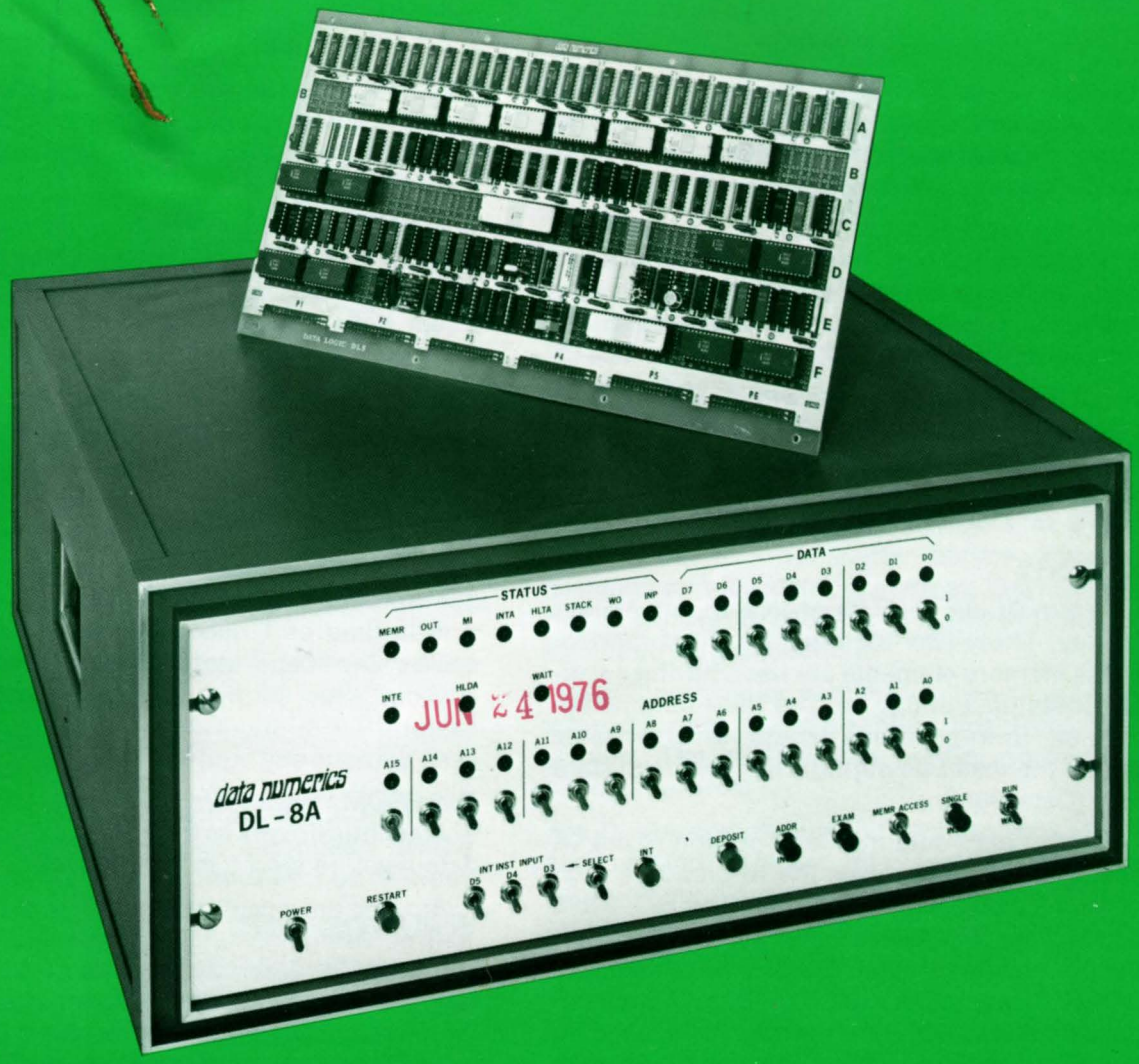

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THE DL-8A MICROCOMPUTER

INTRODUCTION

The DATA NUMERICS' DL-8A is a complete self-contained microcomputer system designed around the Intel 8080 microprocessor.

The DL-8A architecture uses the 8080 to form a significant computing system to be used in applications heretofore economically and functionally not feasible for computer solution.

The DL-8A microcomputer architecture emanates from the basic DL-8A Module (Fig. 1), which is the system's foundation block. The basic unit consists of 4K of random access semiconductor memory, 2K of PROM, four input and four output registers 8 bits each, a universal asynchronous receiver-transmitter (UART) for teletype, or any RS-232 terminal operation, and a versatile interrupt system with priority resolution and self identifying vectors.

And in the same cabinet from this basic DL-8A Module, the microcomputer system can be expanded to 64K of memory.

BUS STRUCTURE

The bus structure of the DL-8A microcomputer system is based on a 16-bit address bus used to output addresses for memory reference and input/output ports and an 8-bit, bi-directional data bus used to output or input instructions or data.

A tri-state Quad Bus Driver/Receiver circuit is used for the 8-bit Data bus. This Driver/Receiver circuit not only provides tri-state operation, but

will drive up to 30 TTL loads compared to the 8080 data bus drive of one (1) TTL load. *This feature enables the user to expand memory or add peripherals without additional hardware.*

Since the 8080 address bus can only drive 750 ua, a high speed Hex tri-state Buffer is used to convert address levels to tri-state TTL bus levels. *This buffer requires only a 400 ua input current and can drive up to 30 TTL loads.*

The DL-8A bus structure provides for maximum system flexibility. Both data and address busses are available at the Input/Output connector of the DL-8A for expansion and DMA operation.

MEMORY

The basic DL-8A consists of 4K Random Access Memory. Thirty-two 1024 word X 1 bit random access memory elements are used having a typical access time of 850 ns. The RAM outputs are "wire-or" to tri-state bus drivers, which enables data on the data bus during a memory read state DBIN (Data Bus In).

In order to read data from any portion of the 4K RAM, the CPU will provide the 16-bit address on the address bus, which is decoded by two, 3 to 8 decoders to chip select either 1K, 2K, 3K, or 4K memory elements. After the CPU sends out the address, it will generate a Data Bus In Signal in approximately 600 ns. This signal is used to enable the gating of data into the DL-8A data bus.

If RAM's having an access time greater than 600 ns are used, a micro cycle delay must be provided, so the CPU can synchronize to the slower memory.

The DL-8A provides a selectable micro cycle delay circuit ranging from 0 us, 1.0 us, 1.5 us, 2.0 us, and 2.5 us. This circuit enables the user to select the appropriate delay needed for slower memories.

Since the DL-8A uses RAM's having 850 ns access time, a wide range of RAM choice can be made without any changes to the system.

The DL-8A has 2K of PROM. These PROMs are 2048 bit erasable and electrically reprogrammable read only memory elements organized as 256 words X 8 bits. The DL-8A PROMs have an access time of 1 usec; therefore, a two micro cycle delay time must be provided. *This is easily accomplished by the selectable delay circuit.* Faster PROMs are available and can be directly used without any modifications.

The PROM outputs are "wire-ored" to the same tri-state bus drivers as the RAMs. Complemented data must be stored in the PROMS.

INPUT/OUTPUT

The basic DL-8A Module has four 8-bit Input and four 8-bit Output ports. These Input and Output registers consist of full parallel 8-bit Data registers with tri-state output buffers, along with control logic, and a service request flip-flop used for

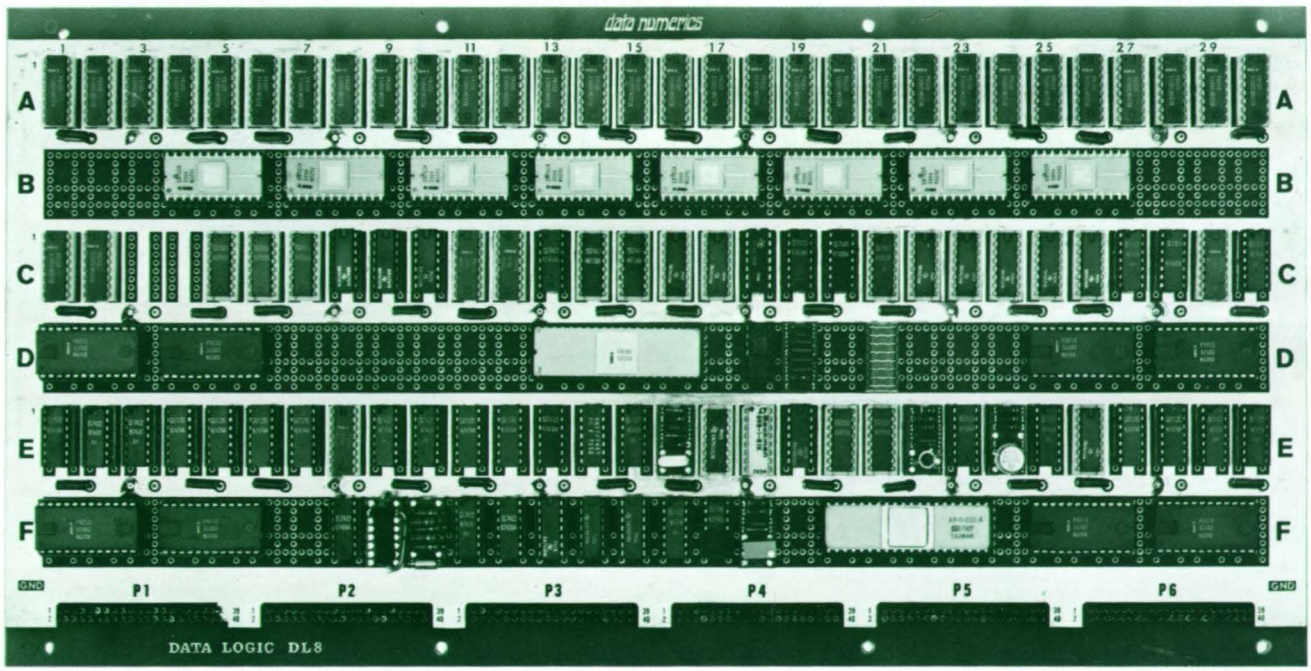


FIGURE 1

DL-8A CONTROL PANEL

The DL-8A Control Panel monitors and directs all activities of the DL-8A Microcomputer system. It provides operational controls of microprocessor activity, operating mode status, machine cycle status, and additional controls for program debugging.

The DL-8A Control Panel has the following features:

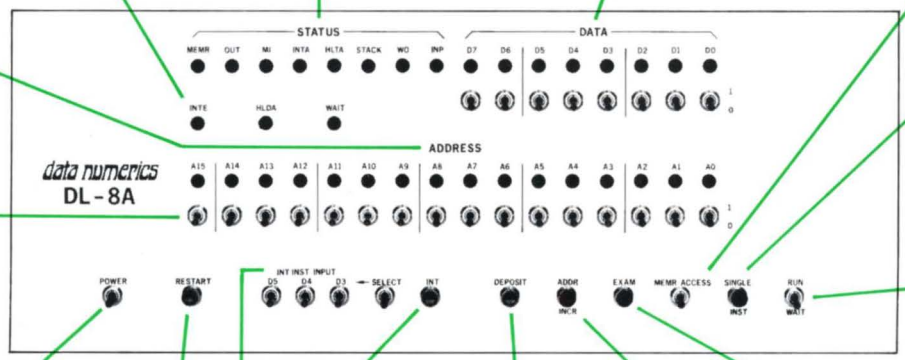
Operation STATUS Display
—3 Displays indicate RUN, WAIT or HOLD Mode

STATUS Display
—8 Displays indicate 8 different machine cycle modes (HLTA, INTA, INP, OUT, MEMR, MI, STACK, and WO)

Data Register and Display
—8 Bit Data Register and Display provides data or instructions to be stored

Memory Access
—Causes the Microprocessor to go into a Hold Mode in order that data may be stored or read in memory

Address Register and Display
—16 Bit Address Register and Display provides Address Data Storage



Single Instruction
—Provides single step execution of a program while the processor is in the Wait Mode

I/O Examine/ Deposit
—By setting the most significant address register switch to "1", the Examine and Deposit functions operate with input (Examine) or output ports (Deposit) rather than memory. The I/O port number is set by the three least significant address bits

RUN/WAIT
—Run/Wait switch provides selection of the Run Mode or Wait Mode

Power
—Power switch

Interrupt
—Causes the Microprocessor to execute an interrupt cycle

Address Increment
—Increments the Address Register by one

Examine
—Stores the Contents of the memory location indicated by the address register into the Data Register

Restart
—Restart switch causes Microprocessor to begin execution of program at memory location zero

Interrupt Instruction Input
—Provides the interrupt instruction during an interrupt cycle

Deposit
—Stores the contents of the Data Register into the memory location indicated by the address register

The DL-8A Control Panel is a 7" X 19" Rack mountable panel that is connected to the DL-8A Microcomputer system by a single flex-cable.

Software

Software is available for the DL-8A to accomplish the following:

Automatic Load and Startup	RAM False Addressing Diagnostic	Symbolic Program Assembly	Hex or ASCII Dumps
RAM Read/Write Diagnostic	I/O Wraparound Self Test	Source Language Editing	CRT Monitoring and Display

Edit and Assembly programs are available *resident with the DL-8A microcomputer,* and *as programs which execute on the PDP-8 or PDP-11,* or *from a number of timesharing services.*

The automatic load program accepts tapes in binary format as well as hexadecimal. Binary formatted tapes load in half the time required for hexadecimal tapes and in one-eighth the time required for BNPF tapes.

DATA NUMERICS supplies programmed PROMs, paper tapes, and listings to DL-8A users at nominal prices.

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Telephone: 516-293-6600

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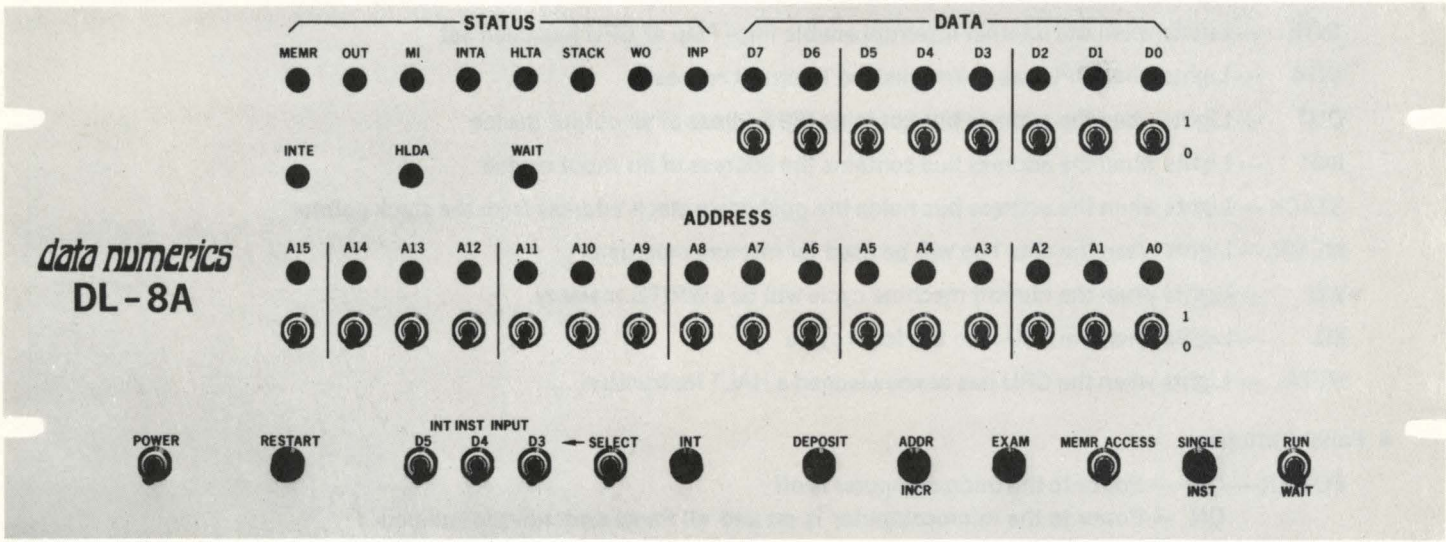
Technical Bulletin



DL-8A CONTROL PANEL

The DL-8A Control Panel monitors and directs all activities of the DL-8A Microcomputer System. It provides operational controls of microprocessor activity, operating mode status, machine cycle status, and provides the user of a DL-8A system a powerful program debugging tool and an effective system maintenance aid.

WITH THE DL-8A CONTROL PANEL, THE USER CAN:

- Examine data in any location in memory
- Deposit data into any location in memory
- Start or Stop the DL-8A System
- Single step execution of program
- Interrupt the DL-8A Microcomputer
- Examine data in any selectable Input/Output Ports
- Deposit data into any selectable Input/Output Ports
- Display the current status of system
- Automatic load paper tape programs into system

THE DL-8A CONTROL PANEL PROVIDES THE FOLLOWING FACILITIES:

- Address Display (16 bits)
- Address Switch Register (16 switches)
- Status Lights:

  Wait
  Hold Acknowledge (HLDA)
  Interrupt Enable (INTE)
  Interrupt Acknowledge (INTA)
  Out Cycle
  In Cycle (INP)
  Stack Operation
  Memory Read (MEMR)
  Memory Write (WO)
  Fetch Cycle (M1)
  Halt Acknowledge (HLTA)

- Control Switches

  Examine
  Address Increment (ADDR, INCR)
  Deposit
  Interrupt (INT)
  Run/Wait
  Interrupt Instruction Input
  Select Interrupt Port
  Restart
  Memory Access
  Single Instruct

- Data Display (8 bits)
- Data Switch Register (8 switches)

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- Status Lights

  WAIT — Lights when CPU is in a WAIT STATE

  HLDA — Lights when CPY has acknowledged a HOLD Request

  INTE — Lights when the internal interrupt enable Flip/Flop of CPU has been set

  INTA — Lights when CPU has acknowledged interrupt request

  OUT — Lights when the address bus contains the address of an output device

  INP — Lights when the address bus contains the address of an input device

  STACK — Lights when the address bus holds the pushdown stack address from the stack pointer

  MEMR — Lights when the data bus will be used for memory read data

  WO — Lights when the current machine cycle will be a WRITE memory

  M1 — Lights when the CPU is in the fetch cycle

  HLTA — Lights when the CPU has acknowledged a HALT instruction

- Panel Switches:

  POWER — OFF — Power to the microcomputer is off
  ON — Power to the microcomputer is on and all Panel switches are enabled

  Address Switch Register — Used to manually load address data into the Address Register

  Data Switch Register — Used to manually load data or instructions into Data Register

- Control Switches:

  EXAM — Transfer contents of the address switch register to the address register and displays the content of this location in Data Display Register

  ADDR INCR — Increments the Address Register by one

  DEPOSIT — Stores the contents of the Data Switch Register into the memory location indicated by the Address Register

  INT — Causes the DL-8A to execute an interrupt cycle

  RUN/WAIT — Provides selection of the RUN or WAIT Mode

  INTERRUPT INSTRUCTION INPUT — Provides the interrupt instruction during a Control Panel interrupt

  SINGLE INSTRUCT — Provides single step execution of a program while the processor is in the WAIT mode

  MEMORY ACCESS — Causes the DL-8A to go into a HOLD Mode in order that data may be stored or read in memory

  RESTART — Provides execution of a program starting at memory location zero

  SELECT INTERRUPT PORT — Selects the Control Panel or the DL-8A to provide interrupt instruction to the microprocessor

- Displays:

  ADDRESS REGISTER — Displays the address of data just examined or deposited

  AUTO PROGRAM LOADER — Paper Tape Reader routine stored in PROM (Optional)

  DEPOSIT — Stores the contents of the Data Register into the memory location indicated by the Address Register

  I/O EXAMINE DEPOSIT — By setting the most significant address register switch to "1", the Examine and Deposit functions operate with input (Examine) or output ports (Deposit) rather than memory. The I/O port number is selectable by the three least significant address bits.

The DL-8A Control Panel is an 7" x 19" Rack mountable panel that is connected to the DL-8A Microcomputer system by a single flexcable.

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MEMO

USING THE DL-8A AS A HARDWARE AND SOFTWARE DEVELOPMENT SYSTEM

The DL-8A MICROCOMPUTER, CONTROL PANEL, and RESIDENT SOFTWARE provide the user with powerful hardware and software development tools.

The CONTROL PANEL provides system initialization, examines or deposits data/instructions at any location in memory; starts or stops the system; allows for single step program execution, has a complete interrupt system; deposits and examines data in any selected input/output ports; displays current system status, communicates with a TTY or any RS-232 device.

Since the CONTROL PANEL is hardware configured rather than software configured the user by means of a cable can extend the panel diagnostic capabilities into his customized system.

This CONTROL PANEL configuration eliminates the problem of operating system software failure when the prototype system is being debugged.

The RESIDENT SOFTWARE provided with the DL-8A includes the SYSTEM MONITOR, ASSEMBLER, and TEXT EDITOR, as well as DATA BREAK, LOOPING and TRACING. Used together, these programs simplify program preparation and speed the debugging task.

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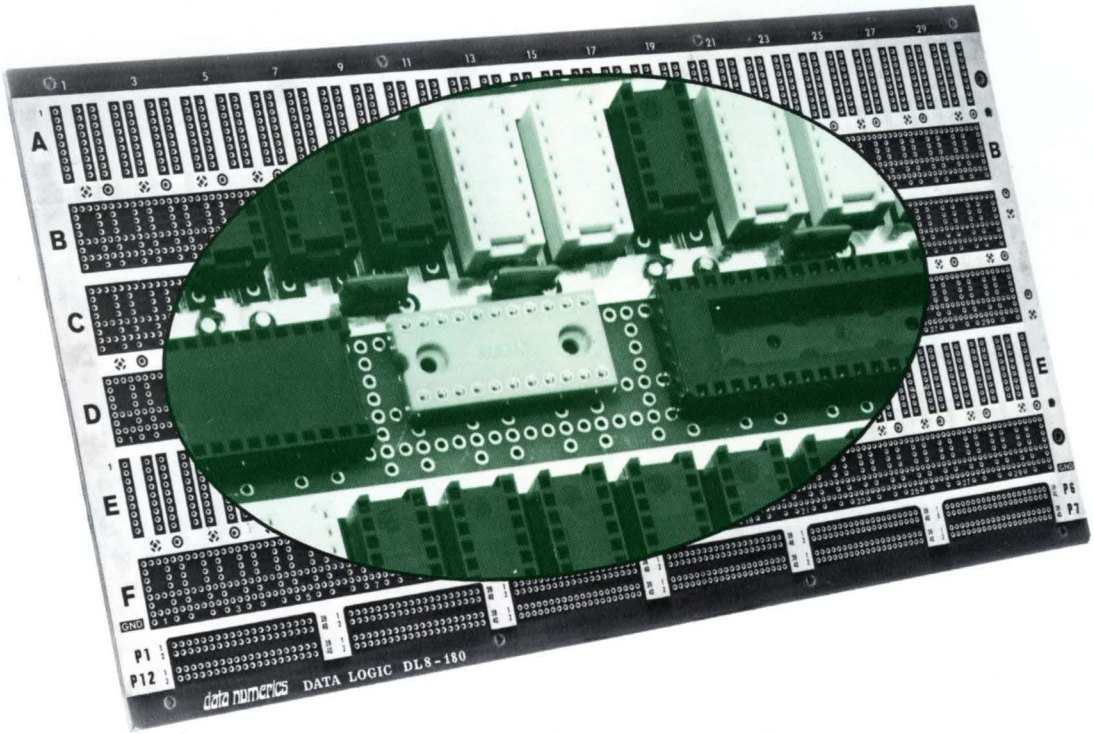


DL SERIES MICROCOMPUTER SYSTEMS SOCKET PANELS

An Architecture of Maximum Flexibility

The basic DL system building blocks are wire wrap socket panels, designed to give the best balance between component density and accessibility, minimum number of connectors, ease of modification, and zero obsolescence.

In developing a design that accepts any I.C. chip configuration, from 8 to 40 pins, present and future higher density elements, such as memory devices, can be accommodated. And since the socket panels are wire wrapped, they can be easily modified at any time to accept new components.

Minimizing interconnects and eliminating printed circuit connectors increases system reliability. However, it buys something else—it eliminates the time consuming requirement of reloading, inherent in power interrupt of solid state memory card file arrangements that use extender cards for servicing.

Component density is maximized, but not at the sacrifice of accessibility for system development and service. Test equipment probes, jumpers, and interconnects are easily accommodated.

To facilitate various input-output configurations, memory expansion, and peripheral interfaces, three (3) panel sizes are available. The DL8-180, the DL8-120, the DL8-90.

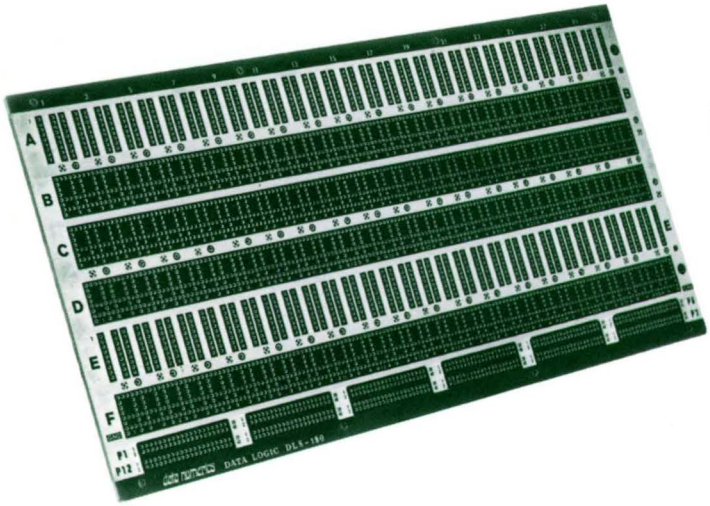
As an example of the capacity and flexibility of these modules, the DL8-180 can accommodate a microcomputer system with the following specifications—4K static RAM, 2K PROM, four 8-bit input ports, four 8-bit output ports, DMA, interrupt system, and a UART communications channel.

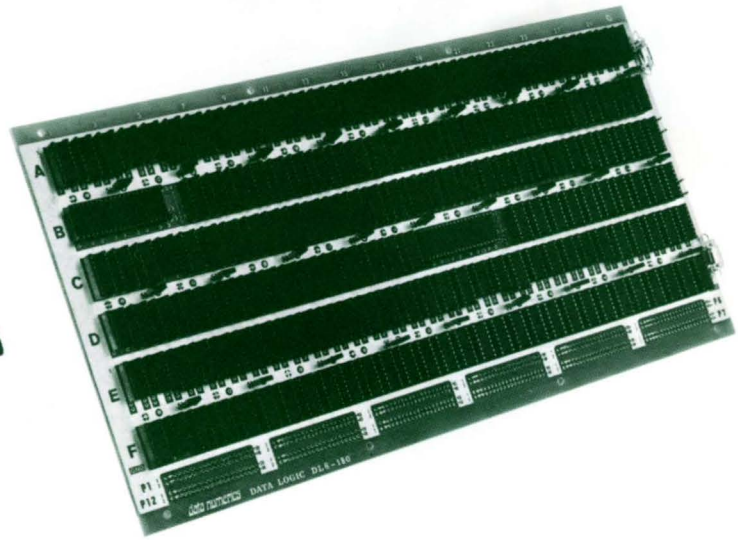
A series of panel cable assemblies are available, including flat ribbon, and twisted pair, and socket plug-in cables.

Chassis hardware includes a basic frame—with provision for mounting one to four DL8 socket panels, configured to a customer's specifications.

A complete microcomputer system including 64K of memory and an extensive I/O capability could be contained in the basic four panel frame. (See Page 4.)

CAPACITY—FLEXIBILITY—ZERO OBSOLESCENCE





SPECIFICATIONS

Material: P.C. Board: 1/8 thick glass epoxy G-10, 2 oz. copper circuitry, plated thru holes.

Sockets: Nylon sockets with beryllium copper gold plated wire wrap contacts or gold flash tin plated wire wrap contacts, 3 level, closed entry.

I/O Connections: Up to 12, 40 position groups designed to accept wire wrappable feed thru pins or standard wire wrappable connectors, positioned to accept standard 40 position flat cable or crimp type contact cable terminations. See Dimensions Table, Page 3 for details.

GND & Vcc: Double sided board. Component side gnd. Terminals to accept voltages, and gnd. are included in assembled panels.

Decoupling: Distributive capacitance. Up to a maximum of 27 decoupling positions on 180 Series Panels. See Dimensions Table, Page 3 for details.

Interconnect: All panels have wire wrap sockets capable of being wire wrapped by hand, semi-automatic, or fully automatic machines.

Panel Configurations: Panels can be purchased in three basic sizes. See Dimensions Table, Page 3 for details. Other sizes available upon request.

Wire Wrap: DATA NUMERICS' wire wrap facility is available for DL-8 Panel users. Supply us with a wire list and socket layout for a completely wired unit. (See Page 3 for typical description of special layout for 90 position socket panel.)

Availability: Most orders can be filled from stock with a maximum delivery of 30 days on production quantities.

DIMENSIONS

Series	A	B	C	D	E	F	I/O Conn.*	Decoupling Cap. Positions
DL8-180	15.90	14.80	10.00	—	4.80	8	6	27
DL8-120	10.90	9.80	—	4.90	—	6	4	18
DL8-90	8.40	7.30	—	3.65	—	6	3	12

* Number of I/O positions normally installed. Up to twice the amount installed, at additional cost, upon request.

DESCRIPTION

Rows A & E Can accommodate 14, 16, & 18 pin sockets
Rows B, C, D, & F Can accommodate 14, 16, 22, 24, & 40 pin sockets

Typical Description of Special Layout for a 90 Position Socket Panel

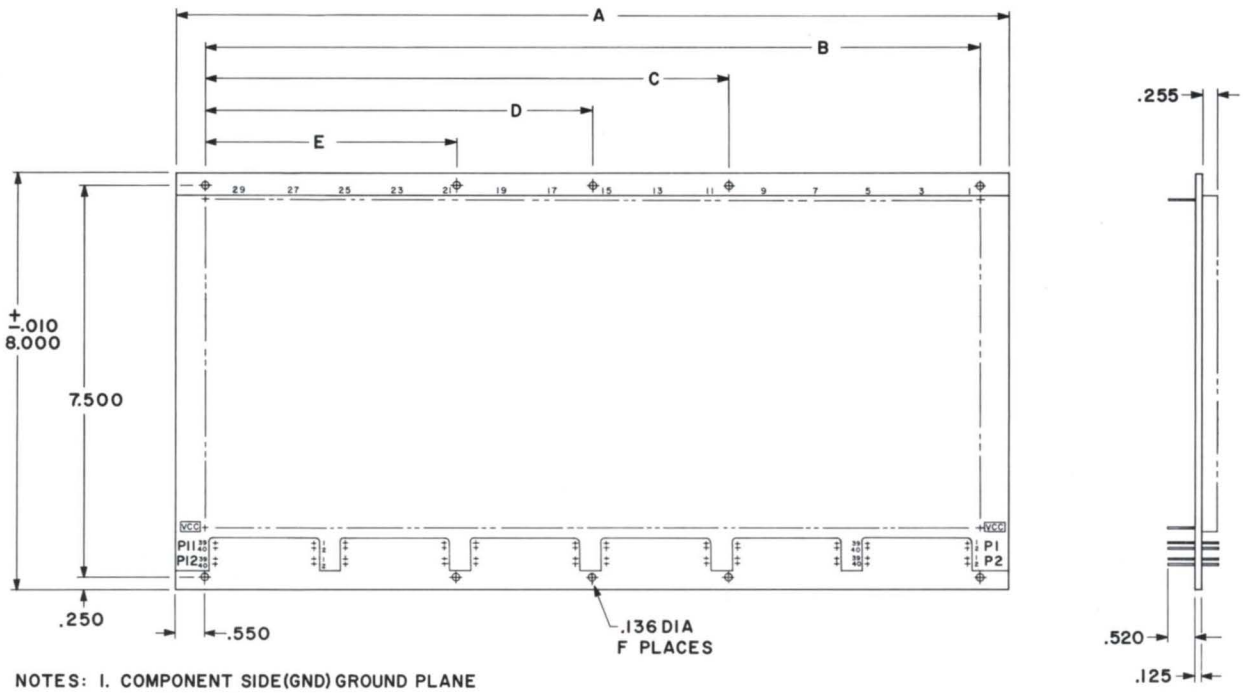
Row A A1 thru A10, 18 pin; A11 thru A15, 16 pin
Row B B1 & B4, 24 pin; B7 thru B10, 14 pin; B11, 22 pin; B14 & B15, blank
Row C C1 thru C4, blank; C5 thru C15, 14 pin
Row D D1 & D4, 24 pin; D7, 40 pin; D12, 22 pin
Row E E1 thru E10, 18 pin; E11 thru E15, 14 pin
Row F F1 thru F9, blank; F10 & F13, 22 pin

When specifying sockets larger than 16 pin in rows B, C, D and F, the following should be taken into consideration:

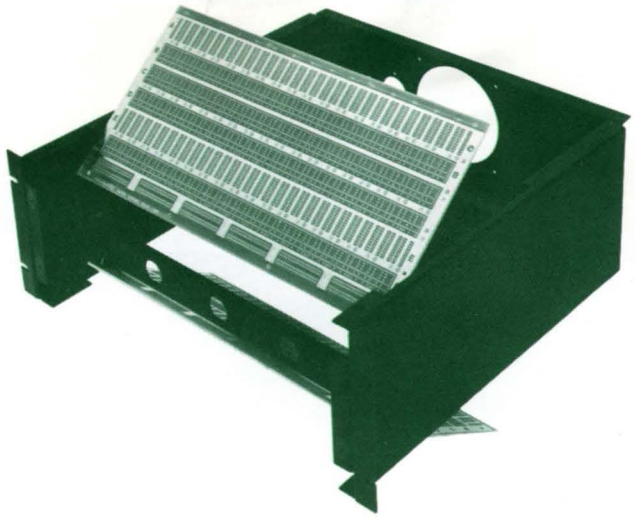
22 or 24 pin sockets require 3 row locations/socket
40 pin sockets require 5 row locations/socket

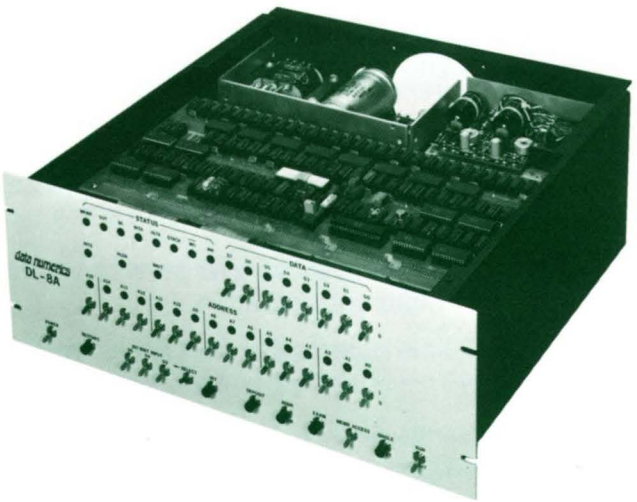
DL-8 Series Socket Panels, as noted above, are available blank, with I/O connectors only, or loaded to your specifications.

Refer to Ordering Information on Page 4 for DATA NUMERICS' part numbers



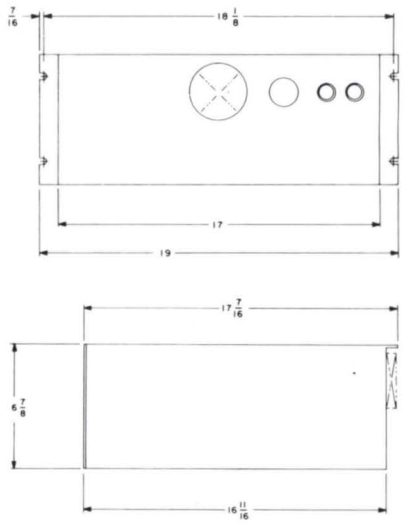
NOTES: 1. COMPONENT SIDE(GND) GROUND PLANE
WIRING SIDE(VCC) POWER PLANE





The chassis is designed to:

1. Handle up to four (4) DL8-180 size P.C. Boards or combinations of DL8-180, DL8-120, and DL8-90 P.C. Boards.
2. Facilitate both side servicing of boards.
3. Mount standard rack mountable DL-8 control panel or blank panel.
4. Accommodate mounting of power supplies as required.
5. Accommodate mounting of chassis slides.



CHASSIS DIMENSIONS

Power supplies, fans, I/O cables, interfacing cables, and various DIP sockets are available. See price list for details.

Subject to change without notice.

Data Numerics 141A Central Avenue, Farmingdale, New York 11735 Telephone: 516-293-6600

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Dear Sir:

In response to your recent inquiry, enclosed please find literature on the DL-8A Microcomputer.

The DL-8A Microcomputer was designed to satisfy the growing demand for an inexpensive but powerful microcomputer architecture. To accommodate this demand, DATA NUMERICS offers several DL-8A system configurations.

These systems and sub-systems are combinations of wire wrapped printed circuit boards, component parts, and control panels that are completely documented, so that using this documentation as a reference, most system configurations can be changed on an economical fixed price basis. Any of these configurations may be ordered at the stage of completion, most compatible with the customer's needs.

This hardware coupled with extensive documentation and system based software offers very broad based, as well as economical solutions.

The DL-8A is constructed using wire wrapped socket board assemblies assuring maximum flexibility, excellent form factor, minimum size, and eliminating many problems inherent in printed circuit card and card file construction.

One of the most important features of our universal card construction layout is its ability to accommodate various pin configurations, which take into account future proposed MSI technology, thus guaranteeing minimum obsolescence.

The basic DL-8A system is designed to accommodate 4K RAM, 2K PROM, 4-8 bit input and 4-8 bit output ports, teletype UART channel (available with an RS-232 interface), interrupt system, and buffered address and data busses. This complete system is assembled on one (1) wire wrap socket panel.

The DL-8A can be ordered as:

1. Bare Bones without any circuit elements
2. With all components, except for memory elements
3. With all components, including 2K PROM, 4K RAM
4. As a complete stand alone unit
5. With variations, such as different amounts of PROM & RAM, other I/O configurations, elimination of various items, etc.
6. With additional socket panels and accessories for system expansion

Besides allowing for ease of servicing, another primary reason for this method of fabrication is to eliminate problems such as solid state memory erasure that occur when an extender card is used on memory cards, avoiding the necessity of time consuming memory re-loading from external devices.

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All these basic configurations are offered without the DL-8A Control Panel for those applications where controls and displays exist, and also where special control panels may be required.

These DL-8A configurations can be directly coupled to teletypes, most CRT terminals, and modems, and their low profile allows them to be easily incorporated into existing consoles.

The DL-8A Control Panel is a stand alone unit complete with all necessary electronics. Combinations of the DL-8A Microcomputer and the Control Panel give an open, easily accessible layout for adding and debugging other devices that may be incorporated.

And, of course, DATA NUMERICS makes available all the component elements of these wrappable socket boards to further facilitate system design.

The DL-8A Peripherals include Paper Tape Reader and Punch, Magnetic Tape, Floppy Disc, Cartridge, Cassette, and CRT.

DATA NUMERICS offers customized I/O configurations and all the elements to accommodate their custom requirements and a construction that allows for ease of future update.

The DL-8A software is systems oriented and includes Cross Assemblers for the DEC PDP-8 and PDP-11, PROM and Paper Tape Loaders, Hardware Diagnostics, Editor and Assembler.

In conclusion, DATA NUMERICS offers the DL-8A with complete documentation, including schematics, wire list, and an extensive users' manual.

If I can be of any further service, please let me know.

Yours truly,

DATA NUMERICS, INC.

John P. Brogan

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EFFECTIVE MARCH 1976

PRICE LIST

BLANK SOCKET PANELS WITH 40 PIN I/O CONNECTORS SINGLE ROW INSTALLED ONLY

QTY	DL8-90	DL8-120	DL8-180
1-24	$45.00	$60.00	$77.00
25-49	37.00	56.00	72.00

BLANK SOCKET PANELS WITH 40 PIN I/O CONNECTORS DOUBLE ROW INSTALLED

1-24	53.00	77.00	99.00
25-49	50.00	73.00	94.00

4 Full Bay Chassis w/Mtg Hardware (2 Swingouts)	$140.00
Blank Front Panel w/Power Switch and Restart Switch	39.00
Fan with Screen and Filter	35.00

40 PIN INTERFACE CABLES - Connector One End

Discrete Wire Cable Part Number	Price	Twisted Pair Cable Part Number	Price	Flat Cable Part Number	Price
CA 1FT-1	$15.50	CT 1FT-1	$17.50	CF 1FT-1	$18.00
CA 2FT-1	16.25	CT 2FT-1	18.25	CF 2FT-1	19.00
CA 3FT-1	17.00	CT 3FT-1	19.00	CF 3FT-1	20.00
CA 4FT-1	17.75	CT 4FT-1	19.75	CF 4FT-1	21.00

Connector Both Ends

Part Number	Price	Part Number	Price	Part Number	Price
CA 1FT-2	$22.50	CT 1FT-2	$24.50	CF 1FT-2	$26.00
CA 2FT-2	23.25	CT 2FT-2	25.25	CF 2FT-2	27.00
CA 3FT-2	24.00	CT 3FT-2	26.00	CF 3FT-2	28.00
CA 4FT-2	24.75	CT 4FT-2	26.75	CF 4FT-2	29.00

DIP SOCKETS - INSTALLED

QTY	14	16	18	22	24	40
1-99	.70	.73	.98	1.25	1.40	2.25
100-249	.60	.63	.80	1.05	1.10	2.00

AS A SERVICE DATA NUMERICS WILL WIRE WRAP FROM YOUR SCHEMATICS OR WIRE RUN LIST. CALL FACTORY FOR PRICE QUOTE.

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