

SYSTEMS ENGINEERING ASSOCIATES

SYSTEMS S3000

INDUSTRIAL CONTROLLER

S3016 COMMUNICATIONS CO-CPU BOARD

FEATURES:

- o COMMUNICATIONS CO-CPU BOARD WITH S3000 SERIAL NETWORK INTERFACE AND RS-232/RS-422 USER PORT
- o BUILT-IN PROCESSOR EXECUTES USER APPLICATION PROGRAM INDEPENDENTLY OF MAIN PROCESSOR
- o 24K BYTES USER PROGRAM MEMORY
- o 2K BYTES DATA MEMORY
- o BUILT-IN REAL TIME CLOCK PROVIDES CURRENT TIME AND DATE
- o FAST PROGRAM EXECUTION TIME (0.6 MILLISECOND PER 1K BYTE PROGRAM MEMORY)
- o PROGRAMMED WITH SYSdev, MS-DOS BASED SOFTWARE PACKAGE ALLOWING PROGRAMMING OF THE S3016 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, COMMUNICATIONS FAULT DETECTION, HARDWARE CONFIDENCE TEST, ETC.
- o STATUS LEDS ON FACEPLATE (RUN, SERIAL NETWORK COMM, AND FAULT)
- o STANDARD DOUBLE HEIGHT EUROCARD

(Photo Unavailable)

GENERAL DESCRIPTION:

The S3016 is a communications CO-CPU board which provides one S3000 serial network interface port and one RS-232/RS-422 USER PORT. The S3016 is a true CO-CPU with its own processor and program/data memory which executes a user application program independent of the S3000

main processor. Typical applications include interfacing to operator interfaces (alphanumeric ASCII displays, CRT-based terminals, etc.) and providing S3000 network expansion. The S3016 can be installed in any I/O slot of the S3000 rack. In addition, any number of S3016 may be installed

GENERAL DESCRIPTION (cont'd):

in one rack (up to the number of I/O slots available).

The S3016 consists of an S3000 bus interface section, S3000 serial network interface section, RS-232/RS-422 USER PORT, real time clock and a processor section.

The S3000 bus interface section consists of a 512 byte buffer which allows the S3000 main processor to pass information between the main processor and the S3016. Using the SYSdev system function sfunc12, up to 256 bytes can be written to the S3016 and 256 bytes can be read from the S3016 in one command.

The S3000 serial network interface section allows the S3016 to be connected to the S3000 network. This allows up to 32 S3000/M4000 boards (S3012s, S3016s, M4010s, etc.) to communicate with one another on one network. The S3016 allows network expansion beyond the normal 32 node limit. Each S3016 added to the rack allows 31 additional nodes (on a separate network) to be

communicated to by the rack.

The real time clock section provides the current time and date. The time is provided in a 24-hour format in the form: hours, minutes, and seconds. The date is provided in the form: month, day of month, and year. The real time clock is accurate to within 1 minute per month even in the absence of power to the S3016.

The processor section executes the user's application program. Processor memory consists of 24K bytes of battery-backed CMOS RAM program memory and 2K bytes of data memory. Programming of the S3016 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 S3016 for program download and on-line monitoring. The program is developed off-line, compiled, then downloaded into the S3016. Typical program scan times are on the order of 0.6 milliseconds per 1K byte program memory.

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 S3016 user program consists of the following files:

- 1) Initialization file (optional): executed once at power up.
- 2) Main Program file (required): scanned continuously.
- 3) CO-CPU Communications Interrupt file (optional): executed in response to a sfunc12 communications request from the S3012 main processor.

- 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 (scanned) continuously unless interrupted by the CO-CPU interrupt. 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 interrupt occurred.

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.

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 S3016 contains three interface ports: the PROGramming PORT, the USER PORT, and the serial network comm port.

PROG PORT: The PROG PORT is an RS-232 port dedicated for on-line 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/RS-422 port accessed under software control of the user program. Typical uses of this port are connection to operator work-

stations or displays for system status or data acquisition.

SERIAL NETWORK: The S3000 network is a high speed (344KBPS), twisted pair, serial network configured in a master/slave topology. Communication between the S3016 and other S3000 boards (S3012s, S3016s, etc.) on the network is controlled via commands in the user application program resident in the master S3000 board. Data is transferred over the network using the sfunc13 system function in the master S3012 or S3016. See the S3016 User's Manual for more details.

DIAGNOSTICS/FAULT DETECTION:

The S3016 contains comprehensive fault detection routines which verify the proper operation of the S3016 at all times. Some of the faults detected include:

- CMOS RAM Battery Low Fault
- Bad Program RAM Memory
- Invalid User Program
- Network Communications Fault
- Loss of Program Scan/Watchdog Timer Timeout
- Etc.

When a fault is detected, a program execution is

suspended, the "RUN" LED on the S3016 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 pinpoint the fault and correct it.

In addition to the fault code detection, a hardware confidence test is resident in the S3016 to provide a complete test of the S3016 hardware. This test is initiated through SYSdev and can be used to verify the S3016 for proper operation.

SPECIFICATIONS:

Board Size:

Length:	9.15"
Height:	6.30"
Width:	0.80"

Processor Memory:

Program:	24K bytes battery-backed CMOS RAM
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SPECIFICATIONS (cont'd):

Processor Memory:

Data:

non-volatile:

2K bytes battery-backed CMOS RAM

volatile:

Flags (F):

104 bits

Bytes (B):

185 bytes

Words (W):

93 words

Interface Ports:

PROG PORT:

Type:

RS-232

Comm Rate:

9600 Baud

USER PORT:

Type:

RS-232/RS-422

Comm Rate:

300, 600, 1200, 2400, 4800, 9600 Baud

Start Bits:

1

Data Bits:

8

Stop Bits:

1 or 2

Parity:

None, Odd or Even

Serial Network:

S3000-N1:

Type:

RS-485

Comm Rate:

344KBPS, 229KBPS, or 106KBPS

of Nodes (Max):

32

Isolation:

2,000 VRMS

Distance:

1,000 ft., 2,000 ft., or 4,000 ft.

Protocol:

Proprietary

Power Requirements :

Icc(+ 5VDC):

1.00 amps (MAX)

Icc(+ 12VDC):

0.10 amps (MAX)

Icc(-12VDC):

0.10 amps (MAX)

Temperature Ranges:

Storage:

0 to 70 degrees C

Operating:

0 to 60 degrees C

Relative Humidity:

5 to 95% non-condensing