Introduction

TERN has always had a simple business model: we design compact, inexpensive, reliable single-board computers that integrate the embedded industry's most useful I/O and networking peripherals, along with easy-to-use software tools, so that you won't need to design them. TERN's single board computers employ modern CPUs (32-bit architecture with 16-bit external data bus) built on the time-proven x86 architecture, integrated with the embedded industry's most popular peripheral components, and utilize widely adopted modern software development tools. Best of all, the features we tout are powerful enough to meet your real-world application needs, not just fill up a marketing letter with vague names.

TERN's C/C++ programmable controllers are the complete solutions for your embedded application. With TERN controllers, established manufacturers can upgrade their existing products with the newest technologies, startup companies can quickly implement new designs, and just about anyone can easily implement a prototype for evaluation. TERN controllers are widely used in embedded systems that require superior performance, PC-compatibility, compactness, low power consumption, and high reliability at a low cost. TERN's industry-leading integrated hardware and software solutions combine comprehensive hardware features with tremendous ease of development.

It doesn't matter if you need only a few units for prototyping, research, or a few thousand units for your newest product… it doesn't matter if you're a software guru who's never touched a soldering iron, or a electrical guru who's never touched a keyboard… there are thousands of customers just like you who've already made their application work with TERN's solutions.

OEM and EOL

TERN has been providing products for OEM users since 1993. We recognize and appreciate the importance of having a reliable, consistently available design. In the rapidly changing embedded world, this can often be a challenge. Processors and technologies are declared obsolete with little warning. Many embedded users have probably been victims to this trend. A board design that's been in use for years is suddenly declared EOL, and the product development cycle has to be restarted from scratch... often with new engineering staff, development tools, and processor architectures. All of the previous development effort is wasted.

TERN is strongly committed to the goal of offering consistent, reliable embedded board designs that will be available for years and even decades. Many of our original customers have now been buying the same designs for 10+ years. No one can avoid change as the underlying technologies evolves, but our goal is to make this as transparent as possible for our customers. We take three steps:

1) we try to inventory, at our expense, single-source components if they're in danger of becoming declared EOL;

2) we work with third-party vendors to develop multiple replacement sources for any vulnerable components;

3) finally, we design replacement solutions that are drop-in compatible at the source, firmware, or hardware level.

TERN controllers are based on AMD, Innovasic, Intel, NEC, and RDC processors:

586-Engine/SC520/CPU basic features:

- 32-bit Am586, 133 MHz system clock • Floating Point Unit (ANSI/IEEE 754) • 16/32-bit data, 32 multifunctional I/Os
- 2 Asyn. and 1 Sync. serial ports • Real-time clock, Supervisor, Watchdog • 114-byte CMOS RAM, 7 timer/counters

i386EX Controllers/CPU basic features:

- 32-bit CPU, 33MHz system clock • 8/16-bit data, 64MB memory space • 24 multifunctional I/Os
- 2 Asyn. and 1 Sync. serial ports • Supervisor, Watchdog timer • 512-byte serial EE, 3 timer/counters

188/186 basic features:

- 16-bit CPU, 40/80 MHz system clock • 32 multifunctional I/Os • External interrupts, and DMA
- 2 async. serial I/O., 2 PWMs • 512-byte EE, Supervisor, Watchdog • 3 16-bit timer/counters

Where are TERN controllers used?

Every year, thousands of TERN controllers are installed and used in the United States and in more than 20 countries worldwide. Since 1993, thousands of satisfied customers have developed their products and complete their projects with TERN's reliable controllers, software, and excellent technical support.

TERN's customers range from large corporations and U.S. governmental agencies to small private firms and engineering consultants.

Organizations such as General Motors, Lockheed Martin, Hewlett Packard, Hughes Aircraft, IBM, NASA, and the U.S. Environmental Protection Agency use TERN controllers in their projects. Some recent applications of TERN controllers include portable instruments, radio remote control and data acquisition, factory automation, packaging machines, robot controls, cellular phone testing, and environment data recorders.

❶

2008 Featured Products

Over the past 15 years, TERN's product line of single-board embedded controller solutions has steadily grown to span a broad range of hardware and software features. We believe that our products have market-leading technical features for all price ranges. Use this page as an introductory guide to your controller selection process; if you don't see a board here that meets your particular needs, be sure to check our full product select guide on page 6, or contact us for a recommendation out of our vast product line. All TERN products are programmable in ANSI C/C++ with our modern Windows-based development environment.

Featured Controllers

Web-solution Ethernet-Engine (EE) and Controller Area Network-enabled CAN-Engine
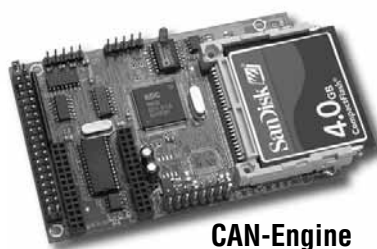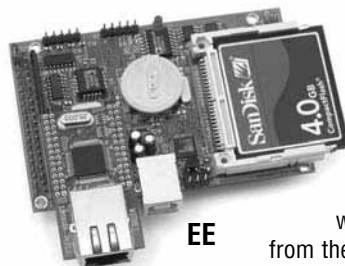
CAN-Engine **EE**

The EE provides a very powerful, tightly integrated, single-board solution for the network environment. Unlike other embedded network solutions, the EE and other TERN boards featuring the I2CHIP TCP module utilizes a hardware TCP/IP stack which provides tremendous bandwidth and reliability for network communications, while freeing the processor from the load of packet-level processing. You can implement any IP-level application directly on top of the lower-level socket interface. Combined with the onboard CompactFlash interface, a TERN webserver can serve up files from the PC-compatible filesystem over HTTP at rates of 200 KB/s and higher while still giving the processor time to process other onboard analog and digital I/Os. The related Ethernet-LCD board also provides an integrated 192x128 graphic LCD.

The new CAN-Engine adds CAN-bus support to the Ethernet/IP network. CAN-bus support is provided via industry standard chipset, and software drivers provide for high-reliability, high-bandwidth communications over a CAN bus.

Embed the E-Engine (see page 20) or CAN-E (see page 21) in your design if you need a network-capable board for your embedded application.
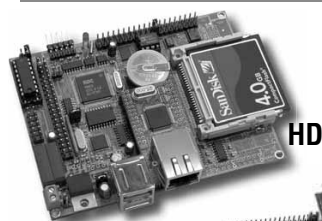
USB-enabled TFT LCD Controllers: Powerful U-Drive, and Low-Cost H-Drive

HD

The U-Drive is TERN's newest generation graphic display board. Featuring an industry standard graphics chipset, the U-Drive is integrated with an ultra-bright 320x240 pixel, 256-color display, along with accurate and reliable analog touchscreen. The UD adds power behind its beauty; it features a wide range of industrial I/O, Ethernet, CompactFlash, etc. The UD Is also the first TERN device to support a USB host interface; this allows support for USB keyboard/mouse for user input, as well as USB memory for portable mass storage. Combined with TERN's graphic display libraries, the UD is the ideal user interface component of your next embedded application.

The HD is the low-cost graphic display solution for your high-volume, price sensitive GUI application. It supports an ultra-low cost 320x240/256 color TFT display, touchscreen, Ethernet/IP, and USB keyboard/mouse.

Choose the UD (see page 28) or HD (see page 29) if your application benefits from eye-dazzling graphic display, touchscreen user input, and USB peripheral support.

UD

Vision-sensor C-Eye or Eye-J

These units bring an entirely new dimension to your embedded application by adding the power of sight. The C-Eye and Eye-J integrate industry-leading CMOS image sensors, enabling embedded recording and processing of VGA (640x480) quality images in real-time.

These two units access images in different ways. The C-Eye provides raw bitmap images, allowing on-board analysis of the image (to detect edges/motion/color). The Eye-J expansion board provides hardware JPEG-compressed images; compressing the image dramatically decreases image size, and increases the rate at which they can be captured; a raw VGA image may be about 300 KB in size, while a compressed image may be less than 1/10th that size. For basic recording or transmission of images, the Eye-J is a better option.

The integrated CF interface can log tens of thousands of photos over the course of months or even years for later processing.

Choose the C-Eye (page 19) and Eye-J (page 47) if you need a standalone computer with machine vision/image-capture capabilities.
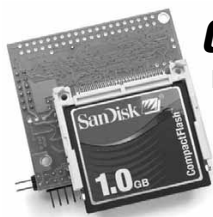
Eye-J **C-Eye**

CompactFlash-enabled Core Data-logger (FB/FN)

Measuring only 2.1" by 2.35", the FlashCore-B is a variant of the basic programmable core, now improved to also support data logging applications. With the integrated CompactFlash drive (using cards up to 2 GB in size), the FlashCore-B can add an entire new dimension to your embedded application. With the FB, your equipment becomes truly stand-alone. With FAT filesystem support (see featured software below), accessing your data is as easy as plugging the card directly into a CompactFlash drive on your PC/PDA. The FlashCore-N is designed for use in applications requiring numerous serial ports. It features a total of 10 asynchronous serial ports.

Choose the FlashCore-B (see page 22) to add an embeddable data-logging standalone computer with basic ADC and serial port support.
Choose the FlashCore-N (see page 23) to add embedded CompactFlash, with extensive serial port handling capabilities.
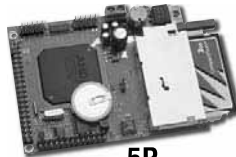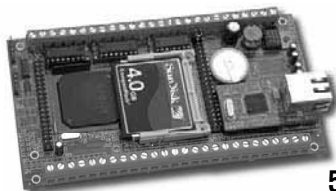
586-P and 586-D Powerful Data Acquisition and Control

Based on a 586-generation processor (with integrated hardware floating point coprocessor) and clocked at 133 MHz, the 586-P and 586-Drive (586-D) are capable of driving applications with intense data acquisition and computing requirements.

The 586-P version integrates 4 ch. 1 MHz 16-bit parallel ADC and 8 ch. 16-bit DACs; combined with an integrated CompactFlash interface, the 586-P is the most powerful core single-board analog/processing unit of the entire TERN product line. The 586-Drive surrounds this basic set of peripherals with a number of protected industrial I/Os: opto-couplers, solenoid drivers... and is available with a DIN-rail mountable enclosure. The 586-Drive also adds additional serial ports, a high-speed Ethernet interface, making it the ideal solution for any demanding industrial control application.

5P

5D

Choose the 586-Engine-P (see page 10) if your application requires high-performance, high-speed real-time, floating-point intensive embedded computation.
Choose the 586-Drive (see page 8) for a demanding embedded industrial control application.

Software Run-Time

Developing embedded software can be daunting, with a never-ending glossary of terms and technologies. TERN's software systems are designed to keep the learning curve low. Write your software on top of simple software drivers that look like the underlying hardware, while relying on the TERN runtime system to provide useful software features.

In order to make your development progress as easy and efficient as possible, TERN includes a wide range of software drivers and associated sample programs demonstrating various hardware peripherals. For example, we show you how to read characters from, and write characters to the serial ports. We'll show you how to turn on a digital output, or read the current value of a digital input, or handle interrupts from external inputs. We have numerous samples showing how to deal with real-time events based on a high-speed internal timer.

Beyond abstracting away simple hardware peripherals, TERN offers runtime libraries that provide a wide range of software capabilities, similar to those offered in other third-party commercial operating systems. The following section briefly introduces some of the runtime support your application can utilize:

FAT16 Filesystem

Many of TERN's current products include an integrated CompactFlash drive (or support CompactFlash via inexpensive expansion board). With widely available CompactFlash storage cards, your system can now access up to 2 GB worth of non-volatile data storage. With TERN's embedded filesystem support, the card is equivalent to a PC-based drive. You can create, read, write, and delete logical files. You can set/check modification times, list the contents in the directory, and other basic behavior. The read/write bandwidth can be in the 300-800KB/s range.

Very importantly, TERN's embedded filesystem is FAT12/16 compatible. The FAT filesystem dominates in a variety of computing environments. This means that files created on a TERN controller can be directly read and modified on a PC/PDA with CompactFlash, and vice versa. Transferring large amounts of data from or to your embedded system

becomes trivial. TERN also offers runtime library support that allows the loading of an application file from the CompactFlash card into SRAM for execution, allowing easy code upgrades.

TCP/IP Networking

For boards based on the basic CS8900A Ethernet MAC, TERN offers a TCP/IP stack based on the open-source OpenTCP package. This implementation supports popular network protocols including ARP, UDP/IP, TCP/IP, with all processing handled in software.

TERN has also introduced a new generation of network-enabled TERN controllers based on a 10/100-baseT TCP/IP hardware module called I2CHIP. Supporting controllers include the RL, 5D, EE, EL and expansion boards P52 as well as MMC. The I2CHIP module allows socket-level access to 4 separate sockets with hardware transmit/receive buffering of up to 8 KB. With direct memory access to both data and control registers, the I2CHIP module is ideal for network applications of any complexity and bandwidth.

Instead of dealing with packet-losses or TCP clocks in software, the TCP stack is entirely managed in I2CHIP hardware, thus freeing your system up for hard real time processing. Typical Ethernet-only solutions from other vendors are limited to a few KB/s of data throughput, while consuming valuable resources from the operating system + user application for stack management. With I2CHIP, the solution is far easier. Your application will only need to access a region of memory when data traffic has received, or is being sent. The software interface is BSD-socket style, providing direct tremendous flexibility, including access to raw IP packet fields.

"RoHS and Lead Free" project.

With a worldwide trend towards cleaner production methods, lead-free production is becoming a critical issue for all embedded systems. TERN has verified "Green" RoHS-compliant versions of components used on our systems, rebuilt PCBs with gold immersion, and started utilizing a lead-free production process. TERN is ready to work with you on integrating "green" RoHS-compliant versions of all of our products.

Software for TERN C/C++ programmable controllers

Programming TERN controllers — 3 easy steps

A $2000 Value

EV-P *C/C++ Evaluation Kit* $249
(Includes: Paradigm C/C++ Lite TERN Edition 32-bit Windows IDE, choice
of one Tern controller, hardware accessories/basic options)

DV-P *C/C++ Development Kit* $699
(Includes: Paradigm C/C++ TERN Edition 32-bit Windows IDE, choice of
one Tern controller, hardware accessories/basic options)

***Upgrade from EV-P to DV-P* $450**
(includes software in CD, Password & one Debug ROM for controller
specified by customer)   *Pricing may be higher on some high-end controllers

Step 1 Debugging
- Program in C/C++, compile, locate, and remote debug
- Connect controller to a PC via RS-232 serial link

Step 2 Standalone Field Test
Run controller standalone, away from PC, with
➤ DEBUG ROM installed, and STEP2 jumper set
➤ application program running in battery-backed SRAM
(Battery lasts 3-5 years under normal conditions.)

Step 3 Production (DV-P Kit only)
- Generate an application HEX or BIN file
- Produce your own ROM/Flash

Developers today face a bewildering range of embedded application development options. Even with project requirements that seem straight-forward, developers often find their first challenge has nothing to do with their actual design. On lower-end systems, developers first have to plan their strategies for squeezing the necessary logic into a few kilobytes worth of obscure machine code. On higher-end, 32-bit PC-derived operating systems, embedded engineers often find themselves evaluating complicated features that have almost no relevance to their immediate application (Plug-n-Play support? Network boot daemons? Windowing systems? Kernel build configuration?).

And there's no source of greater headache than being forced to combine hardware, compiler, runtime, and debugger development tools from different vendors. There's no doubt about it: getting started on a new embedded programming project can be complicated and confusing.

TERN's software kits simplify the entire process. They include all of the software, hardware, accessories, and manuals needed to complete your application development on any controller of your choice. With the TERN development kits, you will be able to run and debug sample programs on your controller within minutes of opening the box, installing the software on your PC, connecting the provided serial cable, and powering up the board.

The EV-P Kit is for the first-time buyer looking to make a prototype stand-alone unit for evaluation and field testing. It supports STEP 1 and STEP 2, but not STEP 3 of the development cycle. With the EV-P, you will still be able to compile, download, and debug your application code. You even have the capability to run your code out of the battery-backed SRAM for initial stand-alone testing. The *DV-P Kit* will be needed to generate ROM-able application files, necessary when you go into OEM production for your system

(STEP3 of the development cycle). If you began with the EV-P kit for evaluation purposes, a software-only upgrade is available for upgrading your system to the full DV-P.

The TERN kits include:
- ✔ software tools needed for the entire development process from beginning to end,
- ✔ choice of production hardware controller, ready to be debugged,
- ✔ accessories, including DB-9 serial cable, wall transformer,
- ✔ documentation for all TERN products, specifications for peripheral parts/processors used on TERN products.

Software

The EV-P and DV-P kits provide comprehensive, professional software tools for building embedded applications. These software kits provide a modern 32-bit Windows-based C/C++ Integrated Development Environment (IDE) that hosts the entire development process in one location (available for Windows 95/98/NT/2000/ME/XP).

The IDE consists of:
- A modern editor with syntax highlighting, header file expansion.
- A Project Manager for tracking build dependencies in large projects, and managing source version control.
- Built-in class/method/struct symbol database.
- Integrated ANSI C and C++ compiler/assembler, executable re-locater.
- Remote debugger integrated with the editor: watch windows, dynamic expression evaluation, conditional breakpoints

You can see the development system in action on the page 5 screen-shot. This screen-shot shows the sample program *led.c*

being debugged. This basic C program, which blinks the LED, is running directly on the TERN controller while the debugger retains full control over the execution.

The C/C++ kits provide a variety of software solutions to assist you in developing your project. At the lowest level, these kits include a set of hundreds of C library functions (like the *led()* function used above) that allow you to easily access the features of your TERN controller, such as the serial I/O, ADC, DAC, Flash, graphics LCD, timers, interrupts, etc. TERN also offers higher-level software runtime libraries for more complicated application requirements (see previous page for Software Runtime details).

A wide range of sample programs for every controller demonstrates the use of these library functions and hardware features, allowing you to quickly and easily develop your application. Even those with basic C/C++ knowledge will find development to be straight-forward.

the other options available for that controller.

For example, if you selected the AE-P controller, the Kit (**EV-P-AEP40**, $249 or **DV-P-AEP40**, $699) includes a 40 MHz AE-P with 128KB SRAM, RS232, 5V regulator, DEBUG ROM, wall transformer, serial cable and software in a CD. If you need it, add the 11 channel 12-bit ADC option for an additional $20.

International customers must specify 110V or 220V AC power supply for your wall transformer.

Support
TERN takes pride in intimate technical support for all of our development customers. Our customers are our partners, and we will do our best to assist in your project development process. Whether it's a simple compilation error, or a complicated request for new sample code, TERN is always accessible via email at tech@tern.com. You may also find help online at: http://groups.yahoo.com/group/tern.

Custom Application Development

controllers, and you can leverage our experience to increase your own productivity.

We will work with you to develop an initial application specification (including controller selection/design). Based on this specification, our engineers will implement a prototype of the application. The fully commented source code and a working hardware demonstration is provided to you once we complete development. Our focus is on making the code reliable and easily modifiable to fit your changing application needs over time. We will provide support to make sure the deliverables can be integrated into your system successfully. *TERN can also help port (re-code) applications implemented in other languages or for other platforms for use on TERN systems.*

Contact us to discuss your application needs and ask for a quote!

TERN's ultimate commitment is in helping customers develop their application successfully. *Our success is intertwined with the success of your project.* The C/C++ software kits make this task easier, but there can still be a substantial learning curve involved in developing embedded applications for a new platform; even quick application prototyping can be a frustrating experience.

For those most interested in getting started quickly in the development of their applications, TERN now offers professional custom software development and board design. Engineers at TERN and our partners have accumulated thousands of hours worth of experience developing applications for use on TERN

Controller Selection Guide

Page	Board	CPU	Size (inches)	DC Power (V)	TTL I/O	High Voltage I/O	UART	12-bit ADC (16-bit ADC)	12-bit DAC (16-bit DAC)	Maximum Speed (MHz)	External Bus Width	Regulator*	Timer/cnts	Ethernet CAN 232/485	CF/USB	Expansion Board
28	UD	186	6.5x4.4	9-30	20+	20+	6	[28]	12	40/80	16	S	3	ETH+,232,CAN	CF/USBH	All
29	HD	186	4.25x3.3	9-30	4+	8+2	6	11,[16]	8	40	16	S	3	ETH+,232,485	CF/USBH	All
30	CANE	186	3.6x2.6	5/9	20+		2	(4)		80	16	L	3	232,ETH+,CAN	CF	All
8	586D	586	6x3.2	9-30	10+	40	4	[16],(4)	8+	133	16	S	7	ETH+, 232,485	CF	All
9	586E	586	3.6x2.3	5	32		3	19	8	133	16		7	TTL		All
10	586P	586	3.6x2.6	9-30	20+		2	(4)	(8)	133	16	S	7	232	CF	All
11	A104	188	3.6x3.8	12	60+	14	3	16	4	40	8	L	3	232,485		All
12	A104S	188	3.6x4.0	30	80+		7	11	2	40	8	S/L	3	232,485		All
13	AC	188	2.2x2.3	5/12	20+		2			40	8	L	3	232		i2x
14	AC86	186	2.2x2.3	5/12	20+		2	(1)	2	40	16	L	3	232		i2x
15	AE	188	3.6x2.3	5	40+		3	11	2	40	8		3	TTL		All
16	AE86	186	3.6x2.3	5	50+		3	19	6	40	16		3	TTL		All
17	AE86D	186	3.6x2.9	9-30	20+		3	8	8	40	16	S/L	6	232,485		All
16	AE86P	186	3.6x2.9	9-30	50+		3	19	6	40	16	S/L	3	232,485		All
15	AEP	188	3.6x2.8	12	40+		3	11	2	40	8	L	3	232,485		All
18	BBA	188	4.5x3.6	9-30	70+	7	4	11	2	40	8	S/L	3	232,485		All
19	CEye	186	4.0x3.0	5-30	10+		2			40	16	S/L	3	232, ETH+	CF	
20	EE	186	3.6x2.6	5/9	20+		2	(4)		80	16	USB/L	3	232, ETH+	CF	All
21	EL	186	4.2x3.0	9-30	10	7+1	2	[16],(4)	10	40	16	S/L	3	232, ETH+	CF	All
22	FB	188	2.4x2.1	6-12	20+		2	(8)	4	40	8	L	3	232	CF	i2x
23	FN	186	3.6x2.9	9-30	40+		10	(8)	4	40	16	S/L	3	232,422	CF	All
24	GE	186	4.3x3.1	9-30	20+	2	2		2	40	16	S/L	3	232/485 ETH	CF	All
25	ID	386	4.5x4.7	9-30	70+		5	22	2	33	16	S/L	3	232,485	2 QD	All
26	IE	386	3.6x2.3	5	30+		3	11	4	33	16		3	TTL		All
31	IEL	386	3.6x2.8	9-30	50+		3	19	2	32	16	S/L	3	232,485		All
32	IEM	386	4.5x2.7	9-30	20+		3	(8)	4	33	16	S/L	3	232,485		All
32	IEP	386	4.5x2.7	9-30	20+		3	1		33	16	S/L	3	232,485		All
13	MD88	188	3.1x2.6	9-12	35	35	2			40	8	L	3	232		
33	RA	186	3.6x3.5	9-30	40+		3	32, (8)	8	80	16	S/L	6	232,422	CF	All
34	RB	186	4.0x3.0	9-30	20+	15	3	(8)	8	80	16	S/L	3	232/485	CF	i2x
35	RD	186	3.9x3.6	9-30	40+	21	3	8, (8)	8	80	16	S/L	3	232,422,ETH	CF	All
37	RE	186	3.6x2.3	5	40+		3	11, (8)	6	80	16		3	TTL		All
37	RM	186	4.2x5.2	9-30	40+	21	3	8, (8)	8	80	16	S/L	3	232,422,ETH	CF	All, MODEM
38	RL	186	4.9x3.5	9-30	20+	35,20	5			80	16	S/L	3	232,485,ETH†	CF	All
39	SC	186	4.5x2.0	9-12	8		2	[48]	2	80	16	L	3	232, ETH+	CF	All
39	SCA	186	4.5x2.0	9-12	10+		2	48		80	16	L	3	232, ETH+	CF	All
40	SD	386	6.1x4.5	9-30	70+		11	11	2	32	16	S/L	3	232,485		All
41	SL	188	6.5x4.3	9-12	70+	7	3	21	4	40	8	S/L	3	232,485		All
42	ST	186	6.5x4.5	9-30	20+	20	5	12	14	40	16	S/L	6	232/485 ETH	CF	All
43	TD40	188	4.8x3.4	9-30	50+	35	3	11	2+	40	8	S/L	3	232,485		i2x
44	TD86	186	4.8x3.4	9-30	50+	30	4	6	4	40	16	S/L	6	232,422		All

* S=switching regulator, L=linear regulator   CF = CompactFlash,
QD = Quadrature Decoder   ETH = CS8900 Ethernet Controller
ETH† = 100BT Ethernet Controller with hardware TCP

Expansion Board Guide

Processor and controller performance

A simple analogy for controller performance is a highway system. The clock speed is the speed limit at which data can travel. The width of the external data bus is the number of lanes on the freeway. More lanes and a higher moving speed means better performance supported by the highway system. You can think of "186-40 MHz" as cars moving at 40MPH on 16 lanes and "586-133MHz" as cars moving at 133 MPH on 16 lanes.

Expansion Board Overview

TERN expansion boards offer features in addition to those provided by TERN CPU controllers. Expansion boards can increase a TERN controller's I/Os and memory storage capabilities. The integrated modular design of the expansion board line allows a fast, easy, and flexible way of upgrading a TERN controller's capabilities.

Mounting a TERN Controller On an Expansion Board

TERN controllers mount directly on top of the expansion board, connecting via high quality gold-plated pins and sockets. These boards can be further secured with fastening screws connected through aligned mounting holes. TERN controllers can be used as components directly soldered into OEM products.
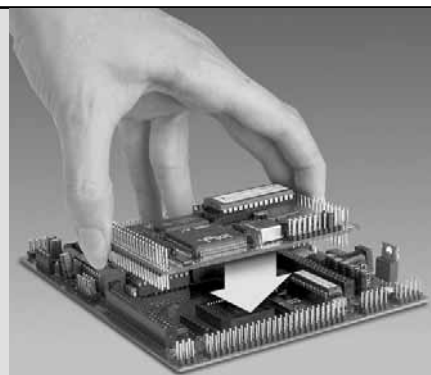
Page	Expansion Board	Size (inches)	DC Power (V)	Regulator*	RS232/485	Ethernet	TTL I/O	HV I/O	ADC	DAC	Decoder/CAN	Special Functions
27	ACU	3.6x2.3	5			ETH+	9		16		1	ADC, CAN, Ethernet, HOST USB ports
27	P100CAN	4.4x2.9	9-30	S/L	3		96	7			1	CAN, 96 I/O lines, 7 HV I/O
45	CUSB	2.1x1.3	USB									USB Interface
54	C24	3.6x2.3	5									24 ch. 16-bit counters
47	EyeJ	1.2x2.0	5									Image sensor with JPEG
22	FC0	2.4x2.1	5									CompactFlash Interface
48	Grabber	3.6x2.3	5						2			Flash ADC, 25-80 MHz, FIFO/Buffer
49	i2x-D32	3.2x1.5	5				32					i2x, 32 I/Os, LCD interface
49	i2x-KP	5.3x2.6	5-12	L			16	9				I2x, LCD, 8x2 keys, 7 HVs, 2 relays
49	i2x-R16	3.3x1.7	5-12	L				16				I2x, 16 relays
50	LD	5.7x4.1	9-30	S/L	10			48	22			8 UARTs, 10 RS232, 22 solenoid drivers
51	MM-B	3.6x2.3	5-12	L	2	1			39			CF, Ethernet , 8 MB SRAM
	MMC	3.6x2.3	5			ETH+			4			6 24-bit ADC, 33 12-bit ADC, 4 16-bit ADC
52	MC2140 MC2540	4.7x3.8	9-30	S/L	3		24	7	8	4	4	DSP, 4-axis motion control, servo/stepper, DAC, Quad. Decoders
*	MC1401 MC1451	6.1x4.7	12	S/L	3		24	4		4	4	DSP, 4-axis motion control, servo/stepper, DAC, Quad. Decoders
19	Eye0	2.5x1.85	5									CMOS image camera
53	MCP2140 MCP2540	4.6x5.3	9-30	S/L	3		48	40	8	4	4	OPTO, SSR, DSP, 4-axis motion control, servo/stepper, DAC, Quad. Decoders
53	MCS2340	4.5x4.8	9-30	S/L	3		24	19	16		4	Brushless, sinusoidal waveform, ADC, DAC, Quad. Decoders
48	OPA	2.0x1.6	5-12				3		8			8 ch. +-10V analog inputs, 16-bit ADC
48	OPS	2.8x2.4	9-12									4 instrumentation ops, Gain >1000
46	P50/P52	4.4x3.1	9-30	S/L	3	ETH+	24	14	8	4	2	16-bit bus, ADC, DAC, Ethernet
50	P100	4.4x2.9	9-30	S/L	3		96	7			2	96 I/O, 7HV I/O, 2ch. Quad. Decoder
50	P300	7.5x5.0	9-30	S/L	3		264	240				264 TTL I/O or 240 high voltage I/O
*	PC-Co	4.9x4.2	12	L	4		72	7				3 relays, RS232, LCD, DB9/25 connector
*	PD	7.9x5.6	12	L	3		26	13	8	4	2	HP2020 decoders, opto-couplers
45	QD8	3.6x2.3	5								8	8 Quadrature Decoders, 3 Counters
48	Relay7	4.4x2.2	12					14				7 10A mechanical relays, 7 HV I/O
50	UR8	3.6x2.3	12		8							8 RS232 or 4RS232+4 RS485
46	VE232	2.3x1.4	12	L	3							5V Regulator, 2 RS232, 1 RS485

✳ Call for information

586-Drive™ (5D)

586-based 100M Ethernet Web Controller with 24-bit ADC, DAC, HV I/O, and CompactFlash Interface

NEW!
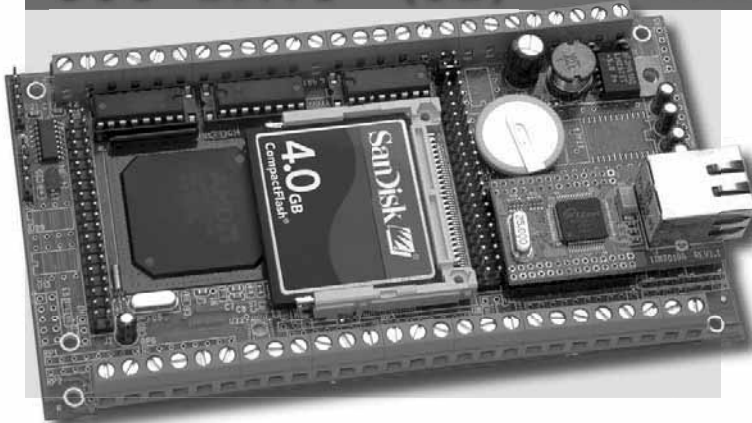
Features:

- 151x82 mm. DIN rail mounting, 110 mA at 24V DC power
- 133 MHz, AMD SC520, program in C/C++
- High performance hardware floating point coprocessor
- Non volatile SRAM, Flash, RTC, timers, interrupts
- 4 RS232/485 Async serial ports and 1 Sync serial port
- CompactFlash and FAT16 file system support
- 4 ch 16-bit ADC (AD7655) and 8 16-bit DAC(LT2600)
- Hardware TCP/IP stack for 100M Base-T Ethernet
- 16 analog or digital inputs(30V) with 24-bit ADC(LT2448)
- 20+ Solenoid Drivers, 4 Opto-couplers, 10+ digital I/Os.

Introduction

The 586-Drive™ (5D) is a C/C++ programmable controller based on the 32-bit 133 MHz AMD Elan SC520. It combines this high performance 586 generation processor with an extensive set of industrial I/O features on a single-board, ideal for OEM product.

The SC520 integrates an Am586 CPU and a high performance ANSI/IEEE 754 compliant hardware floating point unit (FPU). The SC520 has a total of seven timers including PIT timers and GP timers, plus a software timer. A real-time clock (RTC) provides a time-of-day calendar and 114 bytes of battery backed RAM. 13 user programmable multifunctional I/O lines are available. One synchronous serial interface (SSI) supports full-duplex, high speed bi-directional communication.

By default, 256KW low power 55 ns SRAM is installed to allow longer battery backup lifetime; this requires slower 2 wait state access to memory. Optionally, if battery backup is not required, a high speed 20 ns SRAM can be installed to allow higher performance zero wait state operation.

In addition to the on-board surface mount Flash, a 32-pin DIP IC socket allows using traditional user application plug-in ROM/Flash. A 50-pin CompactFlash interface supports low cost, removable, up to 2 GB mass storage CompactFlash cards with Windows compatible FAT file system support. A 512/2K bytes EEPROM can be installed. The **5D** can be powered by a single unregulated DC power from 8V to 30V range with the on-board high-efficiency 5V switching regulator.

Networking/Connectivity

An Fast Ethernet Module can be installed to provide 100M BaseT network connectivity. The hardware LSI TCP/IP stack implements TCP/IP, UDP, ICMP and ARP in hardware. With 16KB internal transmit and receiving buffer, the Ethernet module releases internet connectivity and protocol processing from the host processor.

The system can easily handle TCP/IP traffic of up to 200 Kbyte/s. Samples for HTTP, Telnet, FTP applications are available.

Up to 4 RS232 serial ports (2 from SC520, and 2 SCC2691) are available. Two ports can be factory-configured as RS485.

Industrial I/O

By default, 7 high voltage inputs(30V), and 14 high voltage sinking drivers(ULN2003A) are installed in DIP sockets. Each driver is capable of sinking 350 mA at 50V per line. They can directly drive solenoids, relays, or lights. Optionally, 12 DAC channels can be installed in their place.

Four high isolation voltage photo couplers (PS2701, NEC) can be installed to provide optically isolated inputs. 16 additional input channels are provided with a 24-bit ADC(LTC2448), connected via hardware configurable buffer resistors and screw terminal blocks. Variable resistor dividers can be installed to allow variable(up to 30V) input range(as default, 0-5V). They can be processed as analog or digital signals. With a peak sample rate of 5 KHz, this ADC works well directly with analog signals from strain gages, current shunts, RTDs, resistive sensors, and also work well directly with thermocouples in the differential mode. A precision reference(LT1019/REF02) with a internal temperature sensor providing local temperature for thermocouple applications.

In addition, an additional 4 ch. 16-bit parallel ADC (AD7655, 0-5V) supports ultra high-speed (1 MHz conversion rate) analog signal acquisition. The AD7655 contains two low noise, high bandwidth track-and-hold amplifiers that allow simultaneous sampling on two channels. Eight 16-bit digital to analog converters (TLC2600) can be installed to provide analog voltage (0-5V) outputs.

With the 388 pin BGA package of the SC520, repair support is not available. The 5D works with TERN expansion boards including the UR8, C24, P100, and P300.

A 192 x 128 pixel graphic LCD can be installed replacing 14 high voltage drivers.

Ordering Information

586-Drive (5D)	**$229/$199/$169**	**Qty 1/100/1K+**

Includes SC520 with FPU, 256KW Flash, 256KW 55 ns SRAM, 2 RS232s, RTC, high voltage I/Os, and Switching Regulator.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) High speed SRAM 64KW/256KW ....$20/$40
2) CompactFlash Interface $20
3) 4 ch. 16-bit ADC(AD7655)..$40
4) 8 ch. 16-bit DAC (LTC2600)..$40
5) 100M BaseT Ethernet $30
6) SCC2691 (a)232, (b)485 up to 2 sets...............................$30x2
7) 24-bit ADC(LTC2448) with buffer resistors..........................$50
8) OPTO couplers (PS2701), up to 4 ....$10x4
9) 2 ch. 12-bit DAC in HV socket, up to 3 chips...................$20x3
10) 192 x 128 graphic LCD $50
10) 192 x 128 graphic LCD $50
11) 2 K bytes EEPROM $20

Typical Order Example: 586-Drive, Ethernet, 16 24-bit ADC

5D +5+7 = $229 + $30 + $50 = $309
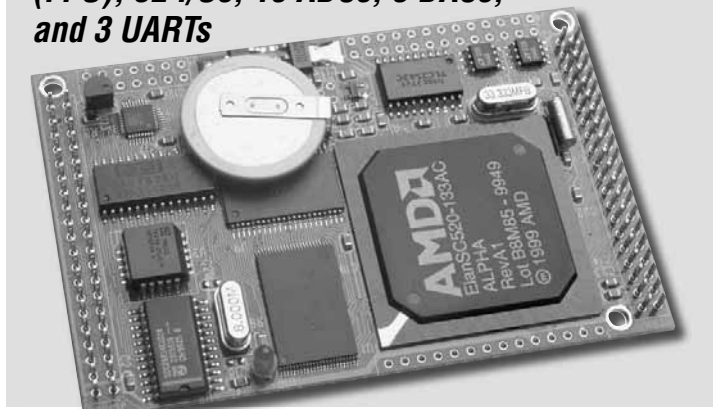
586-Engine™ (5E)   133 MHz, Floating Point Unit

High Performance, C/C++ programmable, Low Cost 32-bit 586 CPU with Floating Point Unit (FPU), 32 I/Os, 19 ADCs, 8 DACs, and 3 UARTs

Features:

- 3.6 x 2.3 x 0.3", 440 mA@5V, Battery
- 133 MHz, 32-bit AMD SC520, program in C/C++
- High performance hardware floating point coprocessor
- 256 KW SRAM*, 256 KW Flash, 114 byte internal RAM
- 32 PIOs, 7 timers, 15 interrupts, 1 Sync and 2 UARTs
- 19 ADCs, 8 DACs, Real-time clock, 3rd UART*

    *Optional

The **586-Engine™** (**5E**) is a C/C++ programmable controller based on the 32-bit 133 MHz AMD Elan SC520. The SC520 integrates an Am586 CPU and a high performance ANSI/IEEE 754 compliant hardware floating point unit (FPU). The FPU provides arithmetic instructions to handle numeric data and transcendental functions for sine, tangent, logarithms, etc, useful for intensive computational applications. It is estimated to be 10-50 times faster than an 8/16-bit controller without a FPU.

The **586-Engine™** supports up to 15 external interrupts. There are a total of seven timers including one programmable interval timer (PIT) that provides three 16-bit PIT timers, three 16-bit GP timers, and a software timer. These timers can also be used to count external events. The software timer provides a very efficient hardware time base with microsecond resolution. A real-time clock (RTC) provides time-of-day, 100-year calendar and 114 bytes of battery backed RAM.

Two industrial-standard 16550-compatible UARTs support baud rates up to 1.152 M baud. One synchronous serial interface (SSI) supports full-duplex bi-directional communication. One optional UART (SCC2691) can be installed as the 3rd serial port.

The **586-Engine™** boots from the on-board 256KW 16-bit ACTF Flash. By default, 256KW low power 55 ns SRAM is installed to allow longer battery backup lifetime; this requires slower 2 wait state access to memory. Optionally, if battery backup is not required, a high speed 20 ns SRAM can be installed to allow higher performance zero wait state operation.

The SC520 supports 32 programmable multifunctional TTL-level I/O lines (PIO) that can be used as general I/O. Two supervisor chips monitor 5V and 3.3V and provide power failure detection, watchdog and system reset. The 2.5V is used for the SC520 core and 3.3V for the I/O operation. Signal lines on headers are 3.3V output, and 5V maximum input. All components are soldered on board for highest

reliability. Repair support is not available due to the 388 pin BGA package of the SC520.

The **586-Engine™** can be powered with a single regulated 5V using the on-board 3.3V and 2.5V regulators. It also can be powered by external regulated 5V, 3.3V, and 2.5V.

A total of 19 analog inputs are supported with a serial ADC (TLC2543, 11 inputs, 20KHz sample rate, 12-bit, 0-REF+) and a parallel ADC (AD7852, 8 inputs, 100KHz sample rate, 12-bit, 0-5V). Two serial DACs (LTC1446, 2 channels, 0-4.095V) and a parallel 12-bit DAC (DA7625, 4 channels, 0-2.5V) can be installed to provide a total of 8 analog outputs.

The **586-Engine™** works with TERN expansion boards including the **P50, P100, P300, MCS/MC/MCP, MMB**, and **FC-0.**

Ordering Information

586-Engine™(5E) $199/$175/$149/$99   **Qty 1/50/100/1K+**

Includes 133 MHz SC520 with FPU, 256KW Flash, 64KW SRAM, 2 UARTs, 3 timers, RTC, Battery, and 32 I/Os.

NOT including add-on options. OEM option discounts available.

EV-P or DV-P kit (Software & 586-Engine) **$349/$799**

Add-on Options:

1) High speed SRAM 64KW/256KW .... $20/$40
2) 3rd UART(SCC2691) $20
3) 11 ch. 12-bit ADC(TLC2543) $20
4) 8 ch. 12-bit ADC(ADS7852), 300KHz $20
5) 2 ch. 12-bit DAC (LT1446) up to 2.................................$20x2
6) 4 ch. 12-bit DAC (DA7625), 200 KHz.................................$40

Typical Order Example: 586-Engine™, 256KW SRAM

5E + 1 = $199 + $40 = $239

J1 Signal

Function	Pin#	Pin#	Function
VCC	1	2	GND
MPO	3	4	CLKT
RxD	5	6	GND
TxD	7	8	D0
VOFF	9	10	D1
/BHE	11	12	D2
D15	13	14	D3
/RST	15	16	D4
RST	17	18	D5
/CS1	19	20	D6
D14	21	22	D7
D13	23	24	GND
	25	26	A7
D12	27	28	A6
/WR	29	30	A5
/RD	31	32	A4
D11	33	34	A3
D10	35	36	A2
D9	37	38	A1
D8	39	40	A0

J2 Signal

Function	Pin#	Pin#	Function
GND	40	39	VCC
P31	38	37	P27
P28	36	35	P29
TxD0	34	33	P23
RxD0	32	31	/RTS1
P30	30	29	P26
TxD1	28	27	/RTS0
RxD1	26	25	P25
P24	24	23	P22
/CTS1	22	21	P21
P19	20	19	P20
P17	18	17	P18
P15	16	15	P16
P11	14	13	P12
P9	12	11	P10
P7	10	9	P8
P13	8	7	P6
P14	6	5	P5
P2	4	3	P4
GND	2	1	P3

TERN INC.

9

586-Engine-P™

32-bit 586-based Standalone Embedded Controller
16-bit ADC, 16-bit DAC and CompactFlash Interface
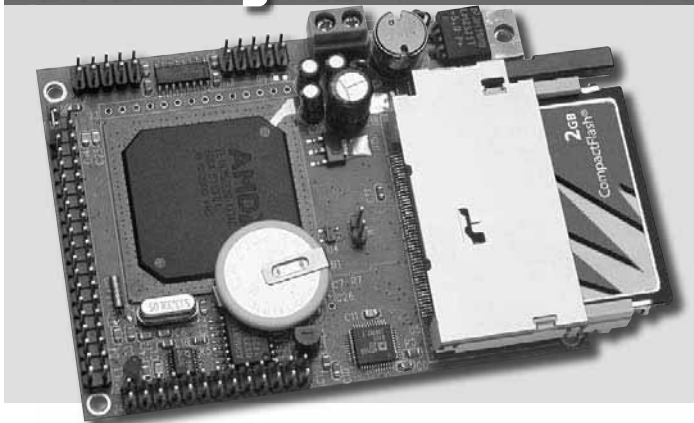
Features:

- 3.6 x 2.6 x 0.3", 110 mA at 24V DC power input
- 133 MHz, 32-bit AMD SC520, program in C/C++
- High performance hardware floating point coprocessor
- 64/256 KW SRAM, 256 KW Flash, RTC
- 32 PIOs, 7 timers, 15 interrupts
- 1 high-speed synchronous serial and 2 RS-232 ports
- 4 ch. high speed 16-bit ADCs and 8 ch. 16-bit DACs
- CompactFlash cards and FAT16 file system support

Summary

The 586-Engine-P™ (*5P*) is a complete C/C++ programmable standalone controller based on a 32-bit 133 MHz AMD Elan SC520. The 5P improves upon the standard 586-Engine core by integrating additional peripheral components.

Most significantly, the 5P has added voltage regulator and RS232 line drivers, making it a true stand-alone product. The 5P also adds high-speed 16-bit analog I/Os, making it appropriate for a whole new generation of high-performance data acquisition (DAQ) and precision control applications.

Inputs/Outputs

The SC520 supports 32 programmable multifunctional I/O lines (PIO) that can be used as general discrete I/O. Two industrial-standard 16550-compatible UARTs (RS232) support baud rates up to 1.152 M baud. One synchronous serial interface (SSI) supports full-duplex, high speed bi-directional communication.

A unique 16-bit parallel ADC (AD7655, 0-5V) supports ultra high-speed (1 MHz conversion rate) analog signal acquisition. The AD7655 contains two low noise, high bandwidth track-and-hold amplifiers that allow *simultaneous* sampling on two channels. Each track-and-hold amplifier has a multiplexer in front to provide a total of 4 channels analog inputs. The parallel ADC achieves very high throughput by requiring only two CPU I/O operations (one start, one read) to complete a 16-bit ADC reading. With a precision external 2.5V reference, the ADC accepts 0-5V analog inputs at 16-bit resolution of 0-65,535.

An octal rail-to-rail digital to analog converter (TLC2600) can be installed to provide eight channels of analog voltage (0-5V) outputs. At power on, all analog outputs are zero with the on-board reset. The DAC chip is accessed through a 3-wire SPI-compatible serial interface, which is connected to the 5P's high-speed synchronous serial port (clockable up to 50 MHz). Eight builts-in analog output buffers can drive rail-to-rail analog voltage with up to 15 mA.

Other Features

The 5P boots from on-board 256K 16-bit ACTF Flash. By default, 256KW low power 55 ns SRAM is installed to allow longer battery backup lifetime; this requires slower 2 wait state access to memory. Optionally, if battery backup is not required, a high speed 20 ns SRAM can be installed to allow higher performance zero wait state operation. The 5P supports low- cost, removable, up to 2 GB mass storage CompactFlash cards.

The SC520 integrates an Am586 CPU and a high performance ANSI/IEEE 754 compliant hardware floating-point unit (FPU). The FPU provides arithmetic instructions to handle numeric data and transcendental functions for sine, tangent, logarithms, etc, useful for intensive computational applications. It is estimated to be 10-50 times faster than an 8/16-bit controller without a FPU.

Up to 15 external interrupts are supported. There are a total of seven timers including one programmable interval timer (PIT) that provides three 16-bit PIT timers and three 16-bit GP timers, plus a software timer. These timers can support timing or counting external events. The software timer provides a very efficient hardware time base with microsecond resolution. A real-time clock (RTC) provides time-of-day, 100-year calendar and 114 bytes of battery backed RAM.

Signal lines on headers are 3.3V output and 5V input tolerant. Absolutely no voltage greater than 5V should be applied to any pins. With the 388 pin BGA package for the SC520, repair support is not available. The *5P* can be powered by a single unregulated DC power from 8V to 30V range with the on-board high-efficiency 5V switching regulator (LM2575). The 5P can also be powered by a regulated 5V without using on-board 5V regulator.

The *5P* works with TERN expansion boards including the P100, P300, P50, LittleDrive, and MotionC.

Ordering Information

586-Engine-P (5P) $209/$189/$159/$119   Qty 1/50/100/1K+

Includes SC520 with FPU, 256KW Flash, 64KW SRAM, 2 RS232s, RTC, I/Os, and 5V, 3.3V, 2.5Vregulators.

NOT including add-on options. OEM option discounts available.

EV-P or DV-P kit (Software and 5P) $359/$809

Add-on Options:

1) High speed SRAM 64KW/256KW ....$20/$40
2) CompactFlash Interface $20
3) 4 ch. 16-bit ADC (AD7655), 1MHz......................................$40
4) 8 ch. 16-bit DAC (LTC2600)...$40

Typical Order Example

586-Engine-P, 256KW SRAM
5P + 1 = $209 + $40 = $249

A104™

40MHz, 50+ I/Os, 3 UARTs, 24-bit ADCs, and DACs

40 MHz!

A104™
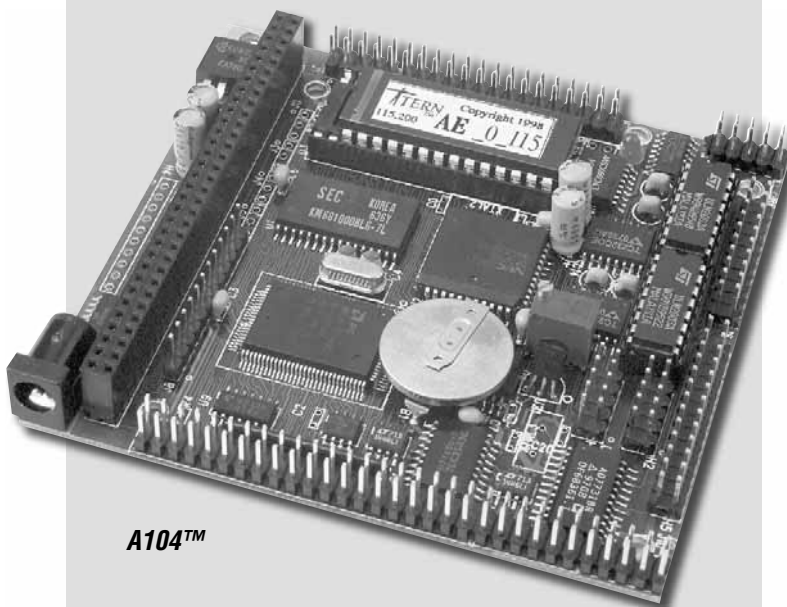
Features and Options:

- 3.8x3.6x0.5 inches
- 16-bit CPU (188), 40 MHz
- Power consumption: 190 mA at 5V for 40 MHz
- Power saving mode: 30 mA at 5V for 40 MHz
- 512KB Flash/ROM, 512KB SRAM*, 512 bytes serial EE
- PWM output, external interrupts, 3 16-bit timer/counters.
- Up to 3 RS-232 serial ports, or two RS-232 plus one RS-485
- 4 ch. 12-bit DAC(TLC1446), 11 ch. 12-bit ADC(LTC2543)*
- Real-time clock RTC72423, lithium coin battery
- 64 pin 8-bit PC/104 compatible connector
- 5 ch. 24-bit ADC, programmable Gain Front End (AD7731)
- 14 solenoid drivers or protected 35V digital inputs.
- 24+ TTL I/O, support for LCD and keypad interface.
- Multifunctional 32 PIOs of CPU, 15+ I/O free to use.
  *optional

Measuring 3.55 by 3.78 by 0.5 inches, the **A104™** offers a complete C/C++ programmable computer system with a high performance CPU (188) operates at 40 MHz system clock speed with zero-wait-state. It features up to 512KB ROM/Flash, 512KB battery-backed SRAM, 512 bytes serial EE, a real-time clock, three 16-bit timers/counters and a watchdog timer. Two DMA driven CPU internal serial ports and a third SCC2691 UART support reliable serial communication up to 115,200 baud. On-board drivers support two RS-232 ports, and the UART can be either RS-232 or RS-485 (supports 8-bit or 9-bit multi-drop networking).

The 3 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) can be used to measure the width of a signal in both its high and low phases. The CPU offers 32 multi-functional and programmable I/O pins, with 15+ available for user use.

FEATURES

The A104 is unique in the wide array of supported hardware features integrated into a single unit. Digital, analog, and protected I/O are all available.

On board is a 82C55 I/O chip providing an additional 24 bi-directional I/O, 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) is on board for LCD contrast. Two 74HC259 chips on-board provide 16 TTL outputs. A total of 14 solenoid driver outputs can each sink 350 mA at 50V.

There are 11 channels of 12-bit analog inputs, with input range of single ended 0-5V(or 0 to REF), and a sample rate of up to 10 KHz. Two DAC chips on board support a total of four channels 12-bit, 0-4.095V analog voltage outputs (5 mA sink/source current.).

A high-resolution 24-bit Sigma-Delta ADC (AD7731, Analog Device) is available. It has 5 inputs with a programmable gain front end, which allows it to accept a range of low level transducer signals. At 800Hz-output rate, the achievable resolution is 16-bit, based on AD7731 data sheet.

A 64 pin 8-bit PC/104 connector can be installed. The A104 is not fully PC/104 compatible; signals are routed to the connector directly from the CPU with no buffering.

Order Information

A104 (40MHz)	$169/$139/$74	Qty 1/100/1K+

Includes: 188 40 MHz with 128KB SRAM, 2 RS232, 3 timers/2 PWM, 14 solenoid drivers, 50+ TTL I/Os watchdog timer, 512 byte EE, 5V regulator.

NOT including options. OEM option discounts are available.

Add-on Options:

1) SRAM: 512KB $20
2) DEBUG ROM *(AE_0_115)* $20
3) Real-time clock(RTC) and battery $20
4) UART(SCC2691) a) RS232 or b) RS485 .... $30
5) 24-bit ADC (AD7731) $60
6) 11 ch. 12-bit ADC(TLC2543) $20
7) 2 ch. 12 bit DAC(LT1446), 2 chips $20x2
8) Precision reference, 20 PPM/°C, 2.5V $10
9) LCD negative voltage pot $10
10) PC104 64-pin connector $10

Order Example:

A104 40MHz, 2 ch. 12 bit DAC (x2)

A104 + 7x2 = $169 + $40 = $209

11

A104S™
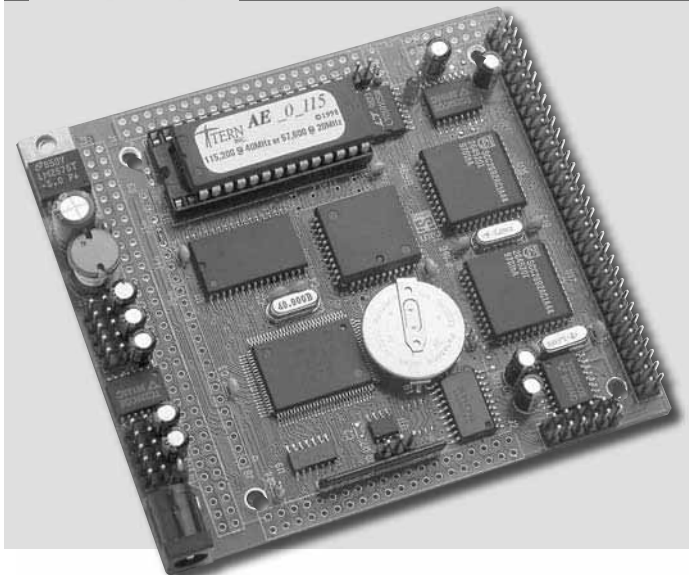
Features:

- 3.8x3.6x0.5 inches
- 16-bit CPU (188), 40 MHz, 70+ TTL I/Os
- 190 mA at 5V for 40 MHz, 30 mA power saving mode
- 512KB Flash/ROM, 512KB SRAM*, 512 bytes serial EE
- PWM, 3 16-bit timer/counters.
- Six RS-232 serial ports, one RS-485 serial port*
- 2 ch. 12-bit DAC(LTC1446)*
- 11 ch. 12-bit ADC(LTC2543)*
- Real time clock, Switching regulator*
  *optional

Summary

The **A104S™** is designed for communication applications that require multiple serial-ports, versatility, compactness, and high reliability.

Measuring 3.8 by 3.6 by 0.5 inches, the **A104S™** offers a complete C/C++ programmable computer system with a high performance 16-bit CPU (188) operating at a 40 MHz system clock speed. It features up to 512KB ROM/Flash, 512KB battery-backed SRAM, 512 bytes serial EE, a real-time clock, three 16-bit timers/counters and a watchdog timer.

Serial Communications

A total of seven UARTs can be installed on-board: two CPU internal UARTs, a single UART (SCC2691), and two DUARTs (SCC2692 or SC26C92) providing 4 total UARTs. These UARTs provide full-duplex asynchronous receivers and transmitters. The receiver is quadruple buffered to minimize the potential of receiver overrun or to reduce interrupt overhead. All UARTs support reliable serial communication up to a programmable rate of 115,200 baud.

On-board six RS232 drivers support two CPU internal serial ports and the 4 DUART channels. One RS485 driver can be installed for the SCC2691, supporting either normal 8-bit or 9-bit multi-drop RS485/422 network with twisted-pair wiring.

Other Features

Three 16-bit 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. The Pulse Width Demodulation (PWD) can be used to measure the width of a signal in both its high and low phases.

More than 70 TTL I/O lines are available for user use. 32 PIO pins from the 188 CPU are multifunctional and user programmable; around 20 I/O pins should be free for user use. An on-board PPI (82C55) provides 24 additional user programmable bi-directional I/Os. Each DUART has 7 TTL inputs and 8 TTL outputs.

The 12-bit ADC (TLC2543) has 11 channels of analog inputs with single ended 0-5V input range, sampled at 10 KHz sample rate. A DAC (LTC1446) can be installed to support two channels of 12-bit, 0-4.095V analog voltage outputs capable of sinking or sourcing 5 mA.

Optional switching regulator (LM2575) can be used to allow 8-30V unregulated DC power input and reduce heat. Using switching regulator, in the power off mode, the controller consumes very low power.

A 64 pin 8-bit PC/104 compatible connector can be installed. Signals routed to the PC/104 connector are directly from CPU with no buffer. The data bus, address bus, control signals, the VCC and GND are routed to the connector and try to match the PC/104 specifications. The A104S is not fully PC/104 compatible.

Order Information

A104S™	**$199/$159/$119/$89**	**Qty 1/100/500/1K+**

Includes: 188 CPU, 40 MHz, 128KB SRAM, 6 RS-232 ports, 3 timers, 70+ TTL I/Os, watchdog timer, 512 byte EE, and 5V regulator.

NOT including options. OEM option discounts are available.

Add-on Options:

1) SRAM: 512KB..$20
2) DEBUG ROM *(AE_0_115)*..$20
3) Real time clock (RTC) and battery $20
4) UART (SCC2691) + RS485 ....$30
5) ACTF_AE Flash a)128KB b)512KB ....$20/$30
6) 11 ch. 12-bit ADC (TLC2543) $20
7) 2 ch. 12-bit DAC (LTC1446)...$20
8) Precision reference, 20 PPM/°C, 2.5V...................................$10
10) PC104 64-pin connector..$10
12) Switching regulator (SR) $20

Order Example:

A104S, 512KB RAM, ACTF flash 128KB.
A104S + 1 + 5(a) = $199 + $20 + $20 = $239

A-Core™ (AC)

C/C++ programmable 16-bit controller with 30+ I/Os, 2 RS-232, RTC
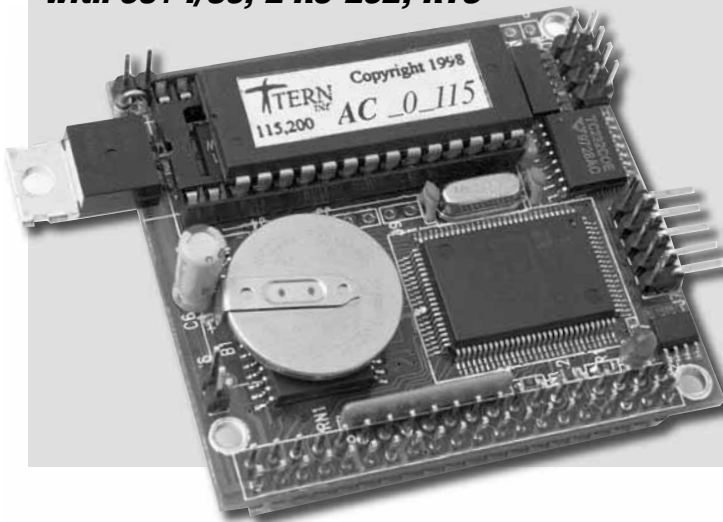
Features:

- 2.3x2.2x0.3"
- 40MHz, 16-bit CPU (188), program in C/C++
- 160mA for 40MHz, 30 mA power-save mode
- 2 serial ports, 32 multifunctional I/Os plus 8 TTL outputs
- 3 16-bit timers/counters, PWM output, 512-byte EE
- Up to 512KB SRAM, 512KB ROM/Flash *****
- Real-time clock (RTC72421), battery *****
- On-board 2 RS-232 drivers and 5V regulator *****
  * optional

The **A-Core™ (AC)** is a low cost microcontroller ideal for integration into an OEM product as the programmable core component. Using the **AC** reduces time from design to market introduction, cuts development costs, minimizes technical risks, and delivers a more reliable product.

The **AC** is a complete C/C++ programmable module based on a 16-bit CPU (188). It supports up to 512KB ROM/Flash, 512KB battery-backed SRAM and 512 bytes serial EEPROM. Two high speed DMA driven serial ports from the 188 support reliable serial communications, up to 115,200 baud. There are 32 multifunctional I/Os from the CPU, 8 TTL outputs from a 74HC259, 3 16-bit timers/counters and a watchdog timer. The timer can count external events, up to 10MHz, or generate PWM outputs. An optional real-time clock (RTC72421, EPSON) provides calendar information and a VOFF control signal.

Two RS-232 drivers and a 5V regulator can be installed, or a VE232 expansion card can be used during development.
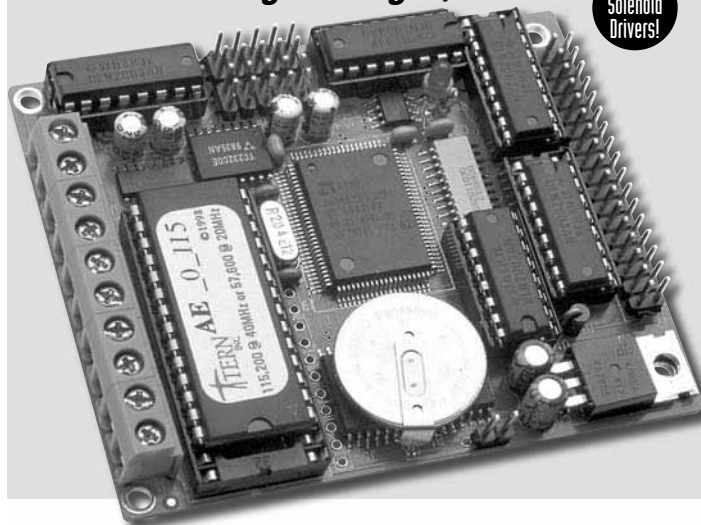
Typical Order Example:

A-Core™ 40MHz, 512KB SRAM, RTC & Battery, RS232 + 5V reg.
AC + 1 + 3 + 4 = $79 + $20 + $20 + $10 = $129

MD88™ 40MHz, 512KB SRAM
MD88 + 1 = $99 + $20 = $119

MiniDrive88™ (MD88) *40MHz!*

35 Protected high-voltage I/Os

35 Solenoid Drivers!

Features:

- 3.1x2.6x0.3"
- Same features as the **A-Core™**
- 35 solenoid drivers support 0-30V input/output signals
- Screw terminals for solenoid drivers

The **MiniDrive88™ (MD88)** adds 35 solenoid drivers to the same basic features offered by the **A-Core™**. The **MD88** is designed for industrial control applications that require solenoid drivers and protected high-voltage inputs. The 35 high-voltage I/O lines are routed to screw terminals and headers. They include 7 inputs, 14 outputs, and 14 hardware-configurable inputs or outputs.

These inputs can take up to 30V DC. The outputs are capable of sinking 350mA at 50V per line, and they can be used to directly drive solenoids, relays, and lights.

Ordering Information

AC (40MHz)	$79/$64/$49/$29	Qty 1/100/500/5K+
MD88 (40MHz)	$99/$74/$55/$34	Qty 1/100/500/5K+

Includes: 188 with 2 UARTs, 3 timers/2 PWMs, I/Os, watchdog timer, power-fail reset, 512-byte EE, 128KB SRAM.

The **MD88** adds 35 solenoid drivers, a RS232 driver and a 5V regulator. **NOT including add-on options. OEM option discounts available.**

Add-on Options:

1) SRAM: 512KB $20
2) Debug ROM (*AC_0_115, AE_0_115 for MD88*)....................$20
3) Real-time clock (RTC) and battery..$20
4) RS-232 and 5V regulator (**AC**)..$10
5) **VE232™** (**AC**) $49
6) Sockets for expansion: 20x2 and 20x1 (**AC** only) $6

13

A-Core86™

AC86, 16-bit Flash & SRAM, 16-bit high-speed ADC
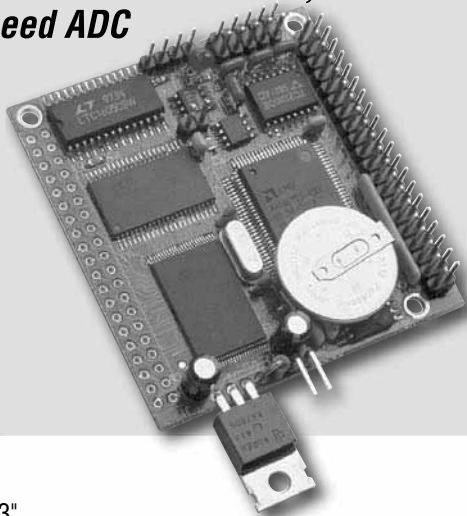
Features:

- 2.3x2.2x0.3"
- 190/30mA normal/power-save
- 40 MHz, 16-bit CPU (186), program in C/C++.
- 256KW ACTF Flash, 2 UARTs, EE, PWM, counter, 32 PIOs
- 64/256KW 16-bit SRAM, Real-Time Clock and battery
- 16-bit ADC, 2 ch. DACs
- 2 RS232 ports and 5V regulator

The A-Core86 is our smallest entry, measuring only 2.3" by 2.2". Consuming less than 700mW of power, the AC86 is designed to be the core computer in your next embedded system. Exploit your greatest competitive advantages by focusing on the design of your own product, rather than designing yet another generic embedded computer. Get your project finished and ready to go into production in the span of a few months (or perhaps only a few weeks) by devoting your time and resources on application-specific peripherals.

Still cramming your code into an 8-bit processor with a few KB of memory? With the AC86, now you can upgrade your system to a C/C++ 16-bit processor and a full MB of code/data memory without adding size, power, or cost. And even an experienced PIC guru can appreciate the advantages of the high-level ANSI C/C++ software development environment.

Or, are you wasting dollars and watts on a PC-based motherboard solution that you don't really need? With the AC86, you can **truly** embed your design by retaining the PC-compatible embedded control functionality that you care about, without throwing dollars at peripherals your embedded application doesn't really need (speaker outputs? IDE controllers? Mouse ports? VGA outputs?).

This tiny board features a full set of hardware peripherals that makes it a fully capable, stand-alone, single-board computer. The AC86 is integrated with a full set of commonly used, modern embedded peripherals, meaning that you'll only need to provide power (consuming only 120mA @5V peak, this power might be coming from a small battery).

The 40 MHz 16-bit 186-generation microprocessor has access to 256 KW 16-bit battery-backed SRAM and 256 KW 16-bit Flash in onboard memory. A host of other peripherals are also integrated onboard, including:

- two asynchronous serial ports, featuring programmable baud rate clock, 8 and 9-bit operation, deep hardware buffers, and DMA-based transfer for perfect reliability even at the highest transfer rates.
- three 16-bit timers/counters, capable of timing and counting events at frequencies as high as 10 MHz, and outputting variable pulse width signals,
- 32 programmable digital (0-5V) I/O lines,
- multiple external interrupt lines,
- 512-byte serial EEPROM for parameter storage,
- *real-time clock capable of tracking second, minute, hour, day, month, and year,
- *two ch. 12-bit serial DAC (LT1446, 10 KHz, 0-4.095V output),
- *one ch. 16-bit high-speed parallel ADC (LTC1605, 100Ksamples/s, ±10V),
- *Two RS232 line drivers, and linear regulator capable of accepting unregulated DC inputs of 9-12V.

These options not included within base price.

These various peripherals (digital and analog I/O, serial I/O, timer input/outputs, interrupts) are accessible via pin-headers on the edge of the controller. You can reach these signals in your design via expansion headers, ribbon cable, or simply by mating the headers directly into your PCB design.

The address bus, 16-bit data bus, and peripheral chip-select pins coming off of the 186 processor are also accessible via pin-headers. This means you have tremendous flexibility to extend the system to interface with your peripherals, whether that's via a parallel or serial interface.

Ordering Information:

AC86	$69/$54/$49/$34	**Qty 1/50/100/1000+**

Includes: 64 KW SRAM, 256KW Flash

Add-on Options: (OEM option discounts available.)

1) 16-bit SRAM: 256KW $20

2) Real-time clock (RTC) and battery......................................$20

3) 100K 16-bit ADC(LTC1605) $60

4) 2 ch. 12-bit DAC (LT1446)...$20

5) RS232 drivers and 5V regulator $10

Typical Order Example:

A-Core86™, Real-time clock (RTC) and battery

AC86 + 2 = $69 + $20 = $89

A-Engine™ (AE)

C/C++ programmable 16-bit microprocessor module with 50+ I/Os, ADC, DAC, 3 UARTs
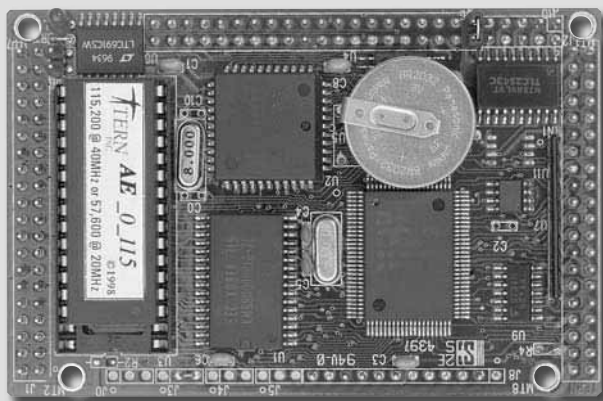
Features:

- 3.6x2.3x0.3" **AE™** and 3.6x2.8x0.3" **AE-P™**
- 190 mA at 5V for 40 MHz
- 40MHz, 16-bit CPU (188), program in C/C++
- Up to 512KB SRAM, 512KB ROM/Flash *****
- 24 I/Os (PPI) , 2 PWMs, 512-byte EE, 3 serial ports*****
- 32 multifunctional I/Os (188), interrupts, 3 timers
- 11 ch. 12-bit ADC, 2 ch. 12-bit DAC
- Real-time clock, battery*****
  *Optional

The **A-Engine™ (AE)** and **A-Engine-P™ (AE-P)** are C/C++ programmable microprocessor controllers based on a 16-bit 40 MHz CPU (188). They support up to 512KB ROM/Flash, 512KB battery-backed SRAM, a 512-byte EEPROM, a real-time clock (RTC72423), 2 asyn. serial ports supporting up to 115,200 baud and an optional UART SCC2691. There are three 16-bit programmable timers/counters and a watchdog timer. The timer can be used to count external events, up to 10MHz, or to generate PWM outputs. There are 32 user-programmable CPU I/O pins, plus 24 bi-directional, user-definable I/O lines from a PPI (82C55) chip. Schmitt-trigger inverters are provided for external interrupt inputs to increase noise immunity. A supervisor chip (691) provides power failure detection and a watchdog timer.

A 12-bit ADC provides 11 single-ended 0-5V (or 0 to REF) inputs with sample-and-hold, with a sample rate of up to 10KHz. Two 12-bit DACs provide 0 to 4.095 Volts analog voltage outputs capable of sinking or sourcing 5mA.

The **AE** is a 5V only module, but the **AE-P** has on-board RS-232 drivers and a 5V regulator allowing 8-12 V power input.
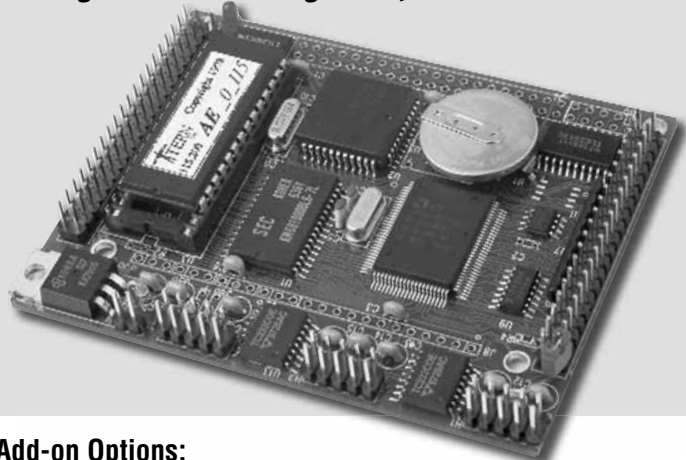
Ordering Information:

AE (40MHz)	$129/$104/$79/$54	Qty 1/100/500/1K+
AE-P (40MHz)	$139/$114/$89/$64	Qty 1/100/500/1K+

Includes: 188, 128KB SRAM, 32 I/O's, 2 UARTs, 3 timers, PPI, watchdog timer, 512-byte EE.

NOT including add-on options. OEM option discounts available.

A-Engine-P™ (AE-P) 40 MHz!

A-Engine-P™ with regulator, RS-232/485 drivers

Add-on Options:

1) SRAM: 512KB $20
2) Debug ROM (*AE_0_115*) $20
3) Real-time clock (RTC) and battery $20
4) 3ʳᵈ UART + (RS232/485 for **AE-P**) ....$20+$10
5) 11 ch. 12-bit ADC (TLC2543) $20
6) 2 ch. 12-bit DAC (LT1446)...$20
7) **VE232™** (for **AE** only)...$49
8) Sockets for expansion: two 20x2, one 25x2 ....$9

Typical Order Example:

A-Engine-P™ 40MHz, 512KB SRAM, RTC & Battery
AE-P + 1 + 3 = $139 + $20 + $20 = $179
AE **and** AE-P **signals on J1 and J2, as shown below:**

J1 Signal			
Function	Pin#	Pin#	Function
VCC	1	2	GND
MP0	3	4	P1
RxD	5	6	GND
TxD	7	8	D0
VOFF	9	10	D1
PFI	11	12	D2
GND	13	14	D3
/RST	15	16	D4
RST	17	18	D5
P16	19	20	D6
MPI	21	22	D7
CLK	23	24	GND
HLDA	25	26	A7
HOLD	27	28	A6
/WR	29	30	A5
/RD	31	32	A4
VRAM	33	34	A3
VBAT	35	36	A2
GND	37	38	A1
VCC	39	40	A0

J2 Signal			
Function	Pin#	Pin#	Function
GND	40	39	VCC
P4	38	37	P14
/CTS0	36	35	P6
TxD0	34	33	/INT4
RxD0	32	31	/RTS1
P5	30	29	P1
TxD1	28	27	/RTS0
RxD1	26	25	GND
P2	24	23	P15
/CTS1	22	21	/INT3
P0	20	19	/INT2
P25	18	17	P24
/WR	16	15	P3
P11	14	13	P17
P10	12	11	P13
VCC	10	9	
/INT0	8	7	/NMI
/INT1	6	5	P12
P26	4	3	P29
GND	2	1	GND

15

A-Engine86™ (AE86)   A-Engine86-P™ (AE86-P)

16-bit Flash & SRAM, 300KHz ADC/DAC, 50+ I/Os
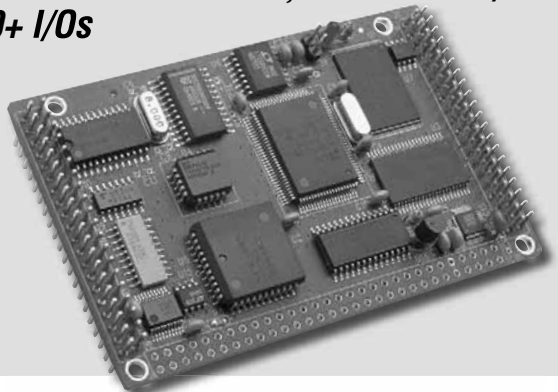
Features:

- 3.6x2.3x0.3" for **AE86,** 3.6x2.9x0.3" for **AE86-P**
- 190/30mA normal/power-save
- 40 MHz, 16-bit CPU (186), program in C/C++
- 256KW ACTF Flash, 256KW 16-bit SRAM, 512-byte EE
- 3 serial ports, 50+ digital I/Os
- 64/256 KW 16-bit SRAM, Real-Time Clock and battery
- Processor features: PWM, counters/timers, interrupts
- 19 ch. ADCs, 6 ch. DACs
- RS-232 line-drivers, 9-35V DC Regulator (**AE86-P**)

The **A-Engine86™** (**AE86**) is a high performance, C/C++ programmable controller module based on a 40 MHz, 16-bit 186-generation embedded microprocessor. Integrating high-performance peripherals, the AE86 can be used in a wide range of demanding embedded applications. The **–P** (**AE86**-P) version of the AE86 is modified for easier stand-alone operation, adding integrated RS232 line drivers and onboard power regulator to all other base AE86 features.

Inputs/Outputs

The AE86 offers 50+ digital I/O channels, all of which can be programmed for either input or output. In both input and output mode, these channels can interface with TTL-level (0, 5V) digital signals through board-edge headers. 24 of these I/O channels come from an PPI component integrated onto the board, while the microprocessor offers an additional 32 multiplexed channels.

With the wide 16-bit data bus featured on the 186-generation microprocessors, it is capable of interfacing high-speed parallel ADC/DAC components. The AE86 takes advantage of this by providing an integrated 8 ch. 12-bit parallel ADC (AD7852, 0-5V), capable of supporting a 300 KHz sample rate. The AE86 is also available with a slower 11 ch. 12-bit serial ADC (P2543, 10 KHz, 0-5V). The AE86 also integrates 4 ch. 12-bit parallel DAC with the same high-speed capability for analog outputs (DA7625, 0-2.5V), as well as a serial DAC providing an additional 2 channels of 12-bit outputs (LT1446, 0-4.095V).

The AE86 can support a total of 3 serial ports (2 available off of the processor, an additional through a SCC2691). On the AE86, these ports are TTL-signals only, while the AE86-P version can support 2 RS232, with the additional port configurable as either RS232 or RS485. All 3 ports have deep hardware FIFO buffers,

and can support either DMA or interrupt driven operation, meaning the AE86 is especially well-suited for simultaneous high-bandwidth serial communications across all channels.

Board Memory

As in all real-mode x86 systems, a total of 1 MB of memory space is available for the use of code and data. On the AE86, this consists of 256 KW (512 KB) worth of Flash, and up to 256 KW (512 KB) worth of battery-backed SRAM. An additional 512-byte serial EEPROM is onboard for storage of non-volatile data (like a board identifier).

Other Features

The AE86 supports a number of other commonly used embedded features. The microprocessor has a total of 3 16-bit timer/counters, which can be used to time events, read input pulses, or output waves with 100 nanosecond resolution. The AE86 features several TTL-

AE86-P version

level external interrupt lines, an optional real-time clock, an onboard watchdog timer, and other basic peripherals. The AE86-P supports, by default, a 9-12VDC linear voltage regulator. It's also available with an optional 8-35VDC switching regulator for wide range flexibility.
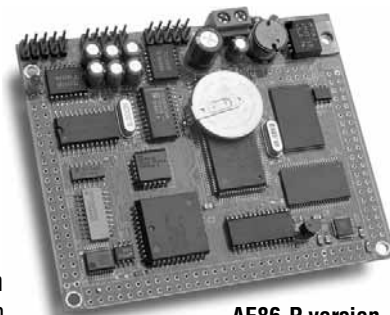
The AE86 and AE86-P have been extended by a number of expansion boards offered by TERN. These include the MotionC-line of boards for high-performance motion control applications, or the P300/P100 boards for up to 300 additional I/O channels.

Ordering Information:

AE86	$169/$129/$99/$64	Qty 1/100/1K/5K+

Includes: 186, 40 MHz, I/Os, 2 UARTs, 3 timers, PPI, watchdog, EE, 256KW **ACTF** flash, 64KW SRAM.

AE86-P	$189/$151/$113/$66	Qty 1/100/1K/5K+

Includes: Basic AE86, and 2 RS232 line drivers, linear regulator.

Add-on Options:

1) 16-bit SRAM: 256KW $20
2) Real-time clock (RTC) and battery......................................$20
3) 3rd UART (SCC2691) + RS232/RS485 (-**P** only) .... $20 (+$10)
4) 4 ch. 12-bit DAC, 200 KHz (DA7625)...................................$40
5) 2 ch. 12-bit DAC (LT1446)..$20
6) 8 ch. 12-bit ADC, 300KHz (ADS7852) $20
7) 11 ch. 12-bit ADC (P2543) $20
8) Switching Regulator (**-P** only) $20

Typical Order Example:

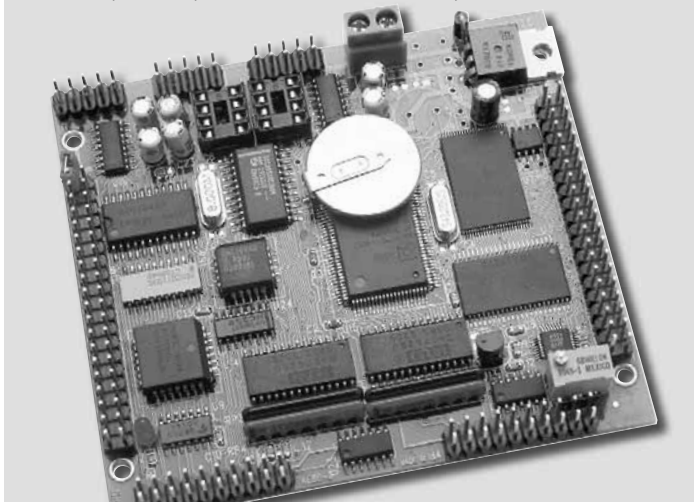**A-Engine86™**, 4 ch. 12-bit DAC (DA7652)
AE86 + 4 = $169 + $40 = $209

A-Engine86-D™   ⑧ High Speed DACs   40MHz!

16-bit Flash and SRAM, 300 KHz ADCs and DACs, I/Os, timers/counters, and UARTs

Features:

- 3.6x3.2x0.3" for **AE86D**
- 190/30 mA normal/power-save
- 40 MHz, 16-bit CPU (186), program in C/C++
- 256 KW 16-bit Flash, 256KW 16-bit SRAM
- 32 PIOs, 3 serial ports (Up to 3 RS232, 2 RS485, 1 RS422)
- Real-time clock, battery
- 512-byte EE, PWM, timer/counters
- Optional switching regulator supports 9-30V power input
- 8 ch. 300 KHz 12-bit ADC (AD7852)
- 8 ch. parallel 12-bit DAC (DAC7625) with output buffer
- 3 ch. 16-bit hardware counters (82C54)
- ***Not all features included in base pricing.***

The **A-Engine86-D™** (**AE86D**) is a high performance C/C++ programmable controller based on 40 MHz, 16-bit CPU (186), ideal for industrial process control and high-speed data acquisition.

The AE86D offers a unique combination of embedded peripherals. In particular, the AE86D features three 16-bit hardware timers/counters (82C54) in addition to the three timers already integrated into the microprocessor. The AE86D also features more DACs, a total of 8 channels, than most other designs.

Input/Outputs

The 186-generation microprocessor used on the AE86D offers 32 channels of programmable digital I/O (some are multiplexed with other processor functions). These channels can interface with TTL-level (0, 5V) digital signals through board-edge headers.

Two high speed parallel DACs (DA7625) chips (each providing four channels) can be installed providing a total of eight analog output signals. These DAC outputs are buffered by operational amplifiers with configurable gains and adjustable offset. As default (gain=2), analog outputs are ±2.5V to 0-5V with offset adjustable. Other output voltage levels (±5V, 0-10V, ±10V) can be specially

hardware configured. Sample software program shows AE86D DAC outputting a smooth 18.5KHz sinewave.

Eight channels of 12-bit parallel ADC (AD7852, 300KHz, 0-5V) can be installed.

The AE86D can support a wide range of serial communications requirements. An optional 3rd UART (SCC2691) can be added to the two UARTs internal to the microprocessor for a total of 3 serial ports. All three are configured for RS232 operation by default. One port (SER1) can optionally be configured for RS485 or RS422 operation, and another port (SCC) can be optionally configured for RS485.

Board Memory

A total of 1 MB of memory space is available for the use of code and data. It consists of 256 KW (512 KB) worth of Flash, and up to 256 KW (512 KB) worth of battery-backed SRAM. Additional 512-byte serial EEPROM is onboard for storage of non-volatile data (like board identifiers, or other program parameters).

Other Features

A real-time clock (RTC72423) with battery can be installed on board. The most unique peripheral on the AE86-D is the integrated 82C54, which features three 16-bit programmable interval timers/counters. These timers have six programmable timer modes, allowing the 82C54 to be used as an event counter, elapsed time indicator, programmable one-shot, and many other applications.

All chips are surface mounted for highest reliability. All options can be installed with no conflict on the same board. An optional switching regulator can be installed to reduce power consumption and heat.

Ordering Information

AE86D	$169/$129/$99/$69	Qty 1/50/100/1K+

Includes 186 with I/Os, 2 UARTs, 6 timers, PPI, watchdog timer, EE, and 256KW ACTF™ Flash, 64KW SRAM

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) 16-bit SRAM: 256 KW $20
2) Real-time clock (RTC) and battery $20
3) 3rd UART (SCC2691): (a)RS232/ (b)RS485 ....$30
4) 4 ch. 12 bit DAC (DA7625), up to 2 chips $40x2
6) 8 ch. 12 bit ADC, 300 KHz (ADS7852)................................$20
8) RS485/422 driver for SER1 ....$10/$20
9) Switching regulator $20

Typical Order Example:

AE*86D*, 256KW SRAM, 8 ch. 12-bit ADC (ADS7852)
AE86D + 1 + 6 = $169 + $20 + $20 = $209

17

BirdBox-A™ (BB-A)

40 MHz!

Single-board User Interface Controller with 4 UARTs, LCD, Keypad, and Enclosure
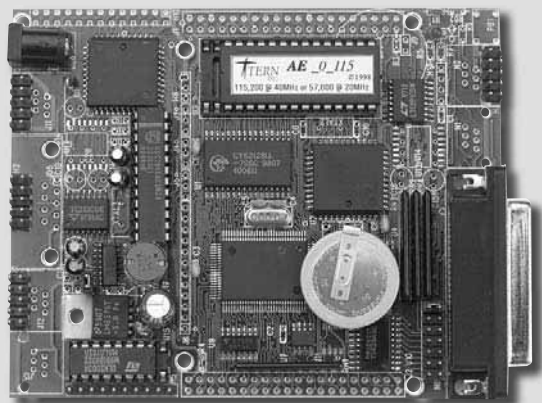
Features:

- 4.5x3.6x0.9"
- 40MHz 188, C/C++ programmable
- Power consumption: <190mA; Power-down mode: 20µA
- Power input: +8.5 to +12V with linear regulator, or
  +8.5 to +35V with switching regulator *
- Up to 512KB SRAM, 512KB ROM/Flash *
- 32 Multiplexed I/O lines, 2 PWM outputs, interrupts, timers
- Up to 4 serial ports* • Real-time clock *
- 7 solenoid sinking drivers • 512-byte EE
- 48 additional bi-directional I/O lines from 2 PPIs
- 11 ch. 12-bit ADC * • 2 ch. 12-bit DAC *
- 16x2 LCD, 4x3 keypad, enclosure (BB-Pack) *
  * optional

The **BirdBox-A™ (BB-A)** can be used to convert protocols into different formats, allowing communication between different systems. It offers a complete C/C++ programmable system with a high performance CPU (188), up to 512KB ROM/Flash, 512KB battery-backed SRAM, a 512-byte serial EEPROM, ADC, and DAC. The **BB-A** supports a real-time clock (RTC72423), battery, three timer/counters, a watchdog, up to four serial ports, a 16x2 character LCD, and a 3x4 keypad, all of which can be packaged in a 4.8" x 3.7" x 1.5" aluminum sheet enclosure.

The **BB-A** offers a total of four serial ports: two from the CPU, two from optional SCC2691 UARTs. All four serial ports are RS-232 by default. The two optional UARTs can be configured for RS-485. A 16-bit counter can be used to count external events at up to 10MHz, and to generate PWM outputs. 32 I/O pins from the Am188ES are multifunctional and user-programmable. There are 11 channels of 12-bit serial ADC (TLC2543) which have a 0-5V (or 0 to REF) input range, at up to 10KHz sample rate. The 2 channels of 12-bit serial DAC, output 0-4.095V. Two PPI chips (82C55) provide 24x2 bi-directional I/O lines that can support a DB25 printer port, 3x4 keypad, and a 16x2 LCD. Seven solenoid drivers can sink up to 350mA at 50V per channel.

The optional BB-Pack consists of a DB9, a DB25, RJ11 phone jacks,

a 16x2 LCD, a 3x4 keypad, a beeper, and an enclosure. An optional switching regulator can be installed to reduce power consumption. A **MemCard™ (MM-B)** can be installed without using the BB-Pack. Up to 250 **BB-A**s can be networked via RS-485.

BirdBox-A™ with optional BB-Pack.

Ordering Information

BB-A (40MHz) **$174/$139/$99/$69** **Qty 1/100/500/1K+**

Includes 188, 128KB SRAM, I/Os, 2 UARTs (RS-232), 3 timers, 24x2 I/Os from 82C55, watchdog, 512-byte EE, 7 solenoid drivers, linear regulator.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM: 512KB $20

2) Debug ROM (*AE_0_115*) $20

3) Real-time clock (RTC) and battery $20

4) UART (SCC2691) + drivers *up to 2*

   a) RS-232   b) RS-485 ....$20 + 10 each

5) 11 ch. 12-bit ADC (TLC2543) $20

6) 2 ch. 12-bit DAC (LT1446) $20

7) Switching regulator $20

8) BB-Pack: 16x2 LCD, keypad, beeper, box $150
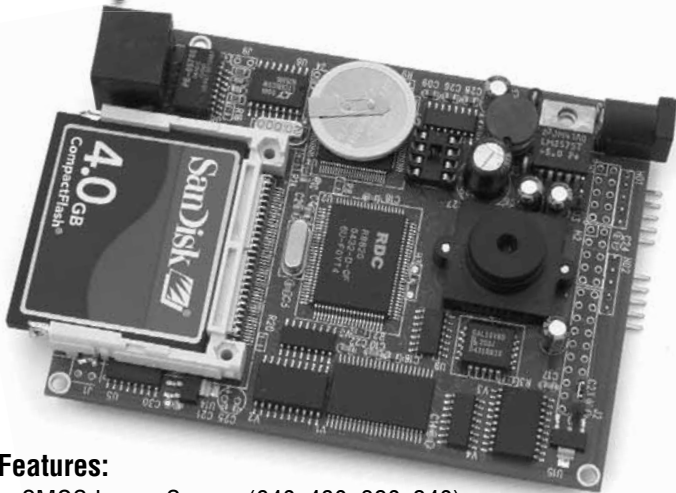
Typical Order Example:

BirdBox-A™ 40MHz, 512 KB SRAM, RTC & Battery, BB-Pack
BB-A + 1 + 3 + 8 = $174 + $20 + $20 + $150 = $364

TERNINC.

1950 Fifth Street, Davis, CA 95616 USA
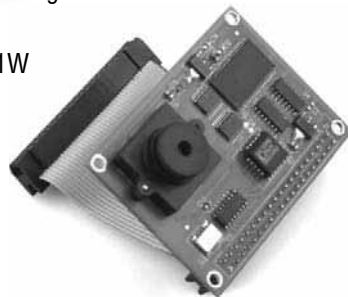**Tel: 530-758-0180 • Fax: 530-758-0181**

CE FC sales@tern.com http://www.tern.com

Features:

- CMOS Image Sensor (640x480, 320x240)
- Supports Grayscale/Color, 1MB image FIFO
- Wide viewing angle Micro Lens
- 4"x3", 9-30V DC Power, Peak <1W
- x86 16-bit CPU, CompactFlash with FAT file system
- Ethernet, 0RS232/485, RTC, Battery, TTL I/Os

EyeO™ Camera only

Introduction

The *CEye™* controller is an innovative new solution for a wide range of vision applications: machine vision; check ID marking; pattern recognition; industrial process control; motion position detection; security monitoring.

The *CEye™* is the ideal board for adding lowpower standalone digital image acquisition and recording to any embedded application. Existing CMOS camera systems generally rely on a connection to other central systems for data storage, image processing, or power. The *CEye™* is intended to be a true stand-alone solution.

Image Acquisition

The onboard CMOS image sensor has 640x480 active pixels, and can output images in both VGA and QVGA (320x240) resolutions. With a pixel clock of 20 MHz, the hardware frame capture period is approximately 150ms. Real-time images are made available to the user-application in image array format, and indefinite acquisition/ storage to the CompactFlash card is possible at rates up to 4 frames/second.

The user application can access any pixel directly from this memory buffer. An application implemented on the *CEye™* might capture images, analyze any zones of interested pixels, and make control decisions based on that image processing result in real-time. These images can also be rendered in Windows bitmap (.bmp) format for easy storage and later transfer to the PC. Tens of thousands of images can be stored on a FAT16-formatted CompactFlash memory card.

Stand-alone Controller

The *CEye™* is a complete stand-alone controller including a 16-bit 40 MHz x86 CPU, onboard regulator, 512KB Flash, battery backed

SRAM, 1 MB image FIFO, an image sensor, two RS232 ports and a CompactFlash interface.

Two RS232 serial ports (SER0 and SER1) can handle 115,200 baud with high reliability. SER1 can also be hardware configured as RS485. There is also a real time clock with battery backup, 10+ TTL I/O pins, multiple external interrupts, and 3 16-bit timer/counters.

The optional WIZNET hardware TCP/IP module can be used to offload images quickly and efficiently over the network. For example, a TERN-supplied webserver sample allows the board to send raw bitmap QVGA images at rates up to 2-3fps to remote Internet browsers over HTTP.

A high speed parallel data-bus expansion header supports external USB interface for high speed data transfer to a PC. A utility software "EyeC Viewer" is available on Windows-based PC for real-time display of camera image.

With dimensions of 3x4 inches, the *CEye™* is designed to fit into an Aluminum Extrusion Enclosure for easy deployment and installation. Optional switching regulator allows the EyeC to sleep in VOFF mode to reduce power consumption in less than 30 uA.

A camera only version (2.5x1.85"), *EyeO™*, is available. The *EyeO™* must be driven by a TERN controller via cable. See sample images acquired by the *CEye™* and *EyeO™*.

Order Information

CEye™ $179/$159/$139/$99   for Qty 1/50/100/1K

Includes: 40MHz CPU, 256KW ACTF Flash, 64KW SRAM, Image sensor, Micro Lens, 1MB image FIFO, 2 RS232, 3 timers, 10+ TTL I/O.

Add-on Options

1) 256K words SRAM $20
2) RTC+BAT $20
3) Ethernet $30
4) CompactFlash Interface $20
5) RS485 driver for SER1 ....$10
6) Switching Regulator $20

EyeO™ $99/$69/$49/$39   for Qty 1/100/1K/5K
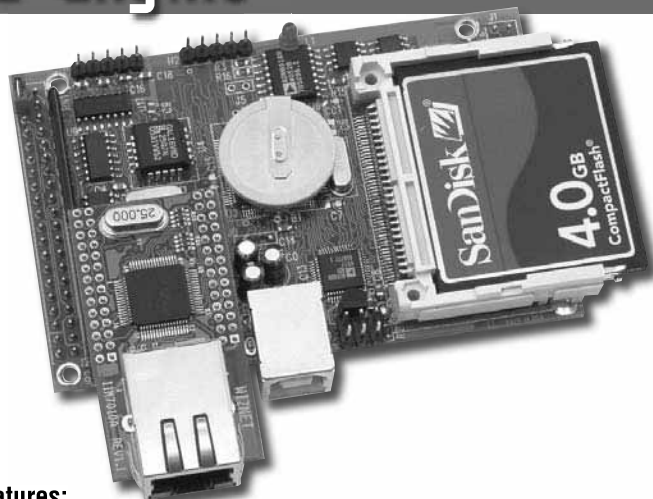
Features:

- 3.6 x 2.3 x 1", 200 mA at 5V for 80 MHz
- 40 or 80 MHz, 16-bit CPU, program in C/C++
- 256 KW 16-bit Flash, 256 KW 16-bit SRAM, 512 bytes EE
- 20+ TTL I/Os, Real-time clock, 2 serial ports, PWM, counters
- 4 ch 16-bit parallel high speed ADC (AD7655)
- Hardware TCP/IP stack for 100M Base-T Ethernet
- CompactFlash card with FAT file system support

Introduction

The **E-Engine™** (**EE**) is a high performance, low cost, C/C++ programmable controller based on a 40 MHz R8820(5V) or 80MHz R1120(3.3V) 16-bit CPU. Ideal for both OEM or prototyping purposes, the EE is intended for demanding networked industrial process control and networked high-speed data acquisition applications.

As embedded systems have developed, advanced connectivity has become another critically important aspect of modern embedded products. The EE addresses this by also integrating advanced connectivity solutions such as hardware USB and TCP/IP network modules, plus Windows compatible file system, making this the ideal core platform for your next-generation projects.

IP Networking

The optional onboard WIZNET Ethernet module with RJ45 connector provides 10M/100M base-T network connectivity.This module represents a huge leap forward in performance when compared to other raw MAC-only embedded Ethernet networking solutions commonly in use today.

This module releases internet connectivity and protocol processing from the host processor, which represents a huge improvement over software-based TCP/IP stacks. No processor cycles are used to track packet transmission/retransmission, timeouts, etc. The resulting system can easily handle transmissions in the 200KB/s+ range in real world applications, leaving the board free to manage other real-time behavior. Software libraries and demo project demonstrating TCP and UDP clients/hosts, HTTP webservers, and more are provided.

The WIZNET module has a hardware LSI TCP/IP stack implementing protocols like TCP/IP, UDP, ICMP and ARP. Four independent sockets can be handled simultaneously, with a peak 4 Mbps protocol processing speed. It has a 16KB internal transmit and receiving buffer which is mapped into host processor's direct memory. The host can then access the buffer via high speed DMA transfers.

USB to PC interface

The **EE** integrates a USB stack chip to offer a very low overhead USB 1.1/2.0 slave interface. The onboard hardware fully handles USB stack processing, and provides large transmit/receive hardware buffers for high-speed bi-directional 8-bit parallel communication. No USB specific firmware programming is required on the controller side. On the PC side, VCP drivers are available supporting peak transmission rates of 150 KB/s.

Other Embedded Peripherals

A 16-bit parallel ADC (AD7655, 0-5V, 1 MHz) provides 4 analog inputs. With on-board precision 2.5V reference, the ADC accepts 0-5V analog inputs at 16-bit resolution of 0-65,535.

The E-Engine is connecting to an EYEO Camera

The **EE** supports up to 2 GB mass storage CompactFlash cards with Windows compatible FAT filesystem support, allowing user easily transfer large amounts of data to or from a PC.

The **EE** features ACTF Flash (256 KW) and battery-backed SRAM. It has 3 timers, 20+ PIOs, 512-byte EE, 2 RS232 ports. A real time clock (DS1337, Dallas) is available.

The **EE** can be powered by regulated 5V. Two pin screw terminals can be installed replacing USB socket plus a 5V regulator allowing DC power of 9-12V. The **EE** works with most TERN expansion boards.

Ordering Information

EE40	$99/$84/$69/$49	Qty 1/50/100/1K+

Includes 40 MHz CPU, 64KW SRAM, PIOs, 2 RS232, 3 timers, watchdog timer, 512 bytes EE, 256KW flash

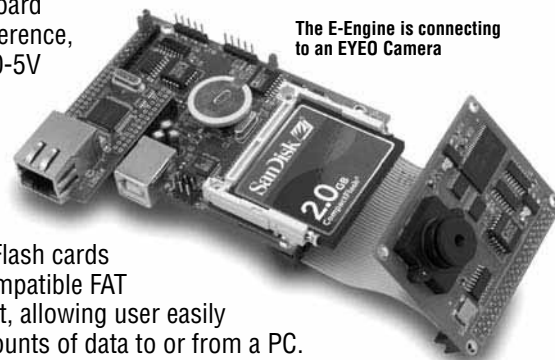NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM 256KW	$20
2) Real-time clock (RTC) and battery	$20
3) CompactFlash interface	$20
4) 100 BaseT hardware TCP/IP Ethernet	$30
5) USB controller	$30
6) 4 ch. 16-bit ADC, 1MHz (AD7655)	$40

Typical Order Example:

E-Engine40™, CompactFlash, TCP-IP Module
EE40 +3 +4 = $99+$20+$30 = $149

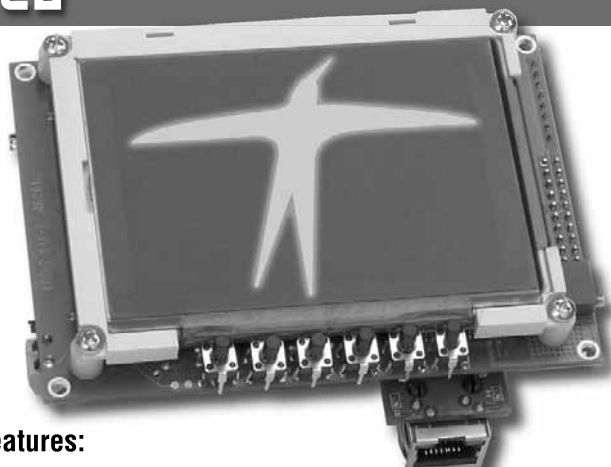## Features:

- 4.2 x 3", 200 mA at 5V for 80 MHz
- 40 or 80 MHz, 16-bit CPU, program in C/C++
- 256 KW 16-bit Flash, 256 KW 16-bit SRAM, 512 bytes EE
- 192x128 (71x54 mm) Graphic LCD and 6 Keys
- 10+ I/Os, Real-time clock, 2 serial ports, PWM, counters
- 16 ch 24-bit ADC (LTC2448), 4 ch 16-bit ADC (AD7655)
- 8 ch. 16-bit DAC(LTC2600), 2 ch 12-bit DAC (DAC7612)
- Hardware TCP/IP stack for 100M Base-T Ethernet
- CompactFlash card with FAT file system support
- 7 Solenoid drivers, and 1 Reed Relay

Summary

The **EL™** is a high performance, low cost, C/C++ programmable controller based on a 40/80MHz 16-bit CPU. It is intended for networking industrial process control, high-speed data acquisition, and especially ideal for OEM applications with basic user-interface requirements.

User Interface

A low power graphic LCD with 192x128 pixels can be installed. The LCD has 71x54 mm viewing area with ultra bright white backlighting. Six mechanical push bottoms can be installed along the side of the LCD. An integrated font library makes text display equally easy. Easy user interface software is available. The EL represents an ideal low cost , panel-mount user interface for many OEM applications.

Ethernet/Connectivity

An Fast Ethernet Module can be installed to provide 100M 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. 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, which represents a huge improvement over software-based TCP/IP stacks. The resulting system can easily handle transmissions in the 100KB/s+ range in real world applications with 4 independent stack connections simultaneously. Software is available for connecting to Windows Internet Explorer.

Other Features

With a precision 2.5V reference, a sigma-delta 24-bit ADC (LTC2448, 5 KHz, 0-1.25V) offers 8 ch. differential or 16 ch. single-ended input channels. A 16-bit parallel ADC (AD7655, 0-5V) supports ultra high-speed (1 MHz conversion rate) analog signal acquisition. The AD7655 can simultaneous sample on two channels of a total of 4 analog inputs. A 16-bit DAC(LTC2600) provides 8 analog output voltages (0-5V). Two channels of 12-bit DAC(DAC7612) can output 0-4.095V analog voltage.

The **EL** supports up to 2 GB mass storage CompactFlash cards with Windows compatible FAT file system support, allowing user easily transfer large amounts of data to or from a PC.

The **EL** features 16-bit ACTF Flash (256 KW) and battery-backed SRAM (256 KW). It also includes 3 timers, PWMs, PIOs, 512-byte serial EEPROM, two RS232 ports, 3 timer/counters, and a watchdog timer. A real time clock (DS1337, Dallas) is available.

Seven high voltage sink drivers are installed, capable of sinking 350 mA at 50V per line, and they can directly drive solenoids, relays, or lights. A mechanical Reed relay provides reliable, fast switching contacts with a specification of 200 V, maximum 1 Amp carry current, 0.5 Amp switching, and 100 million times operation.

The **EL** has on-board optional switching regulator with power-off mode. It can be powered with 9-24V DC.
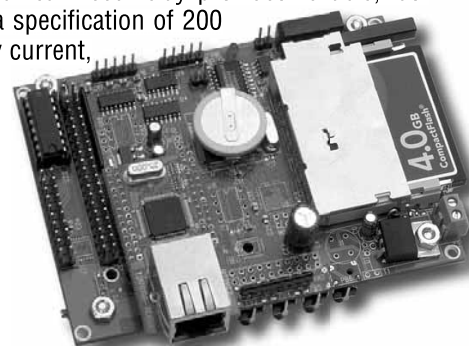
Ordering Information

EL	$169/$84/$69/$54	Qty 1/50/100/1K+

Includes 40 MHz CPU, 64KW SRAM, PIOs, 2 RS232, 3 timers, watchdog, 512 bytes EE, 256KW flash, solenoid drivers

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM 256KW	$20
2) Real-time clock (RTC) and battery	$20
3) CompactFlash interface	$20
4) 100 BaseT hardware TCP/IP Ethernet	$30
5) 16 ch. 24-bit ADC(LTC2448)	$40
6) 4 ch. 16-bit ADC, 1MHz (AD7655)	$40
7) 8 ch. 16-bit DAC (LTC2600)	$40
8) 2 ch. 12-bit DAC (DAC7612)	$20
9) 192x128 graphic LCD+6 keys	$60
10) Reed Relay	$10
11) Switching regulator	$20
12) RS485 driver for SER1	$10

Typical Order Example:

EL™, CompactFlash, LCD
EL +3+9= $169+20+60 = $249

21
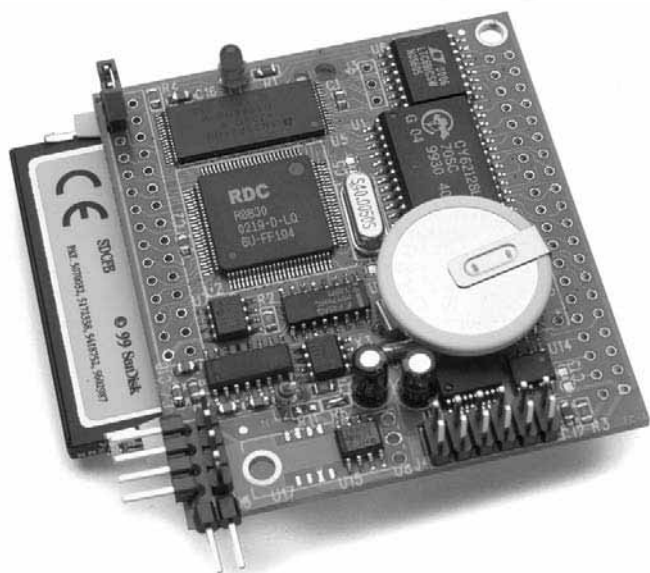
FlashCore-B™ (FB)

Above is the component-side of the FlashCore-B with complete embedded controller.

Features:

- 2.1 x 2.35 x 0.7 inches
- Easy to program in C/C++, 40 MHz 188 CPU
- Power-off mode: 35 µ A low-drop voltage
- Power-save mode: 20 mA with 20 MHz
- 512KB ACTF Flash and 128/512KB battery backed SRAM
- 2 PWM outputs, 3 timers and Pulse Width Demodulation
- 20+ I/O lines, 2 RS232, 512 bytes EE, External interrupts
- 8 channels of 16-bit ADC (ADS8344, 20KHz, 0-5V)
- 4 channels of 12-bit DAC (DAC7612, 0-4V)
- Supervisor chip (691), power failure, reset and watchdog
- Ultra-low quiescent current, low-drop voltage regulator

Summary

The FlashCore-B (*FB*)™ is a low power embedded controller based on a high performance 40 MHz 188 CPU with 2 UARTs, timers, I/Os, 512KB Flash, 128K/512KB SRAM, EE, a real time clock (DS1337, Maxim), 16-bit ADC, DAC and a 50-pin CompactFlash receptacle. It is a variant of the original FlashCore (FC) with better mechanical mounting for the CompactFlash adapter, and more precise analog inputs. The *FB* is ideal for precision data acquisition, industrial process control, and battery-powered solutions for applications requiring mass data exchange.

Special Features

The 16-bit ADC (ADS8344, TI) provides 8 single-ended or 4 differential analog inputs (0-5V) with 65536 counts of resolution at up to 10 KHz sample rate. The ADC available on the *FB* is especially notable for its low noise. Two 12-bit DAC chips (DAC7612, TI) can be installed providing 4 channels 0-4.095V analog voltage outputs capable of sinking or sourcing 5 mA. The *FB* allows access to mass storage CompactFlash cards (up to 2GB). Users can easily add mass data storage to their embedded application via RS232, TTL I2C, or parallel interface. 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. An ultra-low quiescent current (35 µ A), low-drop voltage (85 mV) regulator (TPS76550, TI) can be installed. It allows operating power input as low as 5.1V. It can yield significant improvement in operating life for battery-power. You can also shut down the regulator with a TTL pin, reducing the quiescent current to 1 µ A.

Configuration

By default, the **FB** is configured with 40 MHz CPU and a linear regulator. The low power version FB runs 20 MHz and uses the low-drop regulator.

Ordering Information
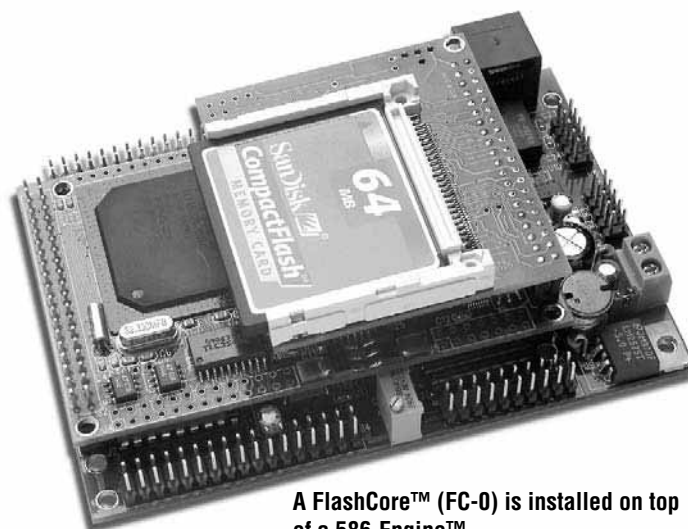
A FlashCore™ (FC-0) is installed on top of a 586-Engine™

Order Information:

FlashCore™ FC-0　　　$49/$39/$29/$15　　　**Qty 1/50/100/1000**

Includes CF Interface, 20x2 header, and PAL

FB　　　$99/$84/$69/$34　　　**Qty 1/50/100/1000**

Includes: 40 MHz CPU, 128KB SRAM, 512KB Flash, EE, TTL I/Os, 2 RS232, 5V regulator, CF Interface.

NOT including add-on options. OEM option discounts available

Add-on options:

1) SRAM 512KB...$20
2) Real Time Clock (RTC1337)+Battery....................................$20
3) 8 ch. 16-bit ADC (ADS8344)...$30
4) 2 ch. 12-bit DAC (DAC7612)x2.....................................$20 x 2
5) Low Power, 20 MHz, TPS76550 ....$20
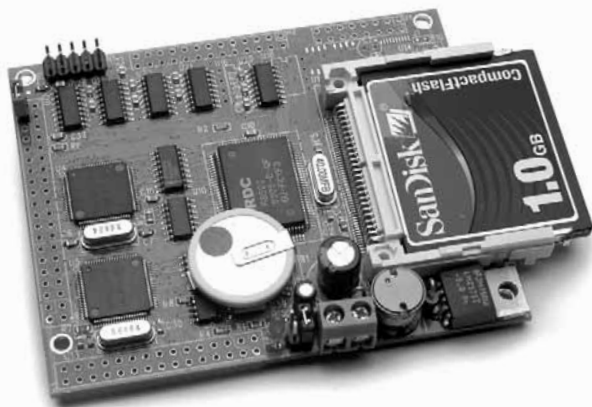
Features:

- 3.6" x 2.9"
- 40 MHz 16-bit 186, C/C++ programmable.
- 150 mA at 40 MHz, 20 mA low power mode
- 10 UARTs, expandable to 18 serial ports
- 256 KW SRAM, 256KW Flash, 512 bytes EE.
- 40+ I/Os, 3 timers, interrupts
- 16-bit ADCs, DACs, real-time clock and battery
- CompactFlash Interface with FAT file system

Summary

The **FlashCore-N™ (FN)** is a board designed for projects requiring mass serial communication capabilities. It is a C/C++ programmable embedded controller based on 40 MHz 186 CPU with 16-bit external data bus. The **FN** integrates 10 UARTs, 8 16-bit ADC inputs, 4 12-bit DACs and a 50-pin CompactFlash interface. In order to support high-speed communications, the **FN** serial ports are handled via DMA or deep FIFO (64 bytes), able to handle very high loads without losing any data.

Serial Communications

Two internal UARTs from CPU, and 8 UARTs from 2 QUARTs (TL16C754B) provide a total of 10 UARTs. Six UARTs have on-board RS232 drivers, with handshaking signals (/RTS, and /CTS). One of these RS232 ports can be replaced with optional RS485/422 drivers. The other 4 UARTs provide TTL level signals only. C/C++ software libraries make accessing all ports an easy process.

The two internal UARTs provided by the 186 processor support reliable DMA-driven serial communication up to 115,200 baud.

The two quad UARTs (TL16C754B, TI) provide a total of 8 high speed serial ports, with each port featuring 64-byte transmit and 64-byte receive hardware FIFOs. These deep FIFOs can release processor load and guarantee reliable performance for multi-serial port high speed (up to 2 Mbps) communication. Programmable FIFO trigger level, software XON/XOFF, hardware flow control are all supported.

With dimensions of 3.6x2.9", the high performance 16-bit CPU uses 16-bit ACTF Flash (256 KW) and battery-backed SRAM (256 KW). There are 512-byte serial EEPROM, a real-time clock (DS1337, DS), and TTL I/Os. Six flow-control signals on each QUART can also be configured as general programmable TTL I/Os, adding to the 32 TTL I/Os available from the CPU.

Other Features

An optional 16-bit ADC (ADS8344, TI) provides 8 single-ended or 4 differential analog inputs (0-5V) at a sample rate of up to 10KHz. Two 12-bit DAC chips (DAC7612, TI) provides 4 analog output channels (0-4.095V, 5 mA sink/source).

Similar to other FlashCore variants, the **FN** allows access to mass storage CompactFlash cards (up to 2GB). Users can easily add mass data storage to their embedded application via RS232, TTL I2C, or parallel interface. 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, making the FN ideal for logging simultaneous serial data from many sources.

An optional switching regulator (LM2575, NS) can be installed. It allows operating power input in the range of 8V to 30V DC, and can be shut-down with a single TTL pin.

The **FN** can be configured to drive the LittleDrive™, providing a total of **18** serial ports, as shown below.
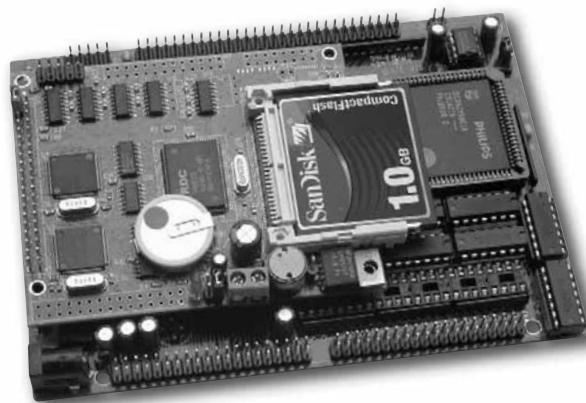
Ordering Information

FlashCore-N(FN) $159/$139/$99/$89   Qty 1/50/100/1K

Includes 186, 256KW ACTF Flash, 64KW SRAM, QUART, 6 RS232 ports, 512-byte EE, linear regulator.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM 256KW..$20
2) Real Time Clock (RTC1337)+Battery....................................$20
3) 8 ch. 16-bit ADC(ADS8344)..$30
4) 2 ch. 12-bit DAC (DAC7612)x2 ....$20 x 2
5) Switching regulator $20
6) CF interface...$20
7) SER1 RS485/422...$10/$20
8) QUART (TTL) $40

Typical Order Example:

FN with 6 UARTs and CompactFlash interface: **FN** +6 = $159 + $20 = $179

Graphic-Engine™ (GE)

Low Cost User Interface Controller
Graphical Color Images on QVGA LCD/TFT, Touch Screen, Ethernet & CompactFlash

Features

- 3.15 x 4.35 inches, 40 MHz 186 CPU, program in C/C++
- Switching regulator, 50 mA standby, 160 mA at 12V
- 256 KW SRAM, 256 KW Flash, 512 bytes EEPROM
- 20+ TTL I/O, timer/counters, RTC, Battery
- 2 Mechanical Relays. 2 DAC outputs
- Supports multiple QVGA panels such as:
  Kyocera (TCG057QV1AA-G00)
  Kyocera (KCG057QV1DC-G50)
  Kyocera (KG057QV1CB-G00)
  Sharp(LM057QC1T01)
  Optrex(F51167NCU)
  NanYa(LCBFBA639NT)
  ARIMA(MC57T01G)
  OKAYA(UMS-7360MC-1CS)
- 4-wire analog touch screen controller
- 2 RS232/RS485 serial ports, 10 BaseT Ethernet with TCP/IP
- CompactFlash with Windows compatible file system support

The ***Graphic-Engine(GE)™*** is a low cost industrial controller ideal for User Interface Applications. Those with premium graphic requirements will benefit from an ultra-bright, wide viewing angle active TFT color display. A LCD controller (S1D13705, EPSON) is on-board with internal 80KB image buffer, supporting QVGA color graphic TFT/LCD of 320x240 pixels. A touch screen controller (ADS7846) supports 4-wire resistive touch screen. All components are installed on single PCB, which can be mounted on the backside of a QVGA LCD for easy integration into user applications. Comprehensive, user-friendly software libraries and samples are provided. User can easily design their custom functions keys, text, logo, and graphics. Supported by the CompactFlash file system, 20 impressive color images can be displayed per second via DMA transfer.

The 40 MHz 16-bit 186 CPU with 256KW flash, 256 KW battery-backed SRAM is C/C++ programmable. The *GE* supports two RS232 ports, timer/counters, RTC, relays, Ethernet, and CompactFlash. One serial port can be configured to RS485. There are 20+ TTL I/Os, 2 mechanical relays with contact rating of 200V, 0.5 Amp., Three 16-bit CPU internal timer/counters supports PWM, or pulse-width demodulation.

Two channels of 12-bit DAC(DAC7612) can output 0-4.095V analog voltage. An optional 10-baseT Ethernet LAN controller (CS8900) can be installed. Software stack library is available, supporting network protocols such as ARP, DHCP, UDP, ICMP, and of course TCP over the Ethernet network.

The *GE* supports 50-pin CompactFlash cards for removable mass data/image storage. TERN software supports Linear Block Address mode, and Windows compatible FAT16 flash file system. On-board switching regulator (LM2575) allows 8-30V unregulated DC power input without over heating.

The on-board LCD controller(S1D13705) provides frame data and control signals for most QVGA color LCD/TFT. The image data and control signals are available on a 24-pin, 0.1" spacing header. These signals includes: frame data D0-11, Vertical Start(YD), Pixel clock (XCK), Line Start(LP), contrast adjust voltage(0-4V) and a DRDY for the TFT. A custom cable may be required to match the color LCD pin interface. Some QVGA LCD also requires adding an external +27V contrast control voltage. See the special cable in the photo connecting the *GE* header(H4) and the Sharp LCD. The single loose wire needs external +25V. Also an external CCFL backlighting power may be needed.

Ordering Information

GE	**$149/$119/$79**	**Qty 1/100/1K+**

Includes: 186 CPU 40MHz, 256 KW Flash, 256KW SRAM, EE, 2 RS232, 2 Relays, 5V linear regulator.

NOT including options. OEM option discounts available.

Add-on Options:

1) RTC and battery	$20
2) 2 ch. 12-bit DAC (DAC7612)	$20
3) LCD controller (S1D13075)	$40
4) Touch screen controller (ADS7846)	$20
5) CompactFlash interface	$20
6) RS485 for the SER1	$10
7) Ethernet Interface(ET)	$30
8) Switching Regulator	$20
9) TFT/STN, TouchScreen, CCFL, Bezel	Call

Typical Order Example:

GE + ***RTC+ battery***
GE + 1 = $149 + $20 = $169

TERN INC.
1950 Fifth Street, Davis, CA 95616 USA
Tel: 530-758-0180 • Fax: 530-758-0181
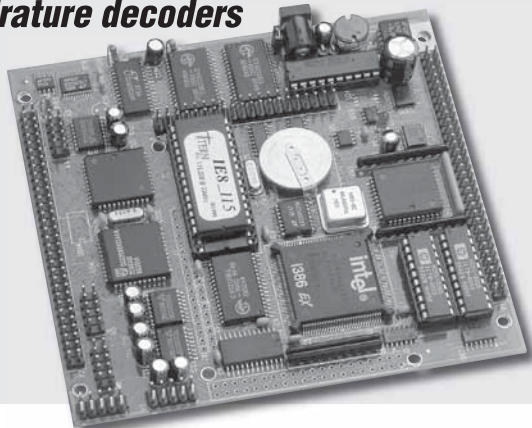CE FC   sales@tern.com   http://www.tern.com

i386-Drive™ (ID)

32-bit Intel i386EX processor module with 70+ I/Os, UARTs, ADC, DAC, quadrature decoders

Features:

- 4.7x 4.5 x 0.6"
- Power consumption: 300/160/80/30mA at 8.5/12/24/35V
- Power input: +8.5 to +12V/35V (linear/switching regulator*)
- 32-bit CPU (Intel i386EX, 33MHz), C/C++ programmable
- 24 multiplexed I/Os, interrupts, DMA, 512-byte EE
- 48 bi-directional I/O lines from 2 PPIs
- Up to 3MB* SRAM/Flash
- Up to 6 serial ports and RS-232/485 drivers *
- Up to 2 quadrature decoders*
- Real-time clock, battery *
- One 100KHz, ±10V, 16-bit ADC and one 5 Hz 24-bit ADC *
- Up to 22 12-bit ADC, two 12-bit DAC, and one 16-bit DAC *
- One 100KHz, high speed 12-bit DAC *
- PCMCIA and Ethernet interface via MMB™

  * optional

The **i386-Drive™ (ID)** is a compact, low-cost, high performance controller based on the 33MHz, 32-bit intel386EX™. It combines the powerful i386EX CPU and numerous peripherals on a single PCB, measuring 4.7" x 4.5".

The **ID** supports up to 512KB 8-bit SRAM, 512KB 8-bit Flash, 1MB 16-bit SRAM, and 1MB 16-bit Flash. A 512-byte serial EE-PROM, which does not require battery backup, can be used as an additional memory device for storing important data.

An optional real-time clock (RTC) provides information on the year, month, date, hour, minute, second, 1/64 second. A lithium coin battery can be installed to back up both the SRAM and RTC.

Two asynchronous serial ports from the i386EX support reliable DMA-driven serial communications (up to 115,200 baud) with RS-232 drivers. The i386EX also offers a synchronous serial port. An optional UART SCC2691 and a dual UART SCC2692 can be added for a total of three asynchronous serial ports with RS-232 or RS-485 drivers.

Three PC-compatible, 16-bit programmable timers/counters can generate interrupts or count external events at a rate of up to 8MHz; they can also generate pulse outputs. Three 8-bit, multifunctional, user-programmable I/O ports are included in the i386EX. Four external interrupts are buffered by Schmitt-trigger inverters

Note: 64KW=128KB, 256KW=512KB, 512KW=1MB

and provide active low inputs. A supervisor chip (691) with a watchdog timer is on-board.

Two PPI chips (82C55) provide 48 user-programmable I/O lines totally free for application use. The optional SCC2692 UART provides 15 additional I/O lines.

The **ID** supports many optional ADC and DACs. Up to 22 channels of 12-bit ADC (TLC2543, 0-5V, 10 KHz), one 16-bit ADC (LTC1605, ±10V, 100 KHz), and one 24-bit ADC (LTC2400, 0-5V, 5 Hz) can be installed. Two 12-bit DACs (LTC1446, 0-4.095V, 10 KHz), one 100 KHz 12-bit DAC (LTC1450, 0-4.095V), and one 16-bit DAC (LTC1655, 0-4.095V, 10 KHz) are available.

Two quadrature decoders (HP2020) can interface to optical encoders for motion control uses. Schmitt-trigger inverters are provided. On-board expansion headers provide data lines, address lines, control signals, and pre-decoded chip select lines.

A 5V switching regulator (up to 35V DC input) can be installed to reduce power consumption and heat.

In "power-off" mode, the **ID** consumes very low (µA) power. Users can turn off the switching regulator via software, and use the RTC or an external signal to turn it on.

A **MMB™** can be installed on the **ID** to provide an additional 33 channels of 12-bit ADC, 6 channels of 24-bit ADC, and 420MB of PCMCIA memory. An Ethernet interface may also be installed.

Ordering Information

ID	$199/$179/$149/$69	Qty 1/100/1K/5K+

Includes: i386EX 33MHz, 128KB SRAM, 2 RS-232, PPIs, watchdog, 512-byte EE, and 5V linear regulator.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) 8-bit SRAM: 512KB $20
2) Debug ROM (*IE8_0_115*) or (*ID16_0_115*)...........................$20
3) Real-time clock (RTC) and battery $20
4) UART (SCC2691) w/ (a) RS-232 (default) or (b) RS-485 .....$30
5) Dual UART (SCC2692) w/ (a) RS-232, or (b) RS-485...........$40
6) 16-bit SRAM: (a) 128KB x2, or (b) 512KB x2 ....$40/$80
7) 16-bit Flash: (a) 256KW $40
8) 24-bit ADC (LTC2400) $20
9) 16-bit ADC (LTC1605, 100KHz) $60
10) 11 ch. 12-bit ADC (TLC2543) *up to 2* ....$20 each
11) 2 ch. 12-bit DAC (LT1446)..$20
12) High-speed 12-bit DAC (LTC1450) $30
13) Switching regulator $20
14) HP2020 Quadrature decoder (up to 2).......................$30 each

Typical Order Example:

386-Drive™, 512 KB SRAM (8-bit), RTC & Battery
ID + 1 + 3 = $199 + $20 + $20 = $239

i386-Engine™ (IE)

C/C++ programmable, 32-bit Intel i386EX processor module with ADC & DAC
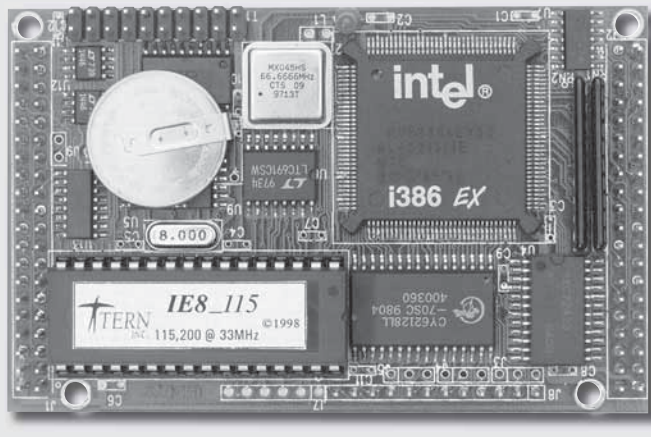
Features:

- 3.6x2.3x0.3"
- 32-bit CPU (Intel i386EX)
- 270mA at 5V, 28mA in power-down mode
- Up to 512KB 8-bit SRAM, 512KB 8-bit ROM/Flash *
- 512-byte EE   • Up to 4 serial ports *
- 3 timers   • watchdog
- 24 multiplexed I/Os, interrupts, DMA
- 11 ch. 12-bit ADC *   • Up to 4 ch. 12-bit DAC *
- Real-time clock, battery *
   * optional

The **i386-Engine™ (IE)** is a 32-bit microprocessor core module based on the 33MHz intel386EX™. It is designed for embedded systems that require high performance and PC-compatibility, at a low cost. The **i386-Engine™** operates with regulated 5V-only power input, and consumes 270mA at 33MHz. In software-programmable power-down mode, power consumption is 28mA. The real-time clock can switch an external power supply on and off to achieve µA-level power consumption. The **IE** operates in either 8-bit or 16-bit external data mode. Up to 512KB 8-bit ROM/Flash and up to 512KB 8-bit battery-backed SRAM can be installed on-board. 64MB of memory space is supported, with 26 address lines and 16 data lines. A 512-byte serial EEPROM is on-board. The optional real-time clock (RTC72423) with a lithium coin battery provides information on the year, month, date, hour, minute, second, and 1/64 second.

Two asynchronous serial ports from the i386EX support reliable DMA-driven serial communication speeds up to 115,200 baud. The synchronous serial port operates at up to 8MHz. A UART SCC2691 can be added to support 8-bit or 9-bit serial communication. Three 16-bit programmable timers/counters can be used to generate interrupts or count external events, at a rate of up to 8MHz, or to generate pulse outputs. Three 8-bit multifunctional, user-programmable I/O ports support up to 10 external interrupts. Four external interrupts are buffered by Schmitt-trigger inverters and provide active low inputs. The other six interrupts provide active high inputs. A supervisor chip (LTC691) offers power-failure detection and a watchdog timer.

The 12-bit serial ADC has sample-and-hold, a high-impedance reference input, 11 single-ended 0-5V (or 0 to REF) inputs, and a 10KHz sample rate. Up to four serial 12-bit DAC provide 0 to 4.095 Volt analog voltage outputs, capable of sinking or sourcing 5mA.

Ordering Information

IE	$186/$134/$99/$64	Qty 1/100/1K/5K+

Includes: i386EX 33MHz, 128KB SRAM, 1 sync. & 2 async. UARTs, 3 timers, watchdog, 512-byte EE.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM: 512KB..$20
2) Debug ROM (*IE8_0_115*) $20
3) Real-time clock (RTC) and battery $20
4) UART (SCC2691) $20
5) 11 ch. 12-bit ADC (TLC2543) $20
6) **VE232™** interface board $69
7) 2 ch. 12-bit DAC *up to 2 chips*...................................$20 each
8) Sockets for expansion: two 20x2, one 10x2 ....$9

Typical Order Example:

i386-Engine™, 512 KB SRAM, RTC & Battery
IE + 1 + 3 = $186 + $20 + $20 = $226

Signals at J1 and J2:

J1 Signal Function	Pin#	Pin#	Function
VCC	1	2	GND
MPO	3	4	TOUT2
RxD	5	6	GND
TxD	7	8	D0
VOFF	9	10	D1
BHE	11	12	D2
D15	13	14	D3
/RST	15	16	D4
RST	17	18	D5
/CS6	19	20	D6
D14	21	22	D7
D13	23	24	GND
M/IO	25	26	A7
D12	27	28	A6
/WR	29	30	A5
/RD	31	32	A4
D11	33	34	A3
D10	35	36	A2
D9	37	38	A1
D8	39	40	BLE

J2 Signal Function	Pin#	Pin#	Function
GND	40	39	VCC
RI1	38	37	P21
P27	36	35	P37
TxD0	34	33	/INT4
RxD0	32	31	/RTS1
P36	30	29	P35
TxD1	28	27	P11
RxD1	26	25	DTR1
P34	24	23	P33
/CTS1	22	21	P32
P13	20	19	P31
P12	18	17	P30
R/W	16	15	/INT7
P10	14	13	P17
P14	12	11	P16
P23	10	9	TCLK2
/INT5	8	7	NMI
/INT6	6	5	P22
DSR1	4	3	P24
GND	2	1	DCD1

J7 and J8 Signal: A8-A25

ACU™ 16-bit ADCs, CAN-bus Ethernet and Host USB ports

NEW!
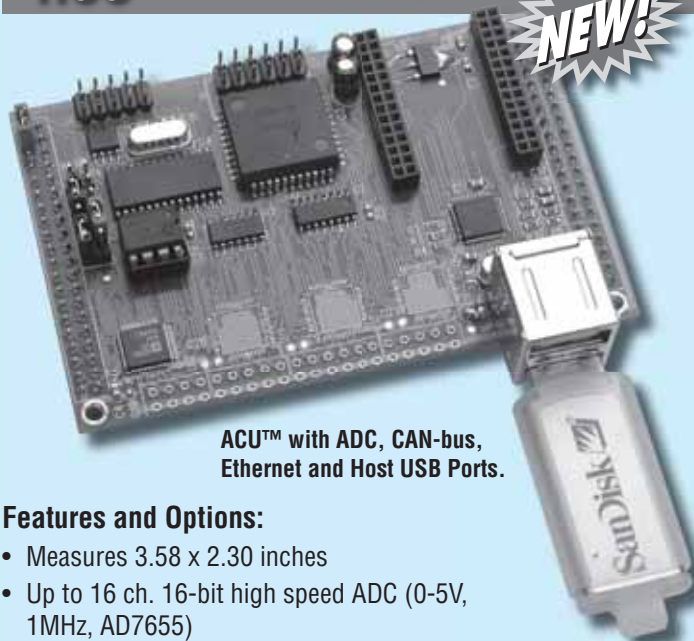
ACU™ with ADC, CAN-bus, Ethernet and Host USB Ports.

Features and Options:

- Measures 3.58 x 2.30 inches
- Up to 16 ch. 16-bit high speed ADC (0-5V, 1MHz, AD7655)
- 10/100-baseT Ethernet with hardware TCP/IP stack
- Host USB ports for USB Flash disk, USB keyboard/mouse
- CAN bus controller (SJA1000) and CAN transceiver

The **ACU™** is an expansion card designed for TERN controllers. It can be used to add ADCs, CAN-bus, Ethernet, and Host USB ports to TERN's family of C programmable Engine controllers.

Up to 4 ADC chips (4 ch. each AD7655, 1MHZ, 16-bit, 0-5V) can be installed to provide a total of 16 ADC inputs. Each AD7655 allows simultaneous sampling on two channels in hardware.

A Controller Area Network (CAN) controller (SJA1000), running at 20 MHz clock can be installed along with on-board CAN transceiver, supporting baud rates up to 1 Mb/s. CAN interrupt and software programmable hardware reset are available. The **ACU™** allows TERN controllers to be directly connected to CAN-bus. All registers of the CAN controller are software accessible, and software-buffering drivers are also provided.

A Fast Ethernet Module can be installed to provide 10/100M Base-T network connectivity. This Ethernet module has a hardware LSI TCP/IP stack, implementing TCP/IP, UDP, ICMP and ARP, and is programmed using a software socket interface.

A Host USB controller can be installed to provide two Host USB Ports. Firmware support is provided to allow low-level accesses to select USB devices. Port1 can interface to USB keyboard/mouse, while port 2 supports a USB Flash Disk. Simple AT-style command set is used to support FAT file system applications.
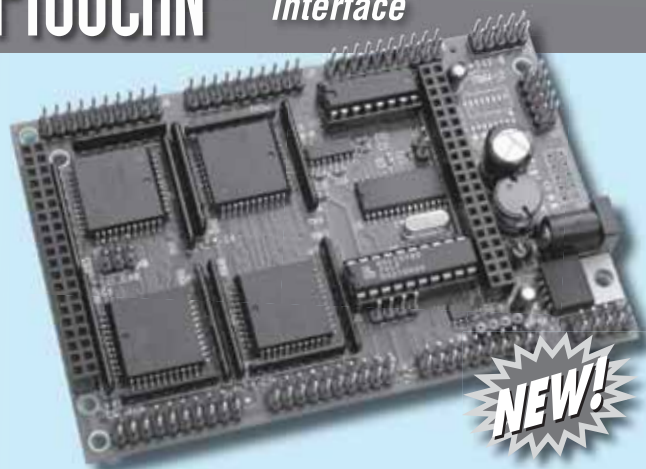
Order Information
ACU™ $69 Qty 1

Add-on Options:

1) ADC (AD7655) up to 4 chips $40x4
2) CAN(SJA1000) with transceiver $40
3) 100 BaseT hardware TCP/IP Ethernet $30
4) Host USB ports...$50

P100CAN™ 96 I/O lines and CAN-bus interface

NEW!

Features:

- 4.4x3.1x0.5 inches.
- Driven by a TERN controller (586-Engine, A-Engine86,…)
- Power consumption: < 200 mA @ 9V-12V
- 24x4 PPIs, 7 high voltage sinking drivers
- 5V switching regulator, RS-232 or RS-485 drivers.

The **P100CAN™** is designed to be used in automotive and general industrial application. It includes four PPI (82C55) chips, providing a total of 24x4 programmable bi-directional TTL I/O lines. 7 high voltage sinking drivers (ULN2003A) provide up to 50V, 350 mA each.

A Controller Area Network (CAN) controller (SJA1000, 20 MHz clock) with on-board CAN transceiver is available, allowing TERN controllers to be easily connected to a CAN-bus. It supports CAN2.0B protocol and up to 1M-bit baud rate. CAN interrupts and software programmable hardware resets are available. All registers of the CAN controller are software accessible, and software-buffering drivers are provided.

Two channels of RS-232 drivers and an optional 3rd RS232 or RS485 driver can be installed. The **P100CAN™** requires 8.5V to 12V DC power supply with linear regulator, or up to 30V DC power input with an optional switching regulator without generating excessive heat.

Ordering Information
P100CAN™ $99/$69/$39 Qty 1/100/1000

Includes: 2 RS-232 ports, 24 PPI I/Os, solenoid drivers, linear regulator. Driven by C/C++ programmable Engine controller.

NOT including add-on options.

Add-on Options:

1) CAN (SJA1000) with transceiver $40
2) Switching power regulators (SR) $20
3) 3rd UART driver a) RS232 or b) RS485...............................$10

Order Example:

P100CAN with CAN controller
P100CAN +1 = $99+$40

27

U-Drive™ NEW!
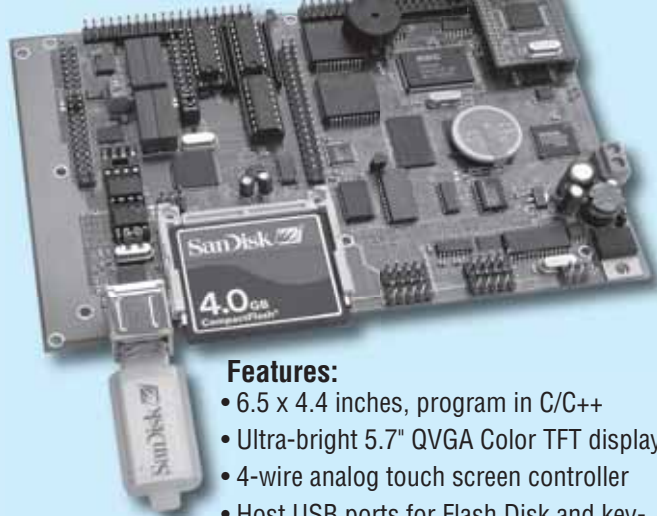
Features:
- 6.5 x 4.4 inches, program in C/C++
- Ultra-bright 5.7" QVGA Color TFT display
- 4-wire analog touch screen controller
- Host USB ports for Flash Disk and keyboard/mouse
- 256 KW SRAM, 256 KW Flash, 512 bytes EEPROM
- 30+ TTL I/O, 3 16-bit timer/counters, RTC, Battery
- 4 mechanical relays, 4 Opto-coupler inputs.
- 14+ solenoid drivers or high voltage inputs (0-30V DC)
- 2 ch. 16-bit ADCs, 16 ch. 24-bit ADCs
- Precision reference and on-board temperature sensor
- 8 ch. 16-bit DACs, 4 ch. 12-bit DAC
- Controller Area Network (CAN2.0B) port
- 4 RS232/and 2 RS485 serial ports
- 10/100 Base-T Ethernet with hardware TCP/IP stack
- Switching regulator, 50 mA standby, 160 mA at 12V
- CompactFlash with Windows compatible file system support

The *U-Drive (UD)* is a very low-cost industrial HMI controller, ideal for OEM applications requiring a user interface. The ultra-bright, wide viewing angle active TFT color display with touchscreen is attractive, can be used in outdoor applications, and easy to program. Other peripherals makes this board a powerful and comprehensive industrial user interface and control solution.

Display
The onboard LCD controller (S1D13075, EPSON) has internal 80KB image buffer, supporting QVGA color graphic LCDs with 320x240 pixels. The integrated TFT display is ultra-bright (rated at 400+ nits). An accurate touch screen controller (ADS7846) supports 4-wire resistive touch screen. All components are installed on single PCB, mounted on the backside of the QVGA TFT for easy integration into user applications. Comprehensive, user-friendly software libraries and samples are provided. User can easily design their custom functions keys, text, logo, and graphics. Supported by the CompactFlash-based file system (up to 2 GB), up to 10 user-designed screens can be displayed per second via DMA transfer. Touch-screen and mounting bezel are also optionally available for this display.

USB
A Host USB controller can be installed to provide two Host USB ports. Port 1 can interface to USB keyboard/mouse, allowing a flexible mechanism for accepting user input in addition to touchscreen. Port 2 supports a hot-removable USB flash disk, using a simple command set to manipulate a FAT filesystem format. No other USB specific firmware programming is required on the controller side.

Communications
A Controller Area Network (CAN) controller (SJA1000, 20 MHz clock) is available. It supports network baud rates up to 1M-bit per second. Software drivers allow access to all CAN controller registers, as well as packet buffering software layer.

A Fast Ethernet Module can be installed to provide 10/100 Base-T network connectivity. This Ethernet module has a hardware LSI TCP/IP stack, implementing TCP/IP, UDP, ICMP and ARP support in hardware. Socket-based software drivers show the U-Drive to be used as a web or TCP server.

Also available are 4x RS232 and 2x RS485 serial ports.

Industrial I/O
There are 30+ TTL I/Os, 4 mechanical relays (200V, 0.5 Amp.), 4 opto-couplers and 14 solenoid drivers (sinking/sourcing 350 mA at 50V each). The solenoid drivers can be hardware configured to be high voltage (0-30V) inputs. Three 16-bit CPU internal timer/counters support timing and external counting.

There are up to a total of 28 ADC inputs and 12 DAC outputs: 4 ch.16-bit parallel ADC chip (AD7655, 1 MHz, 0-5V), 24-bit ADC (LTC2448, 5KHz 0-1.25V) configurable for 8 ch. differential or 16 ch. single-ended input channels. A 16-bit ADC (ADS8344, 10KHz 0-5V) provides 8 ch. analog inputs. Eight ch. 16-bit DACs (LTC2600, 0-5V, 10 KHz), and four ch. 12-bit parallel DAC (DA7625, 200 KHz, 0-2.5V) are available.

Ordering Information
UD $479/$419/$379 Qty 1/50/100+

Includes: 186 CPU 40MHz, PPIx2, 256 KW Flash, 256KW SRAM, EE, 2 RS232, solenoid drivers, QVGA TFT display.

NOT including options. OEM option discounts available.

Add-on Options:
1) 16 ch. 24-bit ADC(LTC2448)..$40
2) 4 ch. 16-bit ADC, 1MHz (AD7655).......................................$40
3) 8 ch. 16-bit ADC (ADS8344)...$30
4) 4 ch. 12-bit DAC, 200 KHz (DA7625)...................................$40
5) 8 ch. 16-bit DAC (LTC2600)..$40
6) Real-time clock (RTC) and battery $20
7) CompactFlash interface $20
8) USB Host Port1 and Port2...$50
9) QUART (2 RS232+2 RS485)...$40
10) 10/100 Base-T hardware TCP/IP Ethernet...........................$30
11) CAN controller with transceiver $40
12) Switching Regulator $20
13) Reed Relay, up to 4 (one for TFT backlight)...................$10x4
14) 4 Opto-couplers..$20
15) Touchscreen $40
16) Bezel $50

Typical Order Example:
UD +CompactFlash+Ethernet > **UD** +7+10 = $479+$20+$30= $529

28

H-Drive™   *Host USB, 10/100 Base-T Ethernet, CF, ADC, DAC, TFT*

NEW!
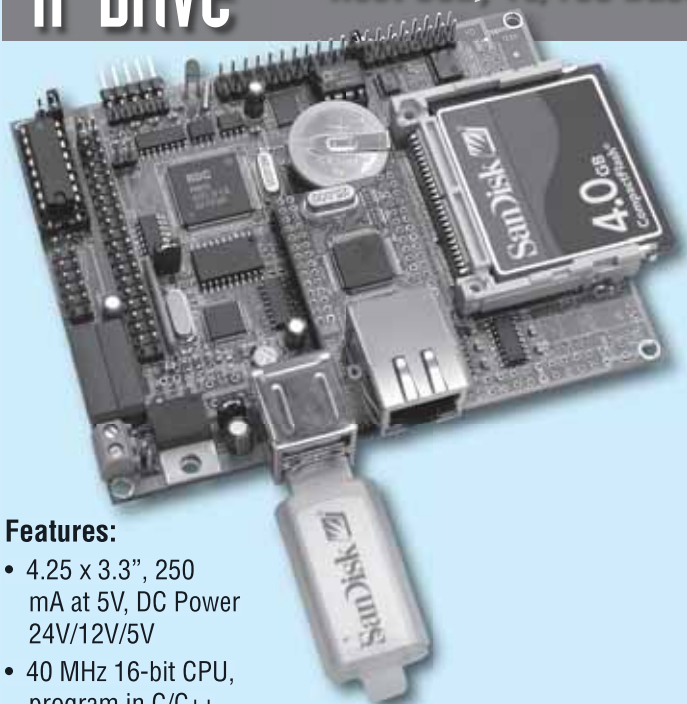
Features:

- 4.25 x 3.3", 250 mA at 5V, DC Power 24V/12V/5V
- 40 MHz 16-bit CPU, program in C/C++
- 8 high voltage I/Os, 4 TTL I/Os and 2 Reed Relays
- 6 RS232/485 serial ports, Real-time clock, PWM,Timers
- 16 ch. 24-bit ADC, 11 ch. 12-bit ADC, 8 ch. 16-bit DAC
- Hardware TCP/IP stack for 100M Base-T Ethernet
- CompactFlash card with FAT file system support
- Two Host USB ports for Flash Disk, USB mouse/keyboard
- QVGA 5.7" TFT color display interface

The ***H-Drive™ (HD)*** is a low cost, C/C++ programmable embedded controller based on a 40 MHz 16-bit CPU. It is intended for networking industrial process control, data acquisition. Costs are reduced by using a LCD panel with an integrated control chipset, making this product especially ideal for cost-sensitive Human Interface Device OEM applications.

A 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. It releases internet connectivity and protocol processing from the host processor, which represents a huge improvement over software-based TCP/IP stacks. The resulting system can easily handle transmissions in the 100KB/s+ range in real world applications.

A Host USB controller can be installed to provide two Host USB Ports. Port1 can interface to a USB keyboard/mouse. Port 2 supports a USB Flash Disk. Simple commands can handle FAT file system applications. No USB specific firmware programming is required on the controller side.

A 24-bit ADC (LTC2448) offers 8 ch. differential or 16 ch. single-ended input channels. A peak single-channel output rate of 5 KHz can be achieved. A 12-bit ADC (TLC2543, 0-5V) provides 11 ch. analog inputs at up to 10K Hz sample rate. A 16-bit DAC (LTC2600) provides 8 analog output voltages (0-5V).

The ***HD*** supports up to 2 GB mass storage CompactFlash cards with Windows compatible FAT file system support, allowing user easily transfer large amounts of data to or from a PC.

The ***HD*** features 16-bit ACTF Flash (256 KW) and battery-backed SRAM (256 KW). It also includes 4 TTL I/Os, 3 timers, 512 bytes EEPROM, watchdog timer, and Real Time Clock(DS1337).

There are a total of 6 UARTs on board: 2 from the CPU chip, 4 from QUART chip(TI16C754B). By default all UARTs are supported by RS232 drivers. Two of the QUART RS232 ports can be converted to RS485.

Seven high voltage I/Os (30V DC inputs or 50V sinking outputs) are included. Optional 8 sourcing driver can be installed. Two mechanical Reed Relays provide reliable, fast switching contacts with a specification of 200 V, maximum 1 Amp carry current, 0.5 Amp switching, and 100 million times operation. A Color TFT display (320x240 pixels, 5.7", No touch screen) with an integrated control chipset is available, allowing access to drawing buffer using limited vendor-provided command set.

The ***HD*** can be powered by regulated 5V, or 9-12V with on-board linear regulator, or 9-24V with optional switching regulator. The HD works with most TERN expansion boards including the P52, P100, P300, MotionC, MMC, UR8, and EyeJ.

Ordering Information

HD $189/$139/$99/$89   Qty 1/50/100/1K+

Includes 40 MHz CPU, 256KW SRAM, PIOs, 6 RS232, 3 timers, watchdog timer, 512 bytes EE, 256KW flash

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) Real-time clock (RTC) and battery $20
2) CompactFlash interface $20
3) USB Host Port1 and Port2 .... $50
4) 100M BaseT hardware TCP/IP Ethernet $30
5) 24-bit ADC(LTC2448) $40
6) Precision Reference with Temp Sensor $15
7) 8 ch. 16-bit DAC (LTC2600) $60
8) 11 ch. 12-bit ADC (P2543) $20
9) Switching Regulator $20
10) Reed Relay, up to 2 .... $10x2
11) 5.7" Color QVGA TFT $200
12) Plastic Enclosure/Aluminum Bezel .... Call

Typical Order Example:

H-Drive™, 5.7" Color TFT
HD +11 = $189+$200 = $389

29

CAN-Engine™
CAN, 100M Ethernet, RS232, CF, and 16-bit ADC
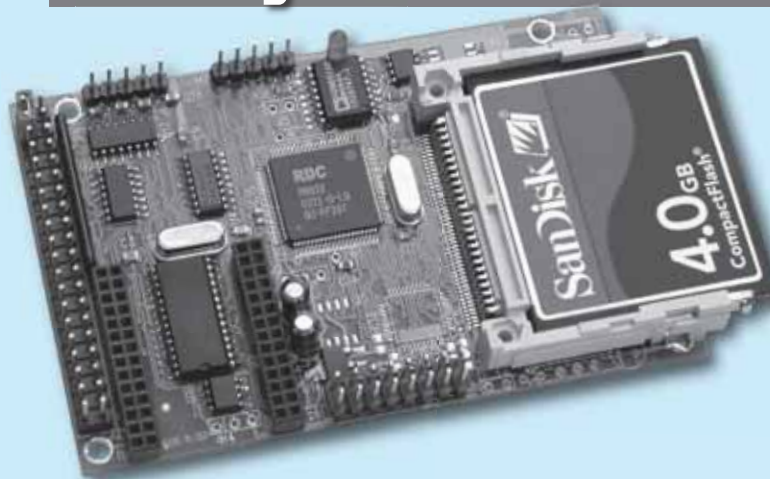
Features:
- 3.6 x 2.3 x 1", 150 mA at 5V
- 16-bit x186 CPU, program in C/C++
- Controller Area Network (CAN2.0B) port
- 256 KW 16-bit Flash, 256 KW 16-bit SRAM, 512 bytes EE
- 20+ TTL I/Os, Real-time clock, 2 serial ports, PWM, counters
- 4 ch 16-bit parallel high speed ADC (AD7655)
- Hardware TCP/IP stack for 10/100 Base-T Ethernet
- CompactFlash card with FAT file system support

The **CAN-Engine™ (CANE)** is a high performance, low cost, C/C++ programmable embedded controller with CAN support. It is intended for networking, automotive, industrial process control, high-speed data acquisition, and especially ideal for OEM applications.

A Controller Area Network (CAN) controller (SJA1000, 20 MHz clock) can be installed along with on-board CAN transceiver. Supported baud rates range from 300 bps to 1 Mbps, and interrupt-driven buffering software allows reliable, efficient delivery and receipt of packets over the CAN network. CAN control registers off the SJA1000 are accessible in software.

A Fast Ethernet Module can also be installed to provide 100M BaseT 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. The hardware Ethernet module releases internet connectivity and protocol processing from the host processor, which represents a huge improvement over software-based TCP/IP stacks. The resulting system can easily handle transmissions in the 100KB/s+ range in real world applications. It supports 4 independent stack connections simultaneously at a 4Mbps protocol processing speed. Software libraries and sample projects demonstrate simple TCP and HTTP client/server applications based on Ethernet connectivity.

A 16-bit parallel ADC (AD7655, 0-5V) supports ultra high-speed (1 MHz conversion rate) analog signal acquisition. The AD7655 contains two low noise, high bandwidth track-and-hold amplifiers that allow simultaneous sampling on two channels. Each track-and hold amplifier has a multiplexer in front to provide a total of 4 channels analog inputs. The 16-bit parallel ADC requires only two

CPU I/O operations (one start, one read) to complete a 16-bit ADC reading. With on-board precision 2.5V reference, the ADC accepts 0-5V analog inputs at 16-bit resolution of 0-65,535. Two 12-bit DACs provide 0 to 4.095 Volts analog voltage outputs capable of sinking or sourcing 5mA.

The CANE supports up to 2 GB mass storage CompactFlash cards with Windows compatible FAT filesystem support, allowing user easily transfer large amounts of data to or from a PC.

The **CANE** features fast execution times through 16-bit ACTF Flash (256 KW) and battery-backed SRAM (256 KW). It also includes 3 timers, PWMs, 20+ PIOs, 512-byte serial EEPROM, two RS232 ports, 3 timer/counters, and a watchdog timer. The three 16-bit 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. The PIO pins are multifunctional and user programmable. A real time clock (DS1337, Dallas) is available.

The **CANE** can be powered by regulated 5V DC or unregulated 9-12V DC with installing a 5V regulator. The **CANE** works with TERN expansion boards including the P52, P100 and MotionC.

A CAN-Engine™ installed on the top of a P100 board.

Ordering Information

CANE	$99/$84/$69/$39	Qty 1/50/100/1K+

Includes 40 MHz CPU, 64KW SRAM, PIOs, 2 RS232, 3 timers, watchdog timer, 512 bytes EE, 256KW flash

NOT including add-on options. OEM option discounts available.

Add-on Options:
1) SRAM 256KW $20
2) Real-time clock (RTC) and battery $20
3) CompactFlash interface $20
4) 10/100 Base-T hardware TCP/IP Ethernet............................$30
5) CAN controller with transceiver $40
6) 4 ch. 16-bit ADC, 1MHz (AD7655).......................................$40
7) 2 ch. 12-bit DAC (LT1446)...$20

Typical Order Example:
CAN-Engine™, CAN port
CANE +5 = $99+$40 = $139

i386-Engine-L™ (IEL)

Intel 386EX, 16-bit Flash & SRAM, ADC, DAC, 50+ I/Os, 3 RS232/485, and RTC

i386-Engine-L™
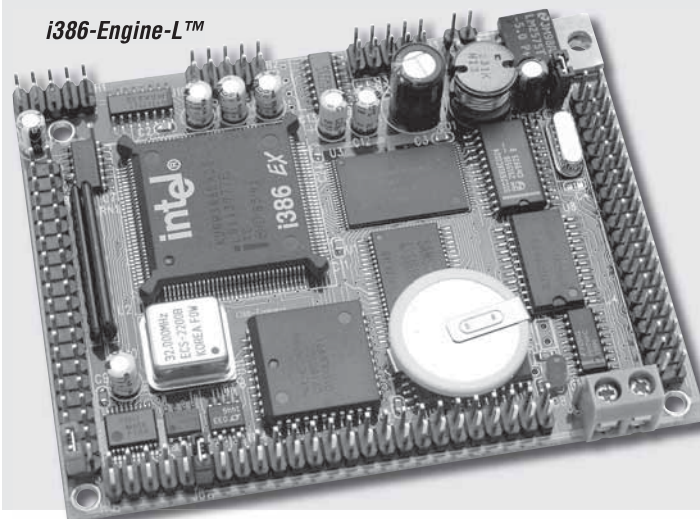
Features:

- 3.6 x 2.8 x 0.3 inches
- Power consumption: 80 mA at 12V (32MHz, SR)
- Intel i386EX, C/C++ programmable
- 16-bit 256KW Flash, 256KW SRAM, 512-byte EE
- 40+ TTL I/Os
- Up to 3 serial ports, RS-232/485 drivers*
- 11 ch. 12-bit ADC and 2 ch. 12-bit DAC*
- 5V switching regulator and real-time clock, battery*
  - * optional

Measuring 3.6 x 2.3 x 0.3 inches, the *i386-Engine-L™* (*IEL*) is a C/C++ programmable low cost microcontroller based on the Intel 386EX. The *IEL* is ideal for industrial process control and data acquisition.

Summary

The high performance i386EX operates with 32MHz clock as default, or works with the 64MHz clock as an option. In addition to offering a 16-bit external data bus, the *IEL* features on-board 256 KW 16-bit ACTF Flash and 256 KW 16-bit battery-backed SRAM. Application code can be easily programmed in the field via serial link. A wide range of peripheral components makes this board the ideal versatile core component for the most demanding of user applications.

A real-time clock (RTC72423) provides information on the year, month, date, hour, minute, second, and 1/64 second. A 512-byte serial EEPROM is on-board. Two i386EX internal DMA-driven serial ports support communication up to 115,200 baud. A SCC2691 Universal Asynchronous Receiver/Transmitter (UART) provides full-duplex asynchronous receiver/transmitter. The receiver is quadruple buffered to minimize the potential of receiver overrun or to reduce interrupt overhead. It incorporates a special 9-bit mode for multi-processor communications. On-board RS232 or RS485 driver can be installed for the SCC2691.

Three on-board 16-bit programmable timers/counters can be used to count external events or to generate pulse outputs.

Schmitt-trigger inverters are provided to increase noise immunity for external interrupt inputs. A supervisor chip (691) provides power failure detection and a watchdog timer.

The i386EX provides 32 multifunctional I/O pins. A PPI (82C55) provides 24 user programmable bi-directional I/O lines. The 82C55 PPI can be used, in particular, to interface to a LCD and keypad (Kpad-I/O) offered by TERN.

A serial 12-bit ADC (P2543) may be installed, offering 11 single-ended 0-5V inputs with a 20 KHz sample rate. A 2-channel 12-bit serial DAC (LT1446) provides 0-4.095 V analog voltage outputs capable of sinking or sourcing 5 mA.

9-12V DC can power the IEL with a 5V linear regulator. Optional switching regulator (LM2575) can be used to allow up to 30V unregulated DC power input and reduce heat. Using switching regulator, in the power off mode, the IEL consumes very low power (micro-amp).

Signals routed to J1 and J2 (20x2 pin headers) are compatible with IE, IEP, IEM, and ID. IEL has the same mechanical dimension as the AE86P. This allows the IEL to be compatible with a range of TERN expansion boards.

In particular, mass external memory can be added via J1 bus header with *MMB* or *FC-0* to support PCMCIA or CompactFlash Cards of up to 2GB. An additional 33 channels of 12-bit ADC and 6 additional channels of 24-bit ADC inputs can be added with the *MMB*.

Ordering Information

IEL	$189/$129/$99	Qty 1/100/1K+

Includes intel 386EX, 32MHz clock, 2 UARTs, 3 timers, 82C55 PPI with 24 I/O lines, watchdog timer, 512-byte EE, 256KW 16-bit ACTF™ Flash and 64KW SRAM.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM 256KW..$20
2) Real-time clock (RTC) and battery......................................$20
3) UART SCC2691 with a) RS232, or b) RS485.......................$30
4) 11 ch. 12-bit ADC (P2543) $20
5) 2 ch. 12-bit DAC (LT1446)...$20
6) 64MHz clock with 386EX...$30
7) Switching Regulator (SR)...$20
8) Sockets for expansion: two 20x2, one 25x2 ....$9

Typical Order Example:

I386-Engine-L™, 11 ch. 12-bit ADC
IEL + 4 = $189 + $20 = $209

31

i386-Engine-P™ (IE-P)

i386-Engine plus 16-bit ADC, RS-232/485
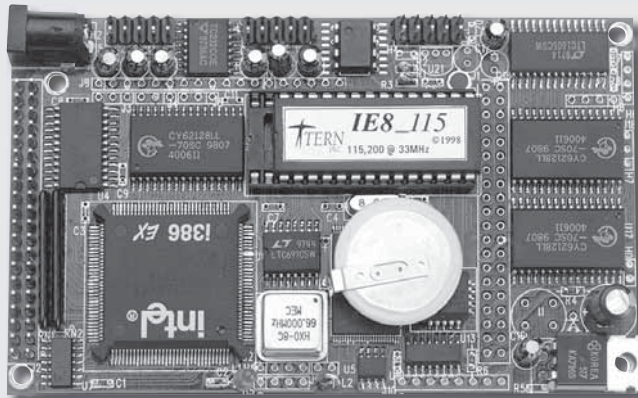
i386-Engine-P™

Features:

- 4.5x2.7x0.3"
- Power consumption: 300/160/80/30mA at 6.5/12/24/30V
- 32-bit CPU (Intel i386EX, 33 MHz), C/C++ programmable
- Up to 3MB on-board SRAM + Flash *
- Up to 4 serial ports • RS-232/485 drivers
- 512-byte EE • 16-bit ADC *
- 24 multiplexed I/Os, plus 8 TTL outputs
- 5V regulator • Real-time clock, battery *
  * optional

The **i386-Engine-P™** (**IE-P**) is based on the **i386-Engine™** design, with regulator, RS-232/485 drivers, single high speed ADC, and more on-board memory. In addition to 512KB 8-bit SRAM and 512KB 8-bit ROM/Flash, the **IE-P** supports up to 1MB 16-bit SRAM and 1MB 16-bit Flash. A 16-bit ADC (LTC1605, 100KHz, ±10 V) can be installed. Eight TTL outputs are designed for operating an external analog multiplexer.

The **IE-P/M** can be installed with **MC2140™, LittleDrive™, Mem-Card™, MotionC™, P100™** or **P300™.**

Ordering Information

IEP/IEM   Call for Pricing

Includes: i386EX 33MHz, 8 TTL outputs, watchdog, 512-byte EE, 5V regulator, 2 RS-232 drivers, 128KB SRAM.

NOT including add-on options. OEM option discounts available.

Add-on Options: (IEP)

1) 8-bit SRAM: 512KB
2) Debug ROM (*IE8_0_115*)
3) Real-time clock (RTC) and battery
4) UART (SCC2691) w/ (a) RS232 or (b) RS485
5) 3 sockets for expansion: two 20x2, one 10x1
6) 16-bit SRAM: (a) 128KBx2 or (b) 512KBx2
7) 16-bit Flash: 256KW
8) 16-bit ADC (LTC1605)
9) Switching regulator

i386-Engine-M™ (IE-M)

8 ch. 12/16-bit ADC
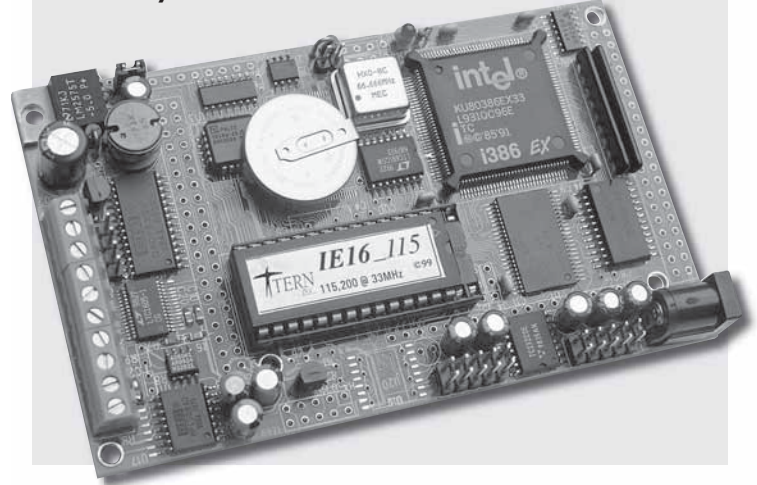
Features:

- Same mechanical/electrical features as the **i386-Engine-P™**
- Single 16-bit SRAM replaces all 8-bit SRAM chips of **IE-P**
- Multiplexer (8 single or 4 differential) for analog inputs
- Optional 12/16-bit high speed parallel ADC
- Optional 4 channels of 5 µs 12-bit DAC(7625, BB)

The **i386-Engine-M™** (**IE-M**) is an excellent high performance controller for high speed data acquisition and motion control. A single 16-bit SRAM chip with battery backup and 16-bit Flash allow the i386EX to operate using the 16-bit data bus for code and data access.

An optional 8 ch. 12-bit ADC (LTC1415, 1MHz, 0-4.096V), or 16-bit ADC (LTC1605-1, 100K, 0-4V) can be installed with an analog multiplexer (508) of 8 single-ended differential inputs. A high speed 12-bit DAC7625 contains four precision output buffer amplifiers, providing 5µs output setting time and outputs of 0 to 2.5V with an external 2.5V reference.

Add-on Options: (IEM)

1)16-bit SRAM: 512KB
2) Debug ROM (*IE16_0_115*)
3) Real-time clock (RTC) and Battery
4) UART (SCC2691) w/ (a) RS-232 or (b) RS-485
5) 3 sockets for expansion: two 20x2, one 10x1
6) 16-bit Flash: 256KW
7) ADC: (a) 8 ch. 12-bit, (d) 8 ch. 16-bit
8) Switching regulator
9) 4 ch. 12-bit DAC 200 KHz (DA7625)

TERN INC.   **1950 Fifth Street, Davis, CA 95616 USA**
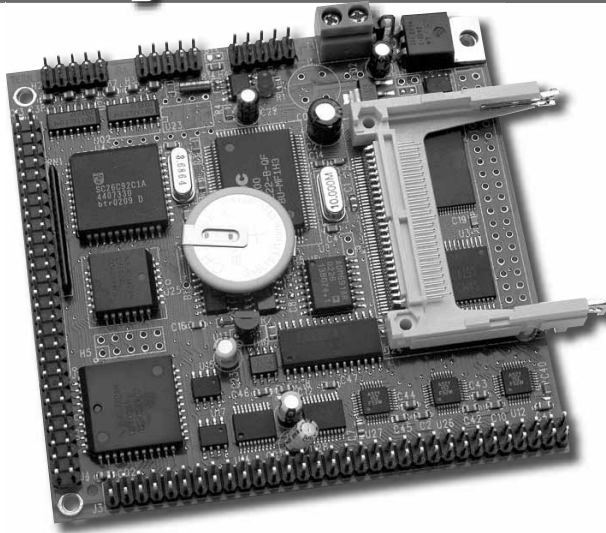**Tel: 530-758-0180 • Fax: 530-758-0181**

sales@tern.com   http://www.tern.com

R-Engine-A™ (RA)

Features:

- 3.6 x 3.5"
- 50 µA standby, 160/20 mA normal/power-save
- Complete C/C++ programmable environment
- 40 high speed, 16/12-bit analog inputs, 0-5V
- 8 high-speed 12-bit analog outputs
- Up to 2GB CompactFlash with File system support
- 80 MHz R1100 or 40 MHz Am186ER
- 256 KW 16-bit Flash, 256 KW 16-bit SRAM
- 40+ TTL I/Os, Real-time clock, 512 bytes EE
- 3 RS-232 serial ports, one can be RS232/485/422
- 6 16-bit timers or counters, PWM output

The **R-Engine-A™** (**RA**) is intended for OEM applications requiring high speed, mass data storage, and up to 40 channels of analog data acquisition. It is ideal for precision data acquisition, industrial process control, and battery-powered solutions for applications requiring mass data exchange.

The **R-Engine-A™** (**RA**) is a high performance C/C++ programmable controller with a 16-bit external bus. The **RA** design uses parallel ADCs which directly interface to the high performance CPU via a true 16-bit data bus allowing for a single I/O instruction per 12-bit ADC reading. A CompactFlash card, up to 2GB, can be inserted for mass data storage.

A total of up to 40 analog inputs are supported. Up to 3 high-speed 12-bit parallel ADC chips (AD7852) can be installed, each chip providing 8 channels analog inputs, with up to 300K samples per second. The AD7852 includes sample-and-hold, a precision internal reference, and has an input range of 0-5 V. Up to 2 high resolution 16-bit ADC (ADS8344, TI) can be installed. Each provides 8 single-ended or 4 differential analog inputs (0-5V, or 0-REF) with 65536 counts of resolution and a max sample rate up to 10 KHz. The **RA** features fast execution times through 80MHz 186 CPU, 16-bit Flash and 16-bit battery-backed SRAM.

A 50-pin CompactFlash interface can be installed to allow access to mass storage CompactFlash cards. Users can easily add mass data storage to their embedded application. C/C++ programmable software packages with file system libraries are available.

CPU internal timer/counters can be used to count or time external events, or to generate non-repetitive or variable-duty-cycle waveforms as PWM outputs. Additional three 16-bit programmable counters (71054, NEC), each with its own clock input, gate input, and output, can be clocked up to 10 MHz.

A serial real time clock (DS1337, Dallas) is a low power clock/calendar with two time-of-day alarms.

Three RS232 serial ports are available: A Dual UART (SC26C92) and a single CPU internal UART(default as DEBUG port). All UARTs have deep FIFOs to minimize the potential of receiver overrun or to reduce interrupt overhead. The UARTs also incorporate 9-bit mode for multi-processor communications. One UART can be buffered by RS232 (as default), RS485, or RS422.

40+ TTL I/O lines are free to use, including 24 bi-directional I/Os from the PPI (82C55), 32 multifunctional CPU internal PIOs, and TTL I/Os from the DUART.

A parallel DAC (DA7625, 5 µs, 4 ch, 12-bit, 0-2.5V) and 2 serial DACs (DAC7612, 2 ch, 12-bit, 0-4.095V) can be installed to support a total of up to 8 analog outputs.

Optional high efficiency Switching Regulator (LM2575) can be installed to allow power input from 8V to 30V DC without generating heat. It also provides an external control pin to shutdown 5V and enter µA standby mode and wake-up by active-low signal.

Two versions of the **RA** are available: the **RA80** is based on the 80 MHz R1100, and the **RA40** is based on the similar 40 MHz Am186ER.

Ordering Information

RA80/RA40	$169/$149/$99/$89	Qty 1/50/100/1K+

Includes: 80/40MHz CPU, I/Os, 3 UARTs, 3 timers, 82C55, 71054, watchdog timer, EE, 256KW Flash, 64KW SRAM.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM 256KW..$20
2) Real-time clock (RTC1337) and battery...............................$20
3) CompactFlash Interface $20
4) 4 ch. 12-bit DAC, 200 KHz (DA7625)..................................$40
5) 2 ch. 12-bit DAC (DAC7612) 2 chips $20x2
6) 8 ch. 12-bit ADC (ADS7852), 300KHz, 3 chips $20x3
7) 8 ch. 16-bit ADC (ADS8344) 2 chips $30x2
8) Switching regulator (SR) $20
9) RS485/422 .... $10/20

Typical Order Example:

80 MHz R-Engine-A™, CompactFlash, AD7852
RA80 + 3 + 6 = $169 + $20 + $20 = $209

R-Box™ (RB)

Low cost portable data-logger with 16-bit ADC & DAC!
80 MHz CPU with CompactFlash, ADC/DAC, 4-20 mA, UARTs, Relays and Optos in a Box
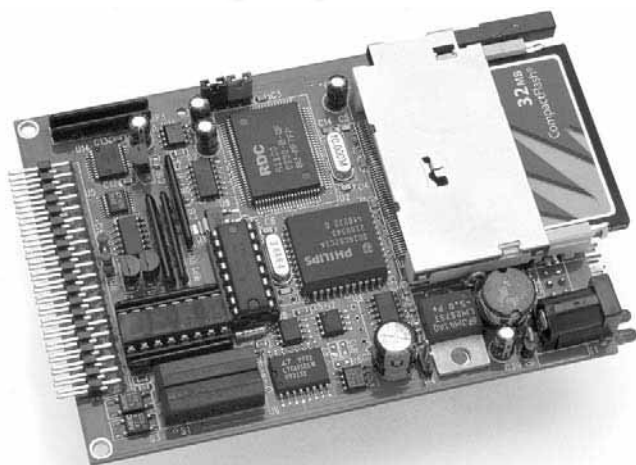
Features:

- 4.0 x 3.6", 50 µA standby, 160 mA, 9-24V DC power
- Complete C/C++ programmable environment
- 8 16-bit ADC with analog inputs, 0-10V
- 8 16-bit DAC (0-5V), two 4-20 mA outputs
- Up to 2GB CompactFlash with FAT file system support
- 80/40 MHz 186 CPU with 256 KW Flash, 256 KW SRAM
- 20+ TTLs, 7 Solenoid drivers, 4 Relays, 4 Opto-couplers
- 3 RS-232 serial ports, one can be RS232/485/422
- 3 16-bit timer/counters, PWM output, RTC, EE
- Aluminum box with field removable screw terminals

Boxed in an extruded aluminum enclosure of 4.0x3.2 inches, the R-Box™ (RB) is designed as a low cost, portable data logger, and an industrial embedded controller. It integrates 16-bit ADCs, 16-bit DACs, 4-20 mA drivers, RS232/485/422, Relays, Opto-couplers, and CompactFlash for mass local data storage.

The RB is based on a high performance C/C++ programmable 186 CPU with 16-bit external data bus supporting fast execution times through 16-bit Flash and 16-bit battery-backed SRAM. In order to secure a longer lifetime supply, the CPU chips come from two vendors, either AMD186ER or RDC R1100.

A 16-bit ADC (ADS8344, TI) provides 8 single-ended or 4 differential analog inputs with 65536 count of resolution at up to 10 KHz sample rate. The analog inputs can be hardware configured for variable input voltage range, default 0-10V. A 16-bit DAC(LTC2600) provides 8 analog output voltages (0-5V). Two of the 16-bit DAC outputs can be buffered with 4-20 mA drivers. The 4-20 mA drivers can be powered by local or remote positive voltage, up to 30V.

A 50-pin CompactFlash receptacle can be installed to allow access to mass storage CompactFlash cards (up to 2GB). Users can easily add mass data storage to their embedded application. C/C++ programmable software packages with file system libraries are available.

Three internal timer/counters can count or time external events, or generate PWM outputs. A serial real time clock (DS1337, Dallas) is a clock/calendar with two time-of-day alarms. Three RS232 serial ports are available: A Dual UART (SC26C92) and a single CPU internal UART (default as DEBUG port). One UART can be buffered by RS232

(as default) or RS485. 20+ TTL I/O lines are free to use, including multifunctional CPU's PIO lines, and TTL I/Os from the SC26C92.

Seven high voltage sink drivers are installed, capable of sinking 350 mA at 50V per line, and they can directly drive solenoids, relays, or lights. Four opto-couplers provide opto-isolation with both positive and negative inputs available on the headers. Two solid-state relays (PS7241, NEC), are designed for AC or DC line switching. Two mechanical Reed Relays provide reliable, fast switching contacts with a specification of 200 V, maximum 1 Amp carry current, 0.5 Amp switching, and 100 million times operation. Optional Switching Regulator (LM2575) provides a shutdown feature (VOFF). It can enter µA poweroff mode and can be waked-up by an active-low signal either from on-board RTC or external source. The RB can use 8.5V to 12V DC power supply with default linear regulator, or up to 30V DC with switching regulator without generating excessive heat. The RB is designed to fit in an aluminum extrusion enclosure. All signals on the two 20x2 pin headers are accessible outside of the enclosure. User can use W40(40 field removable screw terminals) to access I/O signals.

Use one W40P on the front end, one W40S on the back end.

Two versions of RB are available: the RB80 is based on 80 MHz R1100, and RB40 is based on 40 MHz Am186ER.

Ordering Information

RB80/RB40	$169/$149$/$109/$99	Qty 1/50/100/1K+

Includes: 80/40MHz CPU, I/Os, 3 RS232s, 3 timers, 4 Opto-couplers, 7 solenoid drivers, EE, 256KW Flash, 64KW SRAM.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM 256KW	**$20**
2) RTC and battery	**$20**
3) CompactFlash Interface	**$20**
4) 8 ch. 16-bit DAC (LTC2600)	**$40**
5) 8 ch. 16-bit ADC (ADC8344)	**$30**
6) 4-20 mA drivers (for LTC2600)	**$20**
7) Switching regulator (SR)	**$20**
8) RS485	**$10**
9) Aluminum Extrusion Enclosure	**$40**
10) Relays (2 mechanical + 2 solid states)	**$10 each**
11) W40S/W40P(Screw Terminals)	**$20 each**

Typical Order Example:

80 MHz RB, 256KW SRAM

RB80 + 1 = $169 + $20 = $189
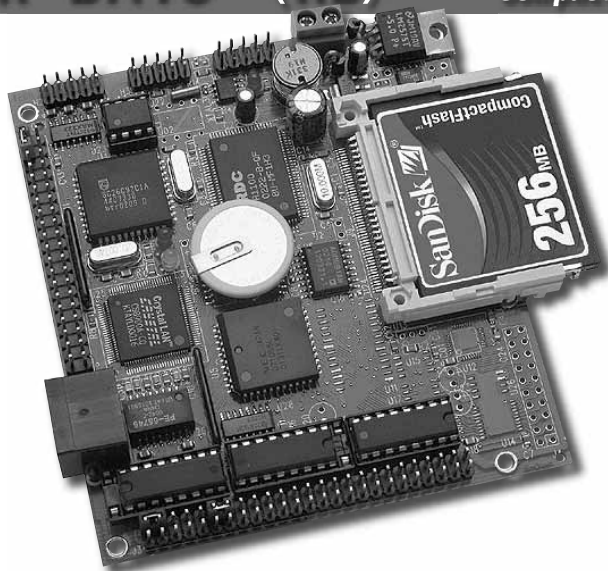
Features:

- 3.9 x 3.6"
- 50 µA standby, 160/20 mA normal/power-save
- Complete C/C++ programmable environment
- CS8900 10 Base-T Ethernet Controller.
- 8 16-bit and 8 12-bit ADC analog inputs, 0-5V
- 8 high-speed 12-bit analog outputs
- Up to 2GB CompactFlash with File system support
- 80 MHz R1100 or 40 MHz Am186ER
- 256 KW 16-bit Flash, 256 KW 16-bit SRAM
- 40+ TTLs, Solenoid drivers, Real-time clock, 512 bytes EE
- 3 RS-232 serial ports, one can be RS232/485/422
- Solenoid drivers and protected high voltage inputs.

Measuring within 3.9x3.6 inches, the *R-Drive™* (**RD**) is an industrial embedded controller integrated with Ethernet, RS232/485/422 connectivity, CompactFlash for mass local data storage, analog I/Os and solenoid drivers. It can be used for precision data acquisition, industrial process control, or remote communication logger.

The **RD** is based on a high performance C/C++ programmable 80 MHz 186 CPU with a 16-bit external bus supporting fast execution times through 16-bit Flash and 16-bit battery-backed SRAM.

A total of up to 16 analog inputs are supported. One high-speed 12-bit parallel ADC chip (AD7852) provides 8 channels analog inputs (0-5V), with up to 300K samples per second. A 16-bit ADC (ADS8344, TI) provides 8 single-ended or 4 differential analog inputs (0-5V, or 0-REF) with 65536 counts of resolution at up to 10 KHz sample rate.

A parallel DAC (DA7625, 5 µs, 4 ch, 12-bit, 0-2.5V) and 2 serial DACs (DAC7612, 2 ch, 12-bit, 0-4.095V) can be installed to support a total of up to 8 analog outputs.

A 50-pin CompactFlash interface can be installed to allow access to mass storage CompactFlash cards. Users can easily add mass data storage to their embedded application. C/C++ programmable software packages with file system libraries are available.

An Ethernet LAN controller (CS8900) can be installed to provide network connectivity. A RJ45 8-pin connector is used to connect to a 10-baseT Ethernet network. A software library is available for Ethernet connectivity.

Three CPU internal timer/counters can be used to count or time external events, or to generate non-repetitive or variable-duty-cycle waveforms as PWM outputs.

A serial real time clock (DS1337, Dallas) is a low power clock/calendar with two time-of-day alarms.

Three RS232 serial ports are available: A Dual UART (SC26C92) and a single CPU internal UART(default as DEBUG port). All UARTs have deep FIFOs to minimize the potential of receiver overrun or to reduce interrupt overhead. One UART can be buffered by RS232 (as default), RS485, or RS422.

40+ TTL I/O lines are free to use, including 24 bi-directional I/Os from the PPI (82C55), 32 multifunctional CPU internal PIOs, and TTL I/Os from the DUART.

Three DIP sockets with 21 high voltage sink drivers (ULN2003A) are installed as default. Each driver is capable of sinking 350 mA at 50V per line. They can directly drive solenoids, relays, or lights. Optional 16 sourcing drivers (USD2982), 7 protected high voltage (up 35V DC) inputs, or TTL signals with resistor pack can be installed.

Optional high efficiency Switching Regulator (LM2575) provides an external control pin to shutdown 5V and enter µA standby mode and wake-up by active-low signal. The **RD** requires 8.5V to 12V DC power supply with default linear regulator, or up to 30V DC power input with switching regulator without generating excessive heat.

Ordering Information

RD	**$169/$149/$109/$99**	**Qty 1/50/100/1K+**

Includes: 80MHz CPU, I/Os, 3 UARTs, 3 timers, 82C55, watchdog timer, EE, 256KW Flash, 64KW SRAM, solenoid drivers.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM 256KW	$20
2) Real-time clock (RTC1337) and battery	$20
3) CompactFlash Interface	$20
4) 4 ch. 12-bit DAC, 200 KHz (DA7625)	$40
5) 2 ch. 12-bit DAC (DAC7612) 2 chips	$20x2
6) 8 ch. 12-bit ADC (ADS7852) 300 KHz	$20
7) 8 ch. 16-bit ADC (ADS8344)	$30
8) Switching regulator (SR)	$20
9) RS485/422	$10/20
10) Ethernet Interface (CS8900)	$30

Typical Order Example:

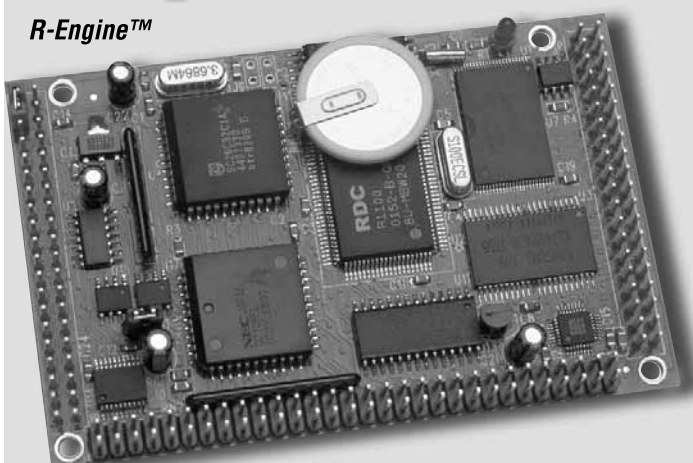80 MHz R-Drive™, 256KW SRAM
RD80 + 1 = $169 + $20 = $189

R-Engine™ (RE)

80 MHz 16-bit CPU, 3 UARTs, 16-bit ADCs, DAC, 40+ I/Os

R-Engine™

Features:

- 3.6 x 2.3 x 0.3", Easy to program in C/C++
- 160/20 mA normal/power-save
- 80 MHz R1100 or 40 MHz Am186ER
- 256 KW 16-bit Flash, 256 KW 16-bit SRAM, 512 bytes EE
- 40+ TTL I/Os, Real-time clock, 3 UARTs, PWM, counters
- 8 ch. 12-bit ADC (ADS7852), and 8 ch. 16-bit ADC (ADS8344)
- 4 ch. 12-bit DAC (DAC7625) and 4 12-bit DAC(DAC7612)

The **R-Engine™** (**RE**) is a high performance C/C++ programmable controller with a 16-bit external bus. Two versions of R-Engine are available: the **RE80** is based on the 80 MHz R1100, and **RE40** is based on the similar 40 MHz Am186ER. The **RE** is intended for OEM applications requiring industrial process control and high-speed data acquisition.

The **RE** features fast execution times through 16-bit ACTF Flash (256 KW) and battery-backed SRAM (256 KW); it also includes 3 timers, PWMs, 32 PIOs, 24 PPIs, 512-byte serial EEPROM, an internal UART, a sync serial port, 3 timer/counters, and a watchdog timer. The three 16-bit 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. The 32 PIO pins from the CPU are multifunctional and user programmable.

The **RE40** has 32KB internal RAM, which fulfills many embedded OEM product SRAM requirements. No external SRAM would be required for an OEM version of the RE40. This increases system reliability and decreases power consumption and cost.

A serial real-time clock (DS1337, Dallas) is a low power clock/calendar with two time-of-day alarms and a programmable square-wave output. A Dual UART (SCC2692 or SC26C92) provides two channels of full-duplex asynchronous receivers and transmitters; this combines with a single serial port available from the processor for a total of three UARTs. (This differs from most other core *Engine* controllers which offer 2 ports through the processor.) The SC26C92 DUART receivers are quadruple buffered to minimize the potential of receiver overrun or to reduce interrupt overhead. The UARTs incorporate 9-bit mode for multi-processor communications. Each DUART also offers 7 TTL inputs and 8 TTL outputs. The PPI (82C55) provides an additional 24 user programmable bi-directional I/Os.

The 16-bit ADC (ADS8344, TI) provides 8 single-ended or 4 differential analog inputs (0-5V, or 0-REF) with 65536 counts of resolution at up to 10 KHz sample rate. Two DAC (DAC7612) chips support four channels of 12-bit, 0-4.095V analog voltage outputs capable of sinking or sourcing 5 mA. A high speed parallel ADC (AD7852, 300KHz, 8 ch., 12-bit, 0-5V), and a parallel DAC (DA7625, 5 μs, 4 ch, 12-bit, 0-2.5V) can be installed.

All chips are surface mounted for highest reliability. RE works with TERN's expansion boards: MC, MCP, P50, P100 and FC0.

Ordering Information

RE80/RE40   **$99/$89/$69/$49**   **Qty 1/50/100/1K+**

Includes: 80/40MHz RE, I/Os, 3 UARTs, 3 timers, 82C55, watchdog timer, EE, 256KW Flash, 64KW SRAM

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM: 256KW	$20
2) Real-time clock (RTC1337) and battery	$20
4) 4 ch. 12-bit DAC, 200 KHz (DA7625)	$40
5) 2 ch. 12-bit DAC (DAC7612) up to 2	$20x2
6) 8 ch. 12-bit ADC, 300 KHz (ADS7852)	$20
7) 8 ch. 16-bit ADC (ADS8344)	$30
8) Sockets for expansion: two 20x2, one 30x2	$9

Typical Order Example:

80 MHz R-Engine™, 256KW SRAM

RE80 + 1 = $99 + $20 = $119

Signals routed to J1 and J2, as shown below:

J1 signal			
Function	Pin #	Pin #	Function
VCC	1	2	GND
OP1	3	4	CLK
RxDB	5	6	GND
TxDB	7	8	D0
VOFF	9	10	D1
/BHE	11	12	D2
D15	13	14	D3
/RST	15	16	D4
RST	17	18	D5
P16	19	20	D6
D14	21	22	D7
D13	23	24	GND
	25	26	P12
D12	27	28	A7
/WR	29	30	A6
/RD	31	32	A5
D11	33	34	A4
D10	35	36	A3
D9	37	38	A2
D8	39	40	A1

J2 signal			
Function	Pin #	Pin #	Function
GND	40	39	VCC
P4	38	37	P14
IP0	36	35	P6
TxD0	34	33	/INT4
RxD0	32	31	P19
P5	30	29	P1
TxDA	28	27	OP0
RxDA	26	25	OP2
P2	24	23	P15
IP2	22	21	INT3
P0	20	19	/INT2
P25	18	17	P24
IP3	16	15	IP4
P11	14	13	OP7
P10	12	11	P13
A19	10	9	P23
/INT0	8	7	NMI
/INT1	6	5	SCLK
P26	4	3	SDAT
GND	2	1	GND

36

RM™ Industrial Controller with On-board MODEM and Ethernet 80MHz CPU, high-voltage drivers, RS232/485, ADC/DAC, and CompactFlash storage.

Features:

- 4.5 x 5.2"
- 50 µA standby, 200/20 mA normal/power-save
- 80 MHz 16-bit x86 CPU, C/C++ programmable
- Ethernet, 3 serial ports, MODEM with DAA, RJ11
- 16 ADC analog inputs, 8 DAC analog outputs
- CompactFlash with FAT16 File system support
- 256KW 16-bit Flash, 256KW 16-bit SRAM
- 40+ TTL I/Os, Real-time clock, 512 bytes EE
- Solenoid drivers, protected high voltage inputs.

Introduction

The **RM™** is a variant of TERN's **R-Drive™(RD)** controller, customized with additional features to support an industrial OEM customer's specific needs. Measuring 4.5x5.2 inches, the **RM** supports an on-board modem, Ethernet, serial ports, CompactFlash, ADCs, DACs, solenoid drivers, DB9, RJ11, and screw terminals. It can be used for precision data acquisition, industrial process control, remote communication logger, or portable test instrument.

The **RM** is based on a high performance 80 MHz 186 CPU with a 16-bit external bus supporting fast execution times through 16-bit Flash and SRAM.

Advanced Communication and Storage

A V.92, 56Kbps or a 2400bps modem module with DAA and RJ11 phone jack can be installed, ready to connect to a telephone line. This modem is designed to be used on U.S. and select international telephone systems; it supports caller ID, DTMF tone detection, voice play back, remote recording, ring detection and supports basic AT commands.

A 50-pin CompactFlash interface can be installed to allow access to mass storage CompactFlash cards (up to 2GB). An Ethernet LAN controller (CS8900) with RJ45 connector can be installed to provide 10 Base-T Ethernet network connectivity.

A set of **TERNDirect™** network stack libraries allow easy programmatic access to data traffic on an Ethernet link, extending on the protocol stack as low as Ethernet frames or as high as TCP/IP.

TERNDirect™ file system libraries support FAT12/16 access to an attached CompactFlash card, meaning that PC-readable data files can be easily created within the user's C/C++ application.

Data Acquisition and Industrial Control

One high-speed 12-bit parallel ADC (AD7852) provides 8 channels of analog input (0-5V), at up to 300K samples per second. A 16-bit ADC (ADS8344, TI) provides 8 single-ended or 4 differential analog inputs (0-5V, or 0-REF) with 65536 counts of resolution at up to 10KHz sample rate. Analog signal conditioning circuits can be installed to support ±10V analog inputs for the 16-bit ADC. A parallel DAC (DA7625, 5 MS, 4 ch, 12-bit, 0-2.5V) and 2 serial DACs (DAC7612, 2 ch, 12-bit, 0-4.095V) can be installed for a total of up to 8 analog outputs.

Three CPU internal timer/counters can be used to count or time external events, or to generate non-repetitive or variable duty-cycle waveforms as PWM outputs. A serial real time clock (DS1337, Dallas) is a low power clock/calendar with two time-of-day alarms. Three RS232 serial ports are available: a Dual UART (SC26C92) and a single CPU internal UART (default as DEBUG port). All UARTs have deep FIFOs to minimize the potential of receiver overrun and to reduce interrupt overhead. One UART can be buffered by RS232 (as default), RS485, or RS422. As many as 40+ TTL I/O lines are free for application use, including 24 bi-directional I/Os from the PPI (82C55), 32 multifunctional CPU internal PIOs, and TTL I/Os from the Dual UARTs (SC26C92).

Three DIP sockets with high voltage sinking drivers (ULN2003A) are installed as default. Each driver is capable of sinking 350 mA at 50V per line. They can directly drive solenoids, relays, or lights. Optional high efficient Switching Regulator (LM2575) supports 8-30V DC power input without generating excessive heat.

Ordering Information
RM $199

Includes: 80MHz CPU, 40+ I/Os, 3 UARTs, 3 timers, 82C55, watchdog timer, EE, 256KW Flash, 64KW SRAM, solenoid drivers.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM 256KW	$20
2) Real-time clock (RTC1337) and battery	$20
3) CompactFlash interface	$20
4) 4 ch. 12-bit DAC, 200 KHz (DA7625)	$40
5) 2 ch. 12-bit DAC (DAC7612) 2 chips	$20x2
6) 8 ch. 12-bit ADC (ADS7852), 300 KHz	$20
7) 8 ch. 16-bit ADC (ADS8344)	$30
8) Analog signal conditioning for 16-bit ADC	$30
9) Switching regulator (SR)	$20
10) RS485/422	$10/20
11) Ethernet Interface (CS8900)	$30
12) 2400 bps or 56Kbps MODEM	$50
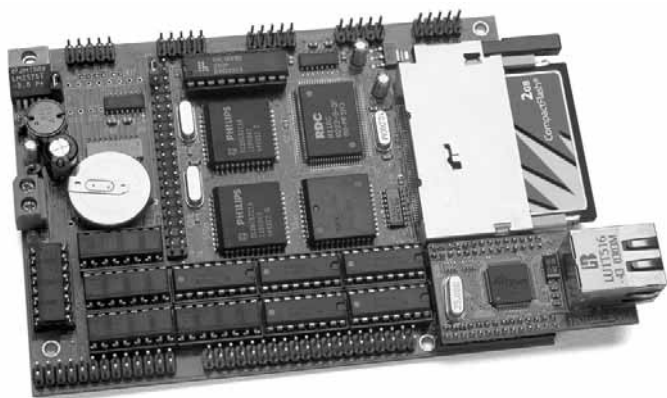
Features:
- 4.9 x 3.5", 50 µA standby, 200 mA normal
- C/C++ programmable, 80 MHz R1100 or 40 MHz Am186ER
- Hardware TCP/IP stack for 100 Base-T Ethernet
- Suitable for protected industrial control applications
- 35 Solenoid Drivers, 20 Opto-coupler inputs
- Flexible hardware-configurable input logic
- Up to 2GB CompactFlash with FAT16 File system support
- 256KW 16-bit Flash, 256KW 16-bit SRAM
- 20+ TTL I/Os, Real-time clock, 512 bytes EE
- 5 RS-232 serial ports, one can be RS485/422

Introduction

The *RL™* is a controller designed for industrial machine control applications. This industrial embedded controller integrates 20 isolated opto-coupler inputs, 35 solenoid drivers, 100 Base-T Ethernet connection, 5 RS232/485/422 serial ports, and CompactFlash mass data storage support on a single PCB. It is ideal for industrial process control, high speed LAN, or remote communication machine control applications.

The *RL* utilizes a high performance C/C++ programmable 186-generation CPU (80MHz R1100 or 40 MHz AM186ER) with a 16-bit external data bus, supporting fast code execution. It has 256KW 16-bit Flash and 256KW 16-bit battery-backed SRAM. Three CPU internal timer/counters can be used to count or time external events, or to generate non-repetitive or variable duty-cycle waveforms as PWM outputs. A real-time clock (DS1337, Dallas) provides clock/calendar with two time-of-day alarms.

A 50-pin CompactFlash interface allows access to mass storage CompactFlash cards (up to 2 GB). TERN C/C++ programmable software packages with FAT16 file system libraries are available.

High-performance Communications

An i2Chip™ Fast Ethernet Module can be installed to provide **100M Base-T** network connectivity, allowing the RL to work with high-bandwidth modern Ethernet networks. This Module implements TCP/IP, UDP, ICMP and ARP with a combination of hardware/software. 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.

Five RS232 serial ports are onboard. The CPU's internal UART is used for remote debugging, but is also available for user application. Two Dual UARTs (SC26C92) provide 4 more UARTs. All UARTs have deep FIFOs to minimize receiver overrun and to reduce interrupt overhead. One RS232 port can be converted to RS485, or RS422.

Protected I/O for Industrial Use

Five power Darlington array chips (ULN2003A) are installed in five DIP sockets, providing a total of ***35 high voltage sinking drivers***. Each driver is capable of sinking 350 mA at 50V per line. They can directly drive solenoids, relays, or lights. In place of the ULN2003As, resistor packs or DAC chips (with modification) can be optionally installed to provide TTL I/O or up to 10 analog outputs. A total of ***20 opto-couplers*** are on-board to provide isolation for high voltage inputs. Furthermore, some control applications need to trigger an event under combined conditions of several sensors/switches. As a result, seven of the 20 opto-couplers are routed to an on-board PAL, allowing flexible hardware-configurable input logic to trigger interrupts. An ***additional 20 TTL I/O lines*** are available on the J2 pin header, including bi-directional I/Os from the PPI (82C55), multifunctional CPU internal PIOs, and TTL I/Os from the Dual UARTs.

Optional high efficient Switching Regulator (LM2575) provides an external control pin to shutdown 5V and enter µA standby mode, waking-up on an active-low signal. The *RL* requires 8.5V to 12V DC power supply with default linear regulator, or up to 30V DC power input with switching regulator without generating excessive heat.

Two versions of *RL* are available: the *RL80* is based on the 80 MHz R1100, and *RL40* is based on 40 MHz Am186ER.

Ordering Information

RL80 or RL40 $199/$169/$139/$79   Qty 1/50/100/1K+

Includes: 80/40MHz CPU, 5 RS232, 3 timers, 82C55, watchdog timer, EE, 256KW Flash, 64KW SRAM, 20 TTL I/Os, 35 solenoid drivers, and 20 opto-couplers.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM 256KW...$20
2) Real-time clock (RTC1337) and battery...............................$20
3) CompactFlash interface $20
4) Switching regulator (SR) $20
5) UART driver, a) RS485, b)RS422....................................$10/20
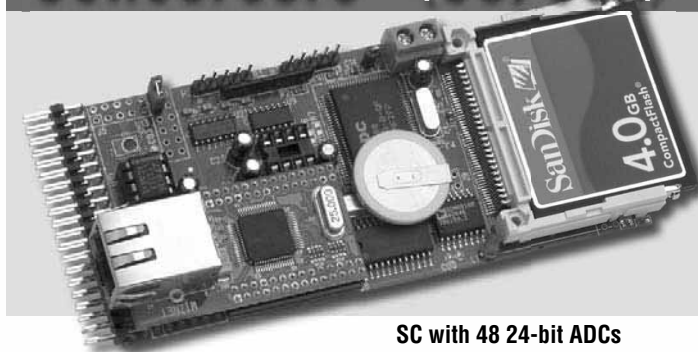6) i2chip 100 Base-T Ethernet Module...................................$30

Typical Order Example:

80 MHz RL™, with 4 RS232 and one RS485
RL80 + 5a = $199 + $10 = $209

SensorCore™ (SC/SCA)

2" wide pipe-fit data-logger with 48 ADCs

NEW!

SC with 48 24-bit ADCs

Features:
- 2.0 x 4.5", 160 mA, 9-24V DC power
- Complete C/C++ programmable environment
- SC has 48 channels of 24-bit ADC inputs(LTC2448, 0-2.5V)
- SCA has 48 channels of 12-bit ADC input(ADS7852, 0-5V)
- 2 12-bit DACs on SC, 8 16-bit DAC on SCA, TTL I/Os
- CompactFlash with FAT file system support
- 40/80 MHz 186 CPU with 256 KW Flash, 256 KW SRAM
- 2 RS-232 serial ports; one can be RS232/485
- 3 16-bit timer/counters, PWM output, RTC, EE
- Hardware TCP/IP stack for 100M Based-T Ethernet

Summary

The SensorCore™(SC or SCA) is designed to fit into narrow spaces. It is a low-cost, low-power data logger for the most demanding analog data-acquisition applications.

Two versions of the 2" wide board are available: **SC** and **SCA**. The SC supports up to 48 **24-bit ADC** inputs(LTC2448, 5 KHz, 0-2.5V). The SCA can have 48 12-bit ADC inputs(ADS7852, 200 KHz, 0-5V). Four SCA boards can be stacked to provide 192 ADC inputs.

There are 2 RS232/RS485 ports, a CompactFlash interface, and a high performance 10/100M BaseT Ethernet. the SensorCore out-performs desktop-based acquisition solutions for a fraction of the price.

Measuring only 2"x4.5", the **SC**'s unique profile allows it to be installed into difficult-to-access physical locations, like pipes. Even with this limited real estate, the SC is a full-featured, stand-alone industrial embedded controller.

The **SC/SCA** is based on a high-performance C/C++ programmable x186 CPU. It integrates 3 timer/counters, 2 Async serial port, a Sync serial port, external interrupts, PIOs, and a real-time clock. The board is available with up to 512 KB of battery-backed SRAM, 512KB Flash, and 512 bytes EEPROM for non-volatile parameter storage.

The board runs on approximately 150mA at regulated 5V, and also can be powered through onboard regulator accepting 9-12V DC. Optional low-drop regulator (TPS765) can be installed to provide Power-off feature allowing low voltage(5.1V) battery operation. Two channels of 12-bit DAC(DAC7612, 0-4.096) can be installed on the **SC**. Eight channels of 16-bit DAC(LTC2600, 0-5V) can be installed on the SCA.

Two RS232 serial ports are available as default, and one can be configured as RS485 operation on the **SC**. An integrated high-performance 10/100-baseT hardware TCP/IP module can be installed, which allows 100KB+ access to TCP/IP networks with minimal CPU load. Sample implementations for the SensorCore allows it to be configured as a HTTP web-server, FTP server/client, etc.

A 50-pin CompactFlash receptacle can be installed to allow access to mass storage CompactFlash cards (up to 4 GB). Users can easily add mass data storage to their embedded application. C/C++ programmable software package includes FAT16 file system libraries are available. More than 1 billion 24-bit samples can be recorded in the field on a single board.

Data Acquisition

The **SC** features three LTC2448 sigma-delta ADCs, interfaced through a high speed Sync serial port. Each LTC2448 chip offers 8 ch. differential or 16 ch. single-ended input channels. A peak single-channel output rate of 5 KHz can be achieved. The LTC2448 works well directly with strain gages, current shunts, RTDs, resistive sensors, or thermocouples. A precision reference(LT1019/REF02) with a internal temperature sensor can provide local temperature measurement.

The **SCA** features six ADS7852 high speed ADCs, interfaced via parallel data bus allowing up to 200 KHz sample rate. Each ADS7852 chip offers 8 channels of 0-5V single-ended inputs.

SCA with 48 12-bit High Speed ADCs

Ordering Information

SC/SCA	$169/$134/$114/$89	Qty 1/50/100/1K+

Includes: CPU, PIOs, 2 RS232s, 3 timers, EE, 256KW Flash, 64KW SRAM.
NOT including add-on options. OEM option discounts available.

Add-on Options:
1) SRAM 256KW...$20
2) RTC and battery $20
3) CompactFlash Interface $20
4) 16 ch. 24-bit LTC2448, up to 3 chips on SC $40x3
  Or 8 ch. 12-bit ADS7852, upto 6 chips on SCA $20x6
5) DAC7612 on SC or LTC2600 on SCA...........................$20/$40
6) Ethernet/TCP Module (i2chip).. $30
7) RS485 driver for SER1 (SC only)...................................... $10
8) Low-drop regulator(TPS765)... $20
9) 80 MHz CPU upgrade $20
10) Precision Reference a)5V, b)2.5V $15

Typical Order Example:
SensorCore, 256KW SRAM, CF, 3 LTC2448 ADCs:
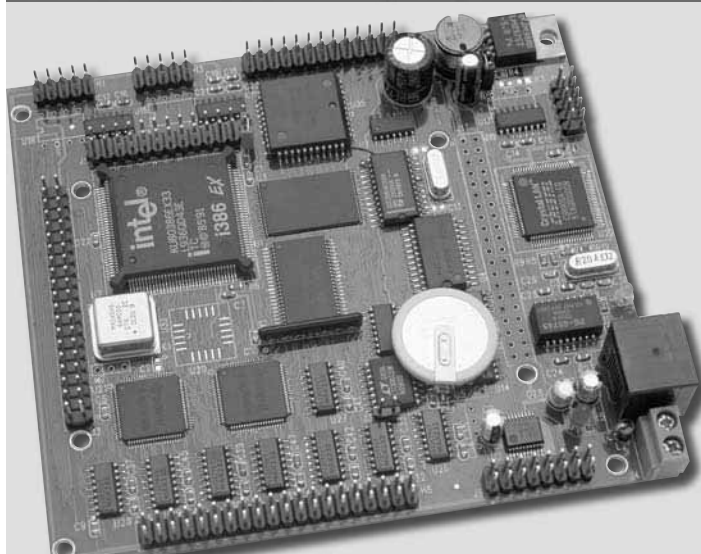**SC** + 1 + 3 + 4x3= $169 + $20 + $20 + $40x3 = $329

TERNINC.

1950 Fifth Street, Davis, CA 95616 USA
Tel: 530-758-0180 • Fax: 530-758-0181

CE FC   sales@tern.com   http://www.tern.com

39

SerialDrive™ (SD)

Features:

- 6.1 x 4.5 x 0.3"
- Intel386EX, program in C/C++, 32/64 MHz.
- 200/350 mA at 12V full operation at 32/64 MHz clock
- 11 ch. RS232, high speed baud rates (up to 2 Mbps)
- 256 KW SRAM, 256KW Flash, 512 bytes EE.
- 70+ I/Os, 3 timers, interrupts, 1 Sync, 10BaseT Ethernet*
- 11 ADCs, 2 DACs, real-time clock and battery*

  *Optional

Summary

The **SerialDrive™** (**SD**) is a board designed for projects requiring mass serial communication capabilities. It is a C/C++ programmable embedded controller based on the Intel 386EX, and integrates up to 11 channels of RS232/485 serial ports, as well as one synchronous serial port, and an Ethernet port.

In order to support high-speed communications, the SD is available with an optional 64 MHz clock, double the default 32 MHz. The serial ports are handled via DMA or deep FIFO (64 bytes), able to handle very high loads without losing any data.

Serial Communications

Two UARTs from the 386EX, 8 UARTs from 2 QUARTs (TL16C754B), plus one SCC2691 UART provides a total of 11 async. serial ports. All transmit and receive data lines plus handshaking signals (/RTS, and /CTS) are buffered with RS232 drivers. Three of these RS232 ports can be replaced with optional RS485 drivers.

The 386EX processor has two internal UARTs, supporting reliable DMA-driven serial communication at up to 115,200 baud. The processor also has a sync. serial port operating at up to 8 MHz. Three 16-bit timers/counters can be used to count external events or generate pulse outputs.

The two quad UARTs (TL16C754B, TI) provide a total of 8 high speed serial ports, with each port featuring 64-byte transmit and 64-byte receive FIFOs. These deep FIFOs can release processor load

and guarantee reliable performance for multi-serial port high speed (up to 2 Mbps) communication. Programmable FIFO trigger level, software XON/XOFF, hardware flow control are supported.

At a sizeable 6.1x4.5", the high performance 386EX uses faster 16-bit ACTF Flash (256 KW) and battery-backed SRAM (256 KW). Other features popular on TERN controllers are also found on the SD (such as the 512-byte EEPROM, real-time clock, PPI for 24 digital I/Os). Other optional components include 11 channels of 12-bit ADC (TLC2543, 20KHz, 0-REF+), and two channels of 12-bit DACs (DAC7612, 0-4.095V).

Six Modem control signals on each UART can also be used as general programmable TTL I/Os. A combined total of 70+ TTL I/O pins are available for user use from the PPI(82C55), i386EX internal multi-functional I/O, and QUART modem control lines.

An Ethernet LAN controller (CS8900) can be installed to provide network connectivity. A RJ45 8-pin connector is used to connect to a 10-baseT Ethernet network. A software stack library will support network protocols like ARP, DHCP, UDP, ICMP, and of course TCP over the Ethernet network.

An expansion port (J1) supports mass memory expansion with CompactFlash or PCMCIA. An optional switching regulator can be installed to reduce power consumption and heat. The switching regulator also supports power-off mode, allowing µA-level power consumption. The **SD** can be powered by unregulated DC 9V to 30V(with switching regulator).

To meet demanding reliability requirement, all IC chips are surface mounted on a single PCB with additional thickness (0.093").

Ordering Information

SerialDrive™ (SD)   **$299/$199/$149**   **Qty 1/100/1K**

Includes 386EX with 32MHz clock, **256KW ACTF Flash**, **256KW SRAM**, 2 RS232, PPI, EE, 3 timers.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) UART(SCC2691) with a) RS232, or b) RS485 .... $30
2) Real-time clock (RTC) and battery $20
3) 11 ch. 12-bit ADC(TLC2543) $20
4) Dual 12-bit DAC (LT1446) $20
5) 64MHz clock with 386EX $30
6) Switching regulator $20
7) Ethernet Interface (CS8900) $30
8) Quad UART RS232, x2 .... $40 x2

Typical Order Example:

SerialDrive with a total of 11 RS232

SD + 1 + 8 = $299 + $30 + $100 = $429

SmartLCD™ (SL)

1/4 VGA, Touch Screen, CCFL, ADC, DAC, and PCMCIA

40 MHz!
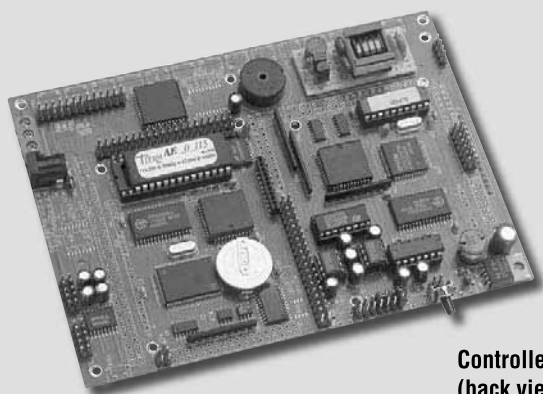
Controller PCB (back view)

1/4 VGA (front view)

Extensive, well written, useful software libraries and samples are provided. User can easily design their custom function keys, text, logo, and graphics.

The **SL** supports up to 512KB ROM/Flash, 512KB battery-backed SRAM, 512-bytes serial EEPROM, real-time clock (RTC72423), three timers, watchdog, and up to three serial ports (RS-232/485). Three PPIs provide 24x3 I/Os, in addition to the 32 multifunctional CPU I/O pins, allowing at least 40+ I/Os free to use.

There are seven solenoid drivers capable of sinking 350mA at 50V, each. Two solenoid drivers are used to control the CCFL backlighting. Up to 2 FC-0 or 2 MMB can be used for additional support. Each can support up to 1GB PCMCIA or CompactFlash card. MMB can add 39 additional ADC inputs, including 6 channels of 24-bit ADC.

The **SL** is not only a user interface, but also a high performance embedded controller which can easily be integrated into an OEM product. An aluminum bezel is available.

Ordering Information

SL $599

Includes: 320X240 LCD, touch screen (7x10), CCFL, 188 40MHz, PPIs, SED1335, 11 ch. ADC, 2 ch. DAC, 512KB SRAM, power supplies, beeper.

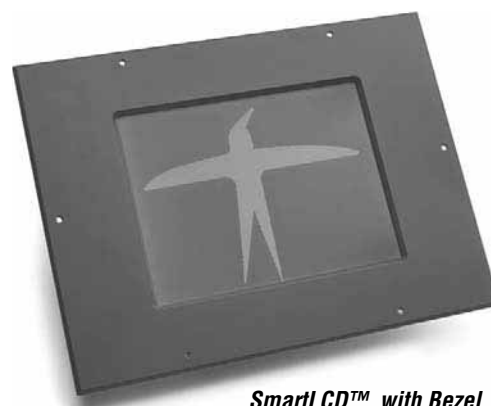**NOT including options. OEM option discounts available.**

Add-on Options:

1) Debug ROM (*AE_0_115*) $20

2) Real-time clock (RTC) and battery $20

3) UART (SCC2691) w/ (a) RS232 or (b) RS485 ....$30

4) 2 ch. 12-bit DAC (LT1446)..$20

5) 10 ch. of 12-bit ADC (TLC2543) $20

6) Bezel + gasket...$50

Typical Order Example:

SmartLCD™ 40MHz + Debug ROM
SL+ 1 = $599 + $20 = $619

Features:

- 6.4x 4.7x 1.3" (PCB 0.7" LCD 0.5")
- 40MHz 188, program in C/C++
- 320x240 graphic LCD, SED1335, touch screen, CCFL (module size 167x109 mm; viewing area 121x91 mm)
- LCD: Black and White
- 50mA standby, or 260mA with backlight, at 12V
- Dual PCMCIA Flash card support, up to 1GB each
- Up to 512KB SRAM, 512KB ROM/Flash *****
- 512-byte EE, 48+ TTL I/Os, plus 7 solenoid drivers
- Real-time clock, battery, 20 ch. 12-bit ADC, 4 ch. 12-bit DAC *****
- Up to 3 RS-232/485 ports *****

   * optional

Controller Solder Side

LCD

The *SmartLCD™* (**SL**) is a complete, user interface plus embedded controller. The **SL** includes a graphic LCD with 320x240 pixels, touch screen with 70 keys, CCFL backlighting, LCD controller (SED1335), and a C/C++ programmable controller (188). All power supplies including a 5V switching regulator, -24V, ±12V, programmable contrast voltage, and CCFL are on-board. Everything is designed into a single PCB, mounted on the backside of the LCD for easy productive software development, with complete hardware readiness.

SmartLCD™ with Bezel

TERN INC.

1950 Fifth Street, Davis, CA 95616 USA
Tel: 530-758-0180 • Fax: 530-758-0181

CE   FC   sales@tern.com   http://www.tern.com

41

SmartTFT™ (ST)
Ultra-bright, Wide Viewing Angle, Rich Color
Low cost industrial controller with 16-bit ADC/DAC, Opto, Ethernet & CompactFlash

Features:

- 6.5 x 4.5 inches, 40 MHz 186 CPU, program in C/C++
- Switching regulator, 50 mA standby, 160 mA at 12V
- 256 KW SRAM, 256 KW Flash, 512 bytes EEPROM
- 20+ TTL I/O, 6 16-bit timer/counters, RTC, Battery
- 4 mechanical relays, 12 Opto-coupler inputs.
- 20+ solenoid drivers (14 can be high voltage inputs)
- 12 ch. 16-bit ADCs, 14 ch. 16/12-bit DACs
- Precision reference and on-board temperature sensor
- Supports multiple QVGA Panels from several manufacturers
- 4-wire analog touch screen controller
- 5 RS232/RS485 serial ports, 10 BaseT Ethernet with TCP/IP
- CompactFlash with Windows compatible file system support
- 2 ch. Quadrature decoders, 2 ch. 4-20 mA outputs
- 160 field removable industrial screw terminals

The *SmartTFT (ST)* is a low cost industrial controller ideal for OEM applications. Those with premium graphic requirements will benefit from the ultra-bright, wide viewing angle active TFT color display. A LCD controller (S1D13075, EPSON) has internal 80KB image buffer, supporting QVGA color graphic TFT/LCD with 320x240 pixels. A touch screen controller (ADS7846) supports 4-wire resistive touch screen. Comprehensive, user-friendly software libraries and samples are provided. User can easily design their custom functions keys, text, logo, and graphics. Supported by the CF file system, 20 impressive color images can be displayed per second via DMA transfer. The 40 MHz 16-bit 186 CPU with 256KW flash, 256 KW battery-backed SRAM is C/C++ programmable. The *ST* is designed for mounting on the backside of a Kyocera QVGA TFT/LCD as easy integration.

The *ST* also supports 16-bit ADC/DACs, RS232/485 ports, timer/counters, RTC, opto-couplers, relays, quadrature decoders, 4-20 mA drivers, Ethernet, and CompactFlash. All these features can be installed on the same PCB at the same time. I/O signals can be accessed via up to four *W40*s to provide 160 field removable industrial screw terminals.

Four RS232 serial ports are default on-board. One serial port can be configured to RS485/422. Optional SCC2691 can provide the

5th RS-232/485 port. There are 20+ TTL I/Os, 4 mechanical relays with contact rating of 200V, 0.5 Amp., 12 opto-couplers that can handle high voltage with opto isolation. 20+ solenoid drivers are capable of sinking or sourcing 350 mA at 50V each. 14 of the solenoid drivers can be hardware configured to be high voltage (0-30V) inputs. Two quadrature decoders (HCTL2020/2021) can be used for motion position feedback. Three 16-bit programmable counters (71054, NEC) can count up to 10MHz. Three 16-bit CPU internal timer/counters support PWM, or pulse-width demodulation. An optional 10-baseT Ethernet LAN controller (CS8900) can be installed. Software stack library is available, supporting network protocols such as ARP, DHCP, UDP, ICMP, and of course TCP over the Ethernet network.

There are a total of 12 analog inputs and 14 analog outputs: 4 ch. 16-bit parallel ADC (AD7655, 1 MHz, 0-5V), 8 ch. 16-bit serial ADC (ADS8344, 0-5V, 10KHz), 2 ch. of 12-bit serial DACs (DAC7612, 0-4.095V, 10KHz), 8 ch 16-bit serial DACs (LTC2600, 0-5V, 10KHz), and 4 ch. 12-bit parallel DAC (DA7625, 200KHz, 0-2.5V). 2 ch 4-20 mA current drivers, driven by LTC2600, support many types of industrial devices.

The *ST* supports 50-pin CompactFlash cards for removable mass data storage. TERN software supports Windows compatible FAT16 flash file system. On-board switching regulator (LM2575) allows 8-30V unregulated DC power input without over heating.

Ordering Information

ST	$299/$199/$99	Qty 1/100/1K+

Includes: 186 CPU 40MHz, PPIx2, 256 KW Flash, 256KW SRAM, EE, 4 RS232, solenoid drivers, opto-couplers, Relays, RTC, BAT, SR and CF

NOT including options. OEM option discounts available.

EV-P or DV-P kit (Software and ST) **$449/$899**

Add-on Options:

1) 2 ch. 12-bit DAC (DAC7612)..$20
2) 8 ch. 16-bit DAC (LTC2600)..$40
3) UART (SCC2691) + (a) RS232 or (b) RS485 ....$30
4) 4 ch. 12-bit DAC, 200 KHz (DA7625)...................................$40
5) 4 ch. 16-bit ADC, 1MHz (AD7655)......................................$40
6) 8 ch. 16-bit ADC (ADS8344)..$30
7) Quad. Decoders (up to 2 chips) ....$30 each
8) RS485/422 for the DUART...$10/20
9) Ethernet Interface(ET)..$30
10) TFT/STN, TouchScreen, CCFL, Bezel ....$500/$400
11) 2 ch. 4-20 mA drivers (for LTC2600)................................$20
12) W40S (40 screw Terminal-pin headers).....................$20 each
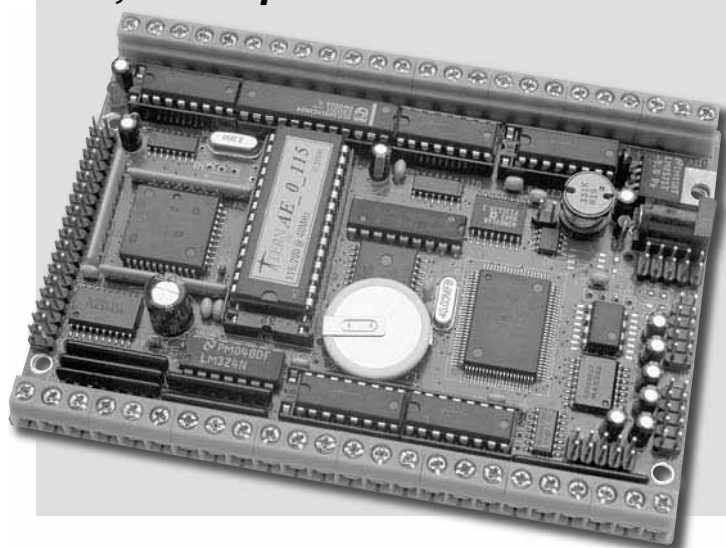
Typical Order Example:

ST + *W40S*x2

ST + 1x2 = $299 + $20x2 = $339

35 solenoid drivers, 24 TTL I/Os, ADC, DAC, 3 serial ports

Features:

- 4.8x3.4x0.5"
- 16-bit CPU (188), 20/40MHz, program in C/C++
- 190mA for 40MHz, 30mA power-save-mode
- Up to 512KB SRAM, 512KB ROM/Flash *****
- 2 PWM outputs and Pulse Width Demodulation
- 512-byte EE, 6 external interrupts, 3 timer/counters
- Up to 3 serial ports, 11 ch. 12-bit ADC, 2 ch. 12-bit DAC *****
- 24 TTL I/O pins and 35 high voltage I/Os
- Real-time clock, battery, switching regulator *****

   * optional

The **40MHz TinyDrive™ (TD40™)** is designed for industrial control applications that require solenoid drivers and protected high-voltage inputs.

The **TD40™** is a complete C/C++ programmable industrial controller system with a 16-bit, 40/20MHz CPU (188). It supports 35 high-voltage I/O lines, 24 TTL bi-directional I/O pins, an 11 ch. 12-bit ADC, a 2 ch. 12-bit DAC, three RS-232/RS-485, a real-time clock, battery, watchdog timer, PWM, three timer/counters, 512-byte EE-PROM, up to 512KB SRAM, and 512KB ROM/Flash.

The 35 high-voltage I/O lines, routed to screw terminals, include 7 inputs, 14 outputs, and 14 hardware-configurable inputs or outputs. The inputs can take up to 35V DC. The outputs are capable of sinking 350mA at 50V per line, and they can drive solenoids or relays. A real-time clock (RTC72421) provides calendar information. Two DMA-driven serial ports support RS-232 communication, at up to 115,200 baud. The optional third UART SCC2691 can be configured as either RS-232 or RS-485, supporting 8-bit or 9-bit RS-485 networking.

A 16-bit counter can count external events, up to 10MHz, or generate PWM outputs. A 82C55 chip provides 24 bi-directional I/Os, which can be used to interface with an LCD. A supervisor chip (691) with a watchdog is on-board.

An optional 11 ch. 12-bit serial ADC (TLC2543) has sample-and-hold and a sample rate up to 10KHz. Four operational amplifiers provide analog signal conditioning. The remaining seven channels are single-ended, 0-5V (or 0 to REF). Two optional 2 ch. 12-bit serial DACs provide 0-4.095V analog voltage outputs, capable of sinking or sourcing 5mA.

An optional switching regulator can be installed to reduce power consumption and heat. It also supports power-off mode, allowing μA-level power consumption. An optional TD-Pack including a 16x2 LCD, 8x2 keys, and an enclosure are also available.

Ordering Information

TD40 (40MHz)   **$174/$144/$109/$74**   **Qty 1/100/500/1K+**

Includes: 188, with 2 RS232 drivers, 24 TTL I/Os, 35 solenoid drivers, watchdog, a 512-Byte EE, PPI, and 128KB SRAM.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM: 512KB $20
2) Debug ROM (*AE_0_115*) $20
3) Real-time clock (RTC) and battery $20
4) UART (SCC2691) w/ drivers
    (a) RS-232 (default) or   (b) RS-485 ....$30
5) 11 ch. 12-bit ADC (TLC2543) $20
6) 2 ch. 12-bit DAC (LT1446)....................................$20
7) Reference, 20 ppm/°C, 2.5V (LT1009)................................$10
8) TD-Pack (Box, 16x2 LCD, 8x2 keypad)..............................$100
9) Switching regulator $20

Typical Order Example:

TD-40™,   512KB SRAM, RTC & Battery, ADC
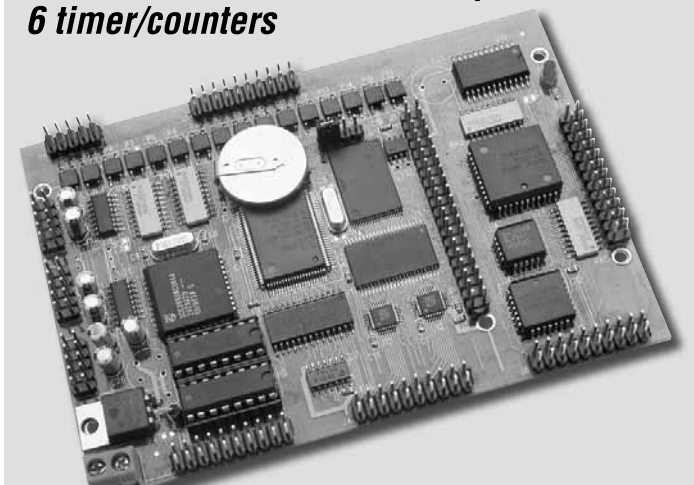TD40 + 1 + 3 + 5 = $174 + $20 + $20 + $20 = $234

TD-Pack

TD86™
Opto-couplers & High-speed analog I/O

16 opto couplers, 14 solenoid drivers, 24 TTL, 16 ADC, 4 DAC, 4 serial ports, 6 timer/counters

Features:
- 4.8x3.4x0.5"
- 16-bit CPU (186), 40 MHz, program in C/C++
- 190 mA at 40 MHz, 30 mA in power-save mode
- Up-to 256KW flash and 256 KW SRAM on-board
- 16 ch. 300 KHz 12-bit ADC (AD7852), 0-5V analog input*
- 4 ch. 200 KHz 12-bit DAC (DAC7625), 0-2.5V analog output*
- 16-bit external data bus, 512-byte EE, 4 serial ports
- PWM outputs and Pulse Width Demodulation
- 6 16-bit timer/counters, 24 TTL I/Os, and 14 solenoid drivers
- 16 opto-coupler inputs including 5 external interrupts
- Real-time clock, battery, switching regulator*
  * optional

The **TD86™** is designed for rugged industrial control applications that require compact size, superior performance, and reliability.

Superior Performance

The **TD86™** is a complete C/C++ programmable industrial controller based on a 16-bit, 40 MHz CPU (186) with 16-bit external data bus, supporting 16 channels of high speed parallel ADCs (AD7852, 12-bit, 300KHz, 0-5V) and 4 channels parallel DACs (DA7625, 12-bit, 5µs, 0-2.5V).

With the wider 16-bit external data bus, code executes directly out of 16-bit SRAM or 16-bit flash. The CPU can access the parallel 12-bit ADC, or parallel DAC with zero wait state in single instruction.

Three 16-bit programmable high-performance counters (71054, NEC), each with its own clock input, gate input, and output, can be clocked up to 10 MHz. Three 16-bit CPU internal timer/counters can support PWM, or pulse-width demodulation.

Industrial Control Input/Outputs

The **TD86** also has 16 opto-isolated digital inputs, 14 solenoid drivers, and 24 TTL I/O pins. The 16 opto-couplers (PS2701/5, NEC) can take up to 50V DC (PS2701, default) or AC (PS2705) inputs. These opto-couplers have 3 µs ON time and 5 µs OFF time. Five opto-inputs are also external interrupts. The 14 solenoid drivers are capable of sinking 350 mA at 50V per line, and they can drive solenoids or relays.

Versatile Applications

Four serial ports (two CPU internal, two from SCC2692) are configured to RS232 by default. One CPU internal UART(SER1) can be configured to RS485 (half-duplex) or RS422 (full-duplex). The SCC2692 UART can be configured to RS485.

The **TD86** also supports a real-time clock (RTC72423) with battery, a watchdog timer, and a 512-byte EEPROM. A 64KW or 256 KW 16-bit SRAM can be installed. Using the DV-P kit, user applications can be easily field-programmed into the 16-bit ACTF flash over the serial link.

A **MMB**, or **FC-0** can be installed to support up to 1 GB PCMCIA, CompcFlash card. The **MMB** supports 10 BaseT Ethernet, and an additional 39 channels of 12-bit/24-bit ADC inputs.

A 82C55 PPI chip provides 24 I/Os, which can also be used to interface to an LCD. An optional switching regulator can be installed to reduce power consumption and heat.

The **TD86** supports power-off mode, allowing µA-level power consumption. In this mode, the real-time clock or an external signal can turn the TD86 on or off via the VOFF pin of the switching regulator.

An optional TD-Pack including a 16x2 LCD, 8x2 keys, and an enclosure is available.

Ordering Information

TD86	$199/$179/$138/$92	Qty 1/100/1K/5K+

Includes: 40 MHz 186, 256KW ACTF Flash, 4 RS232, 24 TTL, 14 solenoid drivers, 16 optos, 6 timers, regulator, EE, and 64KW SRAM.

NOT including add-on options. OEM option discounts available.

Add-on Options:

1) SRAM: 256KW $20
2) Real-time clock (RTC) and battery $20
3) 8 ch. 12-bit ADC, 300KHz (AD7852), 2 chips ....$20 each
4) 4 ch. 12-bit DAC, (DA7625)...................................$40
5) RS485/422 driver for CPU SER1 ....$10/$20
6) RS485 driver for SCC2692-A $10
7) TD-Pack (Box, 16x2 LCD, 8x2 keypad)..............................$100
8) Switching regulator $20

Typical Order Example:

TD86, 256KW SRAM, RTC & Battery, 8 12-bit 300KHz ADCs
TD86 + 1 + 2 + 3 = $199 + $20 + $20 + $20 = $259

# QD8™ 8 channels of Quadrature Decoder Expansion
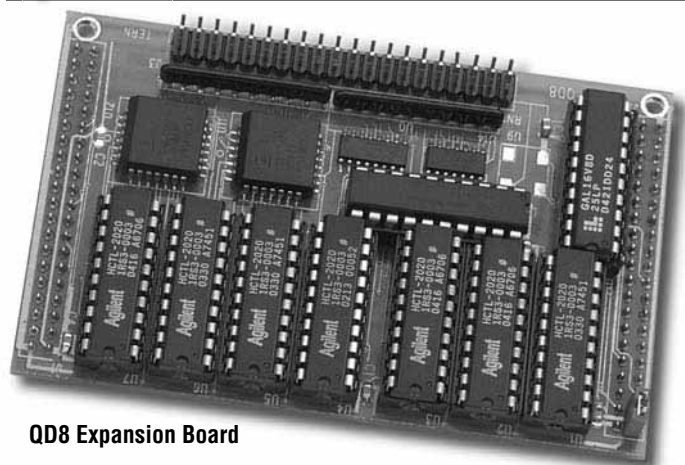
QD8 Expansion Board

Features:
• Up to 8 Quadrature Decoders and 6 Index Counters
• 8-bit parallel high speed bus to TERN controller
• 3.6x2.3 inches, 5V

With dimension of 3.6x2.3 inches, the **QD8** is an expansion board for a TERN controller. The **QD8** adds up to 8 quadrature decoders(HCTL2020 or HCTL2021) and 6 16-bit hardware counters(82C54, can be used to count Index pulses).

The quadrature decoder allows the host controller to interface to a quadrature encoder, used to generate position pulses in a closed-loop motion control application. The **QD8** interfaces to a TERN controller via 8-bit high speed data bus using J1 and J2 headers.
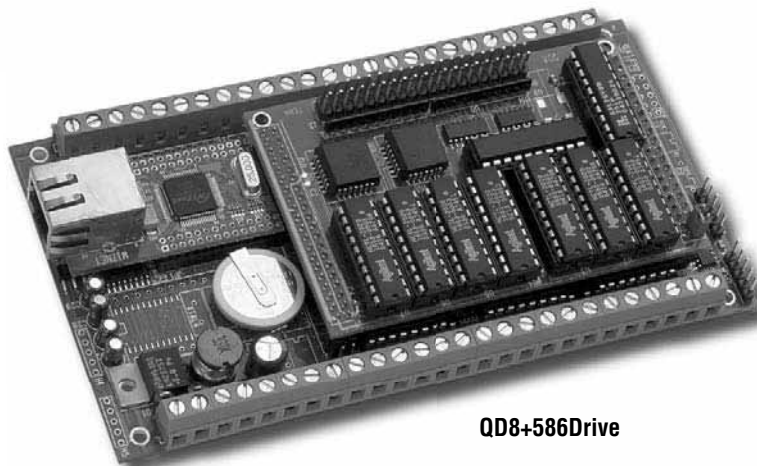
QD8+586Drive

Order Information
QD8™ $49/$39/$29   Qty 1/100/1K+

Includes: PAL, schmit-trigger, J1, J2 socket.

Add-on Options
1) Quadrature Decoders, up to 8 chips $30x8
2) 16-bit counters(82C54), up to 2 chips............................$10x2

CUSB™ Connecting TERN controllers to a PC USB port
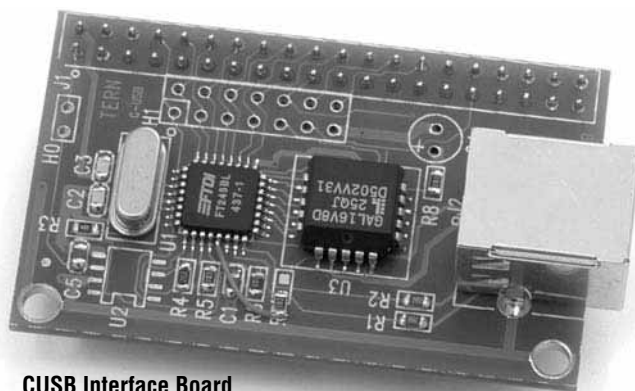
CUSB Interface Board

Features:
• Connecting TERN controller to a USB port
• 8-bit parallel high speed bus or I/O support
• Ready to use, royalty free USB drivers
• Eliminate Windows driver development
• 2.1x1.3", USB bus powered
• USB 1.1 and USB2.0 compatible
• Tx/Rx buffer FIFO for parallel high speed I/O
• Data transfer rate to 150 KB/sec with VCP driver
• Data transfer rate to 500KB/sec with D2xx driver

Introduction
The **CUSB™** is a low cost USB solution for TERN C/C++ programmable controllers.

The **CUSB™** integrates a high-performance USB stack chip to provide an easy to program USB 1.1/2.0 slave interface. The onboard hardware fully handles USB stack processing, and provides for high-speed bi-directional 8-bit parallel communication. The hardware interface includes 384 bytes of FIFO transmit buffer, and 128 bytes of FIFO for the receiving buffer, making this an ideal low-overhead solution for all embedded applications.

The **CUSB™** exposes a slave USB interface, and connects to a PC via USB-B connector. The CUSB interface to TERN controller via J1 expansion header.

Firmware programming on the controller side is simple and straightforward. The USB interface is seen as a transparent parallel FIFO buffer tasked with transferring data back and forth with the remote host.

Order Information
CUSB™ $69/$49/$29   Qty 1/100/1K+

Includes: USB interface + USB 'B' connector, default type 'B' J1 header.

Add-on Options
1) J1 20x2 pin flat cable..$10
2) USB A-B connector cable $10

TERN INC.

45

P50™ and P52™

P50™ and P52™ I/O expansion with ADC, DAC, Precision Reference, Temperature sensor, PPI I/Os, Sourcing or Sinking High Voltage Drivers, Opto-couplers, Ethernet, Quadrature Decoders, RS232/485 and Switching Regulator
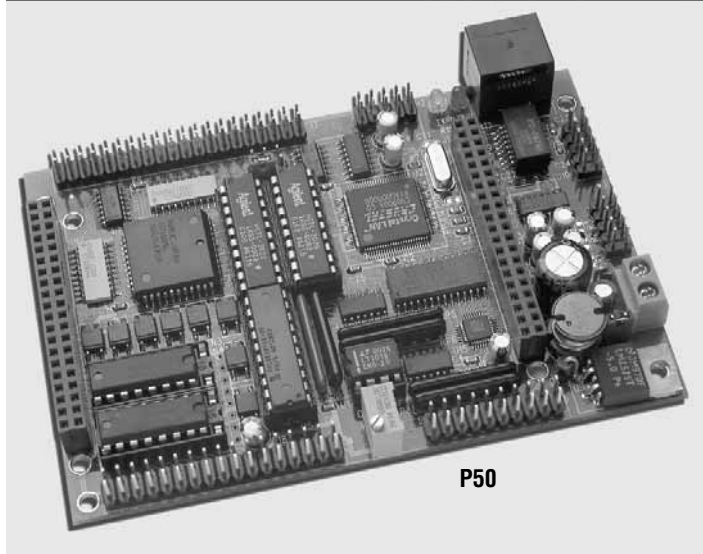
P50

Features and Options:

- 4.4x3.1x0.5 inches.
- Driven by 586-Engine™ , i386-Engine™, A-Engine86™.
- Power consumption: < 200 mA @ 9V-12V
- 24 PPIs, 14 high voltage sourcing or sinking drivers
- 10M Ethernet(P50) or 100M Ethernet(P52).
- 12-bit ADS7852 on P50 or 16-bit AD7655x2 on P52.
- 12-bit DAC7625 on P50 or 16-bit DAC8544 on P52.
- 8 opto-isolators and 2 quadrature decoders
- 5V switching regulator, RS-232 or RS-485 drivers.

Measuring 4.4 x 3.1 inches, the **P50/P52™** is an I/O expansion board designed for and driven by a TERN Engine controller. 16-bit external data bus is required to run the parallel ADC and DAC.

Many embedded applications demand for high speed ADC and DAC with buffered operational amplifiers supporting variable gains or offset for analog signals. The parallel 16/12-bit ADC/DAC can be access via high speed 16-bit data bus with a few host CPU I/O operations. The **P50** supports four 12-bit, parallel DAC (DAC7625, 0-2.5V). The **P52** supports four 16-bit, parallel DAC (DAC7655, 0-5V). The DAC outputs are buffered by 4 ops with hardware configurable gain and offset. The **P50** supports eight 12-bit 300KHz parallel ADC (ADS7852, 0-5V) while the **P52** can have 8 16-bit parallel ADC(AD7655, 0-5V). A precision voltage reference (LT1019) with build-in temperature sensor can be installed. A resistor pot is used to adjust the DAC analog output offset.

The **P50/P52** can buffer J2 PIOs with 16 sourcing drivers (UDN2982), or 14 sinking drivers (ULN2003). These drivers can source or sink 350 mA at 50V per line to directly drive solenoids, relays, or lights. Seven high voltage drivers can be re-configured as high voltage inputs. Eight high isolation voltage photocouplers (PS2701, NEC) can be installed to provide optically isolators to PIOs.

Optional two quadrature decoders, (HCTL2020) can be installed.

P50/P52 includes 24 bi-directional TTL PPI(82C55) I/Os.

An Fast Ethernet Module can be installed on the **P52** to provide 100M Base-T network connectivity. This Ethernet module has a hardware LSI TCP/IP stack. It implements TCP/IP, UDP, ICMP and ARP in hardware. The hardware Ethernet releases internet connectivity and protocol processing from the host processor, which represents a huge improvement over software-based TCP/IP stacks. An RJ45 8-pin connector is on-board for connecting to 10/100 Base-T Ethernet network. Software libraries and demo project are available for Ethernet connectivity. The **P50** is using Ethernet LAN controller (CS8900) to provide network connectivity.

Two channels of RS-232 drivers and a 5V linear regulator are on-board. An optional RS232 or RS485 driver can be installed for the 3rd UART. The P50/P52 requires 8.5V to 12V DC power supply with linear regulator, or up to 30V DC power input with an optional switching regulator without generating excessive heat.
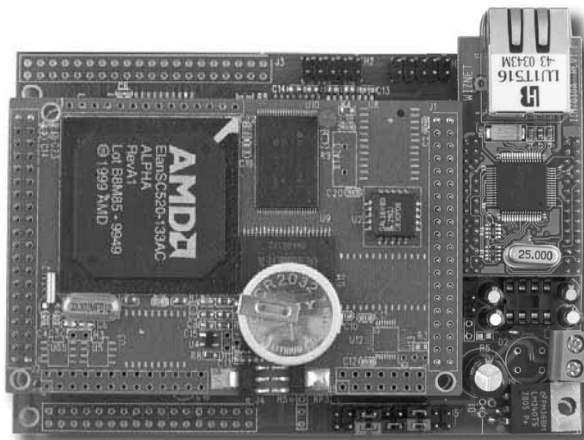
P52 is driven by a 586-Engine

Ordering Information

P50 or P52 $99/$69/$39   Qty 1/100/1000

Includes: 2 RS-232 ports, 24 PPI I/Os, solenoid drivers, linear regulator. Driven by a 586-Engine, or AE86, i386E with limited HV I/O. NOT including add-on options.

Add-on Options:

1) ADS7852(P50) or AD7655 x 2 (P52)   ....$30 or $40x2

2) DA7625(P50) or DAC8544(P52)...............................$40 or $60

3) Opto-couplers (PS2701).......................................$20

4) Quadrature decoders(HCTL2020), upto 2.....................$30 each

5) Switching power regulators(SR)...$20

6) 3rd UART driver a)RS232 or b) RS485................................$10

7) Ethernet (CS8900 P50 or WIZ P52)....................................$30

Order Example

P52 with 100M Ethernet

P52+7 = $99+$30

EyeJ™

C/C++ Programmable Color Image Sensor with Real Time JPEG

EyeJ+ FB

EyeJ+EE
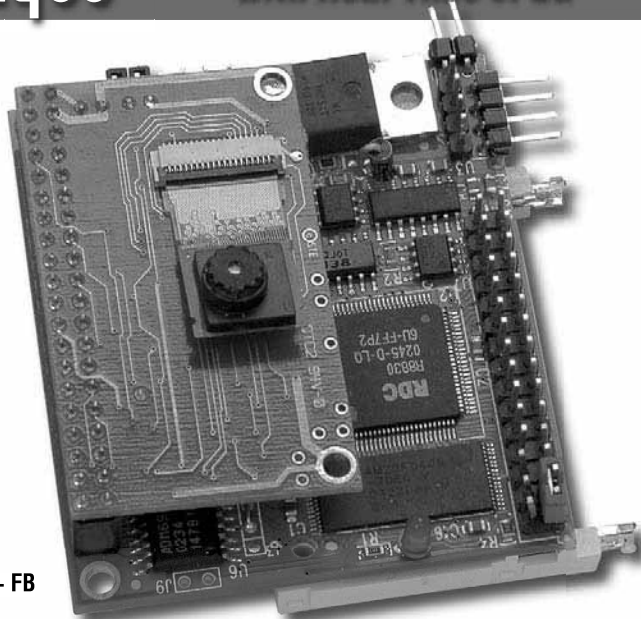
Features:

- Low power CMOS VGA(640x480) Image Sensor
- Embedded real time JPEG encoder.
- Parallel 8-bit Host interface for fast access.
- 2.0x1.2", 5V DC Power, Wide viewing angle Micro Lens
- C/C++ programmable and driven by TERN controller.

Introduction

The **EyeJ™ (EJ)** color image sensor module is an affordable solution for high quality, embedded image acquisition. It is designed to be driven by TERN's C/C++ programmable controllers, like the Ethernet-Engine or FlashCore-B. The EJ integrates a VGA(640x480 pixels) CMOS color image sensor, embedded JPEG encoder, wide viewing angle micro lens, and a high speed parallel host interface.

Using the embedded real-time JPEG encoder for compression greatly reduces image file size. A raw VGA color image file can be more than 300KB+, and require seconds to process and transmit. In contrast, a **real-time** compressed JPEG file can be 30KB typically. The reduced image size allows real time image transfer over RS232, Radio MODEM, USB, Ethernet, or storage into a CompactFlash card.

Variable image acquisition rates (up to 10 fps acquisition), variable image sizes (640x480, 320x240, 128x160, or 128x120), compression quality (high, medium, low), zoom, and contrast can be programmed.

When paired with the FlashCore-B, the Eye-J becomes a low-power, stand-alone, < $80 (OEM quantities) programmable camera backed by PC-compatible FAT16 CompactFlash storage. When paired with the Ethernet-Engine, the Eye-J becomes an inexpensive remote image webserver.

Order Information
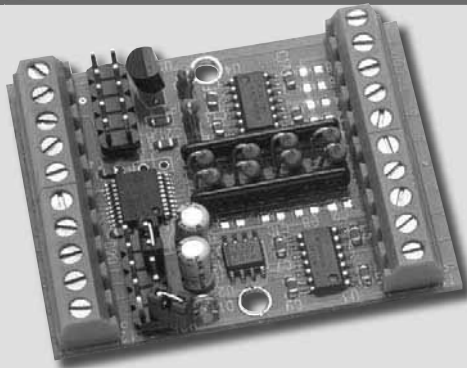
EyeJ™　　$99/$69/$49/$39　　　Qty 1/100/1K/5K
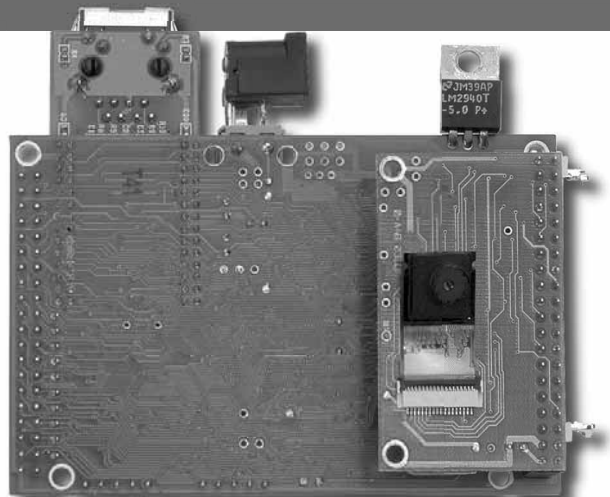
Sample color images acquired by EyeJ™

EyeJ

OPA™ Adding 16-bit ADCs to your embedded system with 3 I/Os

The **OPA** is measures 2.0 x 1.6 inches. It can be powered by 5-9V DC. By using OPA, you can add 8 channels of 16-bit ADC(ADS8344, TI) to your embedded system with 3 TTL I/O lines. Multiple OPAs can also be integrated. Sample software programs are available for many TERN controllers. You can also use the OPA as a low cost analog signal conditioning board to convert industrial standard analog input signals from ±10V to 0-4V.

Order Information
OPA $99

Includes: 8 operational amplifiers for ±10V to 0-4V conversion. Precision 4.096V reference, screw terminals or headers. Not including 16-bit ADCs.

Add-on Options:

1) 8 ch. 16-bit ADC (ADS8344)..$30

Order Example: OPA+1=$99+$30 = $129

Relay7™ (R7)

7 power relays plus 7 solenoid drivers
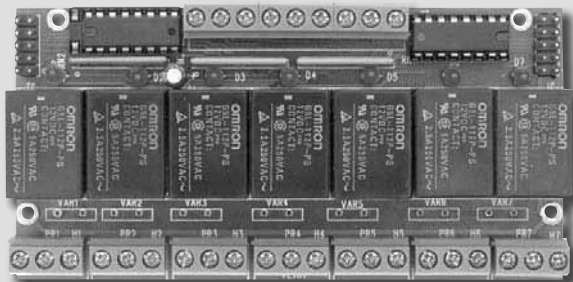
Features:
- 4.4x2.2x0.8", 4.3 ounces, powered by 12V DC
- 7 power relays (10A, 3 contacts of NO, NC, COM)
- Additional 7 high-voltage I/Os hardware configurable to 0V to 30V inputs, or to 0V to 50V outputs at screw terminal
- Easy to interface to and protect TTL I/O signals.

Ordering Information
R7 $99

OPS™ Low Cost Analog Signal Conditioning
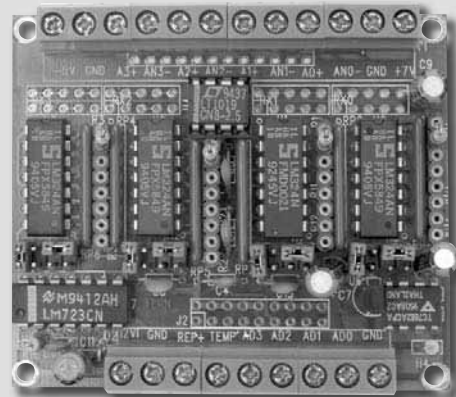
OPS is designed to convert analog input/output signals between TERN controllers and user applications. It measures 2.8x2.4", and can be powered by 8-12V DC.

OPS can be ordered in 4 standard configurations:

OPS-G2: 0-4.095V analog inputs and 0-10V analog outputs. Designed for DAC7612/LT1446.

OPS-G4: 0-2.5V analog inputs and 0-10V analog outputs. Designed for DAC7625.

OPS-G05: 0-10V inputs and 0-5V outputs, for ADCs.

OPS-G1000: Adjustable-gain (up to 1000) and high input impedance. It amplifies thermocouple outputs to 0-5V for ADCs.
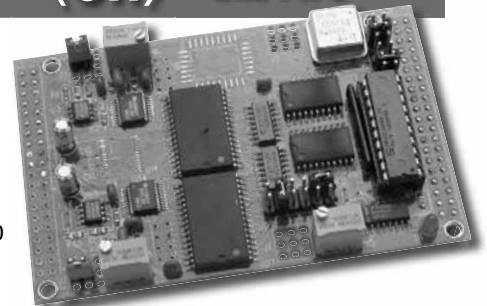
Ordering Information
OPS-xx $99

Add-on Options:
1) LT1014 upgrade for OPS-G1000 (up to 4)....................$10 each
2) Custom gain and offset configuration...................................Call

Grabber™ (GR) 80MHz ADC and FIFO

- 2.3x3.6x0.5 inches
- 80 MHz, 8-bit ADC
- 2 KB 10 ns FIFO for 80MHz ADC data
- 512KB SRAM for up to 20 MHz ADC
- Clock selectable from on-board oscillator, external, or host clock.
- Trigger window based on "one shot"

Ordering Information – Call

TERN *INC.*

1950 Fifth Street, Davis, CA 95616   USA
Tel: 530-758-0180 • Fax: 530-758-0181

CE FC   sales@tern.com   http://www.tern.com

48

i2x™ I/O Expanders: KP, D32, R16, LCD

TERN controllers are designed to offer a rich array of I/O, but experienced embedded engineers know you can never have enough. TERN's i2x™ I/O expanders are intended to solve this problem once and for all by providing a low cost, simple, reliable, and nearly limitless expansion for TERN controllers. TERN's i2x product line adds an unprecedented degree of flexibility to your application design.

Bus Details

TERN i2x™ I/O expansion is designed around an i2c-compatible bus. The bus is driven by only two host TTL signals: one output line acting as **clock**, and one bi-directional I/O acting as **data**. This allows a TERN controller, with its many tens of TTL I/O lines, to control numerous buses at a single time (even better since the **data** line can be shared by multiple buses). Each bus, with its integrated support for node addressing, can further support up to 16 remote node addresses used to control and communicate with remote i2x expanders.

The expanders can be addressed at a maximum rate of approximately 1 KHz; Expander I/O lines can sink up to 25 mA each, making it useful for driving LEDs, lights, or even small relays.

All remote i2x nodes must be used within 5 meters of the host controller. The i2x network consists of up to 5 physical wires: **CLK**, **GND**, **5V**, **DAT**, **INT**(optional). Each i2x expander device has the same standard 5-pin header for easy wiring.

i2x Devices

Available i2x devices: *LCDs*, *KP, D32*, and *R16*. TERN provides software drivers and sample programs.

i2x-LCD™

TERN81S: 8 white Segment-Digits on blue background.

These LCDs have a large font, are impressive looking and easy to use. The display text can be clearly see from 15 feet away.

i2x-KP™

The **KP** is a simple user interface solution supporting a LCD display (16x2 character LCD by default, or 132x32 graphics LCD), and 8x2 dome keys occupying two i2x node addresses. The keys are covered by a blue color plastic overlay with clear windows, allowing the user to use custom key legends.

The optional graphics LCD can display standard 18x2 ASCII characters, or a range of Chinese/Japanese characters. Optional
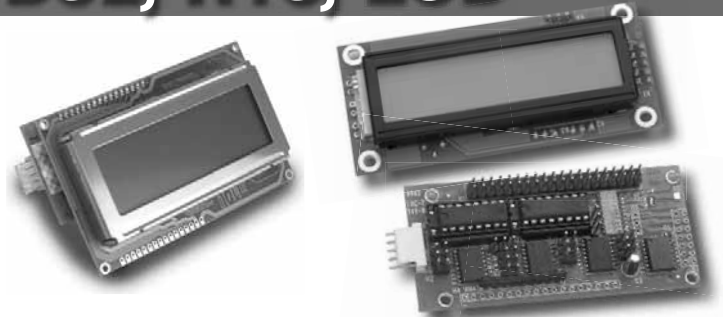
7 solenoid drivers, 7 high voltage inputs, and 2 mechanical relays can be installed (requires additional i2x node addresses). The KP can be powered by 9-12V unregulated DC with on-board 5V regulator or powered with a regulated 5V DC power.

i2x-D32™

The very small foot-print **D32** occupies four i2x node addresses, and can provide an 32 I/O lines. It also supports a character/ graphics LCD. It has 14 hardware configurable high voltage I/Os, capable handling upto 30V DC.

i2x-R16™

The **R16** can be used for driving high voltage load, signal switching and isolation. It features 16 REED relays, occupying two i2x node addresses. Each relay has two normal open contacts. These relays are capable of far higher switching speed when compared to standard electro-mechanical relays. Each output is specified to support a maximum of 200 V, 1 Amp peak current, 0.5 Amp switching current; each output is also rated for up to 100 million switches.

Ordering Information: Qty 1/100/1K

TERN81S, 8 Segment-Digits LCD ....$50/$40/$30
KP-C, 16x2 character LCD, 8x2 keys..........................$79/$49/$29
KP-G, 144x32 graphic LCD, 8x2 keys ....$89/$59/$34
D32, 32 I/O lines..$39/$29/$19
D32-C, 16x2 character LCD+16 I/Os..........................$49/$35/$24
D32-C20x4, 20x4 character LCD+16 I/Os..................$69/$45/$29
D32-G, 144x32 graphic LCD+16 I/Os ....$59/$45/$32
R16, 16 relays ....$69/$49/$24

Add-on options:

1) 14 high voltage I/O, 2 relays on **KP** $20
2) **i2x** cable (3 ft, 4 i2x connectors) $10
3) **W40** (40 screw terminal-pin headers) $20
4) **W20** (20 screw terminal-pin headers) $10

P300™   I/O Board

300+ I/Os, 240 solenoid drivers
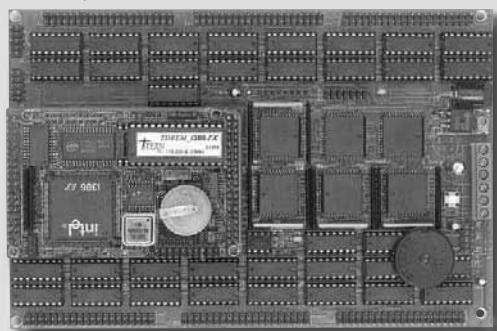
Features:

• 7.5x5.0x0.75"

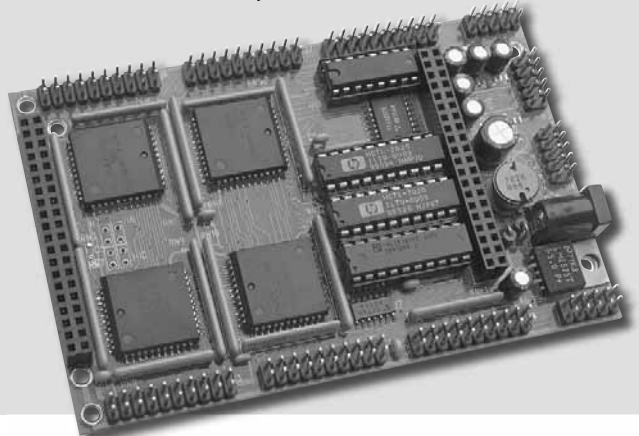• 264 I/Os with buffered 240 high voltage drivers (ULN2003)

The **P300** has 240 high-voltage I/Os, which are hardware-configurable to inputs (30V) or outputs (350 mA, 50V).

Ordering Information

P300	$199/$169/$149	Qty 1/50/100+

1) Switching regulator $20

3) Driver for 3rd UART RS485 ....$10

P100™

2 Quad. Decoders, 7 solenoid drivers

Features:

• 4.4x2.9x0.5"

• 24x4 TTL I/O lines from 4 PPIs, 7 solenoid drivers

The **P100™** or **300™** must be driven by an Engine™ controller. Two RS-232, one RS-485 driver, and a 5V linear regulator are on-board.

Ordering Information

P100	$99/$79/$59	Qty 1/50/100+

1) Switching regulator $20

2) Quadrature decoder (HP2020) *up to 2*..........................$30 each

3) Driver for 3rd UART RS232/485 ....$10

UR8™

UR8™ 8 UARTs, RS232/485/422
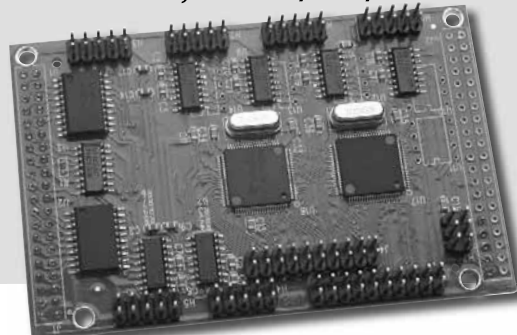
Features:

• 3.6" x 2.3 x 0.3", Two QUARTs

• 64 bytes hardware FIFO buffers , Flow control.

The **UR8™** is an expansion card designed for adding 8 serial ports to TERN controllers. 4 UARTs have RS232 drivers, and the other 4 UARTs can be configured as RS232 or RS485or RS422. All handshaking signals can be used as general I/O.
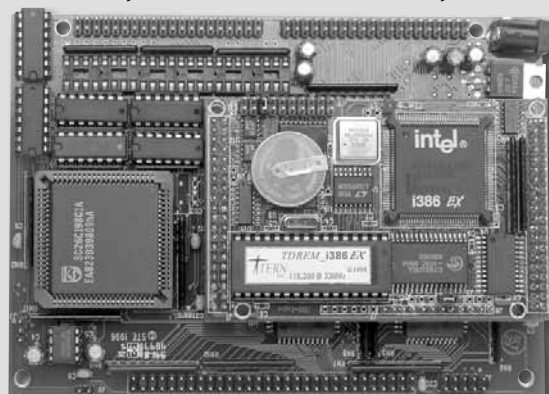
Ordering Information

UR8	$99/$69/$49	Qty 1/100/1K

Includes two QUARTs. 4 channels RS232 without handshaking and 4 ch. RS232 with handshaking.

Options: Modification to RS485 or 422 or TTL $10 per ch.

LittleDrive™ (LD)

10 RS232s, 22 solenoid drivers, 80 I/Os

Features:

• 5.7x4.1", 80 I/O lines including 24x2 PPI I/O lines

• 10 RS-232 drivers; 6 of them configurable to RS-485

• Octal UART, 14 solenoid sinking drivers

Ordering Information
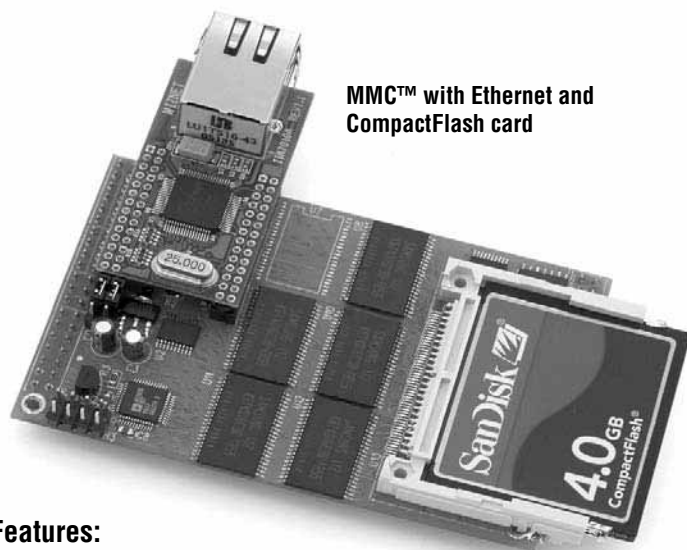
LD	$299	Qty 1

*TERN*INC.

1950 Fifth Street, Davis, CA 95616   USA
Tel: 530-758-0180 • Fax: 530-758-0181

CE FC   sales@tern.com   http://www.tern.com

MMC™

8MB RAM, 2 GB CompactFlash, 100 M Ethernet and 4 16-bit ADCs.

MMC™ with Ethernet and CompactFlash card

Features:
- Measures 3.58 x 2.30 inches
- Up to 8 MB high speed SRAM
- 100 M Ethernet with hardware TCP/IP stack
- 50-pin CompactFlash interface with FAT file system
- 4 channels if 16-bit parallel ADC inputs(AD7655)

With dimensions of 3.6 x 2.3 inches, the **MMC™** is a multi-purpose expansion card designed to add up to 8M bytes of high speed SRAM, a CompactFlash card receptacle, a 100 M baseT Ethernet/IP module, and 4 channels of 16-bit high speed ADC inputs.

Memory
Up to eight low power 16-bit SRAM chips can be installed. In the default configuration, 256KW chips are used to provide a total of 4 MB of memory. Optional 512KW chips can be used to make 8MB of memory available. The host controller can access all 8M bytes of SRAM via a 256-byte memory window. This high-speed SRAM memory could be used as a ring buffer for high speed images or ADC data storage, for example.

Ethernet/IP
Optional WizNet Ethernet module provides 10M/100M base-T network connectivity. This module represents a huge leap forward in performance when compared to other raw MAC-only embedded Ethernet networking solutions commonly in use today. It releases internet connectivity and protocol processing from the host processor, which represents a huge improvement over software-based TCP/IP stacks. The resulting system can easily handle transmissions in the 200KB/s+ range in real world applications, leaving the board free to manage other real-time behavior. Software libraries and demo project demonstrating TCP and UDP clients/hosts, HTTP webservers, and more are provided.

The WizNet module has a hardware LSI TCP/IP stack implementing protocols like TCP/IP, UDP, ICMP and ARP. Four fully configurable independent sockets can be handled simultaneously. It has a 16KB internal transmit and receiving buffer accessed directly through the memory bus.

ADC
A 16-bit parallel ADC (AD7655, 0-5V) supports 4 channels of high-speed (1 MHz conversion rate) analog signal acquisition. The AD7655 allows *simultaneous* sampling on two channels. With a precision external 2.5V reference, the ADC accepts 0-5V analog inputs at 16-bit resolution of 0-65,535.
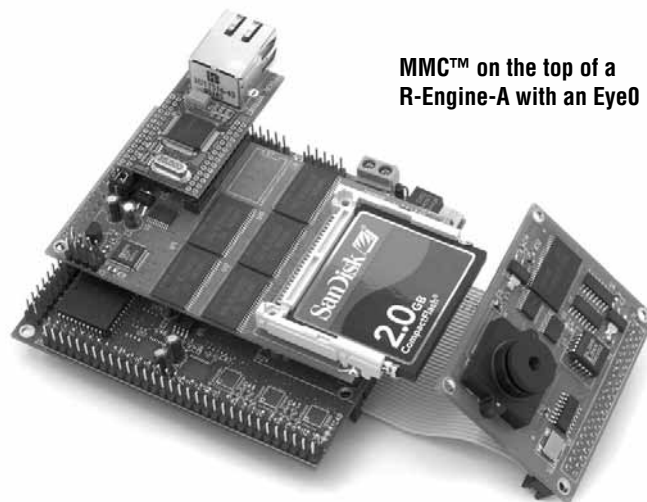

MMC™ on the top of a R-Engine-A with an EyeO

The **MMC** supports mass storage CompactFlash cards with Windows compatible FAT filesystem support, allowing user easily transfer large amounts of data to or from a PC.

The **MMC** can be driven by most TERN controllers via J1&J2 expansion headers.

The original MMB™ is still available to provide the additional 33 12-bit and 6 24-bit ADC inputs.
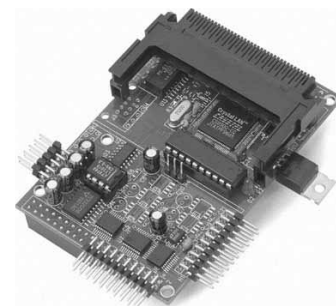
Order Information
MMC™ or MMB™ $49   Qty 1

Add-on Options for MMC:
1) 256KW SRAMs up to 8..$10 each
2) CompactFlash interface $20
3) 100 BaseT hardware TCP/IP Ethernet $30
4) 16-bit ADC, 1MHz (AD7655)..$40

Add-on Options for MMB
3) 24-bit ADC, up to 6..$20
4) 2.5Vreference & temp. sensor (LT1019)............................$15
5) 11 ch. 12-bit ADC (P2543) up to 3 ....$30 each

TERNINC.   **1950 Fifth Street, Davis, CA 95616   USA**
Tel: 530-758-0180 • Fax: 530-758-0181
CE FC   sales@tern.com   http://www.tern.com

51

MotionC™ (MC)
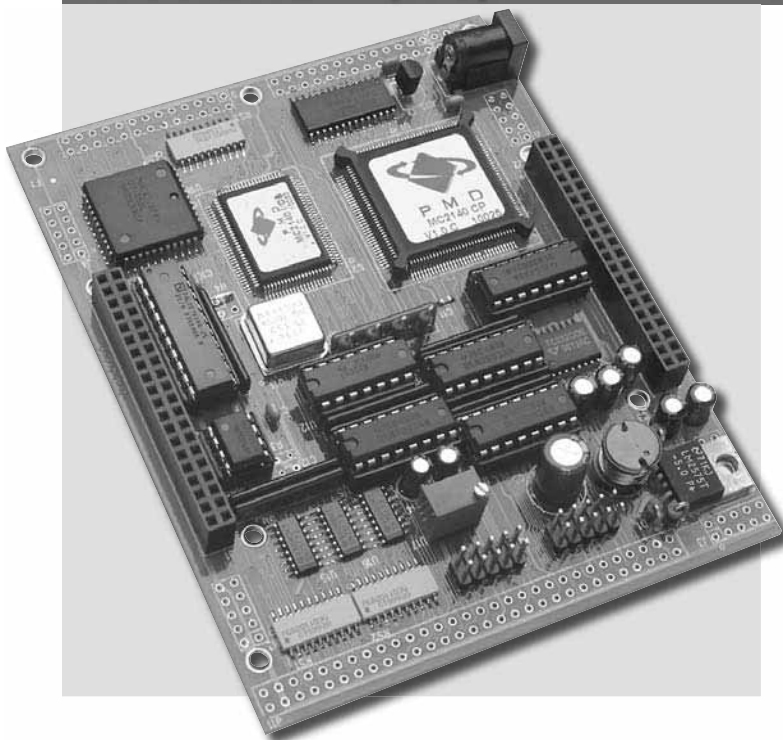
Features:

- 4.65 x 3.75", 200 mA at 12V
- Driven by 586-Engine™, i386-Engine™, or A-Engine86™, R-Engine™, E-Engine
- MC2140: 4-axis closed-loop servo control
- MC2540: 4-axis open-loop stepper control with Quad. Decoders
- 7 solenoid drivers, 24+ TTL I/Os, 2 RS232 and 1 RS485
- Protected switches for home, limit, capture, and fault
- 32-bit registers for position, velocity, acceleration, and jerk
- S-curve, trapezoidal, or contoured velocity profile modes
- Electronic gearing, 1/T counter for stable low velocity
- PID or PI control, programmable loop rate to 100 μs

The *MotionC™* (*MC*) is a low-cost, high-performance, standalone, C/C++ programmable industrial controller. It includes a DSP chipset (**MC2140 or 2540**, PMD) and it is driven by a host **586-Engine, AE, AE86, IE, RE, FN, RA, RD or EE.**

The MC+Engine system is a complete, C/C++ programmable, ready to run, motion controller with built in sophisticated field proven control firmware. User only needs to define parameters for PID algorithm and trajectory profile. The DSP calculates velocity, position and stabilizes the motor output. At the same time, the host controller interfaces with a PC, monitors I/Os, and computes or pre-loads a new set of parameters.

The host Engine interfaces to the DSP chipset via high-speed data bus. User can easily program in C/C++, download, and debug application programs via serial link to a PC. The host writes pre-defined motion commands to the DSP. All commands are double buffered. User can preload a new set of parameters and enable the new operation anytime while the DSP is running the old command. The DSP can interrupt the host at any time.

The **MC** provides protected inputs for home switches, limit switches, and fault switches. Up to 30 V DC signals can be applied to these switches. Seven solenoid drivers are capable of sinking up to 350 mA at 50 V. A PPI (82C55) provides 24 user-programmable bi-directional I/O lines. Two RS-232 and one RS-485 drivers can be installed.

MC2140 supports 4-axis closed-loop digital servo controls. It uses incremental quadrature encoders for position input. It outputs ±8V servo control signals. Each axis contains sophisticated trajectory profile and digital servo capabilities. It provides electronic gearing, PID/PI control, a choice of S-curve, trapezoidal, or contoured velocity profile modes, automatic motor error shutdown, and monitoring of switches. The *MC2120* is a 2-axis servo version.

MC2540 is for 4-axis open-loop stepping motor control. It supports sophisticated trajectory generation and synchronization features, allowing the creation of complex motion sequences. It provides up to 3 MHz pulse and direction signals for driving step motor systems. Each axis has a Quadrature Decoder, which can be read by the host. The *MC2520* is a 2-axis stepper version.

Ordering Information

MC2120 or MC2520	**$349**	Qty 1
MC2140 or MC2540	**$549**	Qty 1

Includes 4/2-axis control DSP chipset, solenoid drivers, 24 I/Os, 2 RS-232, DAC. Host Engine is NOT included.
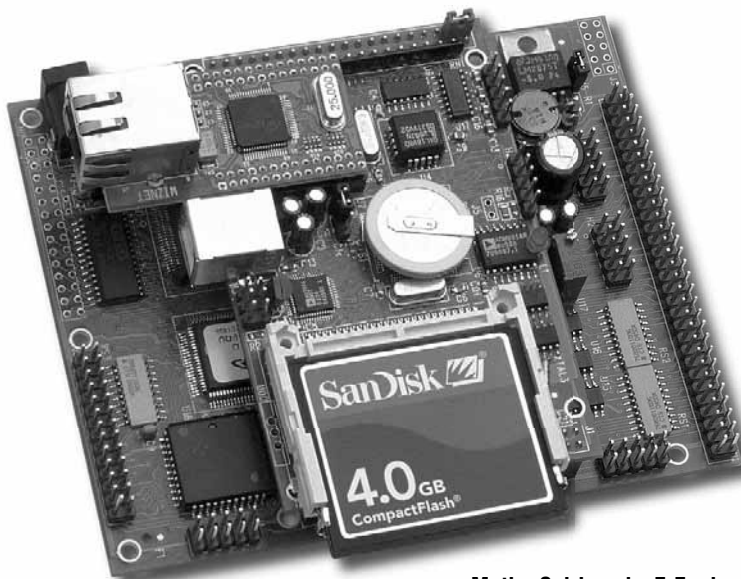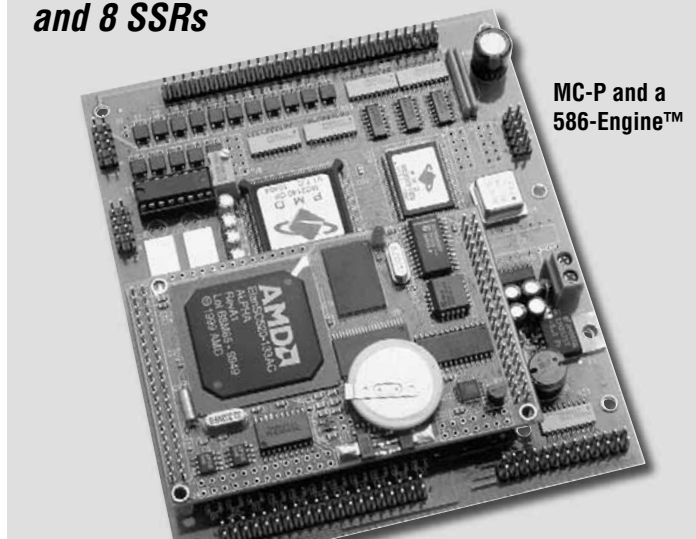

MotionC driven by E-Engine

MotionC-P/S™ (MCP), (MCS)

DSP motion controller with OPTOs and SSR

C/C++ programmable standalone 4-axis motion controller with 80+ I/Os, 32 Optos and 8 SSRs

MC-P and a
586-Engine™

Features:

- 4.55x5.3", 200 mA at 12V
- C/C++ programmable, driven by **AE, I386E, 586-Engine, R-Engine™ or DE™**
- **MCP2540:** 4 axis stepping control with pulse, direction
- **MCP2140:** 4 axis closed-loop servo control
- 7 solenoid drivers, 40+ TTL I/Os, 2 RS232, 1 RS485
- 32 Opto-couplers for home, limit, capture, and fault switches
- 8 opto isolated Solid State Relays (SSR) for AC or DC loads
- 32-bit registers for position, velocity, acceleration, and jerk
- S-curve, trapezoidal, velocity-contour, and electronic gearing
- 5 MHz pulse rate, 100 µs loop rate, and 8 ADCs

The **MotionC-P™ (MCP)** is a low-cost, high-performance, standalone, C/C++ programmable industrial controller for up to 4-axis motion control. The **MCP** includes a DSP motion chipset (**MC2140/2120/2540/2520**, PMD) with built-in sophisticated field proven control firmware. The **MCP** is driven by a host C/C++ programmable TERN controller. User only needs to define parameters for PID algorithm and trajectory profile. The DSP calculates velocity, position and stabilizes the motor output, while the host controller interfaces with user PC, monitors I/Os, reads ADCs, computes or pre-loads a new set of parameters.

The host controller interfaces to the DSP chipset via high-speed data bus. User can easily develop application C/C++ program on a PC, download, and debug via serial link. The host writes pre-defined motion commands to the DSP, and the DSP can interrupt the host at any time.

The **MCP** provides a total of 32 opto-couplers for home switches, limit switches, fault switches and other user inputs. Seven solenoid drivers are capable of sinking up to 350 mA at 50 V. Eight opto-isolated Solid State Relays (SSR) can switch 100 mA AC or DC loads upto 230V. Two PPI (82C55) chips provide 48 I/O lines.

Two RS-232 and one RS-485 drivers can be installed. Expansion headers are available for 8 10-bit ADC inputs, PWM output, step pulses and direction signals.

Additional I/Os, memory, ADC, and DAC can be provided by the host **AE/IE/586-Engine/R-Engine/DE**.

MCP2140 supports up to 4-axis closed-loop digital servo control for a variety of servo motors. It uses incremental quadrature encoders for position feedback, and high speed 12-bit DACs for ±10V servo control voltage output. Each axis contains sophisticated trajectory profile and digital servo capabilities, allowing very low position and velocity tracking errors. It provides electronic gearing, PID/PI control, a choice of S-curve, trapezoidal, or contoured velocity profile modes, 1/T counter for stable low-velocity motion, automatic motor error shutdown, monitoring limit, home, capture, and fault switches. **MCP2120** is a 2-axis version.

MCP2540 is for multi-axis open-loop stepping motor control. It supports sophisticated trajectory generation and synchronization features, allowing the creation of complex motion sequences. It provides up to 3 MHz pulse and direction signals for driving step motor systems.

The **MCP** must be driven by one of TERN's "Engine" controllers: **586-Engine, AE, AE86, IE, RE or DE.**

TERN provides complete C/C++ programming tool kit, including C/C++ compiler, remote debugger, C libraries, and samples.

Ordering Information

MCP2120	**$399**	**Qty 1**
MCP2140	**$649**	**Qty 1**
MCP2520	**$399**	**Qty 1**
MCP2540	**$649**	**Qty 1**

Includes DSP chipset, solenoid drivers, 48 I/Os, 32 optos, and 8 SSRs, 2 RS-232, DAC. Host engine is not icluded.

Typical Order Example:
MCP2140 + 586-Engine
MCP2140 +5E = $649 + $199 = $848

The **MotionC-S™** (**MCS**) is a programmable industrial motion controller designed primarily to support 4-axis brushless motors with sinusoidal waveform outputs (MCS2340 version).

Ordering Information

MCS2340 or MCS2140 orMCS2540	**$649**	**Qty 1**
MCS2320 or MCS2120 orMCS2520	**$399**	**Qty 1**

Add-on Options:
1) 8 channels 16-bit 100K ADC(LTC1605) $100
2) 4 channels 12-bit 300K DAC(DAC7625) $40
3) Switching regulator (SR) $20

C24™ Independent 24 16-bit counters

C24

W20P

W20S
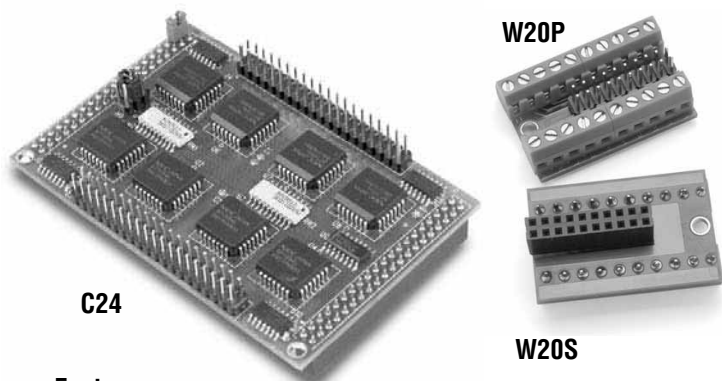
Features:

- 3.6 x 2.3 x 0.3", interfaces to TERN Engine controllers.
- 24 independent 16-bit hardware counters.
- Daisy chain to form a 16x24-bit long counter
- Software programmable in 6 modes.
- All counter inputs are buffered with Schmitt-triggers.
- High speed external event counters, up to 10MHz clock inputs.
- Programmable square wave, or complex wave form generator.
- Software re-triggered counting sequence.

W40P

W40S

The **C24** can interface to a host TERN controller via J1 and J2 bus headers.

The **W40**™ or **W20**™ is a low cost Pin-Screw terminal adaptor. W40 converts standard 0.1" lead spacing 20x2 pin headers to 40 screw terminals for easy field wiring. W20 has 20 screw terminals and 20 pins. The **W40P** has a 20x2 pin-header for using a flat ribbon cable. The **W40S** has a 20x2 socket for mounting on top of pin-headers.

Ordering Information

C24 high speed 16-bit counters	$99
W40/20P (40/20 screw terminals to pin header)	$20/10
W40/20S (40/20 screw terminals to socket)	$20/10
Cable DB9-IDE10 serial cable (DEBUG Cable)	$10
Wall Transformer (AC to DC 9V, 500 mA)	$15
16x2 character LCD, 85x30 mm	$40
20x4 character LCD, 98x60 mm	$60
ACTF Flash a) 128KB/b) 512KB	$20/$30
DEBUG ROM	$20
VE232	$49
Ejecting Mechanism	$10

54

Header Installation Types

TERN controllers use 0.1 spacing, 0.025 square inch straight pin headers.
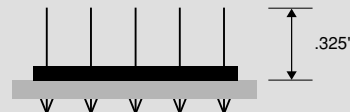
The four types of header installations are as follows:

Type E

.18"
.18"
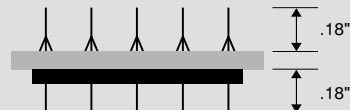
Type E is for evaluation boards, with signal accessible on both top (component) and bottom (solder) sides of the PCB. **Type E** is available with the **EV-P or DV-P Kits.**
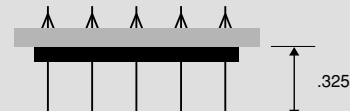
Type T

.325"

Type T puts the long leads with plastic spacer on the top side of the board. The short pins are soldered at the bottom side of the board.
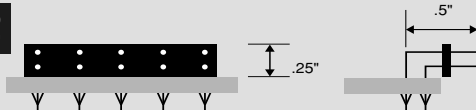
Type T is the factory default installation for OEM.

Type B

.325"

Type B puts the long leads with plastic spacer on the bottom side. The short pins are soldered at the top side.

Type TR2

.5"
.25"

Type TR2 (top, right angle, dual) has long bent pins on the component side of the board.

Type S   Special Header configuration.

Example 1: FlashCore's PCB has 5x2 pads for J5 which supports 2 RS232 ports and DC power input. In order to install two RS-232 cables and a DC power plug at the same time during evaluation, three types of pin headers are installed in J5, including 2 right angle pins for the DC power inputs, 4x1 type "T" pins for SER0, and 4x1 right angle pins for SER1.

Example 2: A-Engine J4 has 25x2 pins and H0 has 5x2 pins. The J4 should be installed as type "TR2" if you want to install an MMB or FC0 on the top of the AE. The H0 should not be installed if you are not ordering the ADC.

Example 3: The "Engine" controllers J2 and J1 header should be installed as Type "B", if the Engine drives a P100, P50, or MotionC. The J4 uses Type "T" to allow access of PPI signals from the top.

After prototype, you can specify and request suitable header configurations for your OEM board orders.

Ordering Information

All prices are in U.S. dollars. California buyers must add sales tax or provide California resale certificate.
Prices are subject to change without notice.

Phone Order: 530-758-0180   **Fax Order: 530-758-0181**

Internet e-mail: sales@tern.com   **URL: http://www.tern.com**

Mail Order: TERN, Inc., 1950 Fifth Street, Davis, CA 95616 USA

International orders

International orders must be prepaid with a cashier's check, money order, bank wire transfer, or VISA/MasterCard/American Express. Please fax or mail your order including your purchase order number, complete shipping address, contact person's name, phone number, fax number, company name, TERN product name, product options, and quantity. We will fax or mail you a confirmation with a delivery schedule, TERN's bank information, and the total cost, including the shipping cost. TERN will make its best effort to deliver the ordered products promptly after receiving the payment.

Terms

For first-time orders we accept prepaid checks, money orders, C.O.D., or VISA/MasterCard/American Express. After the first order and credit approval, Net 10/30 terms are available. A finance charge of 1.5% per month (18% per year) will be applied to accounts past due.

Credit Return Authorization (CRA)

CRA hardware products must be returned within 30 days of purchase and in "like new" condition. There will be a 20 percent retesting and restocking charge.

Return Material Authorization (RMA)

TERN warrants to the original purchaser for a period of one year from the date of purchase that the hardware product shall be free from defects in material and workmanship. The purchaser must pay the cost of parts, labor, shipping and handling for the repair of any damaged or altered hardware. Returned products not covered under the above conditions are subject to a standard retesting fee, plus the cost of shipping and handling.
All returned hardware must have a proper, unaltered serial number. Before returning any products, the original purchaser must obtain an RMA/CRA number from TERN.

Shipping and Handling

All shipping is F.O.B. Davis, California. The customer pays all shipping and handling charges. Minimum shipping/handling charge is $15.

Important Notice

TERN develops complex high-technology integration systems. Although quality control is closely monitored, these systems are integrated with software and hardware in which defects can occur. ***TERN products are not designed, intended, authorized, or warranted to be suitable for use in life-support applications, devices, or systems, or in other critical applications.*** TERN and the buyer agree that TERN will not be liable for incidental or consequential damages arising from the use of TERN products. It is the user's responsibility to protect life and property against incidental failure. TERN reserves the right to make changes and improvements to its products without providing notice. Temperature readings for controllers are based on the results of limited sample tests; they are provided for design reference use only.

VISA   MasterCard   AMERICAN EXPRESS

TERN INC.
CE FC

1950 Fifth Street, Davis, CA 95616 USA
Tel: 530-758-0180 • Fax: 530-758-0181
sales@tern.com   http://www.tern.com

Why should you use TERN controllers?

"I configured a 12 channel psuedo speed control positioning RC servos for 'animatronics' to control the ventriloquist's doll in this project, which is uplinked to a TERN processor on a dual PID for fine control of the swing mechanisms...The TERN processor is the heart of the act... it has the basic controls and timing and I/O, and the two major axis (the swing, and the perch on the swing must move as if the doll is swinging it and working with gravity) ...it then sends command controls across a simple two wire serial link to an inexpensive SCC 12 channel RC servo controller to move each of the arms/legs/head/neck/eyes/shoulders/etc... effectively, the TERN system will replace the talented magician and timed mechanics... The completed re-creation is funded by the world famous Getty Museum in Los Angeles, and when completed will have a permanent display in the "amazing historical mechanisms in that museum."

Richard Wolf, Consultant Burbank, CA

"You guys are great!! Thanks for the wonderful tech support. I felt a little lame calling for help but you guys walked me through everything very nicely. I like your product, it works great and you guys are very good to work with!!!"

Dean Hough, Resource Mining, Inc. Irvine, CA

"TERN is an excellent resource for us. Their standard control products are modular and flexible, allowing us to increase the features we can offer on our standard platforms. The new SmartTFT controller has more than enough I/O to meet our needs and the display quality is excellent. TERN also has great tech support and a thorough under-standing of their products down to the component level."

Brian Rist, EE Kurt J. Lesker Co.

"We had success on every project we used TERN boards:

- Worm robot for intervention in pipelines
- Automatic flushing system for pipelines
- Confidential project for the geophysical seismic industry
- We are currently designing a dynamic-positioning system for large boats.
- I just bid for a large military project (350 units using FlashCoreB's), we are waiting for an answer.

I have to say that your technical support was excellent."

Yann Le Page Cybernetix, France

"We develop software that controls oil-field equipment. **TERN 586-Engine and a custom modified P300 I/O board** gave us a simulator with 36 analog outputs and all of the digital inputs and outputs required. Technical support at TERN was great in preparing and shipping a system in less that one week. **TERN products are extremely adaptable and cost effective.** Thanks for a great job."

Bob Cloud, Sr. Software Engineer, WellDynamics, Spring, TX

"Nevada Automotive Test Center uses Tern's FlashCore-B as part of a system which records the vehicle data bus, GPS, Analog and Counter data to compact flash cards. The system, is used in passenger cars, military vehicles, commercial vehicles and motorcycles as a durability, mileage accumulation and dynamics recorder. **The FlashCore-B is small, robust and inex-pensive,** allowing us to place it in more vehicles and more inconspicuously than previous versions of the recorder."

Rick Capps, Engineer - Nevada Automotive Test Center

"We are a small company and have never worked with Micro controllers before. TERN is **making the learning curve small**. THANKS!"

Christian Menge, Ameritech Simulation, Wyckoff, NJ

"Our Guava PCA-96 system uses the Tern **MotionC** board. The Tern board controls the tray and a mixer paddle. It interfaces with several optical sensors, 4 stepper motors, and a DC motor to precisely position samples for mixing or analysis."

Kim Mulcahy, Guava Technologies, Hayward, CA

"During my first contact with Tern, I was impressed with their knowledge of their products. They answered all of my questions, and understood every need I had. After searching many other microcontrollers for many months, I purchased a Tern for the following reasons: **Small package size, minimal power requirements, Compactflash data storage, Low cost, Very good starter package, Very good program-ming interface with excellent debugging features! Excellent knowledge of their product** I ordered the **FlashCoreB**."

Jeffrey Scharpf, Senior Engineering Technician Milwaukee Electric Tool Corporation

"We use the TERN **FlashCore-B** for analog data acquisition and logging. We needed a product that was very small, re-quired low power and inexpensive. The CompactFlash interface was critical. This allowed us to store large amounts of data for retrieval at a later date. The **technical support from TERN has been excellent.**"

Wes Branstetter. Sr. Developer/Sr. Software Architect.

"I would like to thank you for your help over the last two years, while we developed our AHRS. We are now FAA certified, and are shipping the system in considerable numbers. This has been a **great success,** and due in part to you at Paradigm and Tern. We hope this system, which provides a "glass cockpit" for small airplanes, will have great impact on the general aviation world."

Mark Krebs, ARHS Project Manager Avidyne Corporation