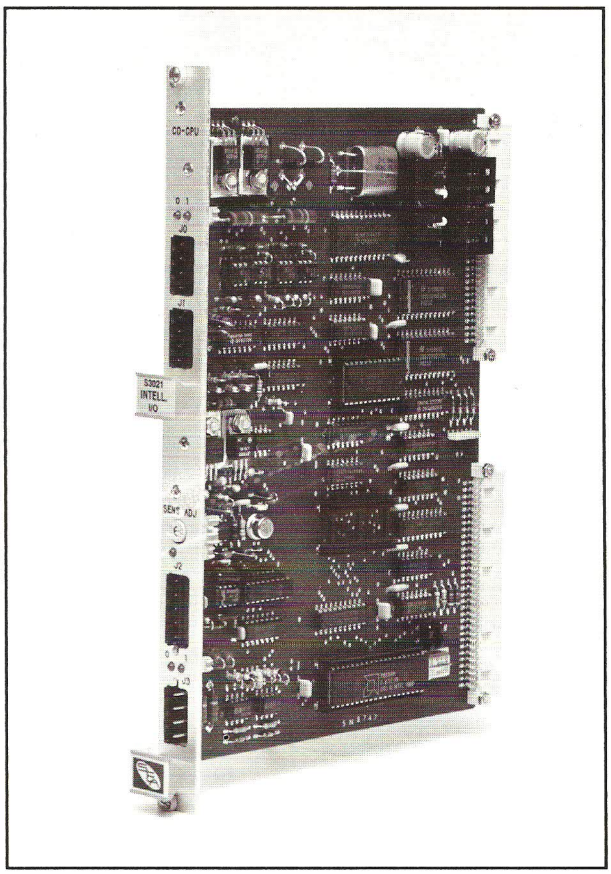
SYSTEMS ELECTRONICS GROUP

SYSTEMS S3000 INDUSTRIAL CONTROLLER

S3021: INTELLIGENT I/O BOARD (TIMING SIGNAL ADVANCE)



FEATURES:

- INTELLIGENT I/O BOARD WITH DIGITAL AND ANALOG INPUTS, DIGITAL OUTPUTS AND AN INTEL 8031 MICROCONTROLLER
- PROGRAMMED WITH SYSDEV51
- 8K BYTES PROGRAM MEMORY (EPROM)
- 128 BYTES RAM DATA MEMORY
- EXECUTES A USER APPLICATION PROGRAM INDEPENDENTLY OF MAIN PROCESSOR WHILE DRIVING APPLICATION SPECIFIC I/O
- DESIGNED FOR TIMING SIGNAL ADVANCE AS A FUNCTION OF MACHINE SPEED BUT CAN BE USED FOR OTHER APPLICATIONS
- 2 DIGITAL 15-30VDC DIFFERENTIAL INPUTS
- 2 DIGITAL 20-30VDC SOURCING OUTPUTS
- 1 - 8-BIT ANALOG INPUT (ANALOG TO DIGITAL)
- 3 FREQUENCY REFERENCE OUTPUTS
- INDIVIDUAL LED STATUS INDICATION FOR ALL DIGITAL INPUTS AND OUTPUTS
- REMOVABLE FIELD WIRING CONNECTORS FOR INPUTS AND OUTPUTS WIRING
- OPTICAL ISOLATION FOR DIGITAL INPUTS AND OUTPUTS

GENERAL DESCRIPTION:

The S3021 is an intelligent I/O board equipped with an Intel 8031 microcontroller and its own dedicated I/O. The S3021 is used as a CO-CPU board in S3000 systems where the S3021 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 processing power and through-put.

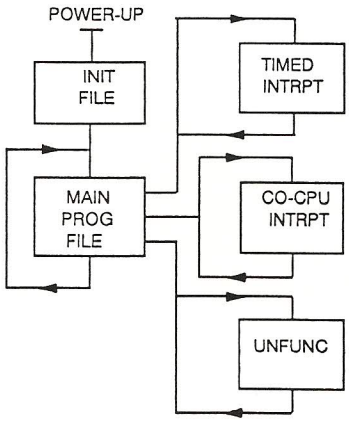
Programming is implemented with SYSdev51, an IBM PC or compatible software package that allows the user to create, compile, and program an EPROM for the S3021. This program is developed off-line and then programmed into an EPROM which is installed in the S3021. The S3021 program memory consists of 1ea. 2764 EPROM (8K bytes).

The S3021 was originally designed for timing advance as a function of machine speed applications but can be used for any applications requiring high speed digital or analog processing.

PROGRAM STRUCTURE:

The typical S3021 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) User function files (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 continuously unless interrupted by the timed 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.

In addition to the standard SYSdev51 timed interrupt file, the user can create two more interrupt files. One interrupt file can be executed in response to an interrupt from input 0 while the other interrupt file can be executed in response to an interrupt from input 1. See the "Programming the S3021" section of the SYSdev51 manual for details on using these interrupts.

SYSTEM CONFIGURATION:

As part of the user program for the S3021, the user must set the system configuration using SYSdev51. The parameters set in the configuration are:

1) Target board: S3021 (board program will run on)
2) Timed Interrupt: "Yes" if timed interrupt file is to be used, "no" if not.
3) Timed time: Time between timed interrupt file execution (0.250 to 65.000 milliseconds).

DIGITAL INPUTS:

The two inputs are mapped directly to port pins on the 8031. These pins are:

INPUT0 = P32 (INT0)
INPUT1 = P33 (INT1)

Both inputs are differential which means that each input has two connection points designated (+) and (-). When a positive voltage, greater than the input on threshold, is applied to the (+) terminal with reference to the (-) terminal, the input is on. When a voltage less than the threshold (even a negative voltage) is applied to the (+) terminal with reference to the (-) terminal, the input is "off". When the input is "on", the corresponding port pin is a "0". When the input is "off", the port pin is a "1". Both of these inputs can generate interrupts either at a "1" to "0" transition (edge triggered) or when the input level is "0" (level triggered).

The inputs are optically isolated from the internal S3021 circuitry. Individual LED status indication for each input is provided on the faceplate of the S3021. The LED is located on the field side of the input and therefore represents the state of the field device, not the internal state of the input.

ANALOG INPUT:

The analog input is a 0 to 10VDC input with an 8-bit analog to digital converter complete with a sample and hold front end. The input sample and hold can either be triggered on a periodic time base or at asynchronous intervals determined by the user program. Two port pins on the 8031 are used to control the sample and hold mode, they are:

P30 = Periodic enable/asynchronous trigger
P31 = Periodic enable

The time base of the periodic sample and hold is 208 microseconds. The periodic sample and hold mode is enabled by setting P30 = "1" and P31 = "1". In this mode the analog-to-digital conversion is performed once per time base. To asynchronously trigger the analog-to-digital conversion, set P30 = "0" and toggle P31 from a "0" to a "1" and then back to a "0". The data from the analog-to-digital converter will be available approximately 75 microseconds later.

The output of the analog-to-digital converter is an external address read using the sfunc07 general read system function. The address of the analog-to-digital output is:

ADC address = 2000H

See the SYSdev51 Program Development manual for more details on using the sfunc07 system function

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DIGITAL OUTPUTS:

The two digital outputs are 20-30VDC, 2 AMP sourcing outputs designed to drive solenoids. The outputs are mapped to two port pins on the 8031. These pins are:

OUTPUT0 = P10
OUTPUT1 = P12

Setting the respective port pin to a "0" turns the corresponding output "on". Setting the port pin to a "1" turns the output "off". The outputs are sourcing such that when the output is "on", the voltage at the output is approximately equal to the users supply voltage with the output sourcing current to the load. When the output is off, the voltage is approximately zero.

Each output contains a surge suppressor which eliminates the requirement of surge suppressors or fly-back diodes on the load itself. Individual LED status indication for each output is provided on the faceplate. In addition, the outputs are optically isolated from the internal circuitry of the S3021. The LEDs are located on the field side of the output and thus represent the state of the actual output, not the internal state.

FREQUENCY OUTPUTS:

The S3021 contains three frequency outputs designed to drive the LEDs of photoelectric transmitters. The frequency outputs provide a 15 microsecond pulse at a frequency of 2400HZ. The outputs provide 150 milliamps of current each. The frequency outputs are enabled by setting P30 = 1 and P31 = 1.

MEMORY MAP:

The S3021 contains two distinct memory spaces. They are: program memory and volatile data memory. The S3021 cannot save any user data variables during power-down. Any variables to be saved must be saved in the main processor non-volatile data space.

The program memory space consists of 8K bytes of EPROM (1ea. 2764). This is where the user program resides and is accessed automatically during program execution.

The volatile data memory space consists of the 128 bytes of on board ram in the 8031. This is where the user variables reside along with reserved bytes used by the system (interrupt registers, stack, etc.). Included in this memory are 120 flags (F000 thru F119), up to 112 bytes (B008 thru B119), and up to 56 words (W008 thru W118). See the SYSdev51 programming manual for a complete description of the variable types. It is recommended that byte addresses B080 thru B119 be used first since the lower byte addresses may or may not be reserved for the system based on which interrupts are enabled.

Notes:

1) Addresses 32 thru 46 are where F000 thru F119 reside. This memory area can be accessed as individual bits (F), bytes (B) or words (W).

2) Addresses 120 thru 127 are where the stack is located. If the stack is larger then this number of bytes, bytes starting at a lower address then 120 are assigned as the stack. Only the number of bytes required for the stack are assigned. These bytes cannot then be used as user variables.

The actual map of the ram memory space is shown below:

ADDR	Usage
0 - 7	reserved for main program general registers
8 - 15	reserved for timed interrupt general registers (only if timed interrupt is used, free for user variables if not)
16 - 23	user variables (B016-B023)
24 - 31	reserved for system
32 - 46	user variables (F000-F119, B032-B046, W032-W046)
47 - 48	reserved for system
49 - 119	user variables (B049-B119, W050-W118)
120 - 127	reserved for system

EPROM INSTALLATION:

The program EPROM is installed in the S3021 as follows:

1) Remove S3021 from rack (see Board Installation).
2) IC socket U18 of the S3021 is the program memory socket.
3) Remove existing EPROM if installed. Take care not to pull socket off board while removing EPROM.
4) Install EPROM by aligning pin 1 indicator on EPROM (dot next to pin 1 or notch at top of EPROM) with the pin 1 indicator of the socket (notch in socket next to pin 1). Make sure pins seat properly in socket (no pins bent under socket).
5) Install board back in rack.

BOARD INSTALLATION:

Prior to installing the S3021, the program EPROM must be installed (see EPROM installation). The S3021 can be installed in any slot of the S3000 rack provided the main processor is configured for an S3021 in the respective slot. Install the S3021 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 faceplate. To remove the S3021, loosen the captive screws and gently pull the board out of the rack using the handles located on the faceplate.

Note: When installing or removing the S3021, power to the rack should be "off".

SPECIFICATIONS:

Location Of S3021 In Rack: Any I/O Slot

Number Of I/O Slots Required: 1

Board Size:
- Length: 9.15"
- Height: 6.30"
- Width: 0.80"

Processor (microcontroller): Intel 8031

Processor Clock Frequency: 12 MHZ

Memory:
- Program (EPROM): 8K bytes
- Volatile data - 8031 (RAM): 128 bytes

DIGITAL INPUT SECTION:

Number of Inputs (total): 2

Input Type (both inputs): differential

Input Voltage:
- Voltage Range: 15 to 30 VDC
- Vin(on) -minimum guaranteed turn on: 15.0 volts
- Vin(off)-maximum guaranteed turn off: 3.5 volts
- Vin(max)-maximum continuous on voltage: 30.0 volts
- Vin(pul)-maximum pulsed (10msec): 150.0 volts

Input Current:
- Iin(max)-maximum input current (Vin=10v): 5.5 milliamps
- Iin(max)-maximum input current (Vin=30v): 17.0 milliamps

Input Impedance (approximate): 2.0K ohms

Input Filter Delay:
- Tplh(min)-minimum input delay (off-on): 100 microsec
- Tplh(max)-maximun input delay (off-on): 300 microsec
- Tphl(min)-minimum input delay (on-off) 150 microsec
- Tphl(max)-maximum input delay (on-off): 500 microsec

Optical Isolation (input to logic): 1500 Vrms

DIGITAL OUTPUT SECTION:

Number of Outputs (total): 2

Output Type (all outputs): sourcing

Output Voltage:
- Voltage Range: 20 to 30 VDC
- Vout(on-min) -minimum on voltage (Iout=1.0 amps): Vcc-2.00 volts
- Vout(on-max) -minimum on voltage (no load): Vcc-0.75 volts
- Vout(off-max)-maximum off voltage (no load): 1.50 volts

Note: Vcc equals users supply voltage.

Output Current:
- Iout(max)-maximum continuous output current (Vout=24v): 1.0 amp DC
- Iout(min)-off state leakage current [Vout=Vout(off-max)]: 100 microamps
- Iout(pul)-maximum pulsed output current (t=100msec): 5.0 amps

Output Impedance (approximate):
- Zout(on) -output on impedance: . 50 ohms
- Zout(off)-output off impedance: 1.5K ohms

Output Response Time:
- Tplh(min)-minimum turn on time (max load): 10 microsec
- Tplh(max)-maximum turn on time (min load): 25 microsec
- Tphl(min)-minimum turn off time (max load): 75 microsec
- Tphl(max)-maximum turn off time (min load): 200 microsec

Optical Isolation (logic to output): 1500 Vrms

FREQUENCY OUTPUT SECTION:

Number of Outputs: 3

Output Voltage:

Voltage Range: 1.0 to 15.0 volts

Output Current:

Iout(pul)-maximum pulsed (15usec) output current: 300 milliamps

Output Impedance (approximate):

Zout(on) -output on impedance: 100 ohms

Zout(off)-output off impedance: 10M ohms

Output Frequency:

Frequency (typ): 2400 HZ

Pulse on duration (typ): 15 microsec

ANALOG INPUT SECTION:

Number of Analog Inputs: 1

Input Voltage:

Voltage Range: 0 to 10 volts

Vin(max)-maximum continuous input voltage: 15.0 volts

Vin(pul)-maximum pulsed 10msec) input voltage: 30.0 volts

Input Impedance (approximate): 4.7K ohms

Analog to Digital Accuracy:

Resolution: 8 bits

Relative accuracy error: 50 mVolts

Differential nonlinearity: 100 mVolts

Full scale error: 200 mVolts

Offset error: 100 mVolts

Sample Rate:

Periodic mode: 4800 samples/sec

Asynchronous mode

maximum sample rate: 20,000 samples/sec

minimum sample rate: 0 samples/sec

Power Requirements:

IccBUS(max)-maximum current drawn from S3000 bus (+5VDC): 750 milliamps

Icc(+15max)-maximum current drawn from S3000 bus (+15VDC): 100 milliamps

Icc(-15max)-maximum current drawn from S3000 bus (-15VDC): 100 milliamps

Temperature Ranges:

Storage: 0 to 85° C

Operating: 0 to 60° C

Relative Humidity: 5 to 95%

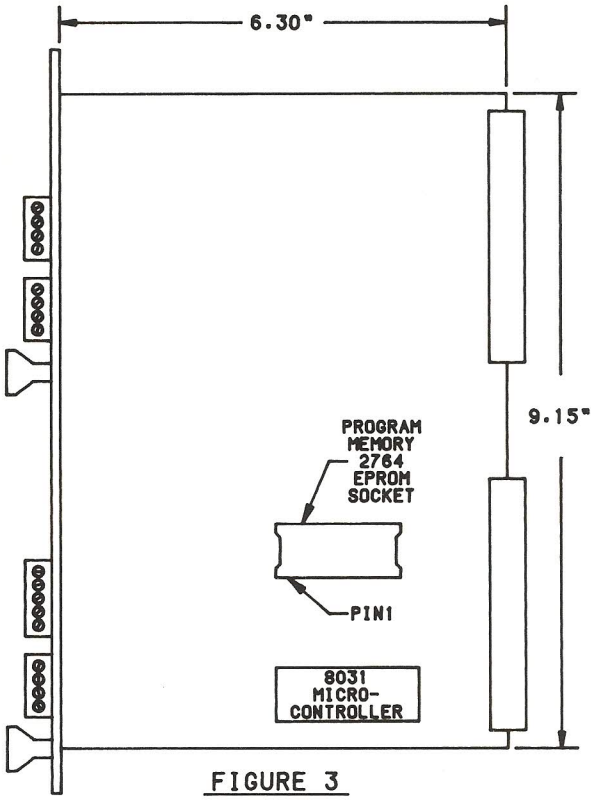

FIGURE 3
BOARD OUTLINE

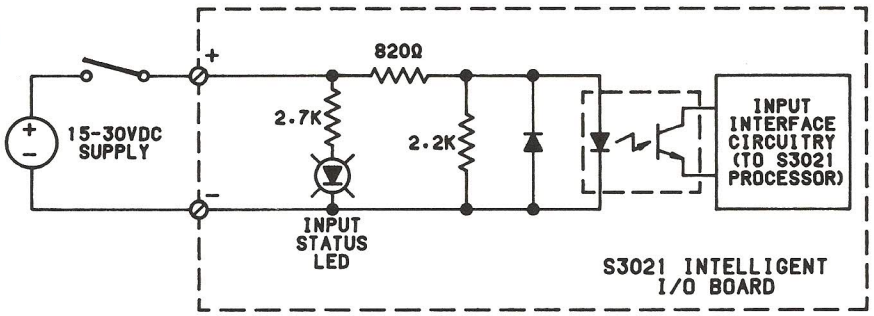

FIGURE 1
TYPICAL INPUT CIRCUIT
(J3 CONNECTOR)

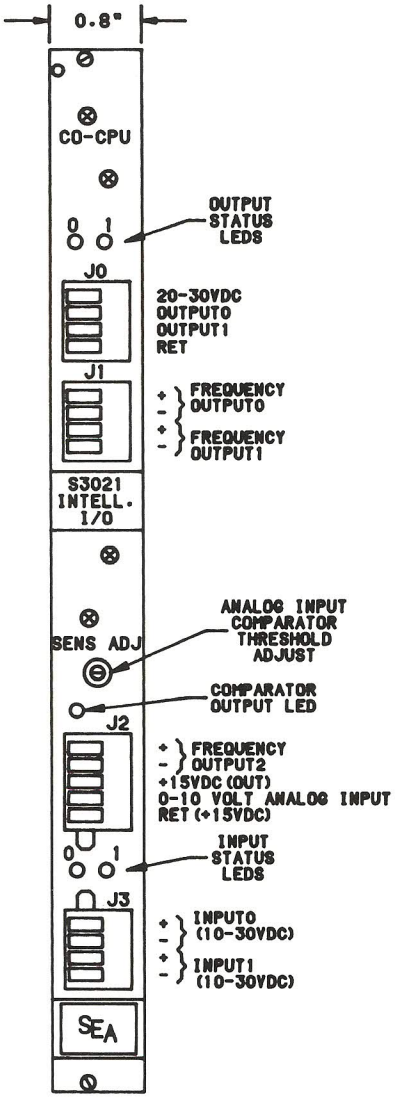

FIGURE 4
FACEPLATE DETAIL

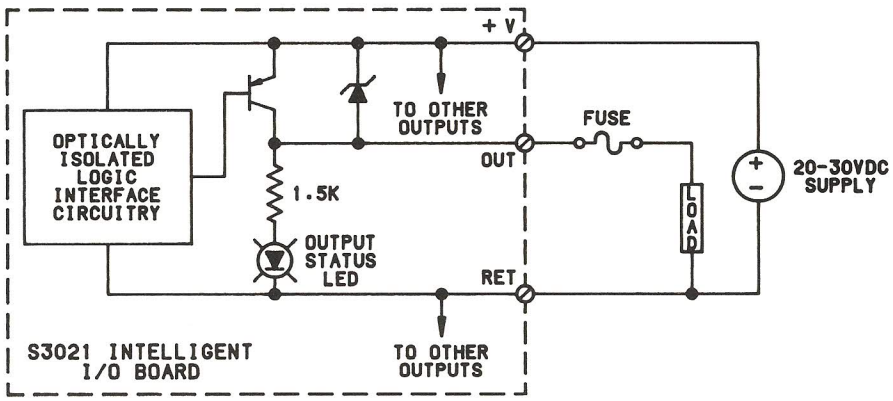

FIGURE 2
TYPICAL DIGITAL OUTPUT CIRCUIT
(J0 CONNECTOR)

NOTES:

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