals will generate for variable ratio programs in the same manner as above.

The interval and event enabling gates are connected to a two-stage BCD Counter serving as a lower limit counter. The output of this counter is decoded by two thumbwheel switches. The decoded output puts a count in the upper limit counter and triggers a 50 nanosecond one-shot, which is connected to a logic coincidence gate and resets the lower limit counter. The other leg of the logic coincidence gate is enabled by a flip-flop, which when set, provides an aperture window for the gate. The 6 kc clock continuously steps another two stage BCD Counter. The output of this counter is decoded by two thumbwheel switches. It is this output that associates the settings of the flip-flop which in turn sets up the aperture window. When a two-digit BCD Counter running at 6 kHz rate reaches a count of one hundred, the flip-flop controlling the aperture resets.

If a coincidence occurs as a result of the 50 nanosecond pulse, and the aperture window coinciding, then the output of the logic gate causes the setting of a memory flip-flop. When the memory flip-flop is set, the variable ratio condition has been met and reinforcement of the subject is immediate through plugboard control. In the case of the variable interval, the next response is programmably-gated with the memory that represents the end of a variable interval. This gated output can then be programmed to provide reinforcement.

Application N — Session Timer

The Session Timer in LAB-K functions as a real-time clock that counts in minutes the operating time of the experiment. With a slight modification, it can also be used to count the number of some event criteria to be programmed to terminate the experiment.

The user is provided with a real-time clock which counts up to 9 hour and 59 minutes, or he can expand the clock to 99 hour and 59 minutes (optional). Two further options are the Nixie tube (decimal) readouts for both the 9 hour and 59 minute or the 99 hour and 59 minute real-time clock.

Application P — 2nd VI/VR Programmer

A second Variable Interval/Variable Ratio Programmer is available to the researcher for situations where two variable intervals must be run simultaneously. It operates in the same manner as Application M and does not use any logic modules of another set as does Application M.

Application Q — IRT Distributor

An Inner Response Time Distributor distributes events in time. These events are dispersed through the ten classes or bins, each terminating at the LAB-K's output drivers.

Events coming into the IRT Distributor are channeled into one of the ten bins, controlled and dependent upon what step of a 10 position ring counter is in an ON position. When the event occurs, the ring counter is automatically reset after the event is recorded in the appropriate bin.

The bins or classes are determined by the time period preselected on an Up Counter, Down Counter, or by a one-shot. This is the time period that causes the ring counter to step. There is a BCD thumbwheel switch which sets the number of bins from 2-10. The 10th bin of the distributor can be used to disable the ring counter until the event occurs.

The amount of time per event can be recorded by stepping the ring counter by events and running a time frequence through the normal event input. All controls for the IRT Distributor are coordinated through the programming plugboard.

Distributions can be refined on subsequent experimental runs by changing the time base causing redistribution of events over time in the ten classes.

LAB-K Offers
Complete Experimental Control

When viewed as a total control system, LAB-K's Application Kits enable a researcher to run a wide range of experiments without the usual confrontation between the investigator and his equipment's limited capabilities.

Below, we have run two LAB-K based experiments, each chosen to demonstrate a distinct series of LAB-K features. By following each experiment, the ease and flexibility of the system as programmed through the 200-position plugboard, the sequencer as the executive of LAB-K and even the advanced capabilities of solid-state logic become immediately apparent.

Multiple Schedules

On LAB-K, Multiple Schedules are easily run on the 200-position programming plugboard. None of the elaborate, complex, and time-consuming effort required with competitive systems, where wiring must be manually brought out to the front panel, is required.

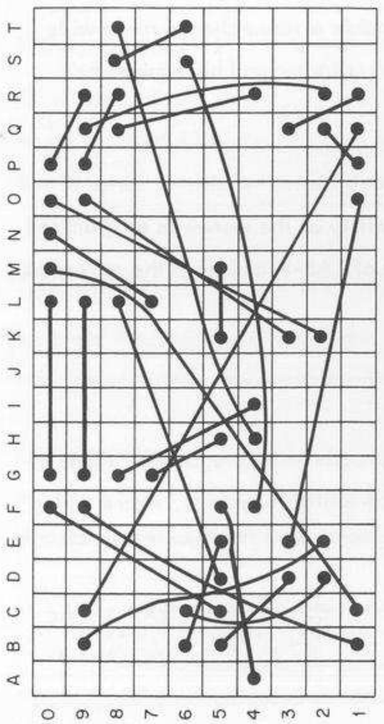
In the Multiple Schedule used here to demonstrate the versatile control capabilities of LAB-K, the following components are desired:

Step	Title	Component	Duration	Variables
0	Fixed Ratio	50 responses	120 minutes	RED lamp ON
1	Rest Period	60 minutes		
2	Sidman Avoidance	SS-20 seconds RS-40 seconds	90 minutes	GREEN lamp ON
3	Rest Period	60 minutes		

Step 0: Fixed Ratio Component

The first component of this Multiple Schedule uses the Down Counter to set up a fixed ratio of responses per reinforcement (50) during the allowed time base (120 minutes). The Down Counter, when it reaches zero after the required number of subject responses, enables both a light duty driver (which activates the RED lamp) and a one-shot input to a heavy duty driver (which reinforces the subject). The Down Counter is then recycled to 50 and repeats the fixed ratio again and again for the remainder of the allowed time duration. After the time duration has expired, the Up Counter steps the sequencer to Step 1 - a 60-minute rest period.

For Step 0, connect the following plugwires on the programming plugboard:



(1) L10 to G10 (Step 0 to BCD Group #1 enable.) Down Counter is set at 50.

(2) F10 to C5 (Connect C5 to enable right event to the Down Counter.)

(3) B5 to D3 (Connect D3 to recycle the Down Counter on zero.)

(4) E3 to O1 (Connect O1 to enable BCD Group #1.) Up Counter is set at 120.

(5) P1 to Q2 (Connect Q2 to enable a 60-sec time base to the Up Counter.)

(6) R2 to Q9 (Connect Q9 to the output of the light duty driver (for the RED lamp).)

(7) R9 to P10 (Connect P10 to step the sequencer to Step 1 with the decoded Up Counter.)

(8) O10 to K2 (Connect K2 to enable #1 of heavy duty driver #4.)

(9) F4 to S6 (Step 0 Control: Detect zero on the Down Counter to input one-shot to heavy duty driver (to reinforce subject).)

Step 1: Rest Period Component

The second component of the schedule is a 60-minute rest period. Logically, the Down Counter (with a 60-sec time base) counts the number set in the BCD thumbwheel switch #2 down to zero and then steps the sequencer.

For Step 1, connect the following plugwires on the programming plugboard:

(10) L9 to G9 (Step 1 to enable BCD thumbwheel switch #2 in the Down Counter.)

(11) F9 to B1 (Connect B1 to the 60-sec time base.)

(12) C1 to M10 (Connect M10 to count the Down Counter to zero and step the sequencer (to Step 2).)

Step 2: Sidman Avoidance Component

The third component is Sidman Avoidance - using an SS Interval of 20 seconds and an RS Interval of 40 seconds. When Step 2 is enabled, the memory flip-flop used for Sidman Avoidance is set in the SS Interval, using a 20-sec time base set in the Down Counter. A GREEN lamp is enabled during this component.

If the subject fails to respond within the required period, he is negatively reinforced (shock) and the Down Counter is reset with 20 seconds in it. However, if the subject does respond, the flip-flop sets the RS Interval into the Down Counter as the next avoidance period. The subject stays in the RS Interval as long as he responds within the time base allowed. Should he fail to respond during the 40-sec RS Interval, he is negatively reinforced (shock) and returned to the shorter SS Interval.

For Step 2, connect the following plugwires on the programming plugboard:

(13) L8 to D5 (Sequencer enables the memory flip-flop outputs.)

(14) E5 to B6 (Connect B6 to the 0.1-sec time base enable.)

(15) C6 to D2 (Connect D2 to Control #2 (to re-cycle the Down Counter on zero).)

(16) E2 to B9 (Connect B9 to enable the event to reset the Down Counter (Avoid-ance).)

(17) C9 to Q1 (Connect Q1 to enable Up Counter thumbwheel switch #2.)

(18) R1 to Q3 (Connect Q3 to enable the 10-sec time base to the Up Counter.)

NOTE

540 is set in the Up Counter. This equals the desired 90 minute component in 10-sec intervals.

(19) R3 to Q8 (Connect Q8 to input to driver #3 (GREEN lamp).)

(20) R8 to P9 (Connect P9 to decoded Up Counter steps the sequencer to Step 3.)

Step 2 (Cont)

(21) O9 to K3 (Connect K3 to enable heavy duty driver #3.)

(22) I4 to G8 (Step 2 Control: Not set memory output to BCD thumbwheel switch #3.)

NOTE

This enables the SS 20-sec component (using a 0.1-sec time base set at 200).

(23) H5 to G7 (Step 2 Control: Enable BCD thumbwheel switch #4.)

(24) A4 to F5 (Step 2 Control: Event enable sets memory gate.)

(25) T6 to S8 (Step 2 Control: Detect zero provides shock.)

NOTE

S6 was previously tied to F4 (zero detected on the Down Counter). This operation will tie T6 to H4 (next step) to accomplish the desired result.

(26) T8 to H4 (Reset memory flip-flop (returns subject to SS Avoidance).)

Step 3: Rest Period Component

The fourth component in the Multiple Schedule is another 60-minute rest period. It is accomplished by tying back into Step 1 and rerunning this component.

For Step 3, connect the following plugwires on the programming plugboard:

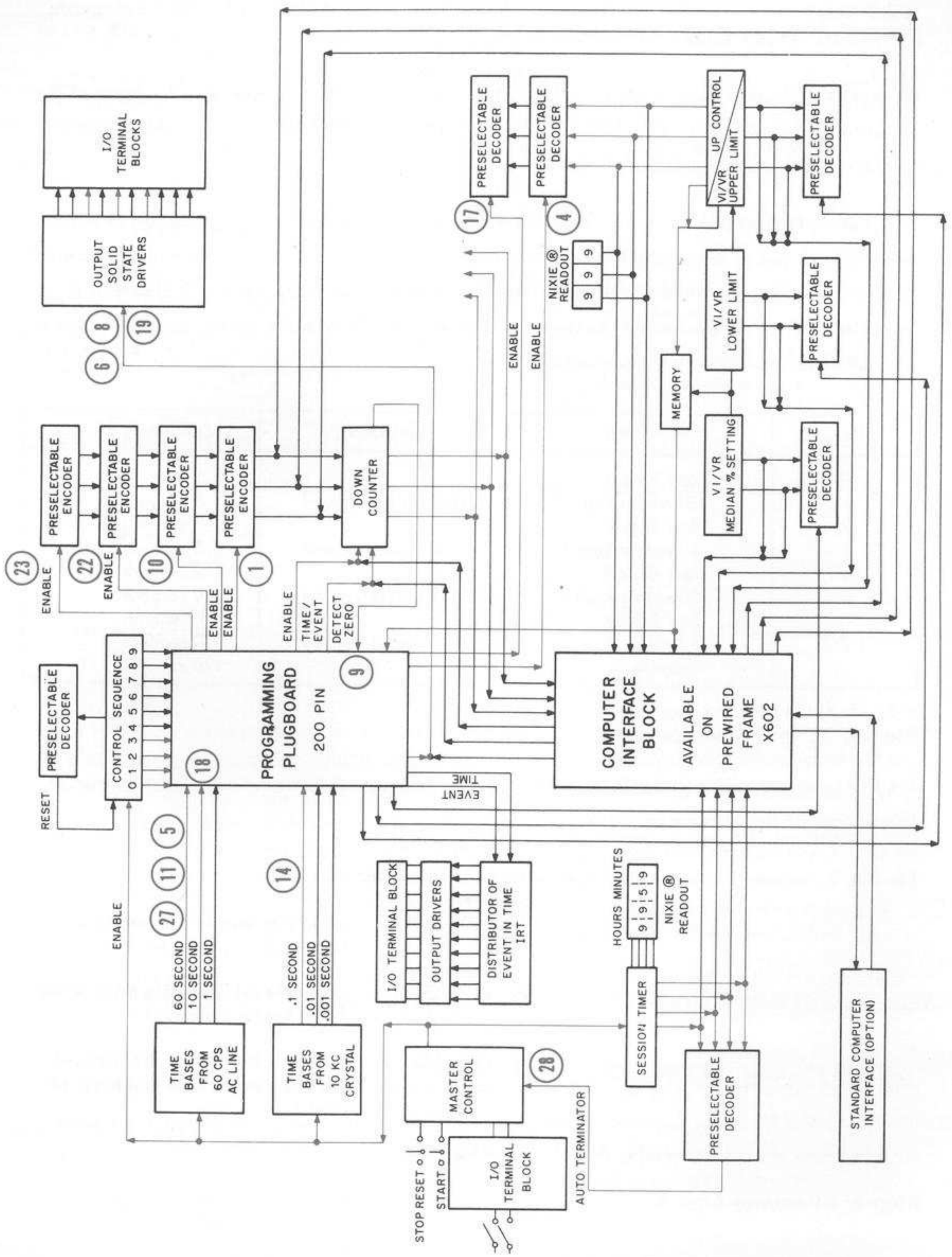
(27) L7 to N10 (Repeat Step 1.)

NOTE

Sequencer is set to 3, enabling the schedule to recycle continuously until the session is terminated.

After the number preselected in the real-time clock has been reached, the signal leaves the session timer and resets the master flip-flop to disable all inputs and time bases. This terminates the session and is accomplished by connecting the following plugwires:

(28) K5 to M5 (Session terminated at time requested. Master flip-flop is now on RESET.)



Multiple Schedule Flow Diagram

Discrete Trial Experiments

An excellent Discrete Trial schedule in Neurophysiology -- one which demonstrates the power of the sequencer as the executive of the LAB-K System -- controls the stimulation of electrodes placed at several cortical loci of a monkey's brain.

In this example, four electrodes are implanted and receive a small current (i.e., 0.8 mA) at discrete intervals from special electrophysiological equipment. The electrodes, when not providing electrical stimulation, record electrical activity generated by the animal's brain by means of a preamplifier and an oscilloscope. (The experiment, however, is concerned merely with the control aspects of providing stimulation according to a desired schedule.)

Step	Title	Component	Duration
0	Rest Period		0.5 seconds
1	Stimulate Loci A	1000 pulses/second	0.8 seconds
2	Rest Period		0.5 seconds
3	Stimulate Loci B	100 pulses/second	1.5 seconds
4	Rest Period		2.0 seconds
5	Stimulate Loci C	10 pulses/second	3.0 seconds
6	Rest Period		2.0 seconds
7	Stimulate Loci D	100 pulses/second	1.0 seconds
	Recycle		120 minutes

Step 0: 0.5-sec Rest Period

The first component (Step 0) is a 0.5-sec Rest Period, implemented through the Up Counter prior to introducing the first stimulus at Loci A.

For Step 0, connect the following plugwires on the programming plugboard:

(1) L10 to Q6 (Step 0 to enable .01-sec time base to the Up Counter.)

(2) R6 to O1 (Connect O1 to enable BCD Group #1 in the Up Counter.)

(3) P1 to P10 (Connect P10 so that the decoded Up Counter steps the sequencer to Step 1.)

Step 1: Stimulate Loci A

Step 1 introduces a 1000 pulse/second stimulus at Loci A over a 0.8-sec duration.

To wire this component through the programming plugboard, connect the following plugwires:

(4) L9 to G10 (Step 1 to enable BCD thumbwheel switch #1 on the Down Counter.)

(5) F10 to B8 (Connect B8 to enable 10-sec output to the Down Counter.)

(6) C8 to M10 (Connect M10 to Down Counter steps the sequencer at zero.)

(7) N10 to K3 (Connect K3 to enable #1 for heavy duty driver #3.)

(8) A10 to S8 (Connect S8 to one-shot input to heavy duty driver #3.)

Step 2: Rest Period

Step 2 is a 0.5-sec Rest Period which, because it can be easily obtained by repeating Step 0, is quickly implemented.

For Step 2, connect the following plugwires on the programming plugboard:

(9) L8 to O10 (Connect Step 2 to Step 0.)

Step 3: Stimulate Loci B

Step 3 introduces a 100 pulse/second stimulus at Loci B over a 1.5-sec interval.

To wire this component through the programming plugboard, connect the following plugwires:

(10) L7 to G9 (Connect Step 3 to enable BCD switch #2 on the Down Counter.)

(11) F9 to B6 (Connect B6 to enable 0.1-sec output to the Down Counter input.)

(12) C6 to M9 (Connect M9 to step the sequencer to Step 4 when Down Counter detects zero.)

(13) N9 to K4 (Connect K4 to enable #1 for heavy duty driver #2.)

(14) A9 to S9 (0.1-sec time base to one-shot input to heavy duty driver #2.)

Step 4: 2.0-sec Rest Period

Step 4 is a 2-sec Rest Period. It is accomplished through the programming plugboard as follows:

(15)	L6 to Q1	(Connect Step 4 to enable BCD switch #2 in the Up Counter.)
(16)	R1 to R5	(Enable 0.1-sec time base for the Up Counter.)
(17)	Q5 to P9	(Connect P9 to have the decoded Up Counter step the sequencer.)

Step 5: Stimulate Loci C

Step 5 introduces a 10 pulse/second stimulus at Loci C over a 3-sec duration. To wire this component, connect the following plugwires:

(18)	K10 to G8	(Step 5 to enable BCD switch #3 from the Down Counter.)
(19)	F8 to C3	(Connect C3 to recycle the Down Counter on zero.)
(20)	D3 to M8	(Connect M8 to have the Down Counter step the sequencer at zero.)
(21)	N8 to K2	(Connect K2 to enable #1 for heavy duty driver #4.)
(22)	A10 to S6	(Connect S6 to the one-shot output to heavy duty driver #4.)

Step 6: 2.0-sec Rest Period

Step 6 is a 2.0-sec Rest Period which, because it can be obtained by repeating Step 4, is easily accomplished:

Connect the following plugwires:

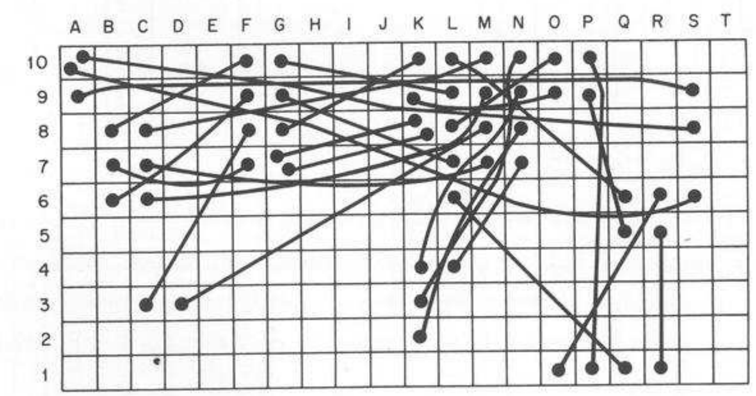
(23)	K9 to 09	(Connect Step 6 to Step 4.)

Step 7: Stimulate Loci D

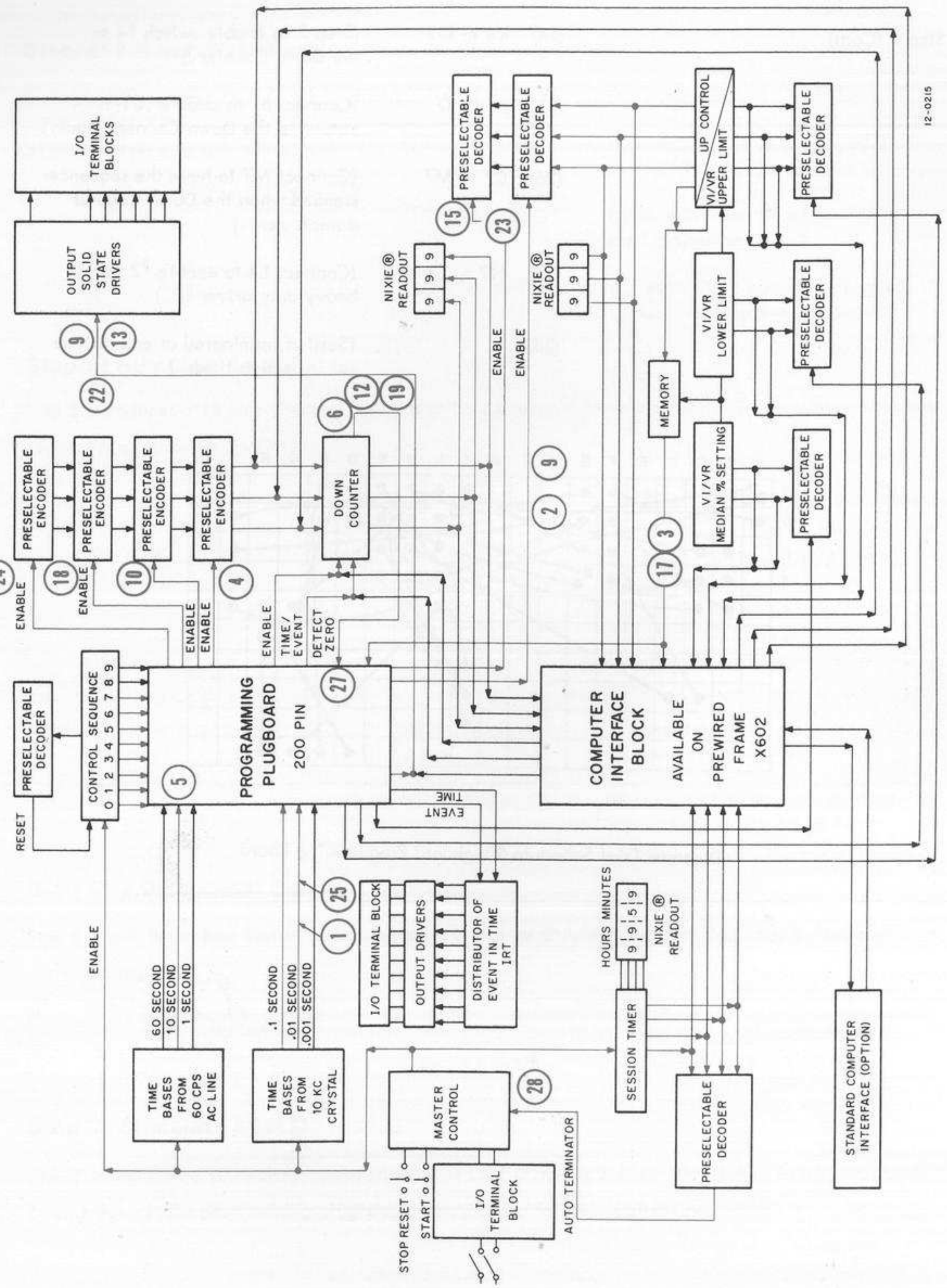
Step 7 introduced a 100 pulse/second stimulus at Loci D over a 1.0-sec duration. To wire this component through the programming plugboard, connect the following plugwires:

Step 7 (Cont)

(24)	K8 to G7	(Step 7 to enable switch #4 to the Down Counter.)
(25)	F7 to B7	(Connect B7 to enable .01-sec output to the Down Counter input.)
(26)	C7 to M7	(Connect M7 to have the sequencer stepped when the Down Counter detects zero.)
(27)	N7 to L4	(Connect L4 to enable #2 for heavy duty driver #2.)
(28)		(Session terminated at end of time set in session timer.)



Discrete Trial Schedule/Plugboard Programming Board



Discrete Trial Schedule Flow Diagram

Flexible Warranty and Field Service Options

Each psychology researcher has different instrumentation requirements, depending on his ability to work with solid-state logic and the type of research undertaken. LAB-K offers the psychologist maximum flexibility in configuring his control logic system to his specific research need.

DEC-Assembled LAB-K

Most researchers do not have the time or interest to devote to assembly of a control logic system. They would prefer to have DEC do this for them, concentrating instead on their research. For this type of investigator, LAB-K is available as a DEC-assembled prewired configuration. The worldwide DEC Field Service organization supports LAB-K in assembled form with a 90 day warranty, effective on completion of diagnostic checkout at the user site. This warranty on DEC-assembled LAB-K includes two extra service calls if required. Assembly and the 90 day warranty, available as an option, is $695.

User-Assembled LAB-K

Some investigators, however, prefer to involve themselves directly in the assembly of their control logic system. For this type of researcher, LAB-K is available:

As a user-assembled predesigned configuration, enabling the researcher to wire the logic of his control system using specifications in the LAB-K Handbook. The warranty for a user-assembled predesigned configuration, ordered as an option, provides 130 day coverage for $195. DEC's Field Service comes in after the user has wired and assembled his LAB-K and runs diagnostics to verify that the system is operational. The researcher then uses his system under the remainder of the 130 day system hardware warranty. After the warranty has expired, Field Service continues its support of LAB-K on a time and materials basis.

As a user-assembled prewired frame to a maximum configuration of applications. The researcher again has a 130 day warranty under which to assemble and operate his LAB-K. Ordered as an option, this warranty provides 130 day coverage for $195. Field Service supports a user-assembled prewired frame in the same manner as above.

As a prewired configuration with intent on the part of the researcher to rewire 20-30 percent of the logic system to suit a special research need. The same 130 day warranty is available, but only for the system as predesigned. However, DEC's Field Service supports a modified LAB-K on a time and materials basis if the user-designed system has been adequately documented so as to provide such support.

As basic hardware which the researcher designs and builds. DEC's Field Service supports a user-designed system on a time and materials basis, provided that the system is adequately documented. Service is provided at per call hourly rates (example: Monday through Friday, 7 A.M. to 6 P.M., $20/hour).

PRICE LIST

labk

Effective July 1, 1970

EQUIPMENT LIST

LABK-A — Input Logic — $ 151

1 ea.	K123	Logic Gate
1 ea.	K124	Logic Gate
1 ea.	K323	One Shot
1 ea.	K420	Spring Loaded/Fixed Toggle Switch (3 ea.)
1 ea.	K501	Schmitt Trigger
1 ea.	K580	Dry Contact Filter
1 ea.	K990	Resistor Capacitor Module Board

LABK-B — 0-9 Sequencer — $ 189

2 ea.	K003	Gate Expander
2 ea.	K113	Logic Gate
1 ea.	K123	Logic Gate
3 ea.	K134	Inverter
1 ea.	K161	Binary to Octal Decoder
1 ea.	K202	Flip-Flop
1 ea.	K210	Counter
1 ea.	K424	Decoding BCD Thumbwheel Switch

LABK-B1 OPTION: Sequencer Indicating Lights — $ 36

2 ea.	K410	6.3V Indicator Lamps (5 ea.)

LABK-C — Down Counter — $ 505

2 ea.	K003	Gate Expander
2 ea.	K012	Gate Expander
1 ea.	K028	Gate Expander
4 ea.	K113	Logic Gate
3 ea.	K123	Logic Gate
1 ea.	K124	Logic Gate
5 ea.	K134	Inverter
1 ea.	K202	Flip-Flop
3 ea.	K220	Up/Down Counter
1 ea.	K323	One Shot
3 ea.	K422	Encoding BCD Thumbwheel Switch
1 ea.	K990	Resistor Capacitor Module Board

LABK-C1 OPTION: Two Sets of 3 Digit BCD Thumbwheel Switches — $ 81

3 ea.	K422	Encoding BCD Thumbwheel Switch

LABK-C2 OPTION: Nixie Digital Readouts for Down Counter — $ 200

3 ea.	K671	Decimal Decoder & Nixie Display
1 ea.	K771	Display Supply

LABK-D — Three Time Bases 1 - 10 - 60 Seconds — $ 234

2 ea.	K123	Logic Gate
9 ea.	K211	Divide-By Counter (1-16)
1 ea.	K731	Source Module

LABK-E — Up Counter — $ 258

1 ea.	K028	Gate Expander
3 ea.	K113	Logic Gate
1 ea.	K123	Logic Gate
3 ea.	K134	Inverter
3 ea.	K210	Counter
3 ea.	K424	Decoding BCD Thumbwheel Switch
1 ea.	K990	Resistor Capacitor Module Board

LABK-E1 OPTION: Nixie Digital Readout for Up Counter — $ 165

3 ea.	K671	Decimal Decoder & Nixie Display

NOTE: If Nixie® Readout for Down Counter not ordered, add: 1 ea. K771 @ $35

LABK-F — Output Logic — $ 297

1 ea.	K644	DC Driver (4 ea.)
1 ea.	K683	Lamp Driver (8 ea.)
3 ea.	K323	One Shot
1 ea.	K003	Gate Expander
1 ea.	K113	Logic Gate
2 ea.	K134	Inverter
1 ea.	K135	Inverter
1 ea.	K432	Adjustable Potentiometer Thumbwheel Control for Timing Modules (2 ea.)
2 ea.	K990	Resistor Capacitor Module Board

LABK-F1 OPTION: — $ 110

1 ea.	K604	AC Switch (4 ea.) (in place of K644)

HARDWARE

LABK-G Power Supply $ 263

1 ea.	714	7 amp 5 Vdc Power Supply
1 ea.	K743	Transformer (separate power for indicator lamps)
1 ea.	K982	Mounting Panel
1 ea.	H002	Pair of brackets for mounting K743 on K982

LABK-H Input/Output Connection Hardware $ 55

1 ea.	K940	Mounting Support
1 ea.	K941	Mounting Bracket
2 ea.	H800	Connector Block
1 ea.	K782	Terminal Module
1 ea.	K784	Terminal Module with protector diodes

LABK-J Modular Mounting Panels & Hardware $ 264.80

1 ea.	K943WP	19" Mounting Panel
2 ea.	H020	Frame Casting
13 ea.	H800W	Connector Block
3 ea.	H808	Connector Block
8 ea.	932	Bus Strip

LABK-K Cabinet and Hardware $ 620

1 ea.	K984	Nixie Display Mounting Panel
5 ea.	H950PA	5-1/4" Cover Panels
1 ea.	K950	Modular Panel Kit
1 ea.	H953A	Table-Top Cabinet With Patchboard Programming Kit (Not discountable) Consisting of:

(a) Cabinet 33-1/4"H, 21-3/4" W, 18"D, Panel Space 31-1/4"H, 19"W

(b) Patchboard Programmer Kit
200 pin receiver with wirewrap pin 1 plugboard
100 plug wires
Printed Circuit Board
8 ea. 19 conductor ribbon cables, 3' long with connectors

LABK-L Three Time Base .001 - .01 - .1 Seconds $ 278

1 ea.	M302	Dual Delay Multivibrator
1 ea.	M405	Crystal Clock
1 ea.	K123	Logic Gate
6 ea.	K211	Divide by Counter (1-16)

LABK-M Variable Interval (VI) or Ratio (VR) Programmer $ 396

2 ea.	M302	Dual Delay Multivibrator
1 ea.	M113	Ten 2-Input NAND Gates
1 ea.	K028	Gate Expander
1 ea.	K113	Logic Gate
1 ea.	K134	Inverter
4 ea.	K210	Counter
1 ea.	K303	Timer
1 ea.	K371	Timer Control, Clock
4 ea.	K424	Decoding BCD Thumbwheel Switch

LABK-N Session Timer $ 158

Maximum 9 hours 59 minutes

1 ea.	K113	Logic Gate
1 ea.	K123	Logic Gate
3 ea.	K210	Counter
2 ea.	K424	Decoding BCD Thumbwheel Switch

LABK-N1 OPTION: Nixie Tube Readout for 9 hours 59 minutes $ 200

3 ea.	K671	Decimal Decoder & Nixie Display
1 ea.	K771	Display Supply; 3- digit Readout

LABK-N2 OPTION: For maximum 99 hours 59 minutes $ 27

1 ea.	K210	Add on to LABK-N Counter

LABK-N3 OPTION: $ 55

1 ea.	K671	Decimal Decoder & Nixie Display for the 4th-digit Readout add to LABK-N1

LABK-P 2ND VI - VR $ 430

2 ea.	M302	Dual Delay Multivibrator
1 ea.	M113	Ten 2-Input NAND Gates
1 ea.	K113	Logic Gate
1 ea.	K123	Logic Gate
1 ea.	K124	Logic Gate
1 ea.	K134	Inverter
7 ea.	K210	Counter
3 ea.	K424	Decoding BCD Thumbwheel Switch

LABK-Q IRT Distributor $ 209

4 ea.	K123	Logic Gate
1 ea.	K161	Binary to Octal Decoder
1 ea.	K210	Counter
1 ea.	K323	One Shot
*1 ea.	K424	Decoding BCD Thumbwheel Switch
1 ea.	K683	Lamp Driver
1 ea.	K784	Terminal

*Not required if 2nd VI/VR option ordered

LABK-R Automatic Wirewrap Frame $ 625

1 ea.	X602	Automatic Wirewrap Frame replaces and includes items under section J.

Item X602 includes items listed under section J, assembled and wired automatically by DEC computer wirewrap service. The frame is wired to the maximum logic configuration including the associated options in sections A through Q. The wiring is guaranteed by a continuity check to be accurate to complete logic documentation provided with the equipment items found in section K.

LABK-X	DEC-Assembled Unit with a 90 day warranty	$ 695
LABK-Y	130 day warranty for User-Assembled LAB-K	$ 195
LABK-Z	Spare Parts Kit	$ 369

1 ea.	K113	Logic Gate
1 ea.	K123	Logic Gate
1 ea.	K124	Logic Gate
1 ea.	K134	Inverter
1 ea.	K161	Binary to Octal Decoder

Spare Parts Kit (Cont)

1 ea.	K202	Flip-Flop
1 ea.	K210	Counter
1 ea.	K323	One Shot
1 ea.	K422	Encoding BCD Thumbwheel Switch
1 ea.	K424	Encoding BCD Thumbwheel Switch
1 ea.	K644	DC Driver
1 ea.	K671	Decimal Decoder & Nixie Display
1 ea.	K683	Lamp Driver

Wirewrap Assessories Used for Additions or Deletions to Wirewrap Frame

**	H810	Pistol Grip Hand Wire-wrapping Tool	$99
		or	
	H811	Hand Wrapping Tool	$21.50
	H812	Wire Un-wrapping Tool	$10.50
	934	1000 foot roll of 24 gauge solid wire, cut resistant insulation	$50
	K791	Test probe. Suggested probe for LAB-K system checkout	$40

**Recommended as a time saver.

Is there a warranty on the K Series Modules?

There is a 10 year warranty. See the Logic Handbook for further information.

What is the quantity discount?

$ 5,000 - 3%	$ 100,000 - 18%
$10,000 - 5%	$ 250,000 - 20%
$20,000 - 10%	$ 500,000 - 22%
$50,000 - 15%	$1,000,000 - 25%

The only item on the equipment list NOT discountable is H953A — table top cabinet with patchboard programming kit.

All shipments are F.O.B. Maynard, Massachusetts

labk order sheet

D.E.C. 256-1 REV. 7/69

digital EQUIPMENT CORPORATION
MAYNARD, MASSACHUSETTS

SPLIT ORDER ☐ REF. TO: **D.E.C. NO.** ______

CUSTOMER ORDER NO. ______
DATE RECEIVED ______

Page 1 of

(SAME AS "INVOICE TO" UNLESS OTHERWISE INDICATED)

SOLD TO ______

SHIP TO ______

CERTIFICATE OF COMPLIANCE — YES — NO | GOVERNMENT SOURCE INSPECTION — YES — NO

SALESMAN	RECEIVED BY	COMMISSION	PARTIAL SHIPMENTS ALLOWED 1) YES 2) NO	SHIP VIA	1) TAXABLE 2) TAX-EXEMPT	REQUIRED DELIVERY
Marketing Application Code	TAX EXEMPT OR RESALE NO.	MFG. DATE	D.E.C. AGREE. NO.	TOTAL YEAR-TO-DATE		SCHEDULED DELIVERY
F.O.B. TERMS 1) MAYNARD 2) SEE "INST" SHEET	TRANSPORTATION TERMS 1) PREPAY 2) COLLECT 3) PPD AND ADD 4) FRT. ALLOWED 5)	PROD. LINE	INST. CODE	HOW RECEIVED	CONF. RECEIVED	RENEG. YES — NO —
Cust. Code	BRANCH	State Code	REASON FOR SHIPMENT 1. CONSIGNMENT 2. SALE 6.	WIRE WRAP REQUIRED YES ☐ NO ☐	SHIPMENT ☐ PART ☐ COMP.	

SPECIAL INSTRUCTIONS:

ITEM	QUANTITY Order	QUANTITY Shipped	MODEL NO.	DESCRIPTION	C/C	P/C	S/C	UNIT PRICE	TOTAL PRICE		SCH.
			LABK-A INPUT LOGIC								
			LABK-B 0–9 SEQUENCER								
			LABK-B1 OPTION								
			LABK-C DOWN COUNTER								
			LABK-C1 OPTION								
			LABK-C2 OPTION								
			LABK-D THREE TIME BASES 1-10-60 SEC.								
			LABK-E UP COUNTER								
			LABK-E1 OPTION								
			LABK-F OUTPUT LOGIC								
			LABK-F1 OPTION								
			LABK-G POWER SUPPLY								

CONTACT & METHOD	DATE	INFORMATION GIVEN	CONTACT & METHOD	DATE	INFORMATION GIVEN

DATE SHIPPED	GROSS WEIGHT	NO. & TYPE OF CART.	WAYBILL NO.	AMOUNT INSURED	INSURANCE CHARGES
SHIPPING CHARGES	OTHER CHARGES	TOT. TRANS. CHARGES	SHIPPED VIA	ROUTING CLERK By	TRAFFIC DEPT. By

LABK ORDER SHEET **LABK MARKETING** REQUISITIONER'S INITIALS ______

labk order sheet

D.E.C. 256-1 REV. 11/69

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MAYNARD, MASSACHUSETTS

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			LABK-H INPUT/OUTPUT								
			LABK-J MODULAR MOUNTING								
			LABK-K CABINET AND HARDWARE								
			LABK-L THREE TIME BASE .001-.01-.1 SEC.								
			LABK-M VARIABLE INTERVAL (VI) OR RATIO (VR) PROGRAMMER								
			LABK-N SESSION TIMER								
			LABK-N1 OPTION								
			LABK-N2 OPTION								
			LABK-N3 OPTION								
			LABK-P 2ND VI-VR								
			LABK-Q IRT DISTRIBUTOR								
			LABK-R AUTOMATIC WIREWRAP FRAME								
			LABK-X DEC-ASSEMBLED UNIT								
			LABK-Y 130 DAY WARRANTY								
			LABK-Z SPARE PARTS KIT								

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Consult the back cover for your nearest DEC Sales office.
Forward completed order sheet to that address.

labk order sheet

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