SYSTEMS ELECTRONICS GROUP

SERIES 3000 — INDUSTRIAL CONTROLLER

S3024
6-IN/6-OUT INTELLIGENT I/O (CO-CPU) BOARD

FEATURES:

- o INTELLIGENT I/O BOARD WITH DIGITAL INPUTS, DIGITAL OUTPUTS, AND BUILT-IN PROCESSOR WHICH EXECUTES USER APPLICATION PROGRAM INDEPENDENTLY OF MAIN PROCESSOR
- o 24K BYTES USER PROGRAM MEMORY
- o 2K BYTES DATA MEMORY
- o 6 DIGITAL 10-30VDC DIFFERENTIAL INPUTS WITH THE FIRST TWO INPUTS AVAILABLE AS INDIVIDUAL INTERRUPTS OR QUADRATURE INTERRUPT FOR USE WITH QUADRATURE ENCODERS
- o 6 DIGITAL 10-30VDC SOURCING OUTPUTS
- o HIGH PERFORMANCE: 0.6 MILLISECOND PER K SCAN TIMES WITH THROUGH-PUTS AS LOW AS 80 MICROSECONDS
- o PROGRAMMED WITH SYSdev, DOS BASED SOFTWARE PACKAGE ALLOWING PROGRAMMING OF THE S3024 IN LADDER, HIGH-LEVEL (C), AND ASSEMBLY (MCS-51)
- o INTERFACES TO IBM PC OR COMPATIBLE VIA RS-232 FOR PROGRAM DOWNLOAD AND ON-LINE MONITORING
- o EXTENSIVE INTERNAL DIAGNOSTICS/FAULT DETECTION INCLUDING: WATCHDOG TIMER, HARDWARE CONFIDENCE TEST, ETC.
- o REMOVABLE FIELD WIRING CONNECTORS
- o STANDARD DOUBLE HEIGHT EUROCARD

GENERAL DESCRIPTION:

The S3024 is an intelligent I/O board equipped with it's own processor and it's own dedicated I/O (6 inputs and 6 outputs). The S3024 is used as a CO-CPU board in S3000 systems where the S3024 is programmed to perform a specific task and interface directly with the I/O related to the task. This reduces the work load of the main processor, thus increasing the total system power and through-put.

SYSTEM CONFIGURATION:

As part of the user program development through SYSdev, the user must set the system configuration of the S3024. The parameters set in the configuration are:

1) **Target Board:** S3024 (board program will run on).

2) **Input0 Interrupt enable:** When set to "yes", the input interrupt feature is enabled. This can be used when IN0 and/or IN1 is to activate an interrupt on the "off"-to-"on" transition of IN0 or IN1, or when the IN0/IN1 quadrature mode is used. When the interrupt occurs, ufunc00 will be called. If the input interrupt is disabled (set to "no"), IN0 and IN1 will not activate the interrupt (call ufunc00).

3) **Co-Cpu com interrupt:** This is set to "yes" if the S3012 main processor will be executing an sfunc05 communications request to the S3024. When this occurs, the Co-Cpu comm file is called in response to the interrupt and must contain a corresponding sfunc06 to respond to the S3012's sfunc05. If the S3012 main processor will not be interrupting the S3024, the Co-Cpu comm interrupt should be set to "no" in the S3024.

4) **Fixed scan time/Timed Interrupt Mode:** In addition to the standard free running main scan time, the S3024 can incorporate either a fixed main scan time or a timed interrupt (but not both). Either the fixed main scan or timed interrupt can be set to 0.5, 1.0, or 10.0 milliseconds. If the fixed main scan is to be used, set "Fixed main scan" to "yes". If the timed interrupt is to be used, set "Timed Interrupt" to "yes". If neither is to be used, set both to "no".

DIGITAL INPUTS:

The six digital inputs (IN0 - IN5) are 10-30VDC differential inputs which can be connected as sinking, sourcing, or differential. The inputs are used to interface to application inputs such as proximity sensors, timing signals, push-buttons, etc. The inputs are "on" when the "+" terminal of the input exceeds the "-" terminal by 10 volts. All inputs are optically isolated. IN2 through IN5 are provided with an input filter delay (nominally 1.0 milliseconds) while the response time of IN0 and IN1 is typically 60 microseconds.

INPUTS 0 AND 1:

The first two inputs, IN0 and IN1, can be used as either individual interrupt inputs, as a quadrature interrupt, or as standard inputs. The states ("on" or "off") of inputs 0 and 1 are read at the following port pins:

Input	Port Pin	State
IN0	P34	0=off, 1=on
IN1	P35	0=off, 1=on

The port pin is read by referencing either P34 or P35 in a high-level block. Note that the state of the pin is read when the instruction that references the port pin is executed.

INPUTS 0 AND 1 (cont'd):

When inputs IN0 and IN1 are used as interrupt or quadrature inputs, the following port pins are used to enable and control the various interrupt modes:

Port Pin	Name	Function
P10	IN0_PP	State of IN0 "off"-to-"on" transition latch. Set to a "1" when IN0 makes an "off"-to-"on" transition and EN_QD (P12) is set to "0" and IN_ACK (P15) is set to "1". IN_PP (P10) is set to "0" when IN_ACK (P15) is set to "0".
P12	EN_QD	0 = IN0/IN1 quadrature mode enabled, 1 = IN0/IN1 quadrature mode disabled.
P13	EN0	0 = IN0 enabled as individual interrupt, 1 = IN0 disabled as individual interrupt.
P14	EN1	0 = IN1 enabled as individual interrupt, 1 = IN1 disabled as individual interrupt.
P15	IN_ACK	0 = reset quadrature transition latches, 1 = enable quadrature transition latches.

Note: at power up, port pins P12 through P15 are all set to "1". The above port pins can only be set or cleared in high-level blocks.

Quadrature Input Mode: To use IN0 and IN1 to interface to a quadrature encoder, set EN_QD (P12) to "0" and enable the Input0 interrupt in the S3024 system configuration. A ufunc00 should then be created to decode the direction of rotation when the quadrature interrupt occurs. The quadrature encoder should be connected with phase A to IN0 and phase B to IN1. IN0 and IN1 cannot be used as individual interrupts if quadrature mode is selected, thus EN0 (P13) and EN1 (P14) must both be set to "1".

The interrupt will occur, and ufunc00 called, when IN0 makes either an "off"-to-"on" or an "on"-to-"off" transition. This sets an internal hardware latch which initiates the interrupt. The ufunc00 should then test the state of IN0 (P34), IN1 (P35), and IN0_PP (P10) to determine which direction the shaft moved (see example at the back of this data sheet). IN_ACK (P15) must then be toggled to "0" and then back to "1" to reset the transition latches in preparation for the next transition.

Individual Interrupt Mode: To use IN0 and/or IN1 as individual interrupts, EN0 (P13) should be set to "0" to enable IN0 as an interrupt and EN1 (P14) should be set to "0" to enable IN1 as an interrupt. These can both be set, or either one by itself can be set, to enable that particular input as an interrupt. The Input0 interrupt must also be enabled in the S3024 system configuration and ufunc00 must be created to respond to the interrupt when it occurs.

The interrupts are activated when the respective input transitions from "off"-to-"on". Ufunc00 is called when this occurs. If both IN0 and IN1 are enabled as interrupts, the states of P34 (IN0) and P35 (IN1) will have to be read in order to determine which input initiated the interrupt. Also note that only one input can initiate the interrupt at a time. If one input is already "on", the other input cannot initiate the interrupt. The other input has to be "off" for the respective input to initiate the interrupt.

INPUTS 2 THROUGH 5

The remaining 4 inputs are all standard inputs, the states of which are automatically read at the beginning of the main program scan, and at the beginning of the timed interrupt if it is enabled. These inputs are memory mapped, that is the status of these inputs is stored in two reserved "B" variable byte locations. The bits from these bytes can then be referenced just as any other bit variables are referenced in the program. The input image byte addresses are:

Input	Byte.Bit address	Function
IN2	B60.0	Main Program input status (0=off, 1=on)
IN3	B60.1	Main Program input status (0=off, 1=on)
IN4	B60.2	Main Program input status (0=off, 1=on)
IN5	B60.3	Main Program input status (0=off, 1=on)
IN2	B62.0	Timed Interrupt input status (0=off, 1=on)
IN3	B62.1	Timed Interrupt input status (0=off, 1=on)
IN4	B62.2	Timed Interrupt input status (0=off, 1=on)
IN5	B62.3	Timed Interrupt input status (0=off, 1=on)

Note: Bits 4-7 in both B60 and B62 are updated when the inputs are read as well (set to "0") and thus are reserved. Do not use these bits for any other purpose.

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 of 5 amps for 100msec. All outputs are optically isolated and contain a transient suppression circuit to protect the output when driving inductive loads. The outputs do not contain fusing, therefore external fusing should be provided.

The status of the outputs is taken from an output image byte. The output image byte is memory mapped, that is the status that is to be written to the outputs is stored in a reserved "B" variable byte location. The bits from this byte can then be set just as any other bit variables are set in the program. The state of the output image byte is then automatically written to the outputs at the beginning of the main program scan, or at the end of the timed interrupt if it is enabled. The output image byte addresses are:

Output	Byte.Bit address	Function
OUT0	B61.0	Output0 status (0=off, 1=on)
OUT1	B61.1	Output1 status (0=off, 1=on)
OUT2	B61.2	Output2 status (0=off, 1=on)
OUT3	B61.3	Output3 status (0=off, 1=on)
OUT4	B61.4	Output4 status (0=off, 1=on)
OUT5	B61.5	Output5 status (0=off, 1=on)

MAIN PROCESSOR INTERFACE:

The S3012 main processor communicates to the S3024 via the sfunc05 and sfunc06 communications system function. The communications can be set up with either the S3012 interrupting the S3024 (sfunc05 in S3012 main program and sfunc06 in S3024 Co-Cpu comm interrupt) or with the S3024 interrupting the S3012 (sfunc05 in S3024 main program and sfunc06 in S3012 Co-Cpu comm interrupt).

If the S3012 is to be interrupted by the S3024, the S3012 must incorporate an sfunc05 call to the S3024 in it's initialization file while the S3024 must incorporate a corresponding sfunc06 in it's initialization file. This is done so that the identifier of the S3024 is set such that when it interrupts the S3012, the S3012 will know from what slot the interrupt was initiated from.

Refer to the S3012 User's manual for complete details on the sfunc05 and sfunc06 system functions.

INTERFACE PORTS:

The S3024 contains one interface port: the PROGramming PORT. The PROG PORT is an RS-232 port generally used for on-line monitoring and program down-load when connected to an IBM PC or compatible running SYSdev.

In addition, this port can be used as a general purpose RS-232 USER port accessed under software control using the sfunc10 (user port read) and sfunc11 (user port write) system functions. Typical applications in this mode include: connection to operator workstations, host computers, ink jets, etc.

The function of the port is selected with flag F104. If F104 is a "0", the port functions as the PROG PORT to communicate with SYSdev. If F104 is a "1", the port functions as the USER port, controlled with sfunc10 and sfunc11. Note that if F104 is a "1", SYSdev will not be able to communicate with the S3024 for program down-load or on-line monitoring and vice-versa if F104 is set to "0", sfunc10 and sfunc11 will not function properly.

See the M4010 User's manual for complete details on using the PROG PORT as a USER port.

DATA MEMORY MAP:

The S3024 contains two distinct data memory spaces: 200 bytes of volatile (non-battery backed) data memory and 2K bytes of non-volatile (battery backed) data memory. The 200 bytes of volatile data memory contain the flag (F), byte (B), and word (W) variables. The 2K bytes of non-volatile data memory can only be accessed using sfunc07 and sfunc08.

DATA MEMORY MAP (cont'd):

The memory map for the S3024 volatile data memory is shown below:

address	valid variable references		
032	F000-F007	B032	W032
033	F008-F015	B033	-----
034	F016-F023	B034	W034
035	F024-F031	B035	-----
thru	thru	thru	thru
043	F088-F095	B043	-----
044	F096-F103	B044	RESERVED
045	RESERVED	RESERVED	RESERVED
thru	thru	thru	thru
062	RESERVED	RESERVED	RESERVED
063	----------	B063	-----
064	----------	B064	W064
065	----------	B065	-----
thru	thru	thru	thru
230	----------	B230	W230
231	----------	B231	-----

These memory locations (B032 thru B231) are not battery backed and will not retain data at power down. At power up or reset, these addresses are cleared. Note that flags F000 thru F103 are mapped into bytes B032 thru B044. Bytes B032 thru B230 are also mapped into W032 thru W230. These addresses can be referenced as any or all three of these variable types.

The following are special function variables. These variables should not be used as general purpose variables within the user program, but only for the purposes described below:

F104: PROG PORT / USER PORT mode selection. When F104 is a "0", the PROG PORT is used to interface with SYSdev for program down-load and on-line monitoring. When F104 is a "1", the PROG PORT will now function as a USER port, responding to sfunc10 (USER port read) and sfunc11 (USER port write) commands.

B60: Main Program input status image byte. Inputs 2 through 5 are mapped to this byte and updated at the beginning of the main program scan. See the "Digital Inputs" section.

B61: Output image byte. This byte is written to the outputs 0 through 5 at the beginning of the main program scan or at the end of the timed interrupt if it is enabled. See the "Digital Outputs" section.

B62: Timed Interrupt input status image byte. Inputs 2 through 5 are mapped to this byte and updated at the beginning of the timed interrupt if it is enabled. See the "Digital Inputs" section.

DATA MEMORY MAP (cont'd):

The memory map for the non-volatile (battery-backed) data memory is shown below. Note that these memory locations are not referenced as user variables (F,B, and W), but instead accessed using sfunc07 and sfunc08.

address	valid variable references
1800H	------
1801H	------
thru	thru
1feeH	------
1fefH	------

These addresses are battery-backed and will retain data when powered down.

DIAGNOSTICS/FAULT DETECTION:

The S3024 contains comprehensive fault detection routines which verify the proper operation of the S3024 at all times. Some of the faults detected include:

- CMOS RAM Battery Low fault
- Bad program RAM memory
- Invalid User program
- Loss of program scan/watchdog timer time-out
- etc.

When a fault is detected, program execution is suspended, the "RUN" LED on the S3024 faceplate is extinguished, and the "FLT" LED is illuminated. 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 S3024 to provide a complete test of the S3024 hardware. This test is initiated through SYSdev and can be used to verify the S3024 for proper operation.

INSTALLATION:

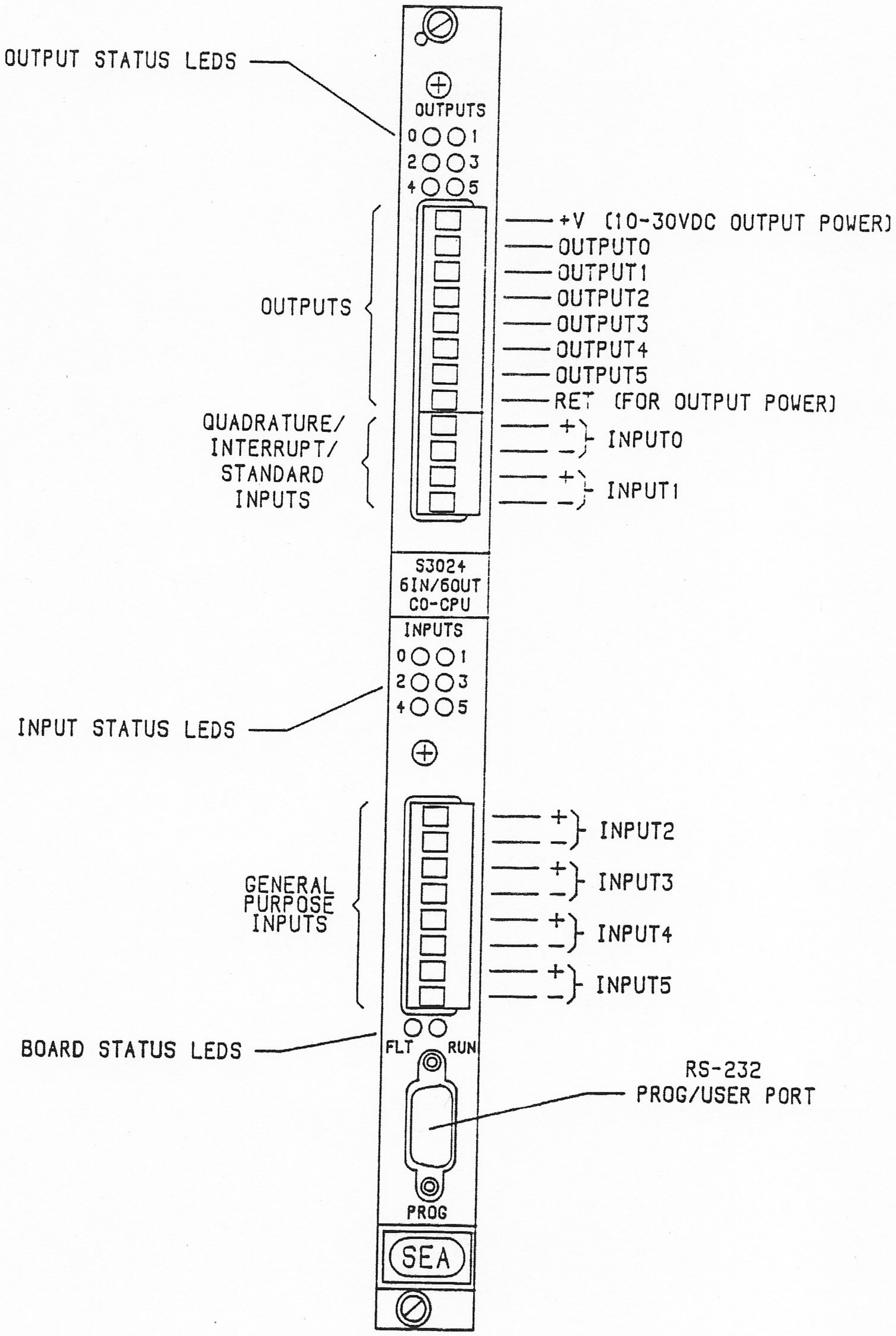
The S3024 occupies only one slot and may be installed in any I/O slot of the rack. Install the S3024 by aligning the board with the card guides and sliding in until firmly seated. The board is held in the rack via captive screws located on the S3024 faceplate. Install the field wiring connectors to the appropriate connectors on the S3024. The field wiring connectors are wired per the diagram at the end of this data sheet.

To remove the S3024, carefully remove the field wiring connectors from the S3024, loosen the captive screws and gently pull the board out of the rack using the handles located on the S3024 faceplate.

NOTE: When installing or removing the S3024, power to the S3000 rack must be off.

SPECIFICATIONS:

Location of S3024 in Rack:	Any I/O slot 0-15
Board Size:	
Length:	9.15"
Height:	6.30"
Width:	0.8"
Memory:	
Program:	24K bytes battery backed CMOS RAM
Data:	
indirectly addressed:	2K bytes battery backed CMOS RAM
directly addressed:	(non-battery backed)
Flags (F):	104 bits
Bytes (B):	200 bytes
Words (W):	100 words
Execution Times:	
Scan time:	0.6 milliseconds per 1K bytes
Main Program overhead:	80 microseconds
Fixed Scan Time bases:	0.5, 1.0, and 10.0 milliseconds
Timed Interrupt Time bases:	0.5, 1.0, and 10.0 milliseconds
Digital Inputs:	
Input Voltage:	
Vin (on-min):	10.0 volts
Vin (on-max):	30.0 volts
Vin (off-max):	5.0 volts
Input Current (max):	20 milliamps at Vin = 30 volts
Input Current (typ):	14 milliamps at Vin = 24 volts
Input Filter Delay:	
Inputs 0 and 1:	60 microseconds (typ)
Inputs 2 thru 5:	1.0 milliseconds (typ)
Optical Isolation:	1500 Vrms
Digital Outputs:	
Output Voltage:	
Voltage Range (VCC):	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):	1.00 amp DC (continuous)
Iout (on max):	5.00 amp DC (pulsed)
Iout (off max):	100 microamps (leakage)
Output Response Time:	
max on time:	50 microseconds
max off time:	200 microseconds
Optical Isolation:	1500 Vrms



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