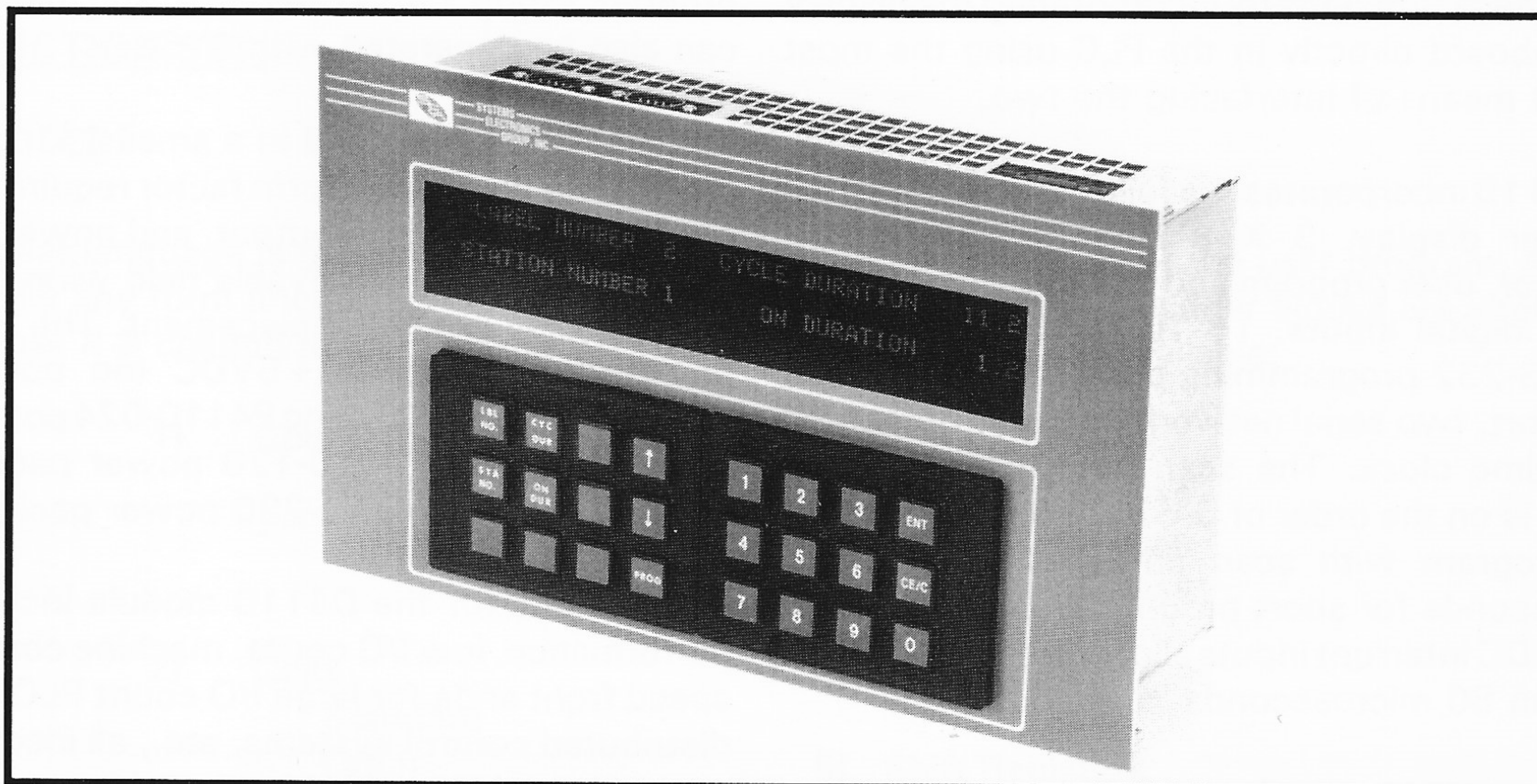




## SYSTEMS M4000

## INDUSTRIAL CONTROLLER

### D4110 PROGRAMMABLE LOGIC CONTROLLER MODULE WITH INTEGRATED DISPLAY AND KEYPAD



#### FEATURES:

- MODULE WITH BUILT-IN PLC PROCESSOR, 2-LINE X 40 CHARACTER DISPLAY, 3 X 8 KEYPAD, 16 10-30VDC DIGITAL INPUTS AND 16 10-30VDC DIGITAL OUTPUTS
- 24K BYTES BATTERY-BACKED CMOS RAM USER PROGRAM MEMORY
- 2K BYTES DATA MEMORY
- TWO ADDITIONAL 10-30VDC DIGITAL INTERRUPT INPUTS
- TWO SERIAL NETWORK INTERFACE PORTS ALLOWS COMMUNICATION TO UP TO 31 M4000 MODULES OR S3000 PROCESSOR BOARDS PER PORT
- BUILT-IN REAL TIME CLOCK PROVIDES CURRENT TIME AND DATE
- HIGH PERFORMANCE: 0.6 MSEC PER K SCAN TIMES WITH THROUGHPUTS AS LOW AS 60 MICROSECONDS
- PROGRAMMED WITH SYSdev, MS-DOS BASED SOFTWARE PACKAGE ALLOWING PROGRAMMING IN LADDER, HIGH-LEVEL(C), ASSEMBLY (MCS-51)
- RS-232/RS-422 USER PORT
- INTERFACES TO IBM PC OR COMPATIBLE VIA RS-232 FOR PROGRAM DOWNLOAD AND ON-LINE MONITORING
- EXTENSIVE INTERNAL DIAGNOSTICS/FAULT DETECTION INCLUDING WATCHDOG TIMER, COMMUNICATIONS FAULT DETECTION, HARDWARE CONFIDENCE TEST, ETC.
- REMOVABLE FIELD WIRING CONNECTORS
- MODULE POWERED EITHER FROM +5VDC, +24VDC, 120VAC, OR 230VAC BY SELECTING THE APPROPRIATE OPTIONAL POWER PACK [P4110-024 (+24VDC), P4110-120 (120VAC), OR P4110-230 (230VAC)]
- DOOR MOUNTABLE (11" x 6.75" x 3.25") PACKAGE



## GENERAL DESCRIPTION:

The D4110 combines the man machine interface of a 2-line by 40 character display and 3 X 8 keypad with the power of a high performance PLC and I/O in one convenient package. Most control applications require some sort of man machine interface which is usually accomplished by connecting a display to the PLC performing the control. This can be cumbersome both in having to implement the protocol required to interface to the display as well as impacting the performance of the PLC with additional program overhead. The D4110 overcomes these problems by incorporating the display and keyboard directly in the PLC using the most efficient means of interfacing the two.

The D4110 incorporates the following: 2-line by 40 character display, 3 X 8 keypad, built-in PLC processor, user program and data memory, 16 10-30VDC digital inputs, 16 10-30VDC digital outputs, RS-232 programming port, RS-232/RS-422 USER port, two serial network interface ports, and a real time clock. The scan time of the D4110 module is on the order of 0.6 milliseconds per K of user program with scan times as low as 120 microseconds for short programs. Two additional 10-30VDC interrupt inputs allow throughputs even less than 80 microseconds.

Program memory consists of 24K bytes of battery-

backed CMOS RAM memory. Data memory consists of 200 bytes of directly addressed non-battery backed RAM and 2K bytes of indirectly addressed battery-backed RAM.

Programming is implemented with SYSdev, an IBM PC or compatible software package that allows the user to create, document, and compile the user program as well as directly interface to the D4110 module for program download and on-line monitoring. Complete program printouts including the user program listing, cross reference, and memory map can also be generated with SYSdev.

The D4110 is packaged in a small 11" x 6.75" x 3.35" door mountable form factor requiring limited panel space. All input, output, and power wiring is implemented with removable field wiring connectors for easy module replacement. The module is powered from either +5VDC (no power pack required), +24VDC (using P4110-024 power pack), 120VAC (using P4110-120 power pack), or by 230VAC (using P4110-230 power pack).

Applications for the D4110 module include: high performance, low I/O count, machine control; high speed front ends for large I/O count PLC systems; distributed control systems, etc., all incorporating sophisticated man machine interface.

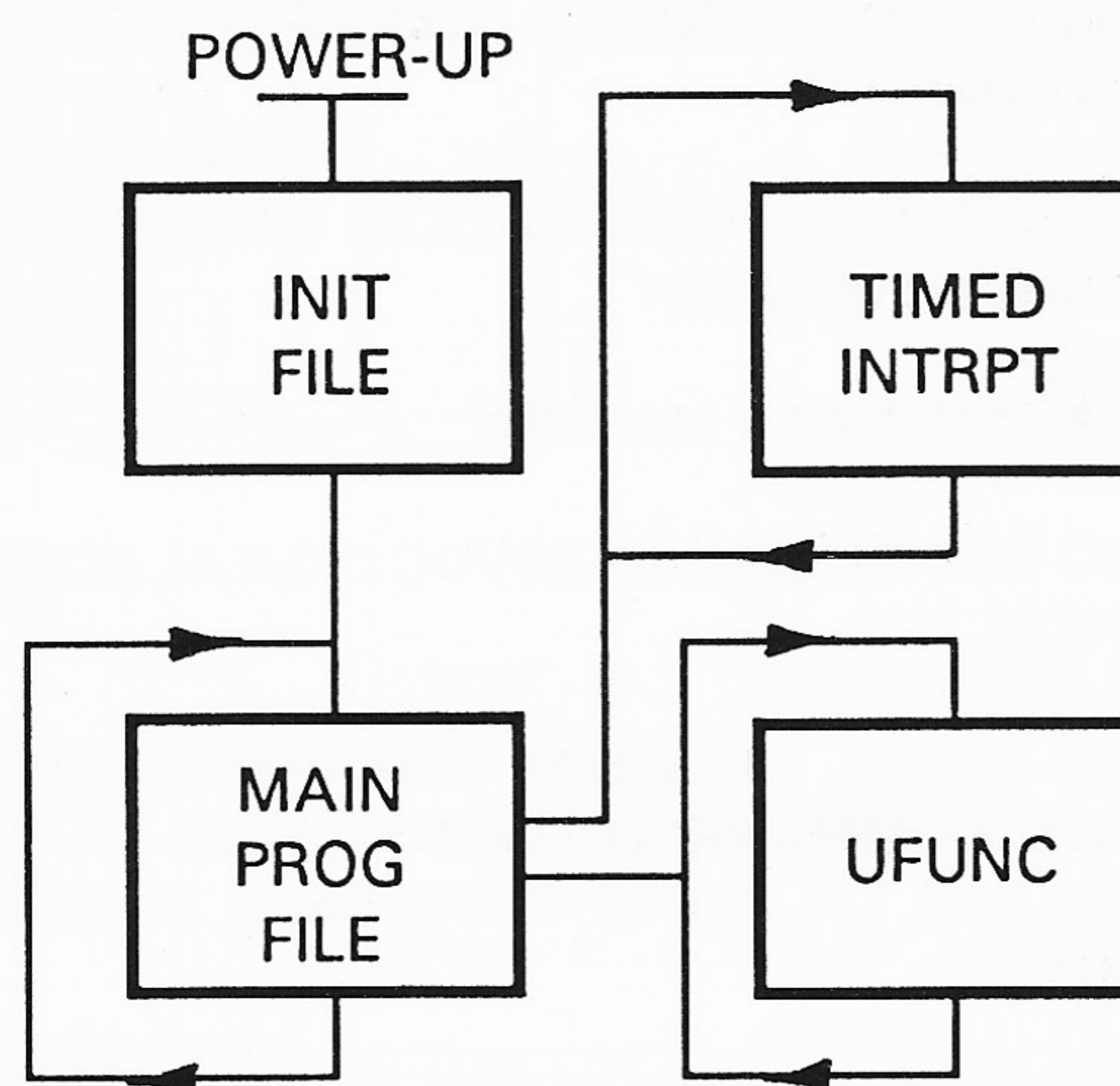
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## PROGRAM STRUCTURE:

The SYSdev programming language is a combination of Ladder, High-level (subset of C) and Assembly (MCS-51). All the files shown in the following are programmed in the same language format. Each file can be written in any combination of the language types.

The typical D4110 user program consists of the following files:

- 1) Initialization file (optional): executed once at power up.
- 2) Main Program file (required): scanned continuously.
- 3) Timed Interrupt file (optional): executed once every 0.5, 1.0, or 10.0 milliseconds as specified by the user.



- 4) User Function file (optional): up to 100 user defined subroutines which can be called from any of the above files.



## PROGRAM STRUCTURE (cont'd):

Each file is executed sequentially from beginning to end. The main program file is executed (scanned) continuously unless interrupted by the timed interrupt or either of the input interrupts. When this occurs, main program execution is suspended while the interrupt file is executed. At the completion of the interrupt, program execution resumes at the point in the main program where the user

function was called.

Each file is implemented as a series of consecutive blocks. Each block is defined as one of the three programming languages: Ladder, High-level or Assembly. Blocks of the different languages can be intermixed as necessary within the file.

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## INSTRUCTION SET:

### ● LADDER

The Ladder language is generally used to implement the boolean logic of the user program. Networks of virtually any form (including nested branches) can be implemented. Ladder blocks are implemented as a 7 row X 9 column matrix. The following ladder instructions are available:

- |                   |                    |
|-------------------|--------------------|
| 1) Contacts       | 3) Timers          |
| - Normally open   | - 0.01 time base   |
| - Normally closed | - 0.10 time base   |
|                   | - 1.00 time base   |
| 2) Coils          | 4) Counters        |
| - Standard        |                    |
| - Latch           | 5) Shift Registers |
| - Unlatch         |                    |
| - Inverted        |                    |

### ● HIGH-LEVEL (C)

The High-level language is a subset of the C programming language. High-level is used for all arithmetic, comparisons, conditional program execution, program looping, calling user functions (subroutines) and calling system functions (I/O operations). High-level blocks are implemented as a 57 row X 80 column text array.

The High-level language incorporates the following:

#### 1) Operators:

+	:add	++	:increment
-	:subtract	--	:decrement
*	:multiply	=	:equate
/	:divide	>	:greater than
%	:remainder	>=	:greater than or equal
<<	:left shift	<	:less than
>>	:right shift	<=	:less than or equal
&	:bitwise AND	!=	:not equal
	:bitwise OR	~	:complement
^	:bitwise EX-OR	*	:indirection (unary)
&&	:logical AND	&	:address operator
	:logical OR	=	:equal (assignment)



## **INSTRUCTION SET (cont'd):**

### **● HIGH-LEVEL (C):**

#### **2) Statements:**

- program statements (equations)
  - conditional program execution ("if else-if else")
  - program looping ("for", "while", and "do while" loops)
  - unconditional program jumping (goto)
  - user function calls (ufuncXX subroutines)
  - system function calls (sfuncXX I/O operations)
- 

## **ALPHANUMERIC DISPLAY:**

A 2-line by 40 character alphanumeric display is built directly into the D4110. Complete control of the display is provided through commands accessed through the user program. Commands such as: "position cursor", "advance cursor forward one space", "backspace cursor one space", "clear display", "enter characters into display",

"line feed", "scroll display" as well as an ASCII string conversion system function allow easy and complete control of the display directly in the D4110 user's program. Vacuum fluorescent display technology at 0.2" character height provides both high visibility and high character density.

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## **KEYPAD:**

The keypad is a 3-row by 8 column sealed keypad with interchangeable legends for easy user customization. Key depressed decode is per-

formed automatically by the D4110 with the key number depressed mapped directly to an input byte.

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## **INTERFACE PORTS:**

The D4110 module contains four interface ports: the PROGgramming PORT, the USER PORT, and two serial network comm ports.

**PROG PORT:** The PROG port is an RS-232 port dedicated for on-line monitoring and program download when the D4110 is connected to an IBM PC or compatible running SYSdev.

**USER PORT:** This port is available as a general purpose RS-232/RS-422 port accessed under software control of the user program. Typical uses of this port are connection to other control equip-

ment, data acquisition to a host PC, etc.

**SERIAL NETWORK PORTS:** The serial network ports conform to the S3000-N1 network. This network is a high speed (up to 344KBPS), twisted pair, serial network configured in a master/slave topology. Up to 32 D4110, M4000 modules and/or S3000 processors (nodes) can be connected on one network. Communications between the nodes on the network is controlled via commands (sfunc13) in the user application program resident in the node acting as the master.

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## **DIGITAL INPUTS:**

The digital inputs are 10-30VDC sourcing (true high) which are used to interface to the application inputs such as proximity sensors, push-buttons, etc. The input is "on" ("1") when the input voltage exceeds 10VDC and is "off" ("0") when the input voltage is below 5VDC. Individual

LED status indication is provided for each input. All inputs are optically isolated and provided with an input filter delay (nominally 1.0 milliseconds). The D4110 contains 16 standard digital inputs and two interrupt inputs.



## **DIGITAL OUTPUTS:**

The digital outputs are 10-30VDC sourcing (true high) which are used to interface to the application outputs such as solenoids, lamps, PLC inputs, etc. Each output is rated at 1 amp DC (continuous) with an inrush (pulsed) current drive capability of 5 amps for 100msec. The sum of the current within an 8 output group must not,

however, exceed 6 amps. All outputs are optically isolated and contain a transient suppression circuit to protect the output when driving inductive loads. The outputs do not contain output fusing, therefore, external fusing should be provided. The D4110 contains 16 digital outputs.

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## **DIAGNOSTICS/FAULT DETECTION:**

The D4110 contains comprehensive fault detection routines which verify the proper operation of the module at all times. In addition, the D4110 contains a fault interlock (24VDC, 100mAMP, sinking) output which can be interlocked to the control system for system shut down or annunciation when a fault is detected. Some of the faults detected include:

- Loss of scan (watchdog timer time-out)
- Invalid User program (no program loaded)
- Network communications fault
- Etc.

When a fault is detected, program execution is suspended, the RUN LED on the D4110 is extinguished, the FAULT LED is illuminated and the fault interlock output is turned "off". Using SYSdev, the fault can be displayed in the SYSdev fault menu. This menu shows the fault code, a description of the fault, and a suggested corrective action to quickly pin-point the fault and correct it.

In addition to the fault code detection, a hardware confidence test is resident in the module to provide a complete test of the module hardware. This test is initiated through SYSdev and can be used to verify the D4110 for proper operation.

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## **SPECIFICATIONS:**

### **Module Size:**

Length:	11.0"
Height:	6.75"
Width:	3.25"

### **Memory:**

Program: 24K bytes battery-backed CMOS RAM

#### **Data:**

indirectly addressed: 2K bytes battery-backed CMOS RAM

directly addressed: (non-battery backed)

Flags (F): 112 bits

Bytes (B): 200 bytes

Words (W): 100 words

### **Execution Times:**

Scan Time: 0.60msec/1K bytes

Main Program overhead: 120 microseconds

Timed Interrupt overhead: 60 microseconds



## **SPECIFICATIONS (cont'd):**

### **Display:**

# of Lines:	2
# of Characters per Line:	40
Character Height:	0.2"
Display Type:	Vacuum Fluorescent

### **Keypad:**

# of Rows:	3
# of Columns:	8
Type:	Sealed
Legends:	Interchangeable by user for easy customization

### **Interface Ports:**

PROG PORT:	
Type:	RS-232
Comm Rate:	9600 BAUD

### **USER PORT:**

Type:	RS-232/RS-422
Comm Rate:	9600 Baud
Start Bits:	1
Data Bits:	8
Stop Bits:	1
Parity:	None

### **Serial Network:**

Type:	RS-485
Comm Rate (max):	344KBPS, 229KBPS, or 106KBPS
# of nodes (max):	32
Isolation:	2000 VRMS
Distance:	1,000 ft., 2,000 ft., or 4,000 ft.
Protocol:	Proprietary

## **INPUTS**

### **Input Voltage**

Vin(on-min):	10.0 volts
Vin(on-max):	30.0 volts
Vin(off-min):	5.0 volts

### **Input Current (max):**

10 milliamps at Vin = 30volts

### **Input Filter Delay:**

min delay:	0.5 milliseconds
max delay:	2.0 milliseconds

### **Optical Isolation:**

1500 Vrms



## **SPECIFICATIONS (cont'd):**

### **OUTPUTS**

#### **Output Voltage:**

Voltage Range:	10-30VDC
Vout (on-min):	VCC - 2.00 volts
Vout (on-max):	VCC - 0.25 volts
Vout (off-max):	1.5 volts

#### **Output Current:**

Iout (on max - continuous):	1.00 amp DC
Iout (on max - pulsed):	5.00 amp DC (for 100msec)
Iout (off max - leakage):	100 microamps

#### **Output Response Time:**

max on time:	50 microseconds
max off time:	75 microseconds

#### **Optical Isolation:**

1500 Vrms

#### **Power Requirements:**

##### **No Power Pack:**

Supply Voltage:	+5VDC + -10%
Supply Current:	2.50 Amps (max)

##### **P4110-024 Power Pack:**

Supply Voltage:	+24VDC + -10%
Supply Current:	1.0 Amps (max)

##### **P4110-120 Power Pack:**

Supply Voltage:	105-125VAC (47 to 420HZ)
Supply Current:	0.5 Amps (RMS)

##### **P4110-230 Power Pack:**

Supply Voltage:	210-250VAC (47 to 420HZ)
Supply Current:	0.25 Amps (RMS)

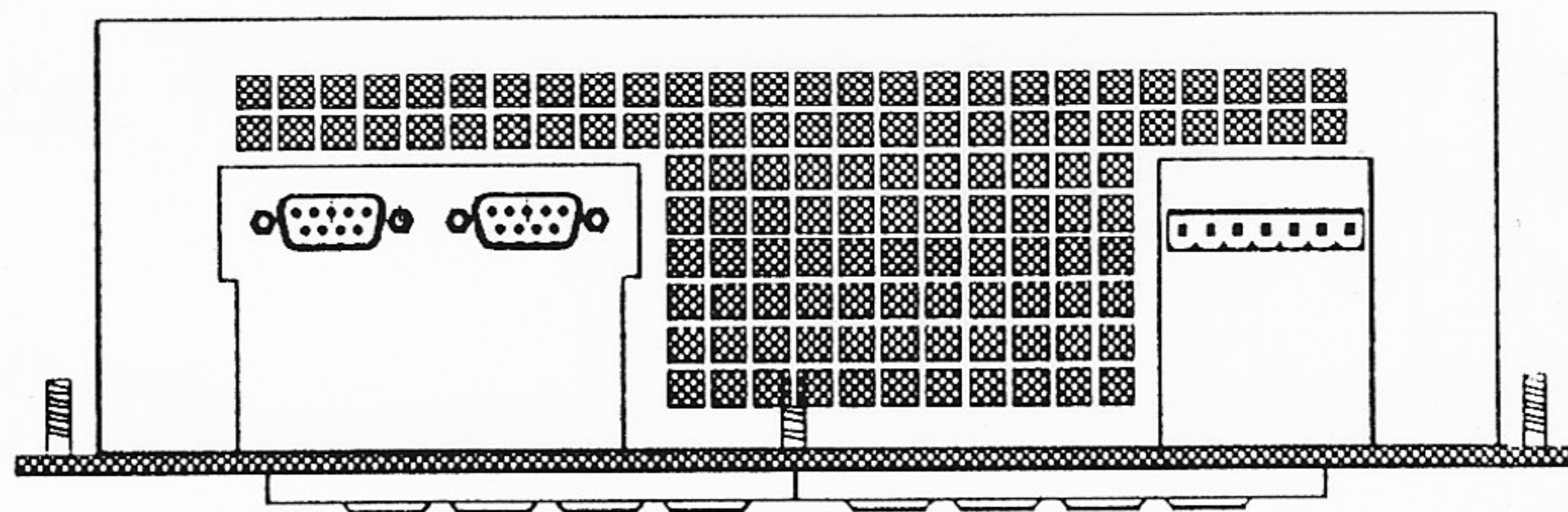
#### **Temperature Ranges:**

Storage:	0 to 60 degrees C
Operating:	0 to 50 degrees C

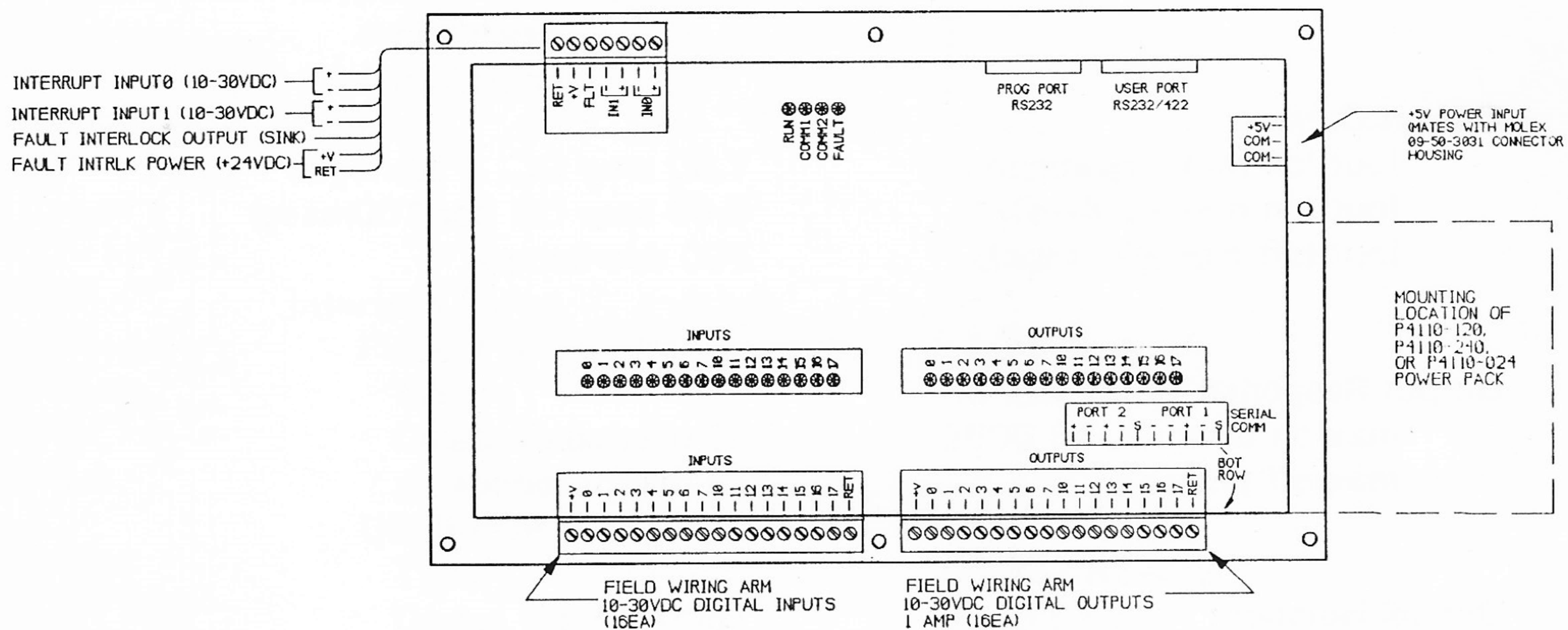
#### **Relative Humidity:**

5 to 95% non-condensing

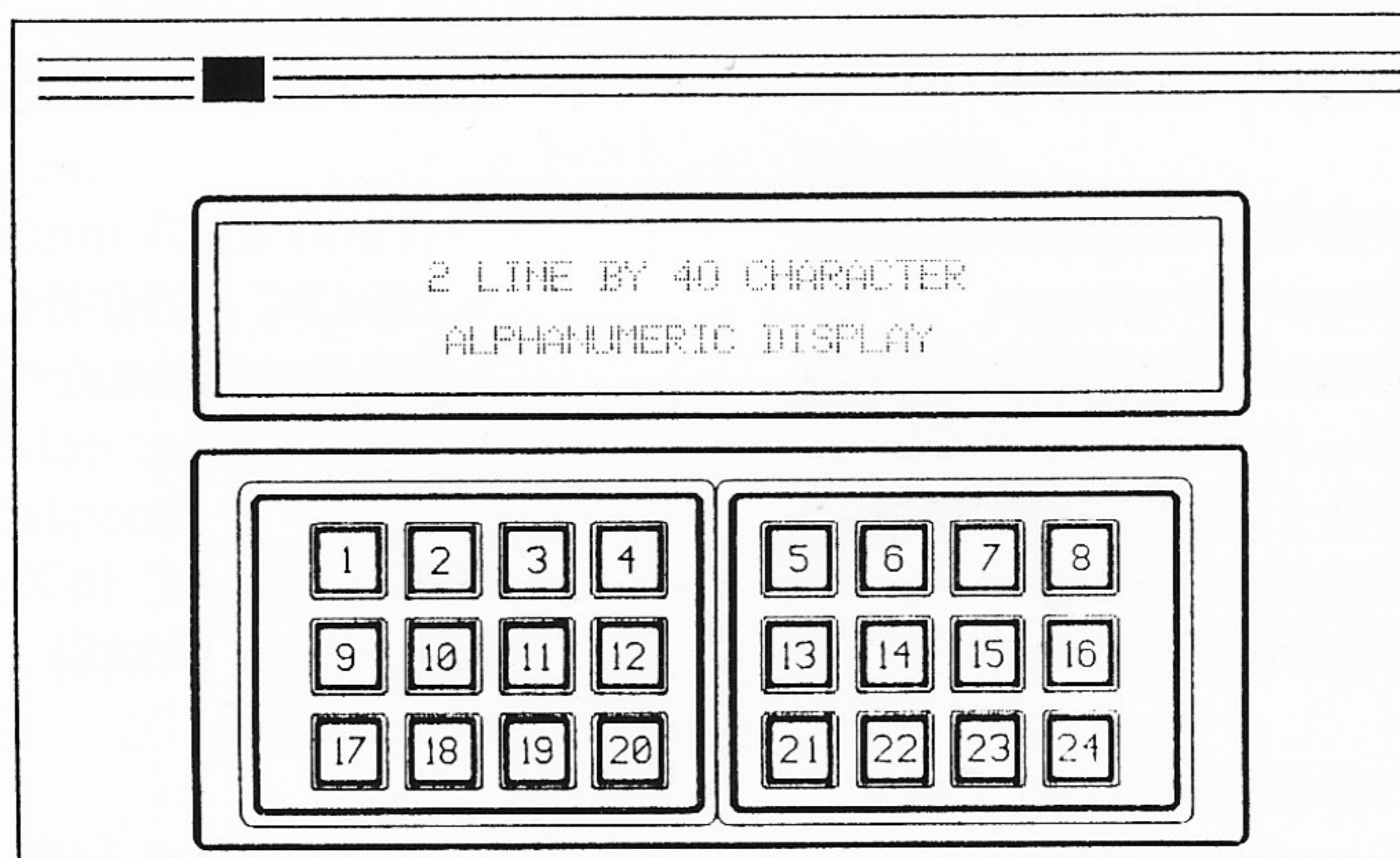




TOP VIEW



REAR VIEW



FRONT VIEW



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