



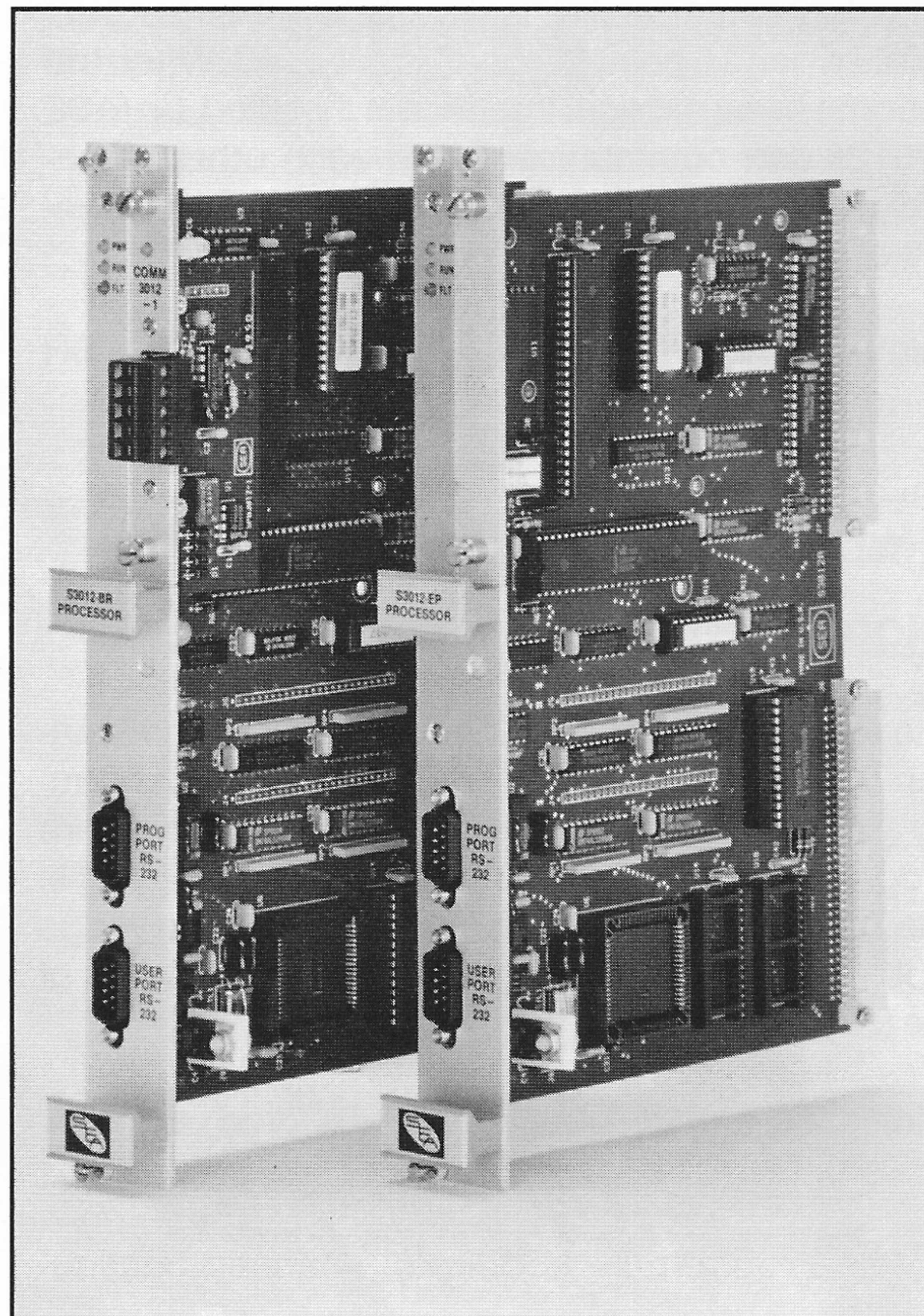
## SYSTEMS S3000

## INDUSTRIAL CONTROLLER

### S3012-BR/S3012-EP MAIN PROCESSOR BOARDS

#### FEATURES:

- FAST PROGRAM EXECUTION TIME (0.25 MILLI-SECONDS PER 1K BYTES PROGRAM MEMORY)
- FAST SYSTEM THROUGH-PUT (0.25 MILLI-SECONDS USING HIGH SPEED TIMED INTERRUPT)
- 44K BYTES PROGRAM MEMORY
- 8K BYTES DATA MEMORY
- PROGRAMMED WITH SYSdev, MS-DOS BASED SOFTWARE PACKAGE ALLOWING PROGRAMMING OF THE S3012 IN LADDER, HIGH-LEVEL (C) AND ASSEMBLY (MCS-96)
- INTERFACES TO IBM PC OR COMPATIBLE VIA RS-232 FOR PROGRAM DOWNLOAD AND ONLINE MONITORING
- MULTIPLE INTERFACE PORTS: PROGRAMMING PORT (RS-232), USER PORT (RS-232) AND OPTIONAL SERIAL NETWORK INTERFACE
- 16 I/O SLOT (256 I/O POINT) ADDRESSING CAPABILITY
- EXTENSIVE INTERNAL DIAGNOSTICS/FAULT DETECTION INCLUDING WATCHDOG TIMER, COMMUNICATIONS FAULT DETECTION, HARDWARE CONFIDENCE TEST, ETC.
- STATUS LEDS ON FACEPLATE (POWER, RUN AND FAULT)



- STANDARD DOUBLE HEIGHT EUROCARD
- TWO VERSIONS AVAILABLE: S3012-BR (BATTERY BACKED CMOS RAM PROGRAM MEMORY) AND S3012-EP (EPROM PROGRAM MEMORY)

#### GENERAL DESCRIPTION:

The S3012 Processor board is used as the primary processor in 4-card, 8-card, and 16-card S3000 systems. As the primary processor, the S3012 controls the S3000 bus, directing communications between the S3012 and other intelligent I/O boards, reads and writes all basic I/O boards in the system, and executes the user application program.

Programming is implemented using SYSdev, an IBM PC or compatible software package that allows the user to create, document, and compile the user application program as well as directly interface with the S3012 for program download and online monitoring. Typical program scan times are on the order of 0.25 milliseconds per 1K bytes program memory.



## GENERAL DESCRIPTION (contd):

Using the high speed timed interrupt, system through-puts as low as 0.25 milliseconds are possible. The program is developed off-line, compiled, then down loaded into the S3012 (S3012-BR only) or programmed into EPROMS for installation in the S3012 (S3012-EP only).

I/O address capability is 16 I/O slots or 256 I/O points when 16 point I/O boards are used. When the optional serial network interface is installed, up to 32 S3012s can communicate with each other, effectively providing a means to expand the I/O capabilities of the S3012 beyond one 16 slot rack.

Two versions of the S3012 are available: S3012-BR

and S3012-EP. The S3012-BR contains 44K bytes of battery backed CMOS RAM program memory while the S3012-EP contains 44K bytes of EPROM program memory (implemented with 2ea 27C256 EPROMS). The S3012-BR is used when faster program development times and ease of use are essential while the S3012-EP is used when program security is of the utmost importance. Both versions are 100% compatible with regard to user program development. Both versions contain 8K bytes of data memory in which 992 flags (single bit variables) reside, along with the remainder of data memory which can be referenced as bytes or words. All but 124 of the data bytes are battery backed for data retention at power-down.

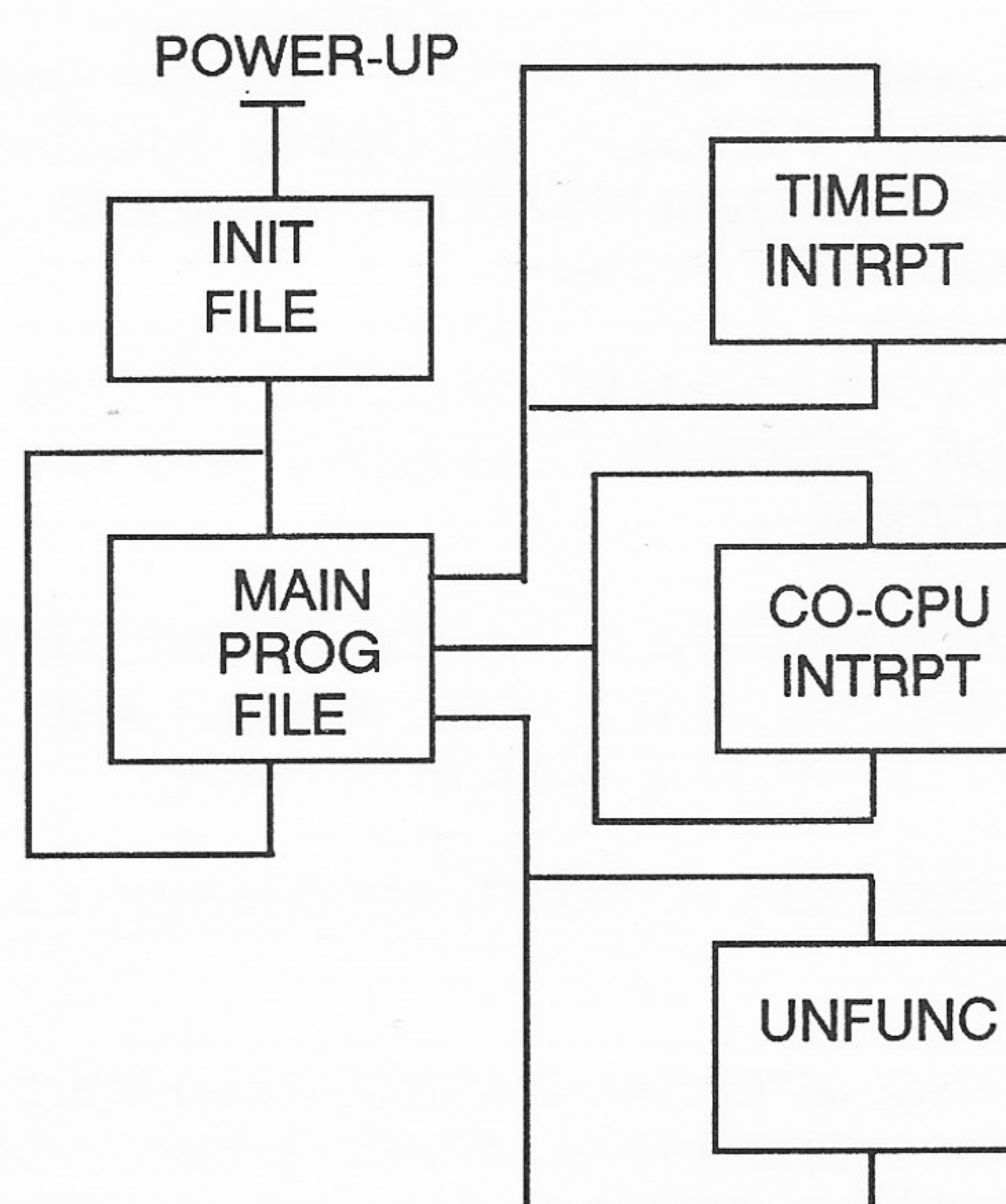
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## PROGRAM STRUCTURE:

The SYSdev programming language is a combination of Ladder, High-level (subset of C) and Assembly (MCS-96). 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 S3012 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 0.250 to 65.000 milliseconds as set by the user.
- 4) CO-CPU communications Interrupt file (optional): executed in response to an intelligent I/O communications request.
- 5) User Function files (optional): up to 100 user defined subroutines which can be called from any of the above files.

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.



Each file is executed sequentially from beginning to end. The main program file is executed continuously unless interrupted by the timed interrupt or CO-CPU interrupt. When an interrupt 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 interrupt occurred. All basic I/O is updated (inputs read, outputs written) at the beginning of each main program scan.



## INSTRUCTION SET:

### o 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        |                    |

### o 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)



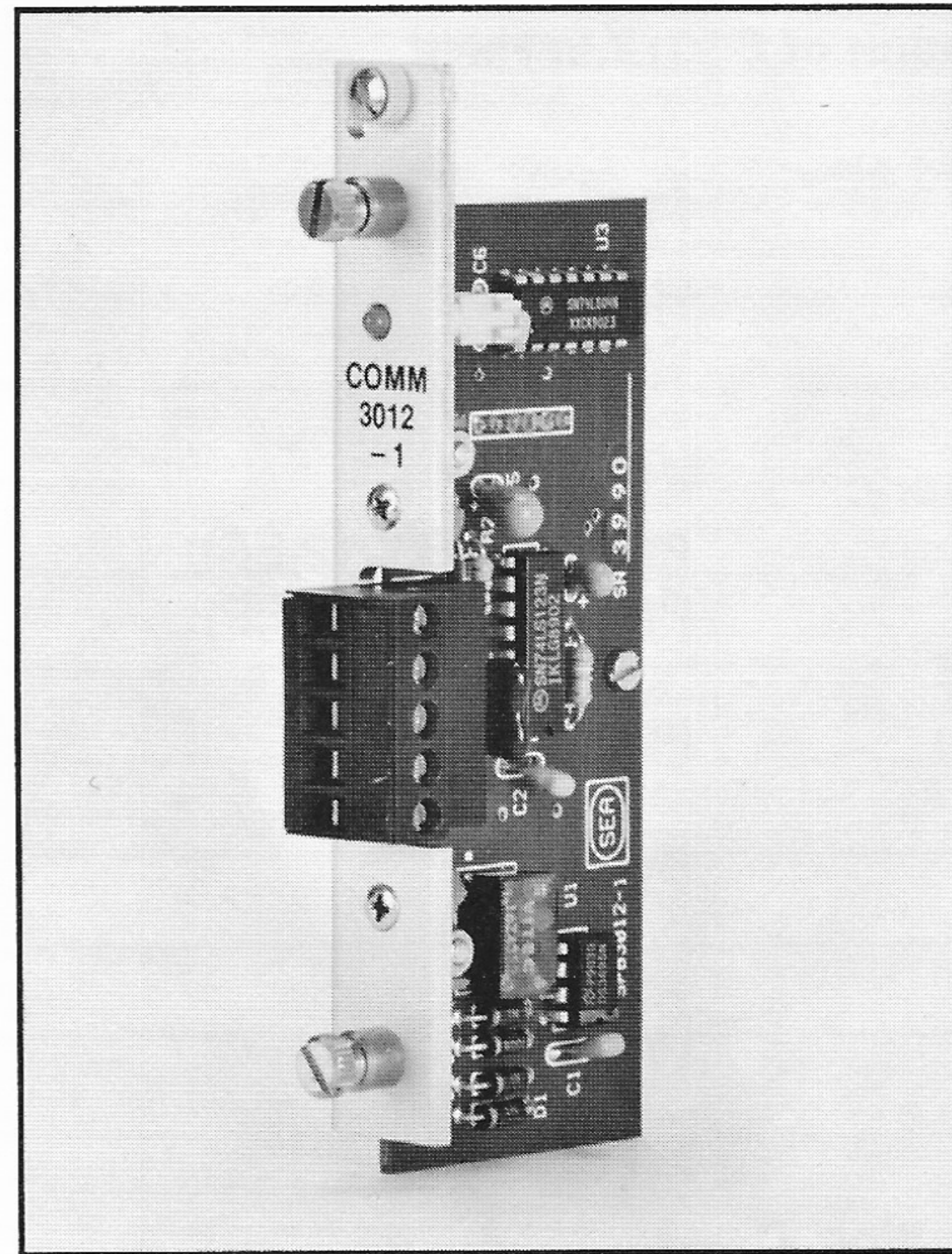
## **INTERFACE PORTS:**

The S3012 contains three interface ports: the PROGramming PORT, the USER PORT, and the optional serial network comm port.

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

**USER PORT:** This port is available as a general purpose RS-232 port accessed under software control of the user program. Typical uses of this port are connection to operator workstations or displays for system status or data acquisition.

**SERIAL NETWORK:** An optional serial network interface board can be mounted on the S3012 to allow communications between up to 32 S3012s. As an example, an SPB3012-1 network interface board, which implements the S3000-N1 network, could be mounted to the S3012. The S3000-N1 network is a high speed (344KBPS), twisted pair, serial network configured in a master/slave topology. Communication between S3012s on the network is control-



led via commands in the user application program resident in the master S3012. Future network options could also be used when available.

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## **DIAGNOSTICS/FAULT DETECTION:**

The S3012 contains comprehensive fault detection routines which verify the proper operation of the S3012 at all times. Some of the faults detected include:

- CMOS RAM Battery Low fault
- Bad program RAM memory
- Invalid User program
- Intelligent I/O communications fault
- Network communications fault
- Loss of program scan/watchdog timer time-out

When a fault is detected, program execution is suspended, the FAULT LED on the S3012 faceplate is illuminated and a fault interlock to the PS3007 power supply is activated. The PS3007 power supply interlock can be interlocked to the system to provide a complete system shut-down if desired. Using SYSdev, the fault can be displayed in the SYSdev fault display. This display 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 S3012 to provide a complete test of the entire S3012 hardware. This test is initiated through SYSdev and can be used to verify all functions of the S3012 for proper operation.



## **SPECIFICATIONS:**

### **Location of S3012 in rack:**

Proc Slot (next to PS3007)

### **Board size:**

Length:	9.15"
Height:	6.30"
Width:	1.20"

### **Memory:**

Program (S3012-BR):	44K bytes battery backed CMOS RAM
Program (S3012-EP):	44K bytes EPROM

### **Data:**

Flags:	992 (volatile)
Bytes:	124 (volatile) 7,664 (battery-backed)
Words:	62 (volatile) 3,832 (battery-backed)

### **Execution Times:**

Scan Time:	0.25msec per 1K bytes
Main program overhead:	0.25msec-.30msec
Minimum Through-put:	0.25msec (using timed interrupt)

### **I/O Address Capability:**

I/O slots in S3000 rack:	16
I/O points in rack:	256

### **Interface Ports:**

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

USER PORT: Type:	RS-232
Comm Rate:	300, 600, 1200, 2400, 4800, 9600 BAUD

### **Serial Network: S3000-N1:**

Type:	RS-485
Comm Rate:	344KBPS
# of nodes (max):	32
Isolation:	2000 VRMS
Distance:	1000 ft.
Protocol:	Proprietary

### **Power Requirements:**

Icc (+5VDC):	1.20 amps (MAX)
Icc (+12VDC):	0.10 amps (MAX)
Icc (-12VD):	0.10 amps (MAX)

### **Temperature Range:**

Storage:	0 to 70 degrees C
Operating:	0 to 60 degrees C

### **Relative Humidity:**

5 to 95% (Non-Condensing)



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