

EMBEDDED PC MONTHLY SECTION

CIRCUIT CELLAR

ENGIN

INK®

THE COMPUTER APPLICATIONS JOURNAL

#95 JUNE 1998

GRAPHICS AND VIDEO

Steve & Jeff Turbocharge a Security System

Wearable Multimedia

Designing Low-Power Systems

HTML and Hand-Held Devices

S2242UNIVE*20223000 98 0110
UNIVERSITY OF IOWA
SERIALS DEPT
LIBRARIES PO#2022300009
IOWA CITY IA 52242

*****ALL FOR ADC 50092
P 1289
S 345

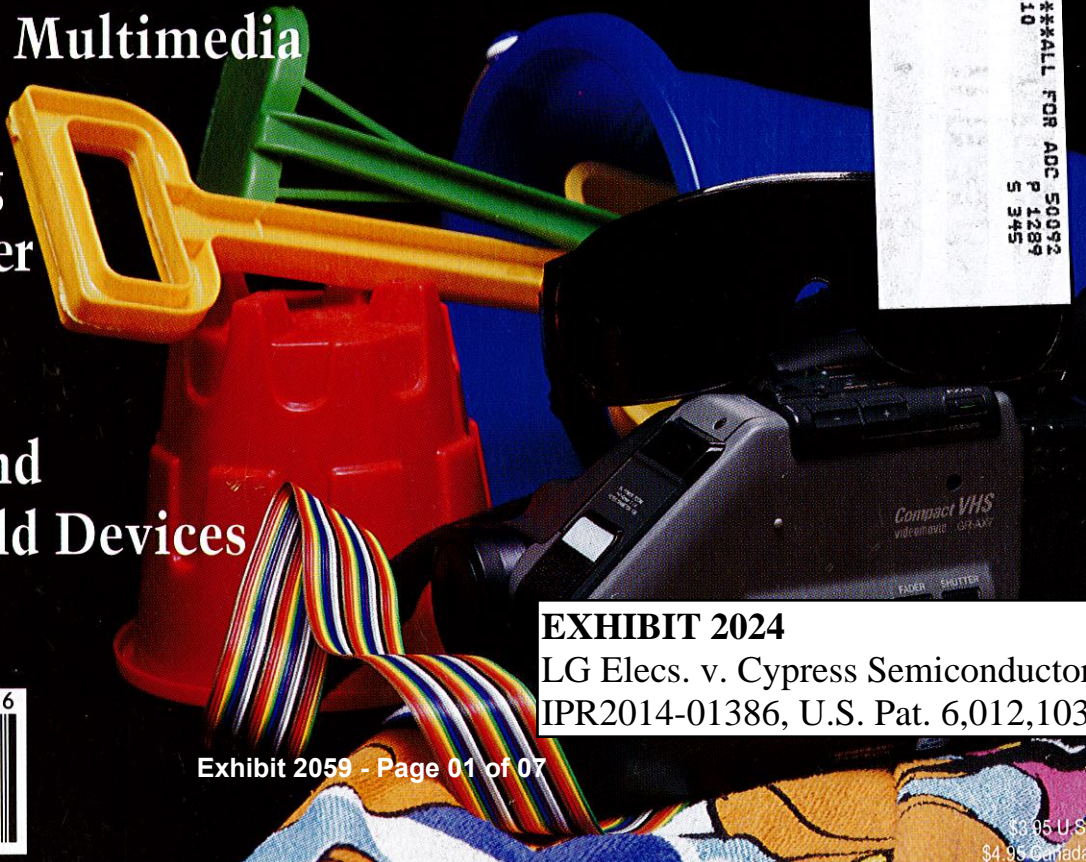


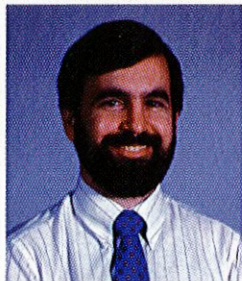
EXHIBIT 2024
LG Elecs. v. Cypress Semiconductor
IPR2014-01386, U.S. Pat. 6,012,103



Exhibit 2059 - Page 01 of 07

\$3.95 U.S.
\$4.95 Canada

Mind is a Terrible
ng...



How often do you get the opportunity to influence and shape tomorrow's design engineers? If you're involved in education, you're already there. I'm not talking to you. I'm talking to the engineers who sit in a lab or in front of a computer all day whose community involvement may extend to playing softball with the rec program.

One of our local universities (Eastern Connecticut State University) is exploring the possibility of building upon their already-established computer science program by adding one or more new majors and/or minors. One of the school officials is taking it to get feedback from the local community about what programs should be offered and how they should be structured. The Computer Science Advisory Board asked Circuit Cellar to send a representative to join the group, and I was elected. Other members of the board are representatives from insurance companies, computer vendors, high schools and secondary schools, community colleges, and nearby nationally known universities.

At our first meeting last night, I was amazed at how well such a diverse group could work together to discuss a common goal: what can we do to help today's college students to best prepare them for the changing world of science and computer engineering. Being able to tap into my own educational background coupled with over a decade of work experience, I hope to be able to offer some useful feedback and suggestions in the coming months.

As a magazine, I like to think we have some influence over the lives of tomorrow's engineers as well. Many dyed-in-the-wool engineers begin their careers experimenting with computers and electronics long before entering college. We have many readers who fit that category and who benefit from articles written by engineers in the field. We also have our college program in which we supply professors with free copies of the magazine for all the students in their engineering classes.

So what's my point? I want your help. We've been doing some work on our Web site, and are going to start offering perks to subscribers. Among these perks will be short application notes. If you have a favorite tip or technique you'd like to share, send it along and perhaps we can use it on the magazine's Web site. Our published articles are a technical source for these college students. Supplemental application notes and technical tips can only add to the overall understanding.

At the same time, I want to encourage you to become involved in your local school system. Students need to be exposed to computers as early as possible if they are going to come out ahead in today's high-tech world. Teachers have enough to do without having to figure out what's wrong with a PC's configuration or why they can't see the server on the network. Our readers possess an incredible wealth of computer knowledge, and just a fraction of that applied to the schools could benefit dozens of young minds.

I look forward to continued work on the Advisory Board. And when my youngest daughter starts kindergarten in a few months, I plan to check with her to see if I can do anything to help.

Ken Davidson
kdavidson@circuitcellar.com

CIRCUIT CELLAR INK®

THE COMPUTER APPLICATIONS JOURNAL

EDITORIAL DIRECTOR/PUBLISHER
Steve Ciarcia

ASSOCIATE PUBLISHER
Sue (Hodge) Skolnick

EDITOR-IN-CHIEF
Ken Davidson

CIRCULATION MANAGER
Rose Mansella

MANAGING EDITOR
Janice Hughes

BUSINESS MANAGER
Jeannette Walters

TECHNICAL EDITOR
Elizabeth Laurençot

ART DIRECTOR
KC Zienka

WEST COAST EDITOR
Tom Cantrell

ENGINEERING STAFF
Jeff Bachiochi

CONTRIBUTING EDITORS
Ingo Cyliax
Fred Eady
Rick Lehrbaum

PRODUCTION STAFF
John Gorsky
James Soussounis

NEW PRODUCTS EDITOR
Harv Weiner

Cover photograph Ron Meadows - Meadows Marketing

PRINTED IN THE UNITED STATES

ADVERTISING

ADVERTISING SALES REPRESENTATIVE

Bobbi Yush Fax: (860) 871-0411
(860) 872-3064 E-mail: bobbi.yush@circuitcellar.com

ADVERTISING COORDINATOR

Valerie Luster Fax: (860) 871-0411
(860) 875-2199 E-mail: val.luster@circuitcellar.com

CONTACTING CIRCUIT CELLAR INK

SUBSCRIPTIONS:

INFORMATION: www.circuitcellar.com or subscribe@circuitcellar.com
TO SUBSCRIBE: (800) 269-6301 or via our editorial offices: (860) 875-2199

GENERAL INFORMATION:

TELEPHONE: (860) 875-2199 FAX: (860) 871-0411
INTERNET: info@circuitcellar.com, editor@circuitcellar.com, or www.circuitcellar.com
EDITORIAL OFFICES: Editor, Circuit Cellar INK, 4 Park St., Vernon, CT 06066

AUTHOR CONTACT:

E-MAIL: Author addresses (when available) included at the end of each article.
ARTICLE FILES: [ftp.circuitcellar.com](ftp://ftp.circuitcellar.com)

For information on authorized reprints of articles,
contact Jeannette Walters (860) 875-2199.

CIRCUIT CELLAR INK®, THE COMPUTER APPLICATIONS JOURNAL (ISSN 0896-8985) is published monthly by Circuit Cellar Incorporated, 4 Park Street, Suite 20, Vernon, CT 06066 (860) 875-2751. Periodical rates paid at Vernon, CT and additional offices. One-year (12 issues) subscription rate USA and possessions \$21.95, Canada/Mexico \$31.95, all other countries \$49.95. Two-year (24 issues) subscription rate USA and possessions \$39, Canada/Mexico \$55, all other countries \$85. All subscription orders payable in U.S. funds only via VISA, MasterCard, international postal money order, or check drawn on U.S. bank. Direct subscription orders and subscription-related questions to Circuit Cellar INK Subscriptions, P.O. Box 698, Holmes, PA 19043-9613 or call (800) 269-6301. Postmaster: Send address changes to Circuit Cellar INK, Circulation Dept., P.O. Box 698, Holmes, PA 19043-9613.

Circuit Cellar INK® makes no warranties and assumes no responsibility or liability of any kind for errors in these programs or schematics or for the consequences of any such errors. Furthermore, because of possible variation in the quality and condition of materials and workmanship of reader-assembled projects, Circuit Cellar INK® disclaims any responsibility for the safe and proper function of reader-assembled projects based upon or from plans, descriptions, or information published in Circuit Cellar INK®.

Entire contents copyright © 1998 by Circuit Cellar Incorporated. All rights reserved. Circuit Cellar INK is a registered trademark of Circuit Cellar Inc. Reproduction of this publication in whole or in part without written consent from Circuit Cellar Inc. is prohibited.

SILICON UPDATE

Tom Cantrell

abulous '51s



Even though it's been around for a long

time, the 8-bit micro keeps on going and going and going. In fact, new variations keep popping up.

Tom lets us in on the smarts some of these new ones possess.



o doubt, you've heard dire predictions like "The 8-bit micro is dead." Of course,

the source is usually some expert who happens to make a living marketing 16- and 32-bit chips. Or, it might be an analyst who sells rosy studies to those marketers so they have some ammo for the next staff meeting.

Well, it's nonsense! Statisticians may quibble over the exact number, but there's no doubt the lowly 8-bit MCU plays a huge—and growing—role in our lives. Yes, 16- and 32-bit chips are doing wonderful things, but their strong

growth derives from the law of small numbers, not the death of 8-biters.

Indeed, today's billions of units per year are just the tip of the iceberg. It's not hard to imagine a cyberfuture where little chips permeate our existence.

MCU CLASSIC

I've worked with various companies hoping to enter the micro business. It's critical, but sometimes difficult, to convey to a commodity IC outfit that micros are a different beast altogether.

For example, a manager recently asked me how designers decide which micro to use. To him, if a micro offered a few key features for a good price and delivery, that was all there was to it.

Of course, that's not at all what happens. The decision is driven by human factors. Designers sometimes choose a new chip for the fun of learning it. Usually, though, they rely on their own stable of chips, tools, and accumulated know-how. Only truly compelling technical issues justify the nontrivial challenge and risk of switching to a completely new architecture.

That's why 20-year-old designs like the '51, 68xx, PIC, and Z8 still play a lead role. The issue isn't whether a new architecture is technically superior (not hard with 20 years of hindsight) but whether the old chips are good enough.

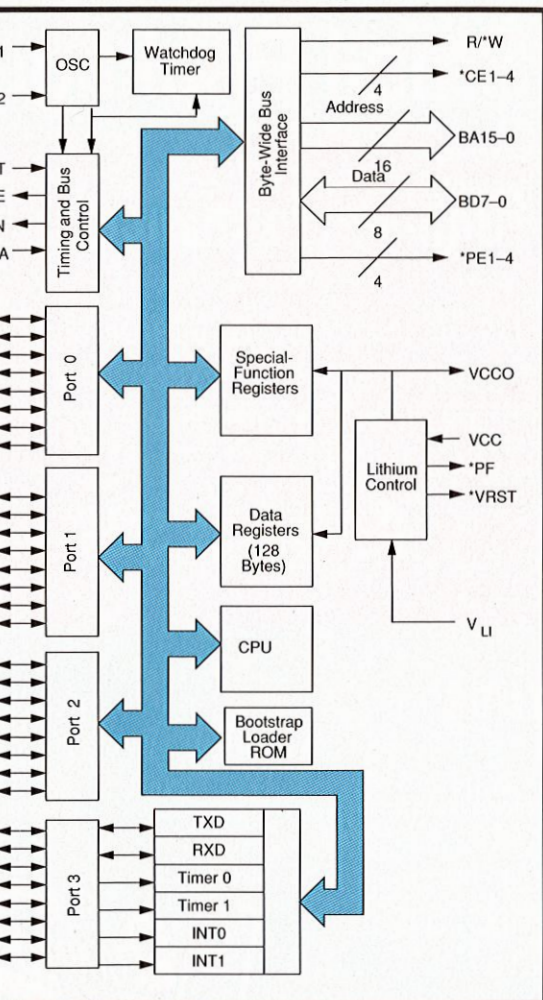
MULTISOURCE CODE

Old-timers will remember the heyday of second sourcing, when chip

Compatible with MCS-51 products
 8 KB of in-system reprogrammable downloadable flash memory
 SPI serial interface for program downloading
 Endurance: 1000 write/erase cycles
 2-KB EEPROM
 Endurance: 100,000 write/erase cycles
 4.0–6-V operating range
 Fully static operation: DC to 24 MHz
 Three-level program memory lock
 256 × 8-bit internal RAM
 32 programmable I/O lines
 Three 16-bit timer/counters
 9 interrupt sources
 Programmable UART serial channel
 SPI serial interface
 Low-power idle and power-down modes
 Interrupt recovery from powerdown
 Programmable watchdog timer
 Dual data pointer
 Power-off flag

		PDIP	
(T2) P1.0	1	40	VCC
(T2 EX) P1.1	2	39	P0.0 (AD0)
P1.2	3	38	P0.1 (AD1)
P1.3	4	37	P0.2 (AD2)
*(SS) P1.4	5	36	P0.3 (AD3)
(MOSI) P1.5	6	35	P0.4 (AD4)
(MISO) P1.6	7	34	P0.5 (AD5)
(SCK) P1.7	8	33	P0.6 (AD6)
RST	9	32	P0.7 (AD7)
(RXD) P3.0	10	31	*EA/VPP
(TXD) P3.1	11	30	ALE/*PROG
*(INT0) P3.2	12	29	*PSEN
*(INT1) P3.3	13	28	P2.7 (A15)
(T0) P3.4	14	27	P2.6 (A14)
(T1) P3.5	15	26	P2.5 (A13)
*(WR) P3.6	16	25	P2.4 (A12)
*(RD) P3.7	17	24	P2.3 (A11)
XTAL2	18	23	P2.2 (A10)
XTAL1	19	22	P2.1 (A9)
GND	20	21	P2.0 (A8)

Figure 1—Atmel, a flash '51 pioneer, offers a new '8252 which incorporates 8-KB flash memory for code and 2-KB EEPROM for data. The chip can be programmed in parallel or serial mode, the latter via a four-pin (select, clock, in, out) SPI interface.



The Dallas '5001FP supplements a standard '51 core with a dedicated code and data bus, freeing port pins to handle peripheral I/O functions.

rs battled for designers' share of y encouraging, at least on the y, wide sourcing. I remember a ola press conference where they the 68k's big tent with a bunch uses that included the likes of i, Philips, Rockwell, and others. n a purchasing agent's point of t was the golden age—much as it s for commodity ICs today. You all multiple distributors and get bidding against each other by each that the other guy was until only one was left standing. t might work for DRAMs, but micro business needs more fixed ment (for R&D, tools, etc.), and profits, than such destructive ition allows. Inexorably, the ourced micro disappeared and practically extinct. ept for the '51, that is. Of the old ar-horses, it's unique by virtue ligate sourcing. It's a veritable

people's micro, if you will.

This doesn't mean the laws of economics are repealed. Yes, you can shop around for a cheap, plug-compatible 8051. But don't expect suppliers to cut their own throats. They're about as excited about a lowball '51 deal as the folks at Rockwell or Hitachi are about a 68k inquiry. In other words, don't call me, I'll call you.

What it means is that, across the raft of suppliers, '51 designers have access to a broad spectrum of products—a lineup more extensive than possible from any single supplier. Furthermore, it means the '51 is continually freshened and upgraded, ensuring that the technology gap with newer architectures doesn't get too wide.

Finally, although true plug compatibility is limited to the old baseline chips, plug similarity goes a long way towards ensuring healthy competition. It's a lot easier to switch from one '51 to another with a few different features than to a completely new architecture.

Let's take a look at the latest developments on the '51 front, and you'll see what I mean.

FLASH IN YOUR FUTURE?

Flash micros are starting to take off, and there's a lot of reason to believe they'll become even more popular. Atmel, the undisputed leader in flash-based '51s, is well-positioned for such an eventuality. However, Philips (the largest '51 supplier overall) has recently announced plans to join the fray.

Before checking out the parts, realize that all flash micros aren't created equal. For example, first-generation flash micros are little more than an EPROM/OTP replacement because they use the same parallel programming scheme, $12.5 V_{pp}$, and so on.

This is OK, but it really doesn't support the popular idea of streamlined assembly line programming. Sure, it's possible to kludge together some kind of hack for a pseudo-EPROM flash chip (e.g., muxes for all the pins, switchable $12 V_{pp}$, etc.), but it isn't clean.

By contrast, Atmel's latest flash '51s, such as the 89S8252 shown in Figure 1, offer the best of both worlds. They still support parallel, high V_{pp} programming for those happy to stick with gang programming.

At the same time, they include a serial programmer that only needs a few pins (SPI interface) and a single power supply (5 V). Holding

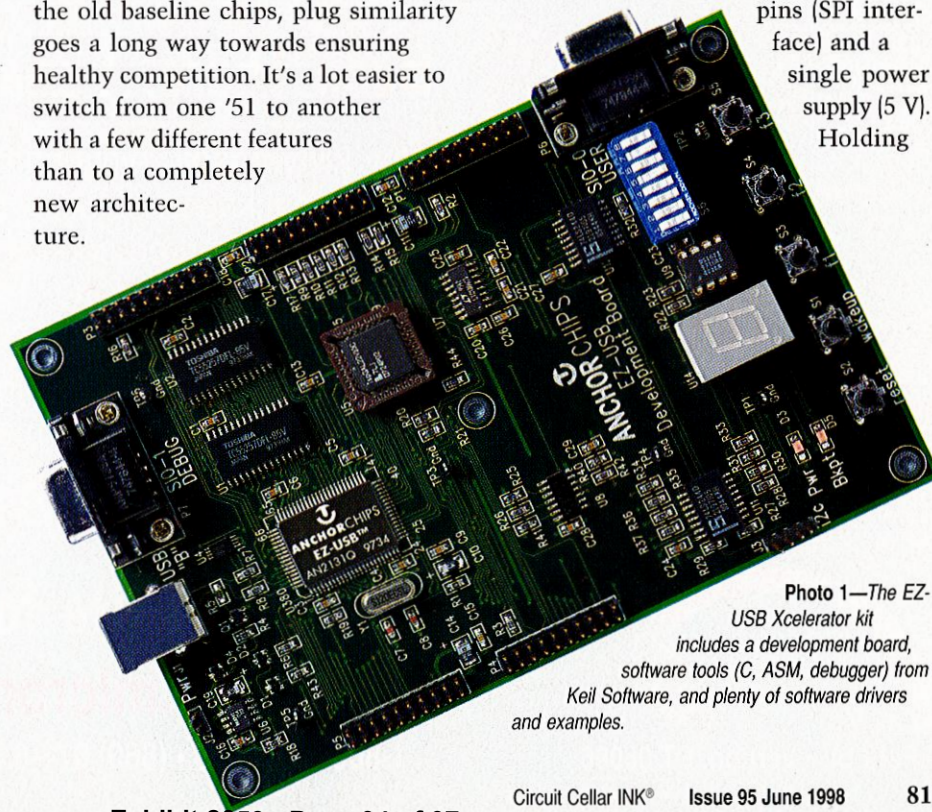


Photo 1—The EZ-USB Xcelerator kit includes a development board, software tools (C, ASM, debugger) from Keil Software, and plenty of software drivers and examples.

the part in RESET invokes the serial programming mode, which lets the flash (and extra 2 KB of on-chip data EEPROM) change a single byte at a time (i.e., no need to erase the entire chip).

The new Philips 89C51RX+ dishes up another flavor of flash memory. Like Atmel, Philips supports traditional parallel and in-system programming (ISP) modes.

However, the Philips ISP philosophy is subtly, but profoundly, different from Atmel's. Both parts are ISP in the sense of easy post-PCB assembly (re)programming. Philips goes a step further with self-programming that enables the chip to dynamically change its own code.

Here's how it works. A Boot ROM overlays the top 1 KB of code space, which contains routines to erase a block, program byte, verify byte, and so on. There's also a Boot Vector that defines what happens after RESET depending on the state of a flash-status byte. Execution at the Boot Vector can also be forced by external pin setting.

The Boot Vector in turn points to a user-written Loader in one block of the flash memory that's responsible for erasing and programming the other blocks. The Loader, taking advantage of calls to the Boot ROM, can self-program the chip using any technique. For example, using the 89C51RX+, you can remotely (re)program it via modem a built-in feature of your design.

Note the default shipping configuration includes a prewritten Loader to accept commands and data via the on-chip UART. That means a factory-fresh part can be inserted in a board and programmed serially at a later time.

One key difference: in serial programming mode, the Atmel part only

needs 5 V, whereas the Philips uses 12 V. For compatibility with existing programmers, both require high voltage for parallel programming.

Otherwise, Atmel and Philips parts have a lot of other neat features and upgrades. They have dual data pointers, fancier peripherals, watchdog timers, faster clocks, and more. Designers are sure to benefit from the battle for their flash '51 favor.

'51 RAM CRAM

Dallas Semi is known for its fast (4 clock/instruction at 33 MHz) 80C320, but it has other tricks up its sleeve, too.

The DS5001FP depicted in Figure 2 is an interesting alternative that combines a vanilla '51 with a dedicated byte-wide memory bus, so adding external memory doesn't consume I/O port pins. Four chip enables (*CE1-4) support various combinations of 32-KB blocks for a total of up to 128-KB memory. Likewise, four peripheral enables (*PE1-4) handle data accesses.

While any type of memory can be used, the DS5001FP is especially well-suited for SRAMs (see Figure 3). An on-chip voltage supervisor not only generates power-fail detect (*PF) and reset (*VRST) but also controls the previously mentioned byte-wide bus enables to prevent spurious writes.

Like Philips' flash parts, the '5001 includes a bootstrap loading feature that downloads the SRAM via serial port after first-time powerup. Once initialized and verified, the bootstrap loader leaves the stage, and power-management logic ensures that the SRAM remains valid (up to 10 years, depending on the battery). The SRAM need never again be touched (at least until the battery runs dry), but it can be rebootstrapped as often as desired by driving the *PROG input.

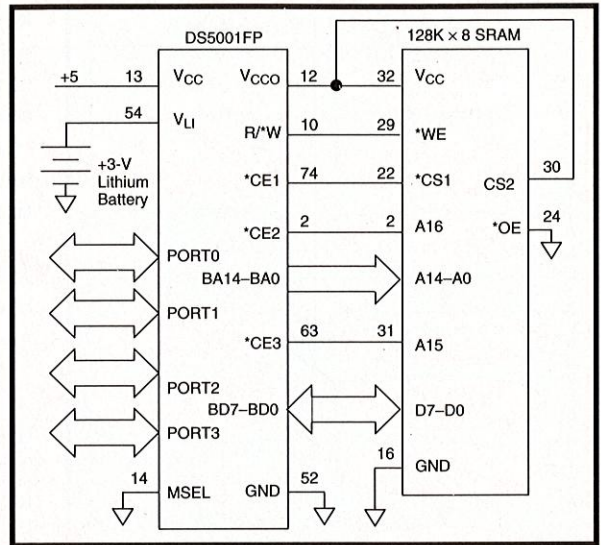


Figure 3—With built-in voltage supervisor, battery switching, and bootstrap ROM, the '5001FP is especially well-suited for SRAM connection. The chip completely manages the SRAM power and control signal generation, maintaining data integrity without needing any glue logic.

Besides the '5001 chip, Dallas also offers the DS2251T module, which combines the MCU with a 32-128 KB of SRAM, real-time clock, and battery.

"OH SAY CAN USB?"

That was the title of my article about USB in INK 74. There, I pointed out that the USB concept was grand, especially compared to the ludicrous rat's nest of parallel, serial, mouse, game pad, and so forth lurking behind PCs.

However, the downside of vaunted PC compatibility is inertia. I correctly reckoned USB wouldn't take off until the arrival of a critical mass of built-in driver software with Win98.

Despite the fact there's a zillion USB-capable PCs out there, the vast majority of USB ports are gathering dust.

The issue is complicated by the fact that Win98 seems to be slipping (no real surprise), with the rather interesting kicker that an awful lot of lawyers are involved. As well, the quality and quantity of USB support in Win98 remains to be seen. I overheard one Microsoft engineer saying they've "got more important networks to deal with."

The transition to Win98 and/or USB may not be as quick and clean as anticipated. At this point, USB is scratching for each peripheral design and inch of shelf space one torturous step at a time.

Ultimately, however, I believe the combination of automatic-installed base (i.e., USB on every motherboard) and

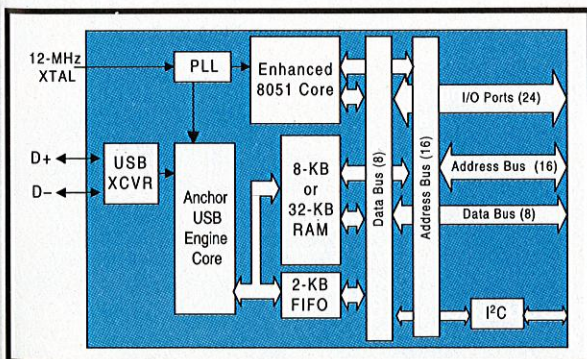
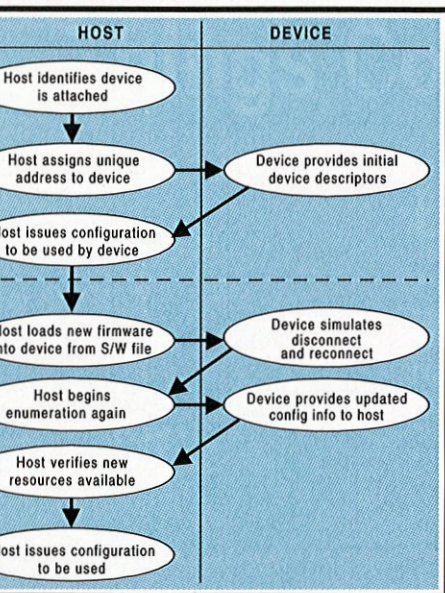


Figure 4—When USB finally starts rolling, look for '51-based derivatives like the Anchor Chips AN21xx to get onboard.



Bootup of the AN21xx is a two-step process. First, normal USB enumeration cycle, and application-specific firmware downloaded into the on-chip RAM. Next, reenumeration as the PC to the now-personalized chip.

sanity will prevail. And when the market for USB chips—none of them '51 based—will explode. The AN21xx from Anchor Chips is an example of the way new blood

keeps the '51 young at heart. It combines the best aspects of other derivatives in a unique combination (see Figure 4).

Anchor Chips starts with a hot-rodded four-clock/instruction core. A PLL fed by an external 12-MHz crystal generates the 24-MHz CPU clock and 12-/1.5-Mbps (high/low data rate) USB clock.

The USB engine is powerful, with a default device descriptor that lets it boot as a generic device. Logic handles the low-level transfer details, accomplishing an entire multipacket transaction in hardware. Thus, according to Anchor, managing the network consumes only 10% of CPU bandwidth, leaving the rest for application-specific processing.

Although a ROM version is available, Anchor's claim to fame is exploiting on-chip RAM—and there's a lot of it (up to 32 KB). There's also an extra 2 KB of USB FIFO which, using a ping-pong

approach, supports full 1024-byte isochronous (i.e., time-sensitive stuff like audio, video, and high-speed data acquisition) packet transfers in less than half of a single 1-ms USB frame.

The chip comes in low-cost 44- and 80-pin PQFP packages (Photo 1). Larger versions support external expansion by bringing the address and data bus (non-muxed, don't need a latch) off chip.

Another variant brings out only the data bus for connection to an external FIFO, providing dedicated read and write pins (*FRD, *FWR) to drive it. Otherwise, every version of the chip includes an I²C port and 24 I/O lines configurable to function as PIO or the usual alternates (e.g., UARTs, timers, interrupts, etc.).

Of course, a RAM-based design raises the obvious question of how to install code after powerup? One approach, like an FPGA, relies on accessing an external boot memory (either I²C or parallel) to load the on-chip RAM after powerup.

Anchor calls its more novel approach "reenumeration." The USB spec requires bus enumeration when a peripheral disconnects or connects (i.e., hot plug).

WIRELESS Data Links

TXM and SILRX modules are a transmitter and receiver which can achieve a one-way radio data link up to a distance of 10 miles over open ground.

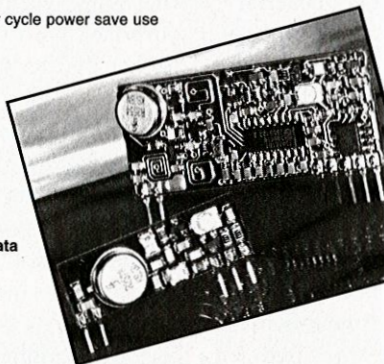
Units are supplied in space-saving single-in-line packages or SAW controlled, wide band FM transmission/reception. Modules are particularly suited to battery-powered, portable applications where low power and small size are critical design

Transmitter - TXM / Receiver - SILRX 418 MHz or 433 MHz

Bit rates, 5Kbps or 10Kbps * Selective double conversion superheterodyne or digital data input * Sensitive typ. 0.5uV (-113dBm) for 20dB SNR
 Frequency range 4.0 to 9.0V
 Standby time, <3ms for duty cycle power save use

Applications include:

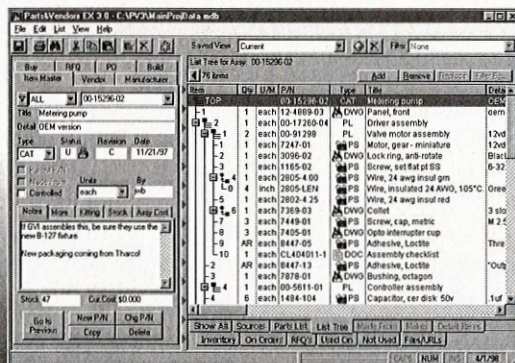
- Transfer through hostile environments
- Industrial process monitoring
- Alert systems
- System / lone patrol
- Battery powered half duplex data links
- Remote control



For sales in USA, CANADA, MEXICO, please contact:
Lemos International Co. Inc.
 100 Cambridge Street, Auburn, MA 01501, Tel: 508-798-5004, Fax: 508-798-4782
 E-mail: lemonsint@ma.ultranet.com
 RADIOMETRIX LTD PLEASE VISIT OUR WEB-SITE: WWW.RADIOMETRIX.CO.UK

Parts & Vendors™ 3

Parts List Software for Engineers and Designers New!



- Easily create and manage multi-level parts lists for products in development...and after.
- Track items-by-source, sources-by-item with price breaks.
- Generate Buy and Kit lists, plus other reports and labels.
- Launch CAD, viewer(s) or browser from any item's specs.
- Generate RFQ's/PO's, calculate product costs at any quantity.

For Windows 95/NT

Single User editions: \$299 and \$99 + s/h

Call 800-280-5176
 or visit www.trilogymdesign.com

Trilogy
 DESIGN

530-273-1985 Fax 530-477-9106
 P.O. Box 2270, Grass Valley, CA 95945



At powerup, the Anchor chip automatically enumerates as a default USB device. Then, as shown in Figure 5, a host PC downloads the '51 code via the USB connection into the on-chip RAM.

Once loaded, the chip simulates a disconnect/reconnect, causing the host PC to reenumerate. This time, Anchor's chip responds to interrogation with the just downloaded device description.

This feature provides a neat chameleon-like capability. For instance, take a piece of USB-based data-acquisition gear with a variety of functions and modes. Depending on the task, an Anchor-based solution can switch hats by redefining the number of endpoints (up to 16), type of connection (e.g., isochronous, bulk, interrupt, control), and FIFO allocation appropriately.

AND THE CHIP PLAYED ON

The 8-bit micro was initially pronounced dead 20 years ago during the height of the original showdown between the 8086 and 68k.

The marketing guy giving the premature eulogy moved on to a small

startup. The company did very well over the years, making him quite wealthy along the way.

If you haven't already guessed, that company's success was based in no small part on a popular line of 8-bit chips! You can bet I always ask him if the 8-bit market is dead yet every time I see him.

MCUs may come and go, but '51s are here forever. ☐

Tom Cantrell has been working on chip, board, and systems design and marketing in Silicon Valley for more than ten years. You may reach him by E-mail at tom.cantrell@circuitcellar.com, by telephone at (510) 657-0264, or by fax at (510) 657-5441.

SOURCES

89S8252
Atmel Corp.
2125 O'Nel Dr.
San Jose, CA 95131
(408) 441-0311
Fax: (408) 436-4300
www.atmel.com

89C51RX+

Philips Semiconductors
811 E. Arques Ave.
Sunnyvale, CA 94088-3409
(408) 991-5207
Fax: (408) 991-3773
www-us2.semiconductors.philips.com/microcontrol

DS5001FP, DS2251T

Dallas Semiconductor
4401 S. Beltwood Pkwy.
Dallas, TX 75244-3292
(972) 371-4448
Fax: (972) 371-3715
www.dalsemi.com

AN21xx

Anchor Chips, Inc.
12396 World Trade Dr., MS 212
San Diego, CA 92128
(619) 613-7900
Fax: (619) 676-6896
www.anchorchips.com

IRS

428 Very Useful
429 Moderately Useful
430 Not Useful

LOW COST... LOW POWER...

LOW RISC! \$1.99

OEM (1K) PRICE
\$1.99
EVAL KIT 7.00

A LOWER COST, FASTER, EASIER TO PROGRAM SINGLE CHIP COMPUTER

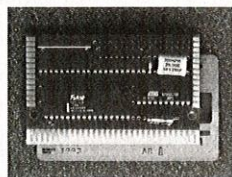
COMPARE:	16C54	MV1200	PINOUT:	
OEM (1K) PRICE	\$2.57	\$1.99	RESET	1 20 VCC
RS232 PROGRAM DOWNLOAD	NO	YES	PD0	2 19 PB7
SINGLE CHIP OPERATION	NO	YES	PD1	3 18 PB6
BUILT-IN BASIC	NO	YES	XO	4 17 PB5
EEPROM DATA MEMORY	NONE	64	XI	5 16 PB4
PROGRAM MEMORY	768 OTP	1K FLASH	PD2/INT	6 15 PB3
MATH REGISTERS	1	32	PD3	7 14 PB2
MAX INSTRUCTIONS/SEC	5M	20M	PD4/TMR	8 13 PB1/AD1
MAX COUNTER BITS	16	18	PD5	9 12 PB0/AD0
INPUT/OUTPUT BITS	12	15	GND	10 11 PD6
A TO D COMPARATOR	NO	YES		
HARDWARE INTERRUPTS	NONE	3		

- LONGER WORD INSTRUCTION - FRIENDLY SYMMETRIC ARCHITECTURE -

CREDIT CARD COMPUTER

OEM (1K) PRICE
\$21
EVAL KIT \$75.00

- RS232/SPI program download
- 256k NV mem., expand. to 8meg
- LCD / keyboard interface
- ISA Bus (modem, memory, etc.)
- RS232/485 serial to 115.2kbaud
- Use assembly or built in BASIC
- 100 microamp OPERATION



visit our web site: www.star.net/people/~mvs

MVS BOX 850
MERRIMACK, NH 03054
(508) 792-9507

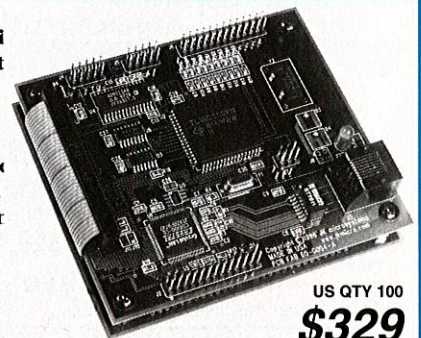


5yr Limited Warranty
Free Shipping
Hrs: Mon-Fri 10-6 EST

FlashLite 386Ex w/ DOS

Embedded Ethernet

- 386Ex / 25 Mhz
- Includes DOS, and flash file support
- 4 PC Compatible Serial Ports
- 1 Printer Port
- 10BASE-T Ethernet
- Drivers included
- 34 Parallel I/O Ir
- Watchdog Timer
- Battery-backed Real Time Clock
- PC speaker port
- Supports Borland QuickBasic and other DOS compilers
- 32-bit processor can run 386 protected mode code
- Compatible with a variety of TCP/IP stacks
- Up to 1M SRAM or Flash
- DIP socket for user EPROM



US QTY 100
\$329

Development kits available

Full featured C++ compiler with target debugging \$99

530-297-6073

Fax 530-297-6074

www.jkmicro.com

jkmicro@jkmicro.com



JK microsystems