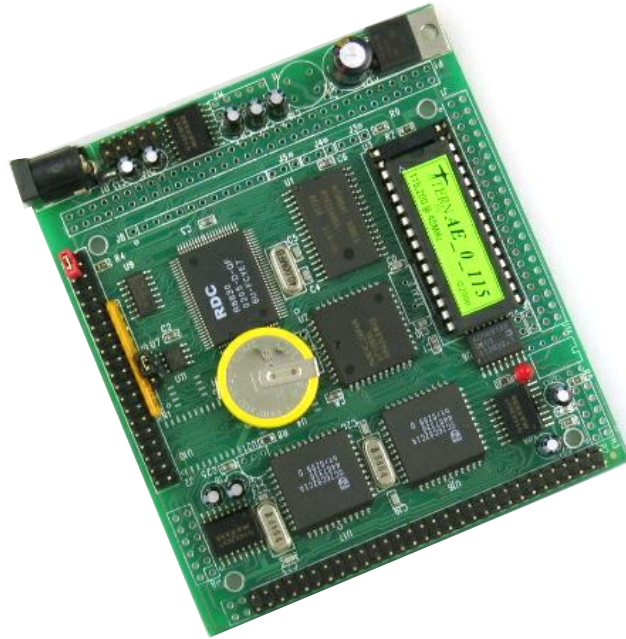# *A104S*™

16-bit microcontroller with 7 Serial Ports, 80+ I/Os,
ADC, DAC, Solenoid Drivers and LCD interface
Based on the 40MHz 188 CPU

Technical Manual

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1.1 Introduction

The *A104*S is a 16-bit microcontroller based on the original **A104** design. Measuring 4.0 by 3.6 by 0.5 inches, the *A104*S offers a complete C/C++ programmable computer system with a 16-bit, high performance CPU (188), operating at 40 MHz system clock with zero-wait-state. The *A104*S supports 24 TTL bi-directional I/O pins, seven TTL outputs, 11 channels of 12-bit ADC, two channels of 12-bit DAC, six channels RS-232 and one channel RS485, a real-time clock, battery backup, watchdog timer, PWM, three timer/counters, a 512-byte serial EEPROM, up to 512 KB SRAM, and up to 512 KB ROM/Flash.

The *A104S* is designed for control applications that require precision analog conversion, solenoid drivers, and high-speed performance. The *A104S* is designed with a 64-pin header which is based upon PC104 standard, routing common signals such as data/address bus, interrupt lines, VCC, and GND to the header, yet it is not 100% PC104 compatible. While some customers have integrated the *A104S* into PC104 applications, TERN does not guarantee compatibility or provide technical support for PC104 applications.

Two asynchronous serial ports from the 188 CPU support reliable DMA-driven serial communication at up to 115,200 baud with RS-232 drivers. In addition, two dual UARTs SC26C92 (RS-232) are installed on-board to give a total of 6 RS-232 channels. An optional UART SCC2691 can be installed using an RS-485 driver for a seventh asynchronous serial port.

An optional real-time clock provides information on the year, month, date, hour, minute, and second and an interrupt signal.

Three 16-bit programmable timers/counters are on board. Two timers can be used to count or time external events, up to 10 MHz, or to generate non-repetitive or variable-duty-cycle waveforms as PWM outputs. Pulse Width Demodulation (PWD), a distinctive feature, can be used to measure the width of a signal in both its high and low phases. It can be used in many applications, such as bar-code reading. The 32 I/O pins on the 188 CPU are multifunctional and user-programmable. You may have 15 or more lines free to use, depending on your application and which optional hardware is installed.

The 82C55 I/O chip on-board provides an additional 24 bi-directional I/O lines, of which 14 TTL user-definable I/O lines can be used to interface to a graphic- or character-type LCD and a keypad. An adjustable negative voltage (-10V) may optionally be installed on-board for LCD contrast.

A supervisor chip (691) provides power fail detection, reset, and a watchdog timer. The optional 12-bit ADC has 11 channels of analog inputs with sample-and-hold and a high-impedance reference input. The ADC conversion rate is up to a sample rate of 10 KHz. One DAC chip may be installed on-board to provide two channels 12-bit, 0-4.095V analog voltage outputs capable of sinking or sourcing 5 mA.

By default, a 5V linear regulator (8.5-12V DC input) is installed. A 5V switching regulator (up to 35V DC input) may be installed to reduce power consumption and heat. The switching regulator introduces more noise than a linear regulator.

The FlashCore-0 expansion card may be installed to provide memory expansion via CompactFlash (up to 2GB). In addition, the MemCard-B expansion card may be installed to add an additional 33 12-bit ADC, 6 24-bit ADC, 2GB memory, and an Ethernet interface.

Features:

Standard Features

- Dimensions: 4.0 x 3.6 x 0.5 inches
- Easy to program in C/C++
- Power consumption: 160/120/60 mA at 9/12/24V
- Power input: +8.5V to +12 V unregulated DC with linear regulator
    or, +8.5 to +35V unregulated DC with switching regulator (optional)
- Temperature: -40°C to +80°C

- 16-bit CPU (188), Intel 80x86 compatible, 40 MHz
- High performance, zero-wait-state operation at 40 MHz
- 128KB SRAM, Up to 512KB Flash/ROM
- 2 high-speed PWM outputs and Pulse Width Demodulation
- 2 SCC2692 dual UARTs with RS-232 drivers
- 24 additional bi-directional I/O lines from 82C55
- 512-byte serial EEPROM
- 6 external interrupt inputs, 3 16-bit timer/counters
- 2 CPU serial ports
- Supervisor chip (691) for power failure, reset and watchdog
- 7 TTL outputs plus 14 TTL I/Os for Graphic/character LCD or keypad interface
- Up to 20 MB memory expansion with PCMCIA via the **MemCard-A**

*Optional Features***:**

- 512KB SRAM
- 11 channels of 12-bit ADC, sample rate up to 10 KHz (TLC2543)
- 2 channels of 12-bit DAC (LTC1446), 0-4.095V output
- SCC2691 UART with RS-485 drivers
- Real-time clock RTC72423, lithium coin battery
- Precision reference, 20 PPM/°C, 5V
- LCD negative voltage port
- 68-pin connector based upon PC104 standard

1.2 Hardware

UART SCC2692

The two dual UARTs (SCC2692, Signetics, U16 and U17) are 44-pin PLCC chips. U16 is mapped into the I/O address space at **0x300**, and U17 is at **0x200**. The SCC2692 includes two independent full-duplex asynchronous receiver/transmitters, a quadruple buffered receiver data register, an interrupt control mechanism, programmable data format, selectable baud rate for the receiver and transmitter, a multi-functional and programmable 16-bit counter/timer, an on-chip crystal oscillator, and a multi-purpose input/output including RTS and CTS mechanism.

A 3.6864 MHz external crystal can be installed as the default crystal for the dual UART.

For more detailed information, refer to the SCC2692 data sheets (TERN installation CD, \tern_docs\parts\scc2692.pdf).

Only RS-232 drivers are provided for the dual UARTs. The RS-232 signals are routed to the P2 header.
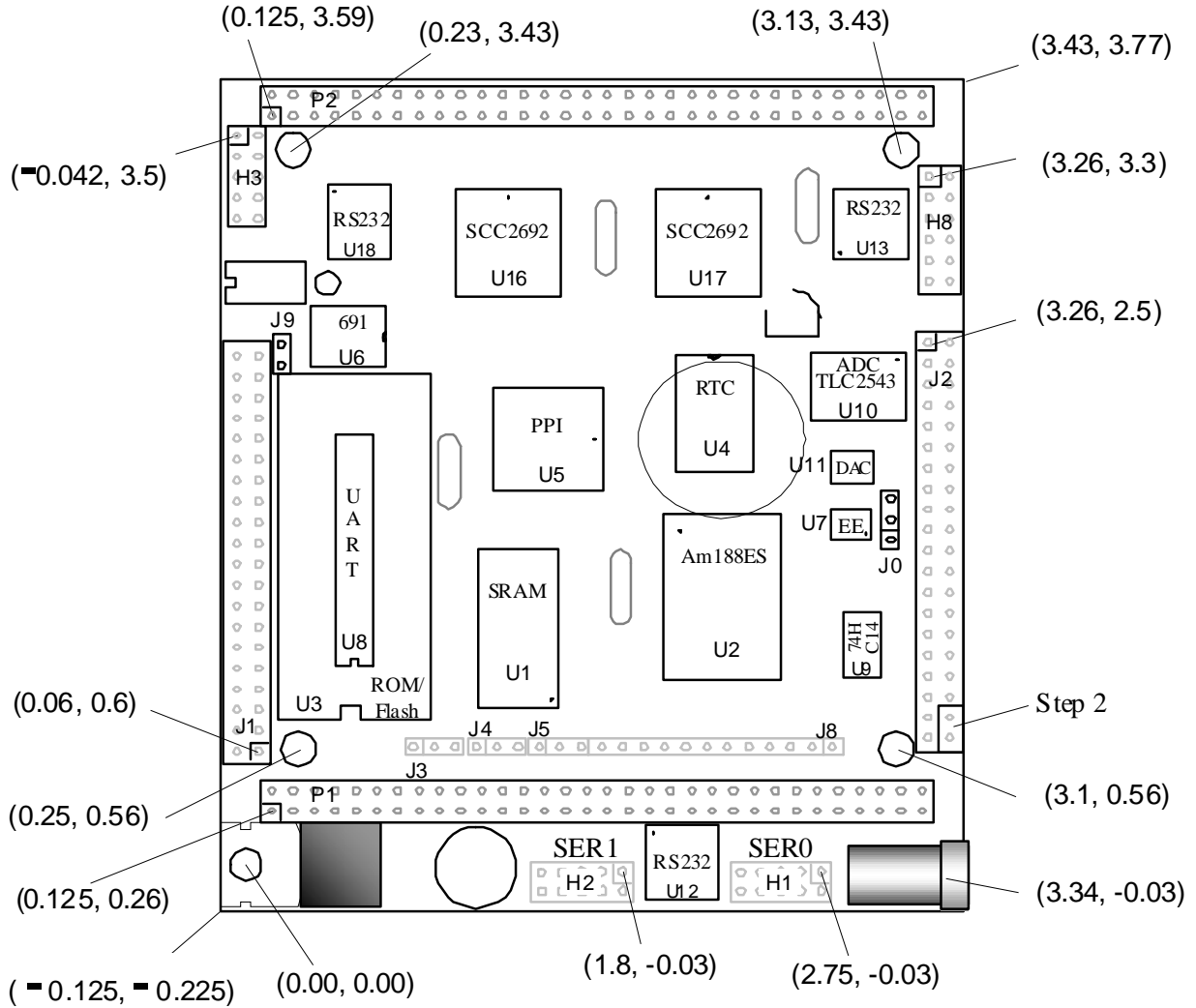
Sample programs for the A104S are included in the **a104s.ide** and **ae.ide** project file found in the **c:\tern\186\samples\a104s** and **c:\tern\186\samples\ae** directories, respectively.

The A-Engine technical manual (\tern_docs\manuals directory) will provide all other relevant information. In addition, sample code found in the \tern\186\samples\ae directory gives examples for the CPU.

A104S Layout   September 6, 2000

The A104S measures 4.0 x 3.6 inches. All dimensions shown below are in inches.

(0.125, 3.59)   (0.23, 3.43)   (3.13, 3.43)

(3.43, 3.77)

(–0.042, 3.5)

P2

H3

RS232
U18

SCC2692
U16

SCC2692
U17

RS232
U13

H8

(3.26, 3.3)

J9

691
U6

RTC

U4

ADC
TLC2543
U10

(3.26, 2.5)

J2

U
A
R
T

U8

PPI

U5

U11 DAC

U7 EE

J0

(0.06, 0.6)

U3

ROM/
Flash

SRAM

U1

Am188ES

U2

74H
C14
U9

(0.25, 0.56)

J1

J4   J5

J8

Step 2

J3

(3.1, 0.56)

(0.125, 0.26)

P1

SER1

H2

RS232
U12

SER0

H1

(3.34, -0.03)

(–0.125, –0.225)   (0.00, 0.00)

(1.8, -0.03)

(2.75, -0.03)

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