



SYSTEMS

ELECTRONICS GROUP

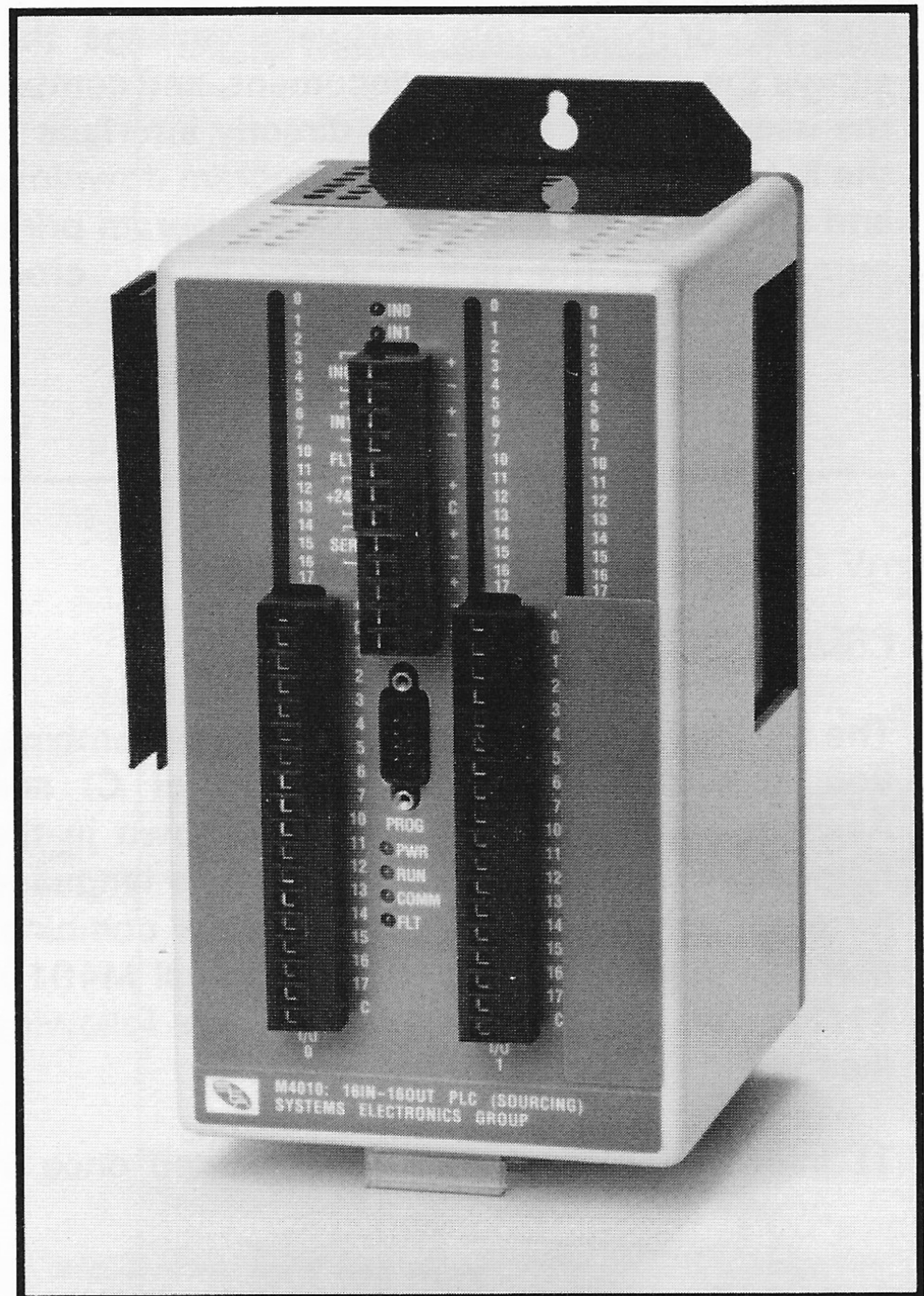
SYSTEMS M4000

INDUSTRIAL CONTROLLER

M4010/M4011/M4012 PROGRAMMABLE LOGIC CONTROLLER MODULES

FEATURES:

- MODULES WITH BUILT IN PROCESSOR, 10-30VDC DIGITAL INPUTS AND 10-30VDC DIGITAL OUTPUTS
- THREE VERSIONS AVAILABLE:
 - M4010: 16 DC INPUTS/16 DC OUTPUTS
 - M4011: 32 DC INPUTS/16 DC OUTPUTS
 - M4012: 24 DC INPUTS/24 DC OUTPUTS
- 24K BYTES BATTERY-BACKED CMOS RAM USER PROGRAM MEMORY
- 2K BYTES DATA MEMORY
- HIGH PERFORMANCE: 0.6 MSEC PER K SCAN TIMES WITH THROUGH-PUTS AS LOW AS 80 MICROSECONDS
- PROGRAMMED WITH SYSdev, MS-DOS BASED SOFTWARE PACKAGE ALLOWING PROGRAMMING IN LADDER, HIGH-LEVEL(C) AND ASSEMBLY (MCS-51)
- INTERFACES TO IBM PC OR COMPATIBLE VIA RS-232 FOR PROGRAM DOWNLOAD AND ON-LINE MONITORING
- TWO ADDITIONAL 10-30VDC DIGITAL INTERRUPT INPUTS
- BUILT IN SERIAL NETWORK INTERFACE ALLOWS COMMUNICATION TO UP TO 31 M4000 MODULES OR S3000 PROCESSOR BOARDS
- EXTENSIVE INTERNAL DIAGNOSTICS/FAULT DETECTION INCLUDING WATCHDOG TIMER, COMMUNICATIONS FAULT DETECTION, HARDWARE CONFIDENCE TEST, ETC.
- REMOVABLE FIELD WIRING CONNECTORS
- SMALL (8" X 4.5" X 5.5") PACKAGE SIZE



GENERAL DESCRIPTION:

The M4010, M4011, and M4012 PLC modules are high performance programmable logic controller modules which incorporate a built in processor, user program and data memory, 10-30VDC digital inputs, 10-30VDC digital outputs, RS-232 programming port and a serial network interface port.

The scan time of the M4010/11/12 modules are on the order of 0.6 milliseconds per K of user program with scan times as low as 80 microseconds for short programs. Two additional 10-30VDC interrupt inputs allow through-puts even less than 80 microseconds.

GENERAL DESCRIPTION (cont'd):

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 M4010/11/12 module for program download and on-line monitoring. Complete program print-outs including the user program listing, cross

reference, and memory map can also be generated with SYSdev.

The M4010/11/12 modules are packaged in a small 8" x 4.5" x 5.5" form factor requiring limited panel space. All input, output, and power wiring is implemented with removable field wiring connectors for easy module replacement.

Applications for the M4010/11/12 PLC modules include: high performance, low I/O count, machine control; high speed front ends for large I/O count PLC systems; distributed control systems, etc.

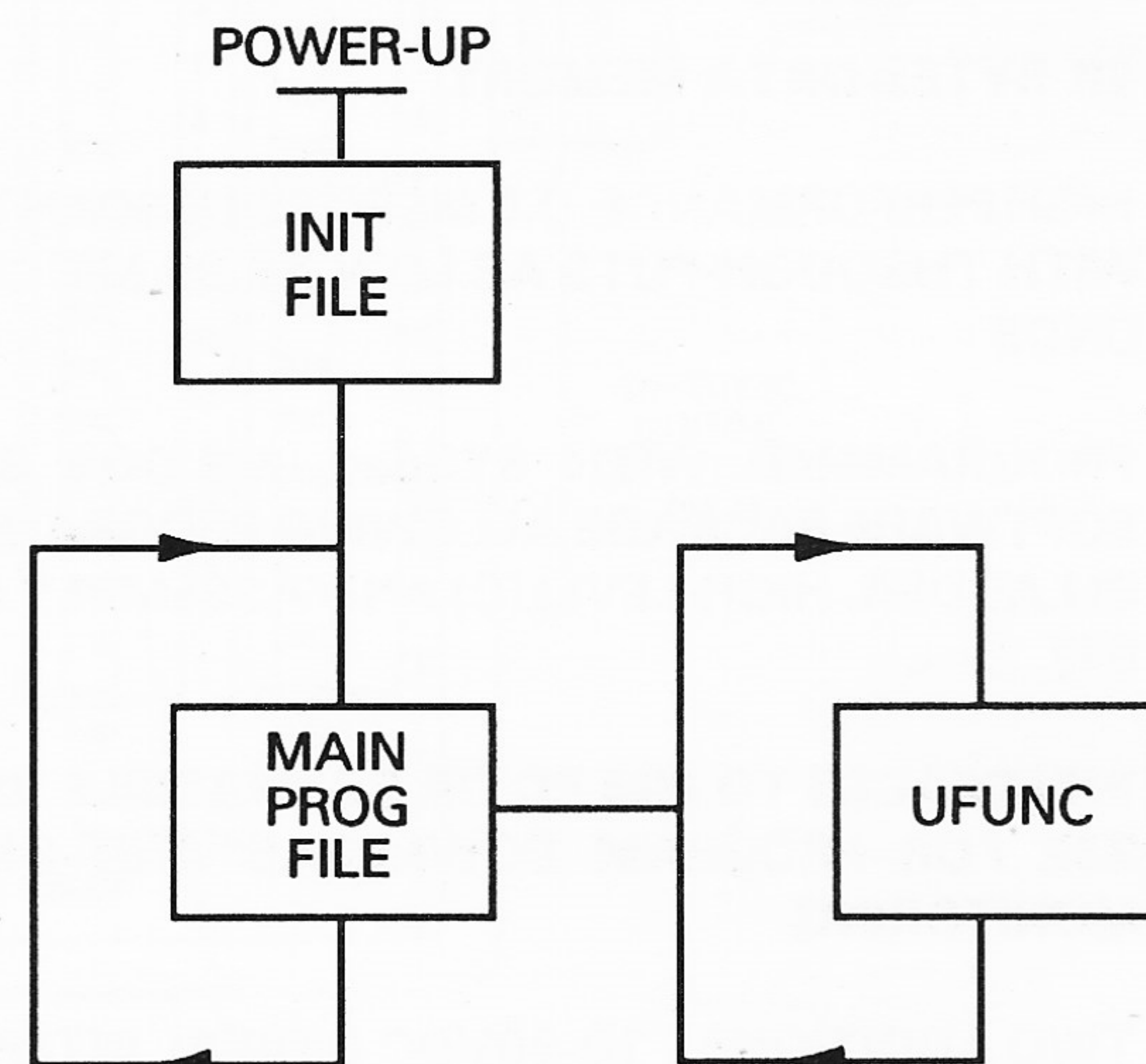
PROGRAM STRUCTURE:

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 M4010/11/12 user program consists of the following files:

- 1) Initialization file (optional): executed once at power up.
- 2) Main Program file (required): scanned continuously.
- 3) User Function file (optional): up to 100 user defined subroutines which can be called from any of the above files.

Each file is executed sequentially from beginning to end. The main program file is executed (scanned) continuously unless a user function is called from the main program. When this occurs, main program execution is suspended while the user function file is executed. At the completion of the user function, 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.

Under normal program execution, the scan time of the main program will vary as a function of the true/false conditions of the logic. When the optional "fixed scan time" feature is enabled in the M4010/11/12 configuration, the scan time can be set to either 0.5, 1.0, or 10.0 milliseconds. This allows fixed rate sampling or high speed time bases to be implemented with the M4010/11/12 modules.

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)

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)

INTERFACE PORTS:

The M4010/11/12 modules contain two interface ports: the serial network comm port and the PROGramming port.

SERIAL NETWORK: The serial network port conforms 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 M4010/11/12 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.

PROG PORT: The PROG port is an RS-232 port dedicated for on-line monitoring and program download when the M4010/11/12 is connected to an IBM PC or compatible running SYSdev.

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).

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.

DIAGNOSTICS/FAULT DETECTION:

The M4010/11/12 contains comprehensive fault detection routines which verify the proper operation of the module at all times. In addition, the M4010/11/12 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 M4010/11/12 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 M4010/11/12 for proper operation.

SPECIFICATIONS:

Module Size:

Length: 8.0"
Height: 5.5"
Width: 4.5"

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 per 1K bytes
Main Program overhead: 60 microseconds
Fixed Scan Time bases: 0.5, 1.0, and 10.0 milliseconds

Interface Ports:

PROG PORT:

Type: RS-232
Comm Rate: 9600 BAUD

Serial Network:

Type: RS-485
Comm Rate (max): 344KBPS
of nodes (max): 32
Isolation: 2000 VRMS
Protocol: Proprietary

Power Requirements:

Supply Voltage: 24VDC $\pm 10\%$
Supply Current: 0.60 Amps (max)

Temperature Ranges:

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

Relative Humidity:

5 to 95% non-condensing

Digital Input Voltage:

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

Digital Input Current (max): 10 milliamps
at Vin = 30 volts

Digital Input Filter Delay:

min delay: 0.5 milliseconds
max delay: 2.0 milliseconds

Digital Input Optical Isolation:

1500 Vrms

Digital 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

Digital Output Current:

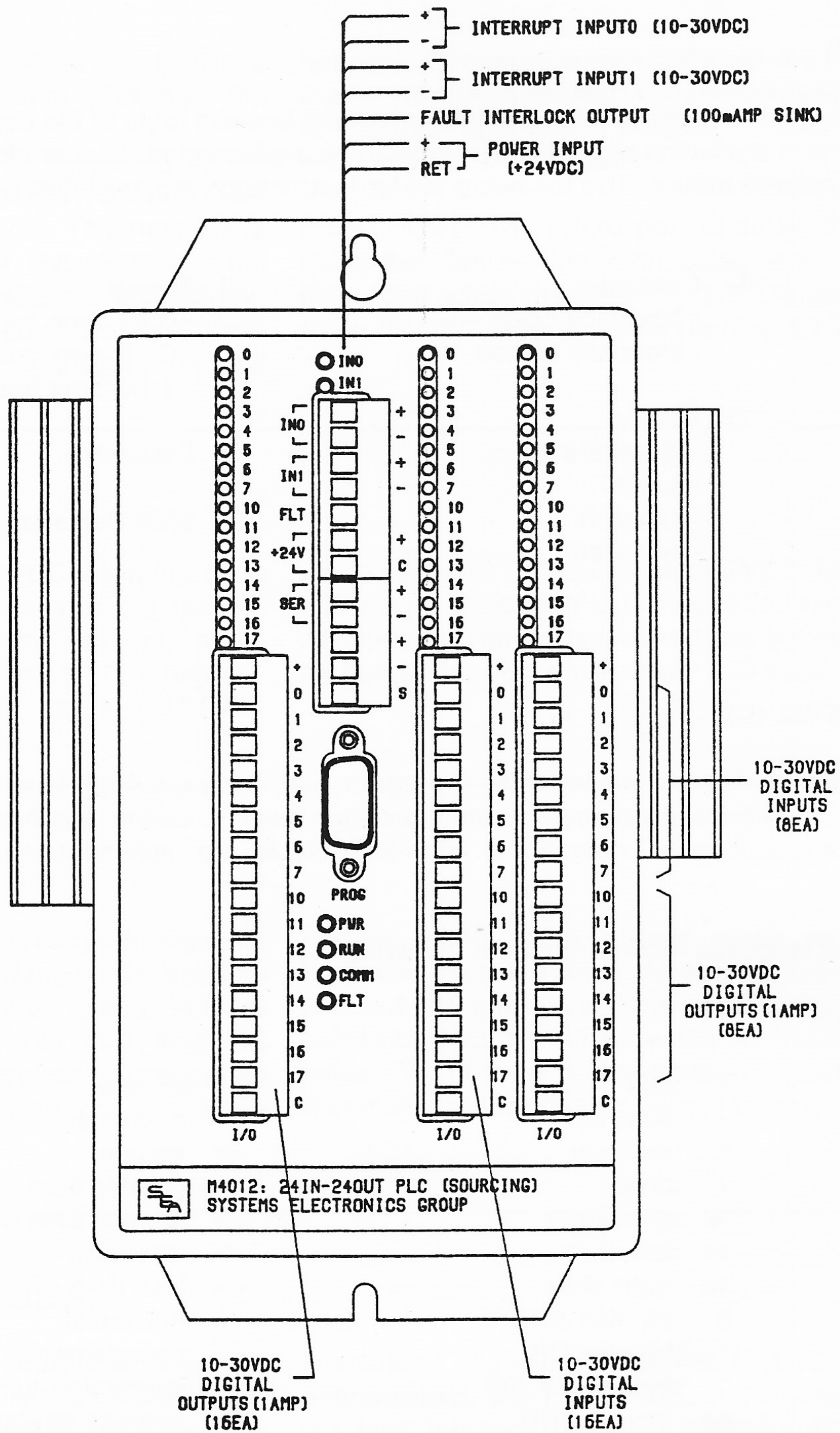
Iout (on max - continuous): 1.00 amp DC
Iout (on max - pulsed): 5.00 amp DC
Iout (off max - leakage): 100 microamps

Digital Output Response Time:

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

Digital Output Optical Isolation:

1500 Vrms



M4012
24IN-24OUT PLC MODULE



SYSTEMS ELECTRONICS GROUP

DIVISION OF SYSTEMS ENGINEERING ASSOCIATES, INC.
14989 W. 69TH AVE, ARVADA, COLORADO, P.O. BOX 750 80001
(303) 421-0233 FAX (303) 421-8108