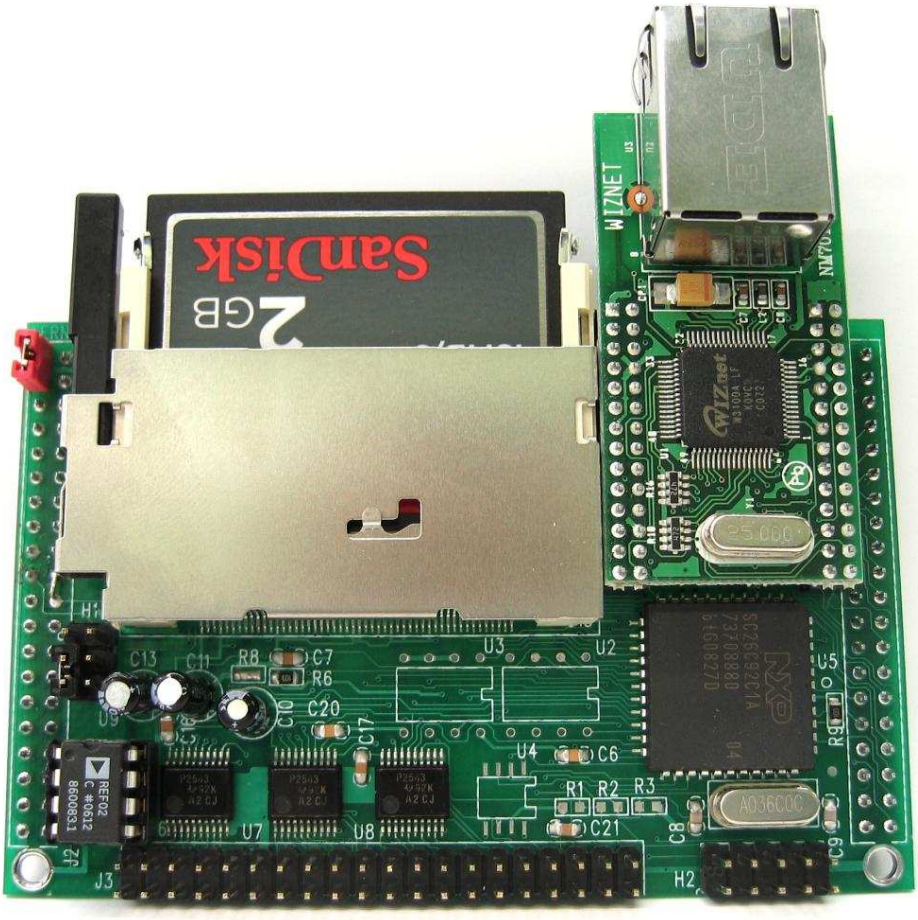
ACE ™

Expansion Card with 12-bit ADCs, DACs, UARTs, CF, and Ethernet



Technical Manual

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Important Notice

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Temperature readings for controllers are based on the results of limited sample tests; they are provided for design reference use only.

Chapter 1: Introduction

1.1 Functional Description

The ***ACE™*** is an expansion card designed for TERN controllers to provide 33 channels of 12-bit/0-5V ADC, 2 channels of 12-bit DAC, CompactFlash storage, 2 UARTs, and Ethernet.

Three ADC P2543 chips (11ch, 12-bit, 0-5V) can be installed to provide a total of 33 ADC inputs. A precision 5V reference can be installed with on-board temperature measurement.

An optional DAC can be installed to provide 2 channels of 12-bit analog output. The DAC outputs a range of 0-4.095V.

ACE™ allows access to mass storage CompactFlash cards (up to 4GB). Users can easily add mass data storage to their embedded application. Complete C/C++ programmable software package includes compiler, remote debugger, samples, and file system libraries. Files on the CF can be easily accessed from a PC.

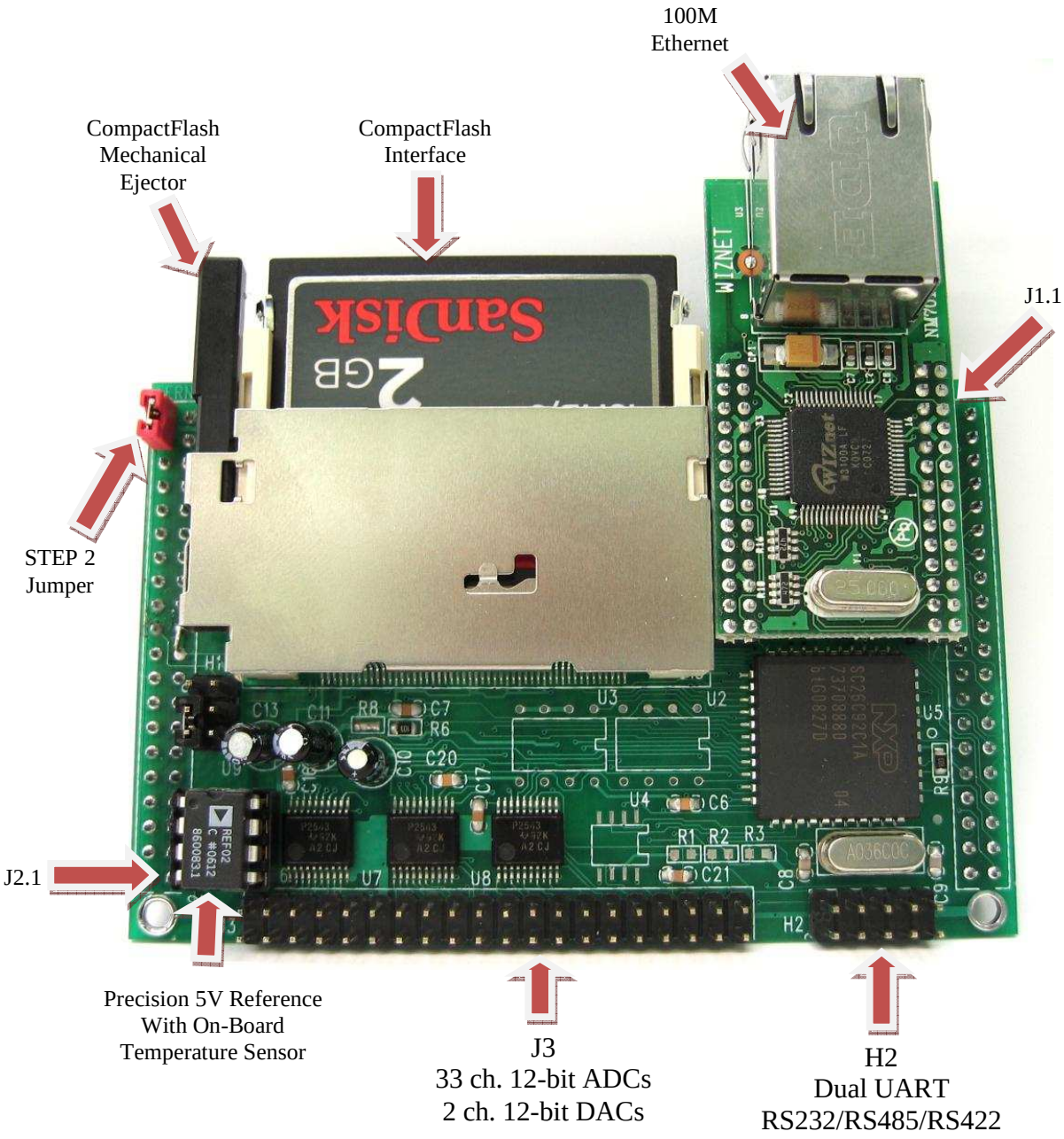
The on-board UART SCC2692 provides two additional serial ports. The ports can be configured as two RS-232 ports or one RS-232 and one RS-458/422.

A high speed Ethernet module can be installed to provide 10/100 Mbs Ethernet network connectivity. The Ethernet module has a hardware LSI TCP/IP stack. It implements TCP/IP, UDP, ICMP and ARP in hardware.

1.2 Features and Options:

- Measures 3.57 x 2.30 inches
- 33 ch. 12-bit ADC (0-5V)
- 2 ch 12-bit DAC (0-4.095V)
- Dual UART with available RS232, RS485 and RS422 drivers
- 100 M Ethernet with hardware TCP/IP stack
- CompactFlash with FAT file system support
- Precision 5V Reference with on-board temperature sensor

Physical Description



Chapter 2: Installation

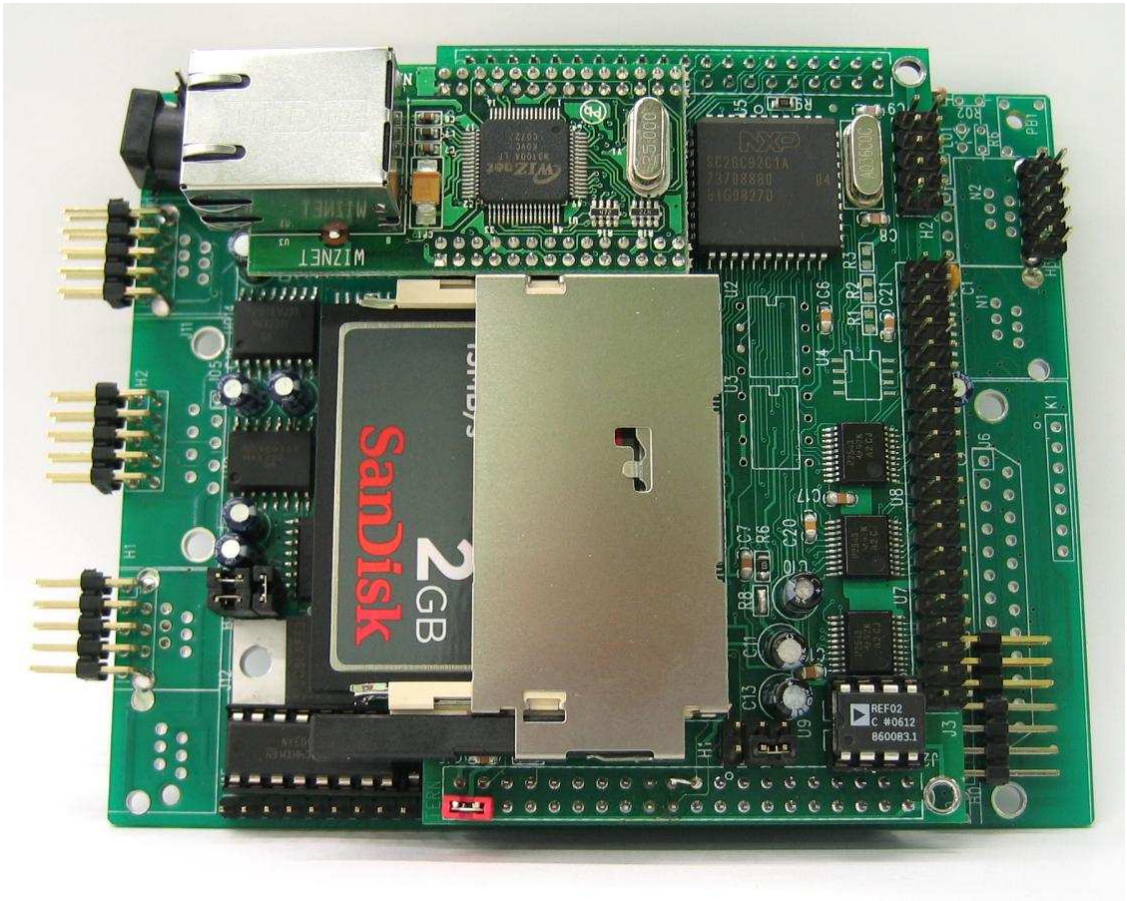
2.1 Software Installation

Please refer to the Technical manual "Software_Kit.pdf" on TERN CD under tern_docs\manuals\ for installing software and evaluation of TERN controllers.

2.2 Hardware Installation

The ACE is an expansion board built for TERN controllers. The ACE can work with most TERN controllers, including: 586-Engine, 586-Drive, 586-Engine-P, A104, A104S, A-Engine, A-Engine-P, A-Engine86, A-Engine86-P, R-Engine, RA, RD, AE86-D, BirdBox-A, i386-Engine, i386-Engine-P, i386-Engine-L, i386-Engine-M, i386-Drive, SmartLCD, SmartTFT, HD, U-Drive.

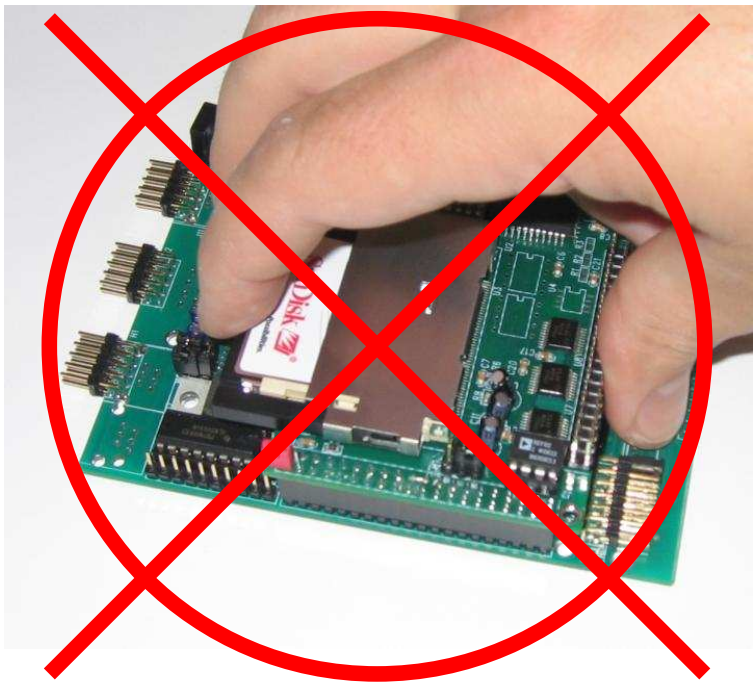
Hardware installation for the ACE consists of installing onto its host controller. The ***ACE™*** interfaces with a TERN controller via the J1 and J2 address/data bus. The photo below shows a ACE is installed on top of a BirdBox-A via the J1 and J2 headers.



ACETM + BirdBox-A

2.3 Hardware Removal

When removing the ACE from it's host unit, it is important not to pull on the Compact Flash. Pulling too hard on the Compact Flash may permanently damage the device.



DO NOT PULL ON COMPACT FLASH CARD, SOCKET OR EJECTOR WHEN REMOVING THE ACE FROM THE HOST!!

Chapter 3: Hardware / Software

The ACE™ is an expansion board supports a 50-pin CompactFlash receptacle, a 100M Ethernet Module, 2 channels of serial UART with RS232, RS485 or RS422, 33 channels of 12-bit ADC, and 2 channels of 12-bit DACs. ACE sample files and projects are in the folders listed below. Use the samples that correspond to your controller.

186 Controllers: c:\tern\186\samples\ace\

386 Controllers: c:\tern\386\samples\ace\

586 Controllers: c:\tern\586\samples\ace\

3.1 50-pin CompactFlash Interface

A 50-pin CompactFlash receptacle can be installed on the ACE and also a mechanical ejector. It supports 50-pin mass storage CompactFlash cards with Windows compatible FAT file system support, allowing the user to easily transfer large amounts of data to or from a PC. The following sample projects demonstrate how to use the flash file system.

186 Controllers: c:\tern\186\samples\flashcore\fs.pdl

386 Controllers: c:\tern\386\samples\ace\fs.pdl

586 Controllers: c:\tern\586\samples\ace\586_fs.pdl

3.2 Ethernet

A WizNet™ Fast Ethernet Module can be installed to provide 10/100 Base-T network connectivity. This Ethernet module has a hardware LSI TCP/IP stack. It implements TCP/IP, UDP, ICMP and ARP in hardware, supporting internet protocol DLC and MAC. It has 16KB internal transmit and receiving buffer which is mapped into host processor's direct memory. The host can access the buffer via high speed DMA transfers. The hardware Ethernet module releases internet connectivity and protocol processing from the host processor. It supports 4 independent stack connections simultaneously at a 4Mbps protocol processing speed. An RJ45 8-pin connector is on-board for connecting to 10/100 Base-T Ethernet network. A software library is available for Ethernet connectivity. See the following sample files:

186 Controllers: c:\tern\186\samples\ace\tcp_echo.c

386 Controllers: c:\tern\386\samples\ace\tcp_echo.c

586 Controllers: c:\tern\586\samples\ace\tcp_echo.c

3.3 UART SC26C92

The dual UART (SC26C92, Phillips, U5) is a 44-pin PLCC chip. The SC26C92 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 is installed as the default crystal for the dual UART. The ACE can support RS232 on channel A and RS232, RS485 or RS422 on channel B.
For more detailed information, refer to the SC26C92 data sheets (Phillips Semiconductors) or on the CD in the **tern_docs\parts** directory. Sample files for the SC26C92 are listed below:

186ES/188ES Controllers: c:\tern\186\samples\ace\ace_echo.c

186ER Controllers: c:\tern\186\samples\ace\ace_echo_r.c

386 Controllers: c:\tern\386\samples\ace\ace_echo.c

586 Controllers: c:\tern\586\samples\ace\ace_echo.c

3.4 12-bit ADC (P2543)

The P2543 is a 12-bit, switched-capacitor, successive-approximation, 11 channels, serial interface, analog-to-digital converter. The ADC digital data output communicates with a host through a serial tri-state output (DOUT= SDAT). The P2543 has an on-chip 14-channel multiplexer that can select any one of 11 inputs or any one of three internal self-test voltages. The sample-and-hold function is automatic. At the end of conversion, the end-of-conversion (EOC) output goes high to indicate the conversion is complete. P2543 features differential high-impedance inputs that facilitate ratiometric conversion, scaling, and isolation of analog circuitry from logic and supply noise. A switched-capacitor design allows low-error conversion over the full operating temperature range. The analog input signal source impedance should be less than 50Ω and capable of slewing the analog input voltage into a 60 pf capacitor. By default, the P2543 reference is tied to a 5V precision reference (U9). Inputs to P2543 are connected to signals AD10-AD1A, AD20-AD2A, and AD30-AD3A on header J3 (see schematics). See the following samples for reading the ADC.

186ES/188ES Controllers: c:\tern\186\samples\ace/ace_ad12.c

186ER Controllers: c:\tern\186\samples\ace\ace_ad12r.c

386 Controllers: c:\tern\386\samples\ace\ace_ad12.c

586 Controllers: c:\tern\586\samples\ace\ace_ad12.c

3.5 DAC (LTC1446)

The LTC1446/LTC1446L is a dual 12-bit digital-to-analog converter (DAC) in an SO-8 package. It is complete with a rail-to-rail voltage output amplifier, an internal reference and a 3-wire serial interface. The LTC1446 outputs a full-scale of 4.096V, making 1 LSB equal to 1 mV. The LTC1446L outputs a full-scale of 2.5 V, making 1 LSB equal to 0.61 mV.

The buffered outputs can source or sink 5 mA. The outputs swing to within a few millivolts of supply rail when unloaded. They have an equivalent output resistance of 40 Ω when driving a load to the rails. The buffer amplifiers can drive 1000 pf without going into oscillation.

The DAC can be installed in U4 on the ACE, and the outputs are routed to J3 pin 39 for DAC channel A(VA), and J3 pin 40 for DAC channel B(VB).

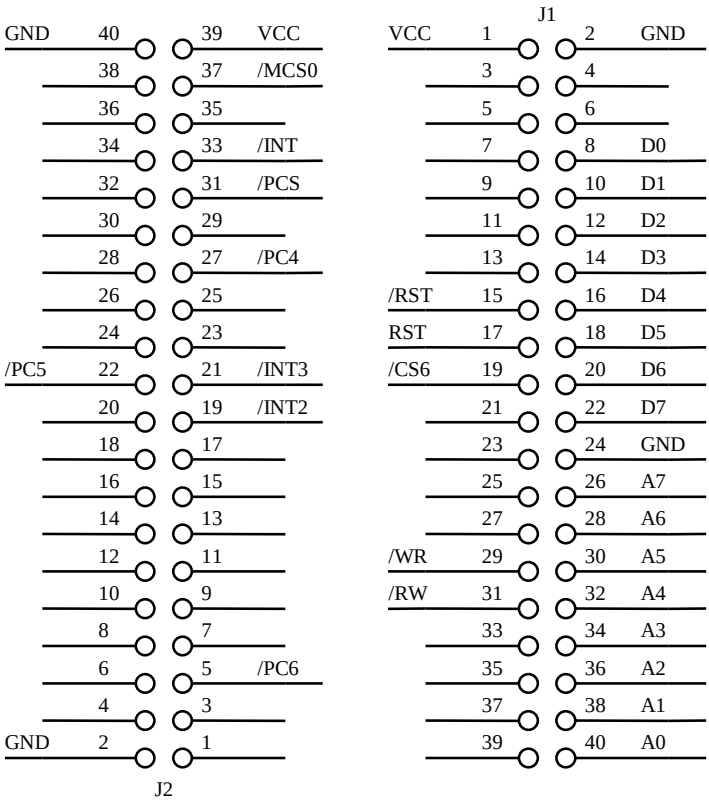
186 Controllers: c:\tern\186\samples\ace\ace_da.c

386 Controllers: c:\tern\386\samples\ace\ace_da.c

586 Controllers: c:\tern\586\samples\ace\ace_da.c

3.6 Interface to TERN host controller via J1 and J2

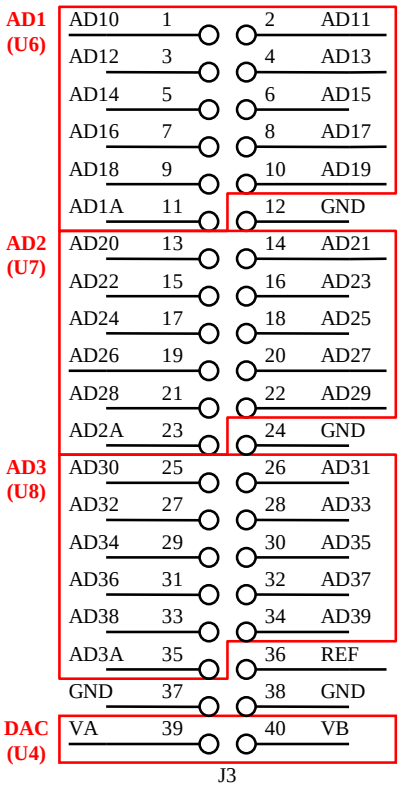
The ACE is designed to interface to a host TERN controller via two 20x2 pin headers. All high speed address, data, and control lines are located on J1. Many PIO lines, interrupt lines, and chip select lines are on J2.



The signal names on J1 and J2 pin headers may be different on different host controllers, such as 586E, i386E, AE86. User needs to find out the active signal names and functions based on the location or the pin number on the J1 and J2 header of the host controller.

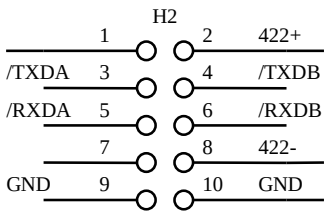
3.7 Header H3 - Analog Interface

Header H3 provides access to the 33 channels of ADC and 2 channels of DAC. The analog input labels are grouped by ADC chip: AD10-AD1A (U6), AD20-AD2A (U7) and AD30-AD3A (U8). The 2 channels of analog output are labels VA (pin 1) and VB (pin 2).

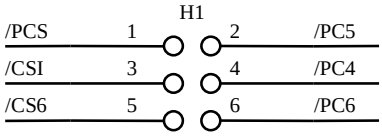


3.8 Header H4 - Serial Interface

Header H4 provides access to the 2 UART channels. Channel A is RS232 driven to signals /TXDA and /TXDB. When configured as RS232 or RS485, channel B signals are /TXDB and /RXDB. When configured as RS422, channel B signals are /TXDB and /RXDB for transmit and 422+ and 422- for receive.



3.9 Chip Selects and Hardware Configuration Header



In order to allow the ACE to work with most of the TERN host controllers in different combinations, a hardware configuration header is on board. Header H1 must be jumpered to /CSI (H1.3) according to the type of the host controller used.

As an example, a BirdBox-A and an ACE are assembled as shown in the photo below. H1 is jumpered so that /CSI (H1.3) = /CS6 (H1.5).

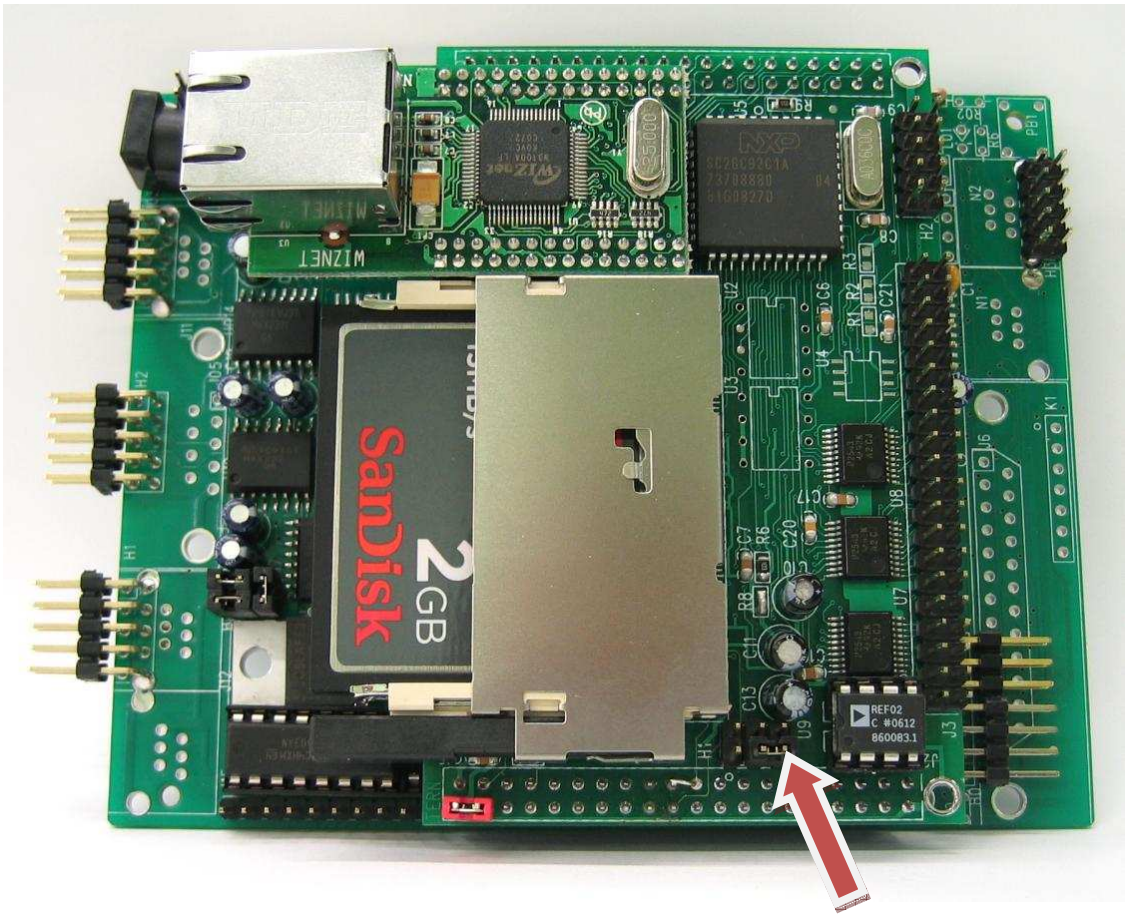
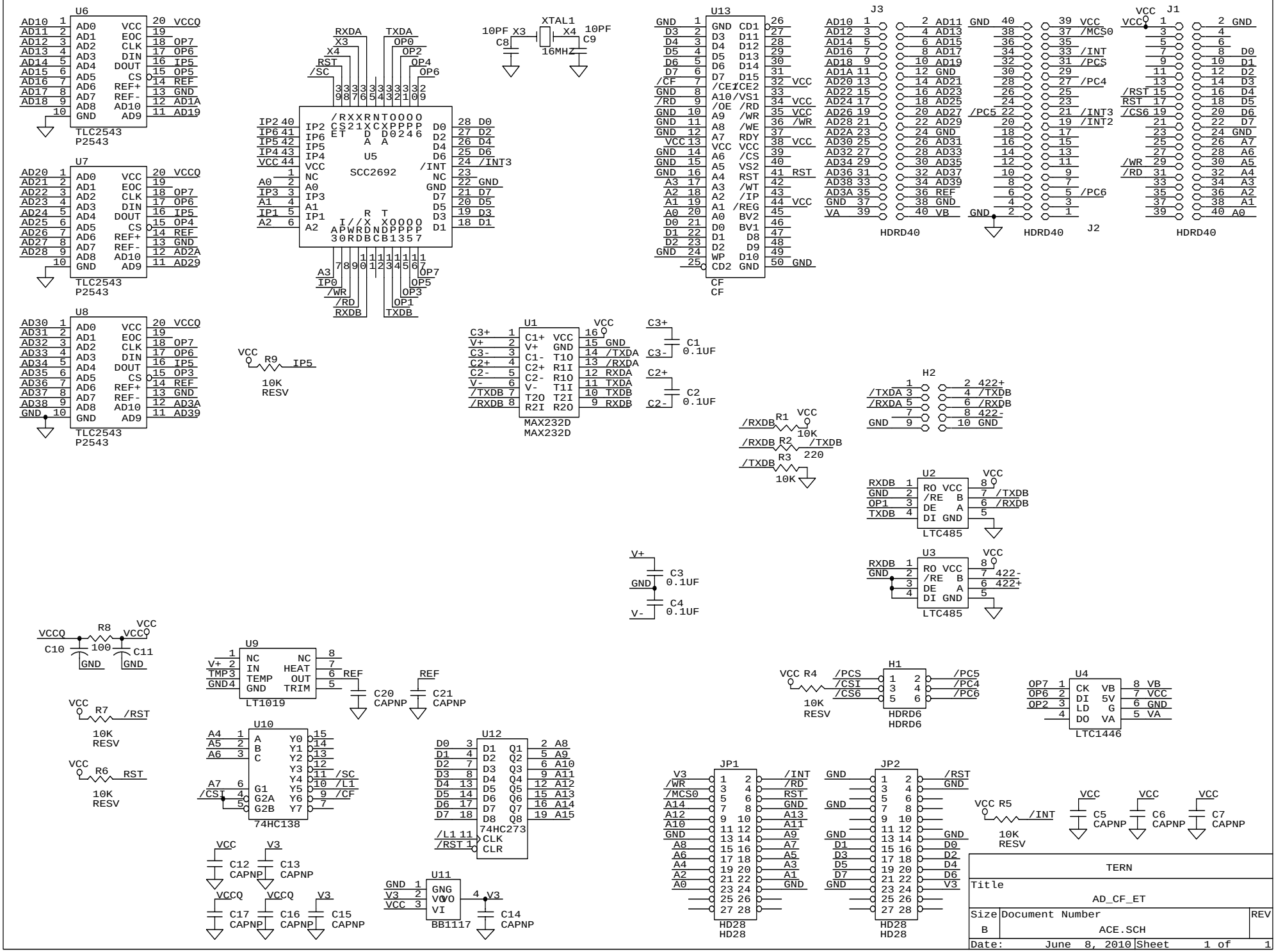


Figure 3.1 ACE™ with BirdBox-A


U6
TLC2543
P2543
U7
TLC2543
P2543
U8
TLC2543
P2543
SCC2692
U5
XTAL1
10PF
16MHZ
U13
CF
J3
HDRD40
J2
HDRD40
J1
HDRD40
U1
MAX232D
MAX232D
R9
10K
RESV
R1
R2
220
R3
10K
H2
U2
LTC485
U3
LTC485
C1
0.1UF
C2
0.1UF
C3
0.1UF
C4
0.1UF
R8
100
U9
LT1019
C20
CAPNP
C21
CAPNP
R7
10K
RESV
R6
10K
RESV
U10
74HC138
U12
74HC273
R4
10K
RESV
H1
HDRD6
HDRD6
U4
LTC1446
R5
10K
RESV
C5
CAPNP
C6
CAPNP
C7
CAPNP
C12
CAPNP
C13
CAPNP
C17
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