SILICON LABORATORIES

Microcontroller Products

Presented By

Ross Bannatyne and Derrell Coker

May 25, 2004

MCU Marketing Overview

- MCU contacts
- Positioning and product differentiation
- Product family and roadmap
- MCU target applications
- Competition
- New product—F350 and F353
- New product—F41x
- New product—F064 and F067
- MCU sales tools
- 2004 marcom plan
- Summary

SILICON LABORATORIES

MCU Marketing Contacts

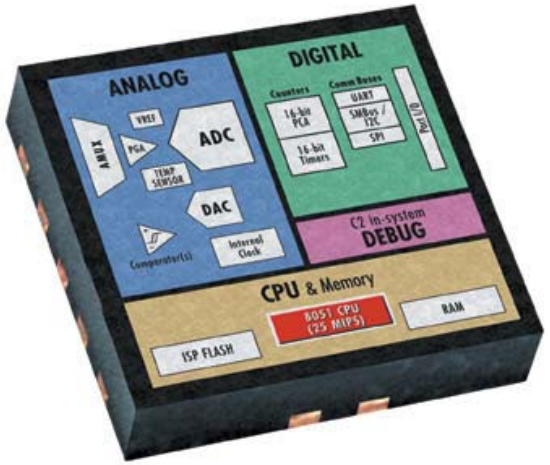
- **Danny Allred** (Phone: 512 532 5209)
  - USB MCUs (F320, F321)
  - Fixed Function products (CP2101)
- **Keith Coffey** (Phone: 512 532 5213)
  - Precision Mixed Signal MCUs (F00x, F01x, F02x, F12x)
  - CAN MCUs (F04x, F06x)
- **Agustin Schuster** (Phone: 512 532 5818)
  - Small Form Factor MCUs (F30x, F31x, F33x)
  - General Purpose MCUs (F20x, F22x, F23x)
  - Americas Distribution, Europe Distribution
- **May Ann Choo** (Phone: TBD)
  - Ultra-Low Power MCUs (F41x)
  - Asia Distribution

- **Gary Daniels** (Phone: 512 532 5219)
  MCU Adviser to Dan Artusi
  - Focus on Automotive, Universities
- **H.L. Lau** (Phone: +852 9018 0882)
  - MCU Sales Manager, APAC
- **Ross Bannatyne** (Phone: 512 532 5780)
  - Director of Marketing, MCU Products

SILICON LABORATORIES

MCU Marketing Overview

- MCU contacts
- Positioning and product differentiation
- Product family and roadmap
- MCU target applications
- Competition
- New product—F350 and F353
- New product—F41x
- New product—F064 and F067
- MCU sales tools
- 2004 marcom plan
- Summary

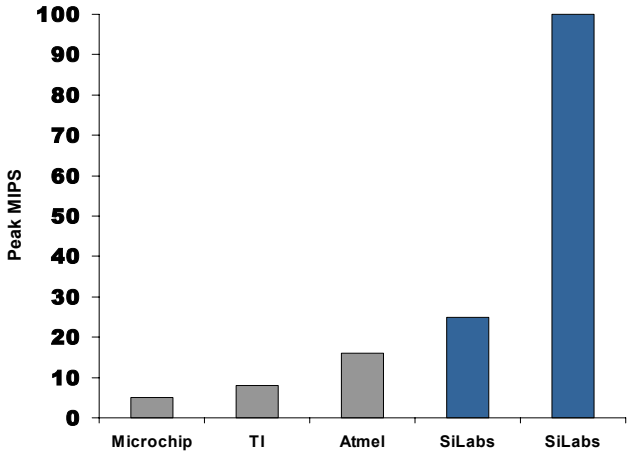


SILICON LABORATORIES

Industry Leading Microcontrollers

Best Analog.

Smallest.



Fastest.

SILICON LABORATORIES

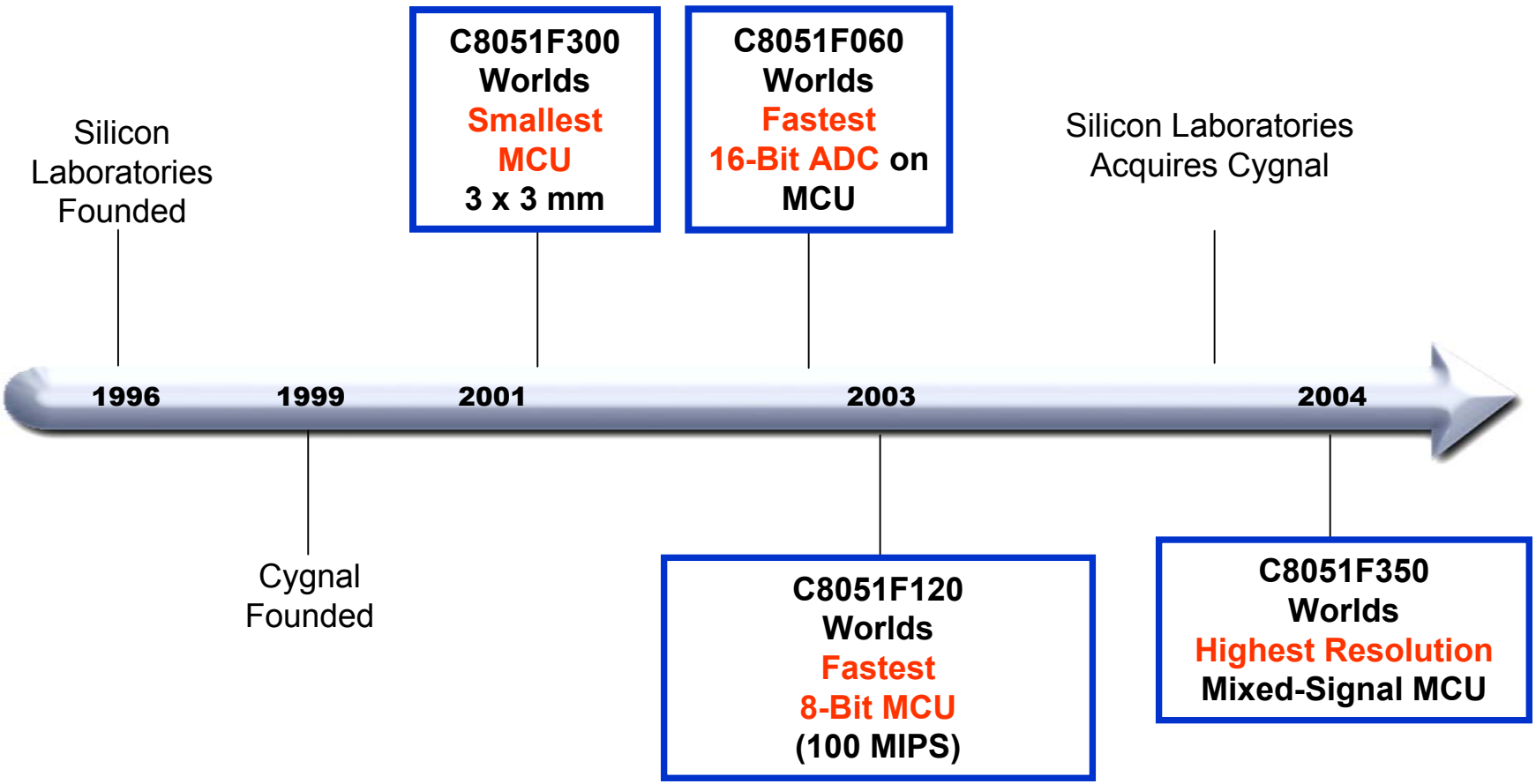
Consistent Product Positioning

Global Leadership in High-Performance, Analog-Intensive, Mixed-Signal IC Solutions

MCU Positioning fits *exactly* into the overall Silicon Labs positioning

SILICON LABORATORIES

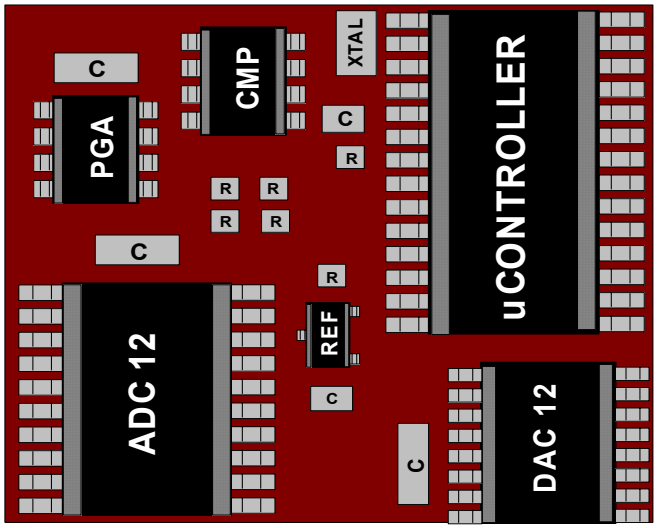
Silicon Labs MCU Evolution

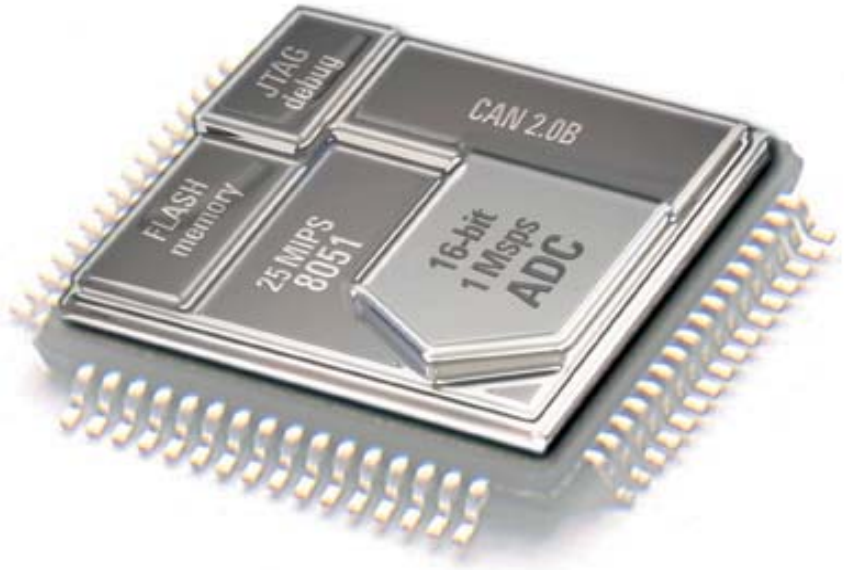


SILICON LABORATORIES

Silicon Labs MCU System-on-Chip

19.4 x 16.5 mm = 320 mm ^{2}

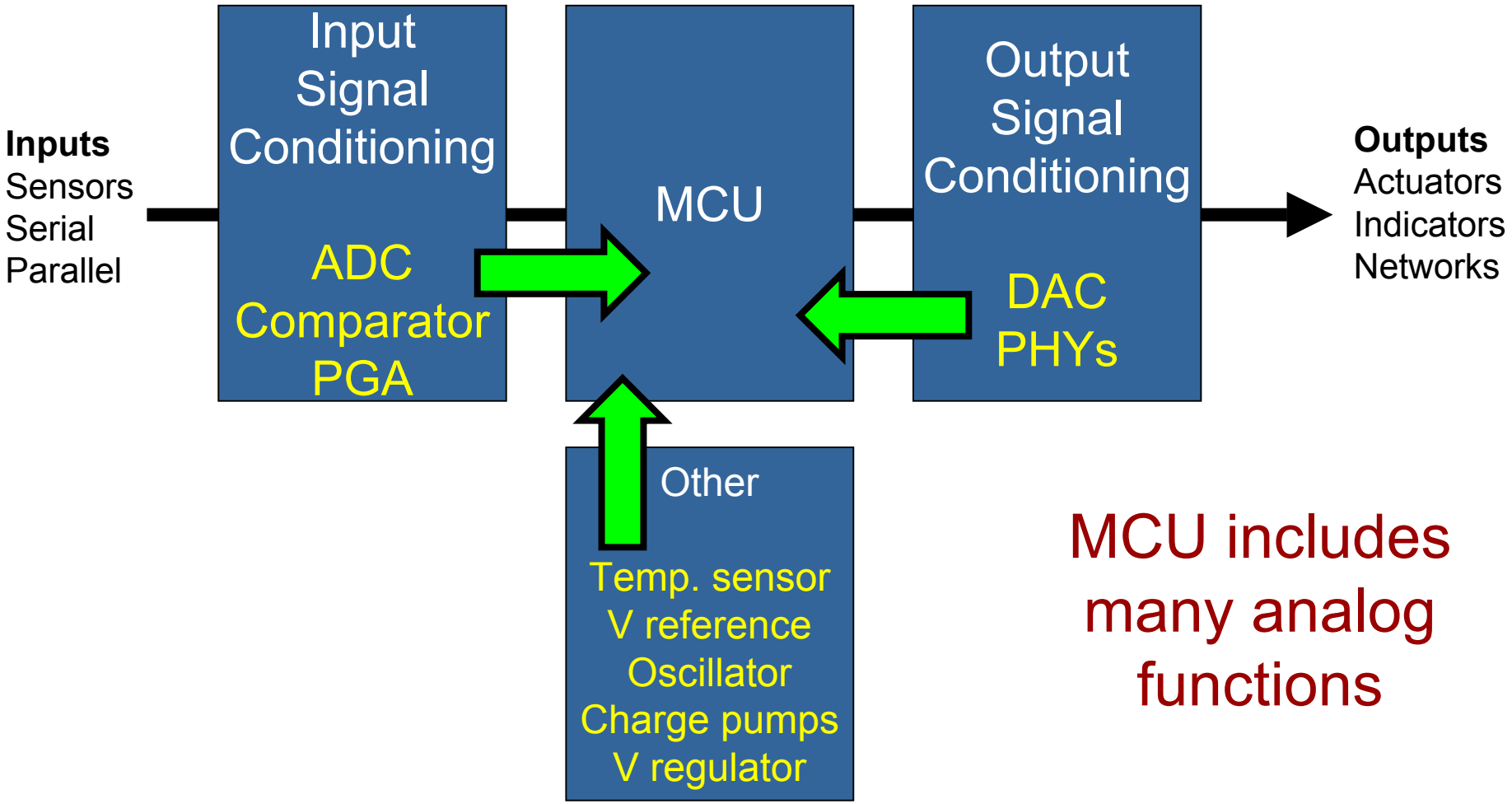




- Silicon Labs MCUs are mixed-signal system chips
- Reduce size, simplify design, simplify logistics, increase reliability, increase performance, shorten design-time, reduce power consumption, decrease time-to-market

SILICON LABORATORIES

Typical MCU-based Embedded System



MCU includes many analog functions

One Page Summary of Key MCU Features

Flash Memory:
On-chip charge pump
Small segments
Security
Emulates byte EEPROM

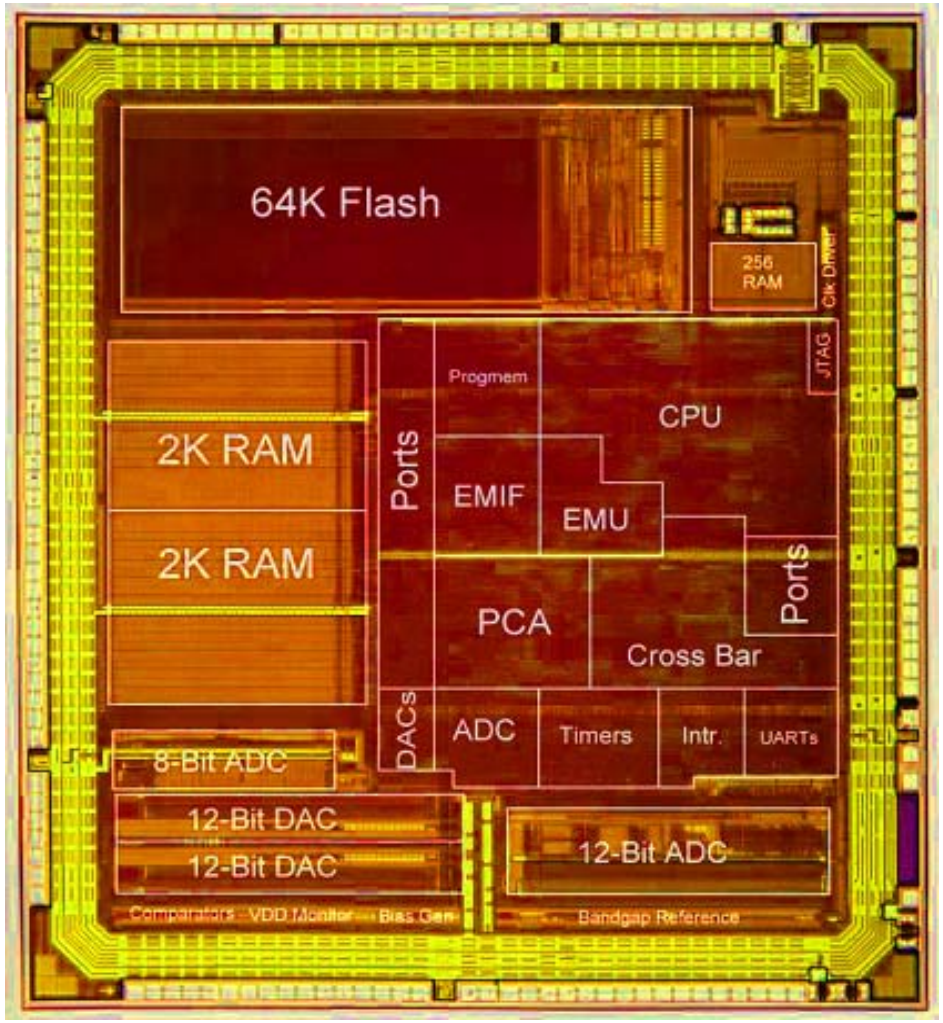
Cross Bar:
Custom select I/O

Serial Comms:
UART
SPI
SMBus
USB 2.0
CAN 2.0B

I/O:
Dynamically reconfigurable

Digital-to-Analog:
Up to 12-Bit

Analog:
Temperature sensor
Programmable comparators



8051 CPU:
Up to 100 MHz
Many 1-Cycle Instructions
Pipelined
Object code compatibility

Debug:
On-chip JTAG-based

Timers:
Capture
Compare
Accumulate
PWM
RTC

Analog-to-Digital:
Up to 16-Bit SAR
Up to 24-Bit Sigma-Delta
Up to 1Msps
Dual ADC option
Up to 32-Channels
Selectable Vref

SILICON LABORATORIES

Analog-to-Digital Converter Benefits

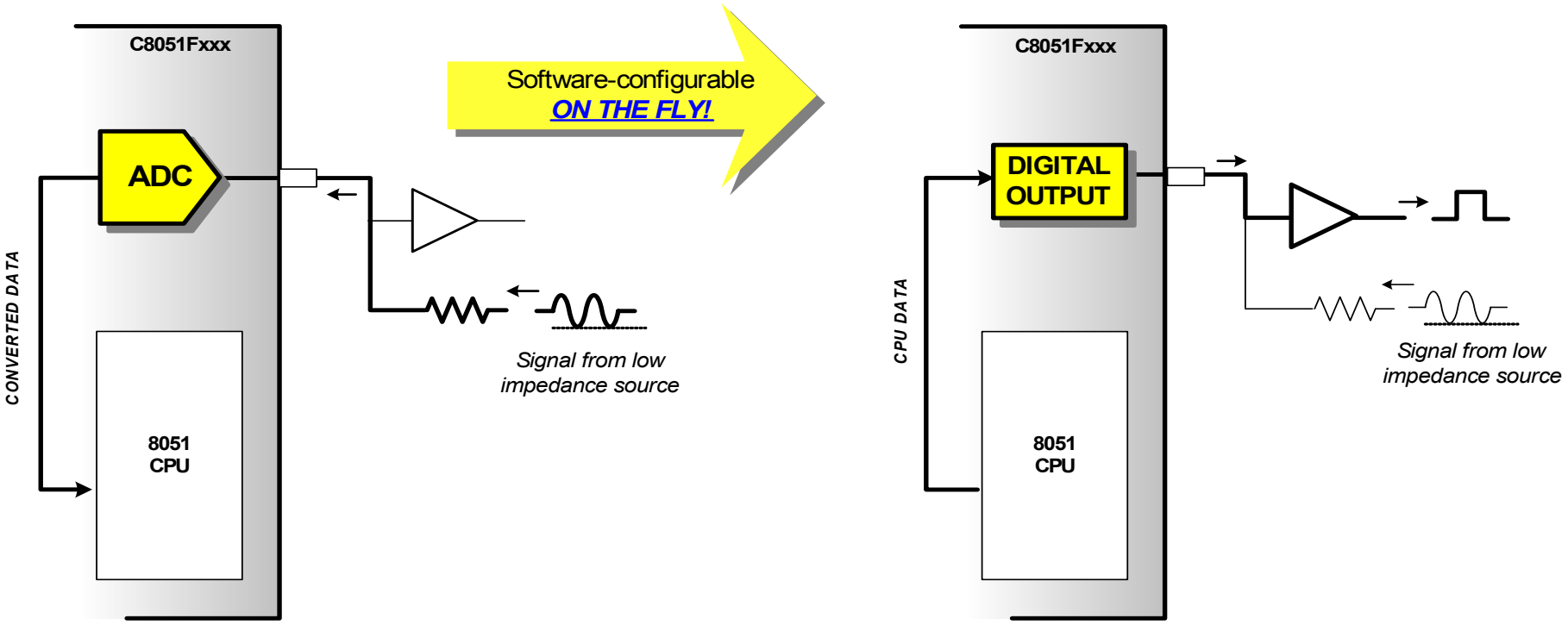
	C8051F300	C8051F330	C8051F005	C8051F060	C8051F350
Resolution	8-Bit	10-Bit	12-Bit	16-Bit	24-Bit
Speed (sps)	500K	200K	100K	1M	1000
SINAD (dB)	48	55.5	66	89	2.4uV*
INL (LSB)	±0.5	±0.5	±1.0	±1.0	±15 ppm
DNL (LSB)	±0.5	±0.5	±1.0	±0.5	N/A
Offset	±0.6 LSB	0 LSB	±1 LSB	0.1mV	±1 ppm
Gain	±0.5 LSB	1 LSB	±3 LSB	0.008%FS	0.002%FS
Vref (V)	None	2.4	2.4	2.4	2.4

* Gain = 1, Output word rate = 10 Hz

Key features of Silicon Labs analog-to-digital converters:

- ADCs include selectable external or internal (2.5 V) voltage reference
- ADCs include programmable gain amplifier
- Guaranteed monotonic
- Specifications comparable to standalone ADCs

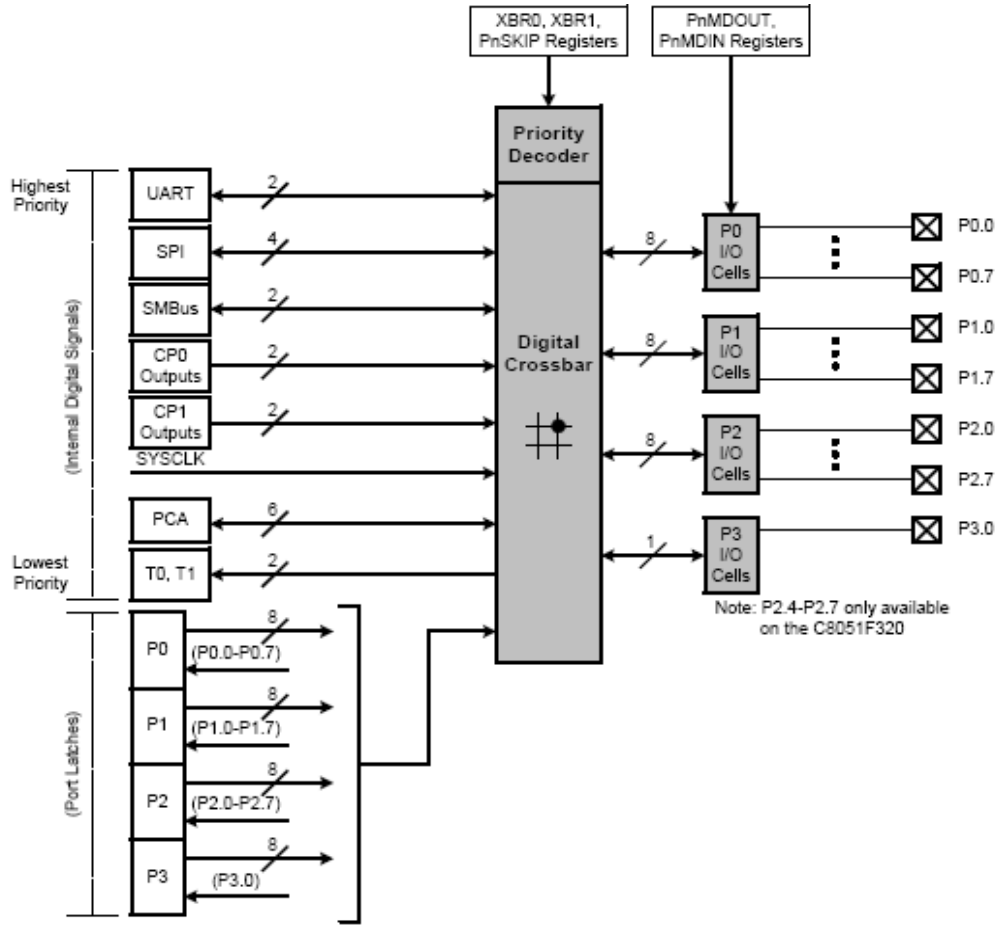
Dynamically Configurable I/O



Analog Input

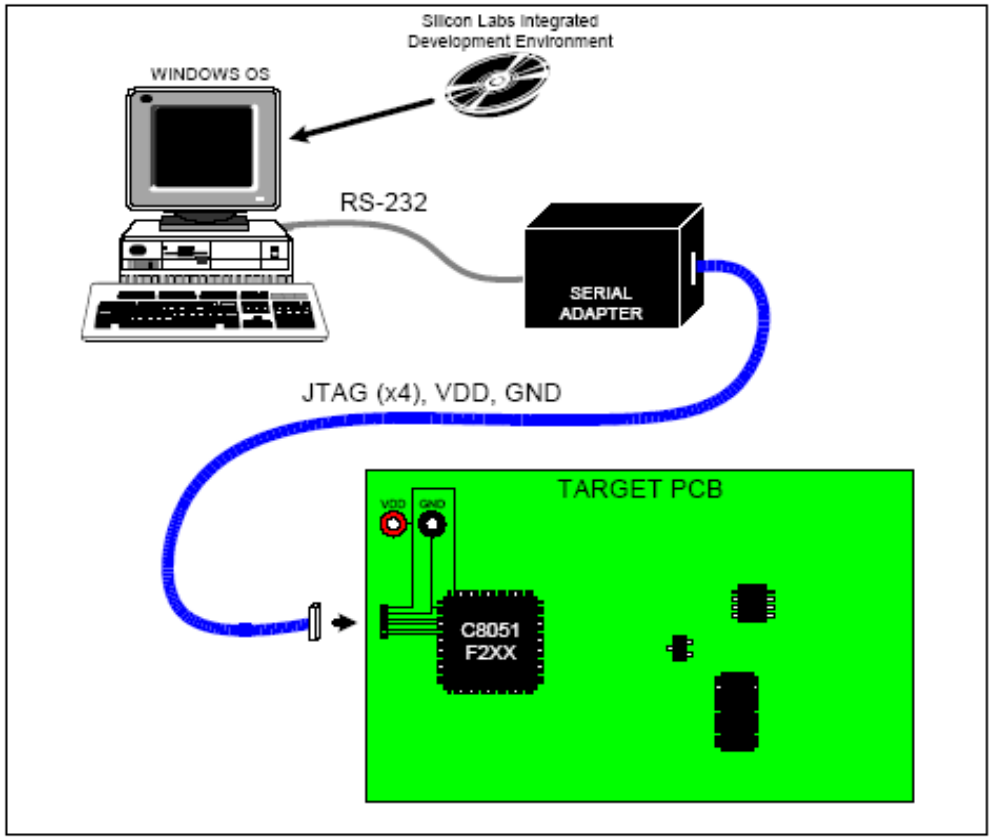
Digital Output

Programmable Crossbar



- Provides mapping from peripherals to Port I/O
- Allow user to select exact I/O functions for application

JTAG-Based Debugging

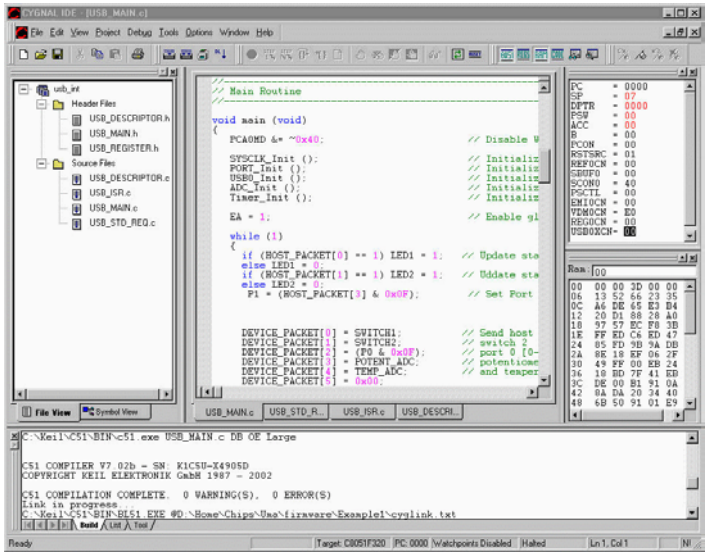


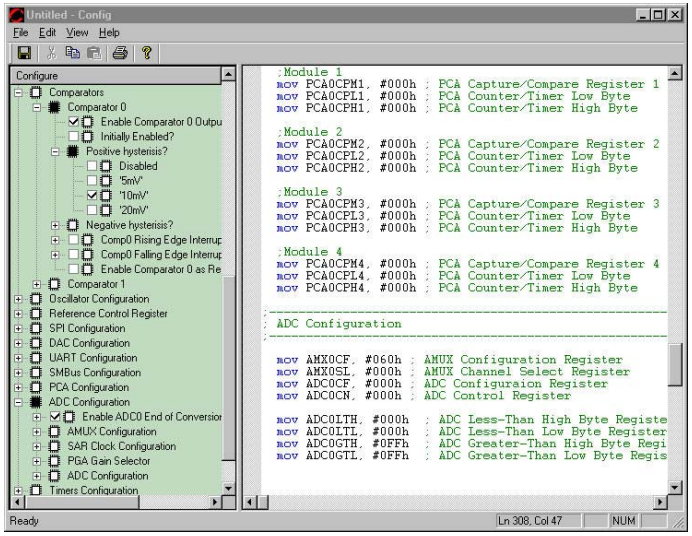
Four pin JTAG interface

- Non-intrusive, full speed in-circuit debugging
- Serial adapter used to interface between PC and JTAG port on target board

Ease of Development

- Windows based IDE
  - Full-featured editor
  - Full macro-assembler with evaluation C-compiler
  - Full debugger support
  - Support for 3rd party tools



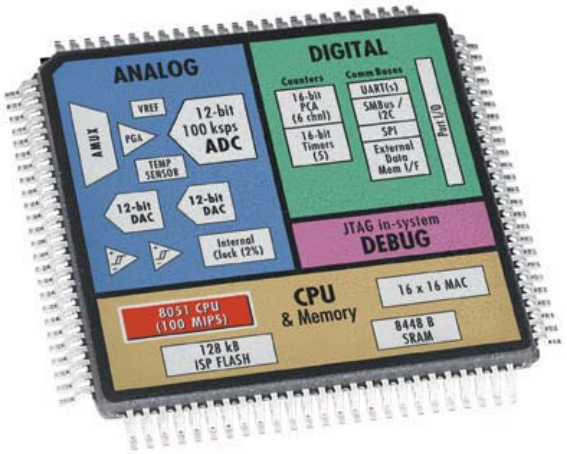


- Configuration wizard
  - Automatically generate configuration code
  - Full peripheral support for C8051 families
  - Generates both C and assembly

Software Development Tools

MCU Marketing Overview

- MCU contacts
- Positioning and product differentiation
- Product family and roadmap
- MCU target applications
- Competition
- New product—F350 and F353
- New product—F41x
- New product—F064 and F067
- MCU sales tools
- 2004 marcom plan
- Summary



SILICON LABORATORIES

C8051F Microcontroller Product Families

Small Form Factor

Packages as small as 3 x 3mm

General Purpose Mixed-Signal

ADC Resolutions up to 12-Bits
Programmable Comparators

Precision Mixed-Signal

16-Bit Successive Approximation ADC
24-Bit Sigma-Delta ADC
12-Bit DAC
Programmable Comparators
CPU speed up to 100 MIPS

CAN

CAN 2.0B Controller
16-Bit Successive Approximation ADC
Programmable Comparators

USB

Full Speed USB 2.0
Integrated Transceiver
No external Oscillator or EEPROM

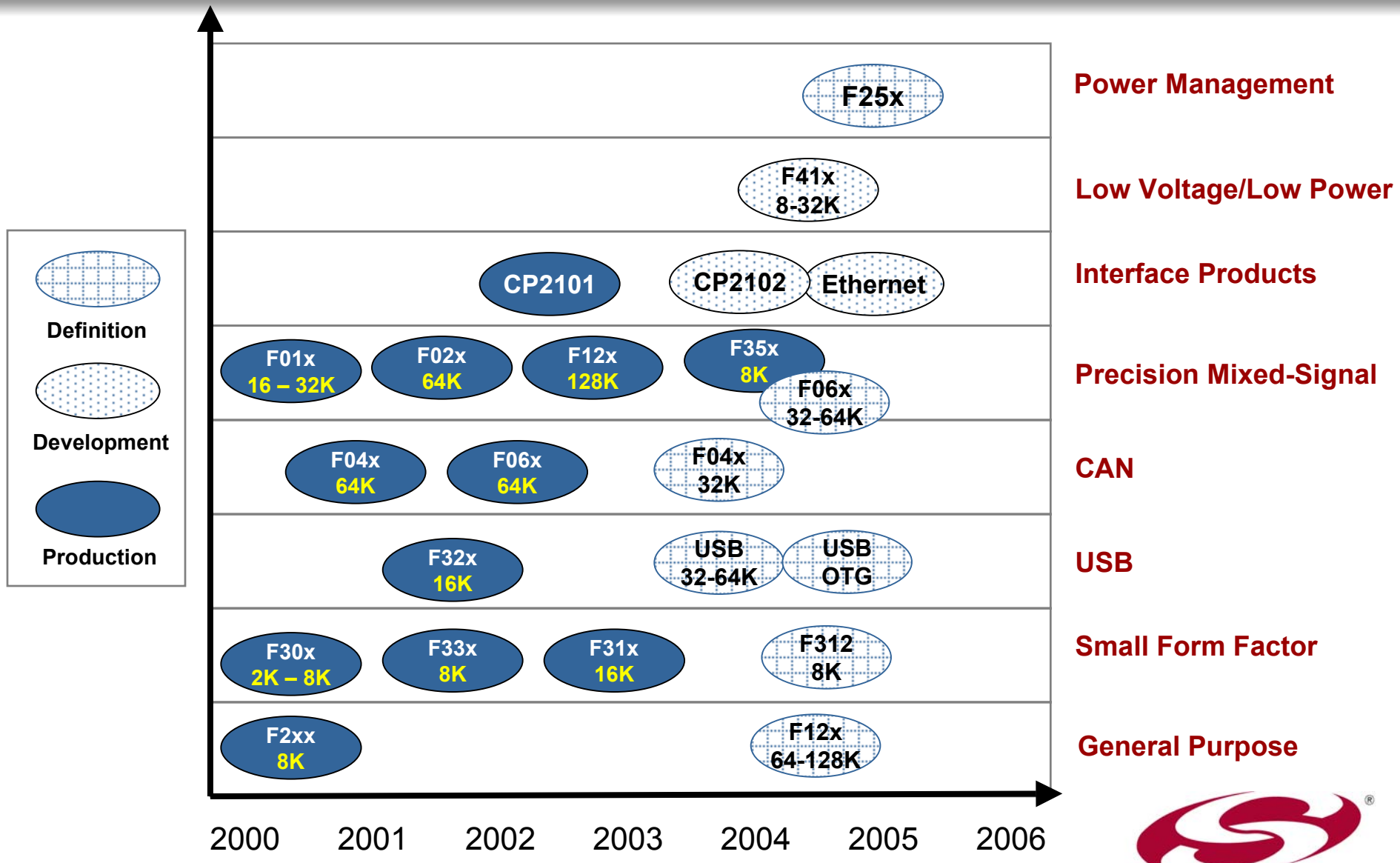
SILICON LABORATORIES

MCU Product Families

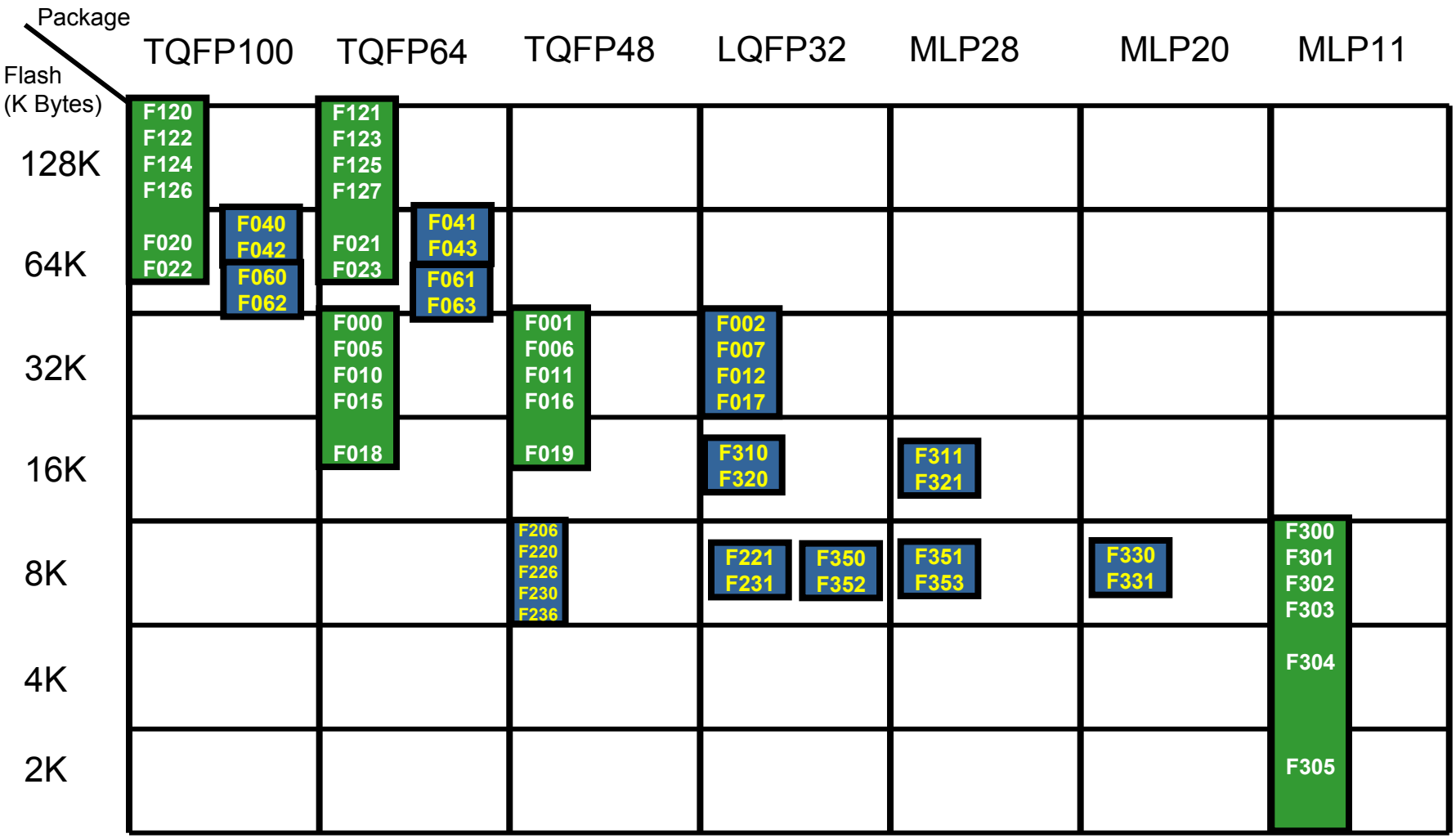
	Capture	Compute	Communicate	Additional
Small Form Factor C8051F3xx MLP MCUs $0.99–$3.28 per 10 Kµ	10-bit ADC, 10-bit DAC, Temp Sensor, V_{REF}	25 MIPS, 16 kB Flash	UART, SPI, SMBus	2% Osc, 3x3 to 5x5 mm footprint Comparators
Precision Mixed-Signal C8051F12x/0xx/35x $3.28–$12.40 per 10 Kµ	24-bit ADC, 12-bit DACs, Temp Sensor, V_{REF}	100 MIPS, 16x16 MAC, 128 kB Flash	2 UARTs, SPI, SMBus	2% Osc Comparators
USB C8051F32x MCUs $3.98–$4.27 per 10 Kµ	10-bit ADC, Temp Sensor, V_{REF}	25 MIPS, 16 kB Flash	USB, UART, SPI, SMBus	Clock Recovery, 5x5 mm footprint Comparators
CAN C8051F0xx MCUs $8.04–$18.02 per 10 Kµ	16-bit ADCs, 12-bit DACs, 60 V PGA, Temp Sensor, V_{REF}	25 MIPS, 64 kB Flash	CAN 2.0B, 2 UARTs, SPI, SMBus	2% Osc Comparators
General Purpose C8051F2xx MCUs $2.39–$3.67 per 10 Kµ	12-bit ADC	25 MIPS, 8 kB Flash	UART, SPI	48-pin TQFP Comparators
Interface Products CP2101 $2.42 per 10 Kµ	USB to UART Bridge	USB Controller 512B EEPROM	USB Transceiver UART	V regulator 48 MHz Osc.

SILICON LABORATORIES

Product Roadmap

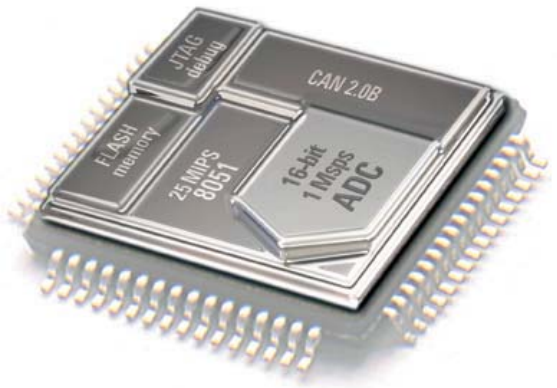


Pin-for-Pin Compatibility



MCU Marketing Overview

- MCU contacts
- Positioning and product differentiation
- Product family and roadmap
- MCU target applications
- Competition
- New product—F350 and F353
- New product—F41x
- New product—F064 and F067
- MCU sales tools
- 2004 marcom plan
- Summary



SILICON LABORATORIES

MCU Target Applications

- CAN
  - CAN applications
- Precision Mixed-Signal
  - XFP Laser Regulators
  - Glucose Meters
  - Weigh scales
- Interface
  - PDA/cell phone cable
  - RS-232 upgrade
- USB
  - Flash memory stick
- Small Form Factor
  - Magnetic stripe reader
  - Power sequencer
- General Purpose
  - F206 targets

These applications are well suited to Silicon Labs MCUs—please look out for other similar applications !

SILICON LABORATORIES

SILICON LABORATORIES

CAN Applications

Featuring the C8051F060 MCU

CAN Background

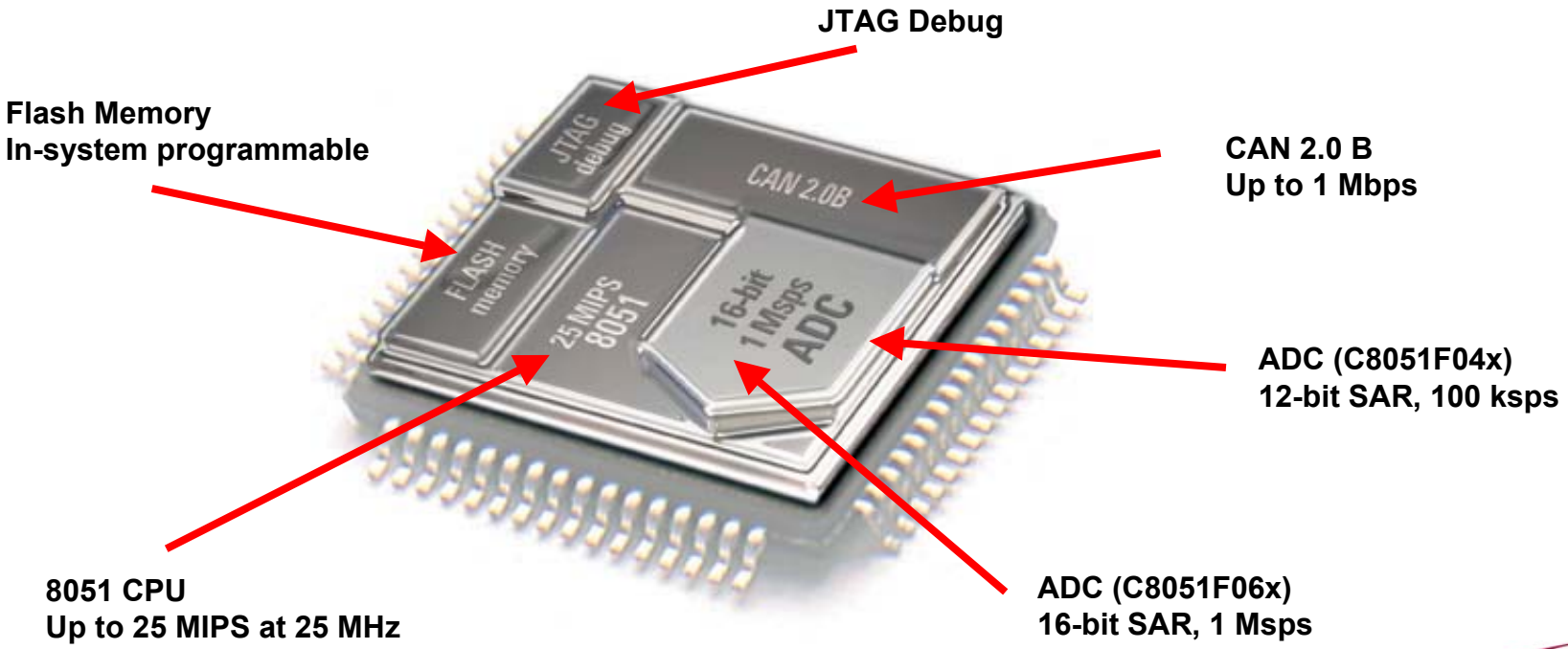
- History
  - Real-time distributed smart network
  - Used as a rugged, reliable, industrial grade communication link
  - Developed in Europe by Bosch
  - Relatively expensive network (when compared to SPI, I2C, etc.)

- Applications
  - Automobiles
  - Industrial networks

- Technical High Lights
  - Multi-master
  - Scalable (can upgrade network by simply adding a new node).
  - Communication and or data transmission starts with message ID/arbitration number followed by framed data packet
  - Built-in CRC16 error check scheme
  - Non destructive- No collisions in arbitration; similar to I2C.

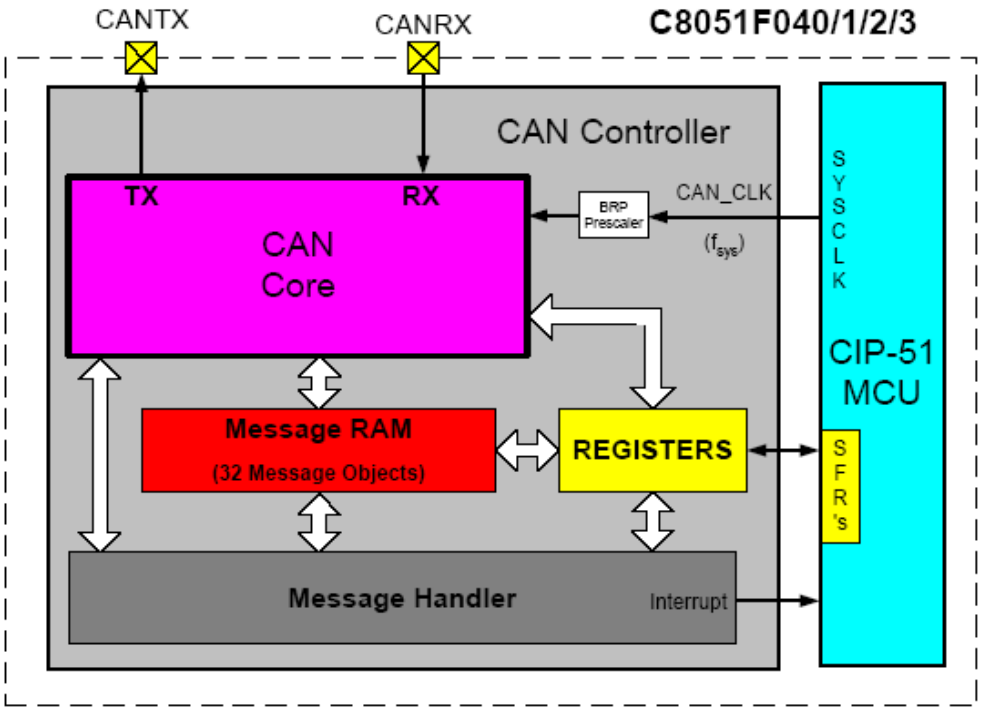
C8051F04x/06x Features and Benefits

Part Number	MIPS (peak)	Flash Memory (bytes)	RAM (bytes)	Ext Mem I/F	Digital Port I/O Pins	Serial Buses	Timers (16-bit)	PCA Chnls	Internal Osc	ADC	DAC	Temp Sensor	Other Analog	Package
C8051F040	25	64KB	4352	Y	64	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	12-bit, 13ch., 100ksps	12-bit, 2ch.	Y	60V PGA, VREF, 3 comparators	TQFP100
C8051F041	25	64KB	4352	Y	32	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	12-bit, 13ch., 100ksps	12-bit, 2ch.	Y	60V PGA, VREF, 3 comparators	TQFP64
C8051F042	25	64KB	4352	Y	64	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	10-bit, 13ch., 100ksps	12-bit, 2ch.	Y	60V PGA, VREF, 3 comparators	TQFP100
C8051F043	25	64KB	4352	Y	32	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	10-bit, 13ch., 100ksps	12-bit, 2ch.	Y	60V PGA, VREF, 3 comparators	TQFP64
C8051F060	25	64KB	4352	Y	59	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	16-bit, 2ch., 1Msps	12-bit, 2ch.	Y	VREF, 3 comparators	TQFP100
C8051F061	25	64KB	4352	Y	24	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	16-bit, 2ch., 1Msps	12-bit, 2ch.	Y	VREF, 3 comparators	TQFP64
C8051F062	25	64KB	4352	Y	59	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	16-bit, 2ch., 1Msps	12-bit, 2ch.	Y	VREF, 3 comparators	TQFP100
C8051F063	25	64KB	4352	Y	24	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	16-bit, 2ch., 1Msps	12-bit, 2ch.	Y	VREF, 3 comparators	TQFP64



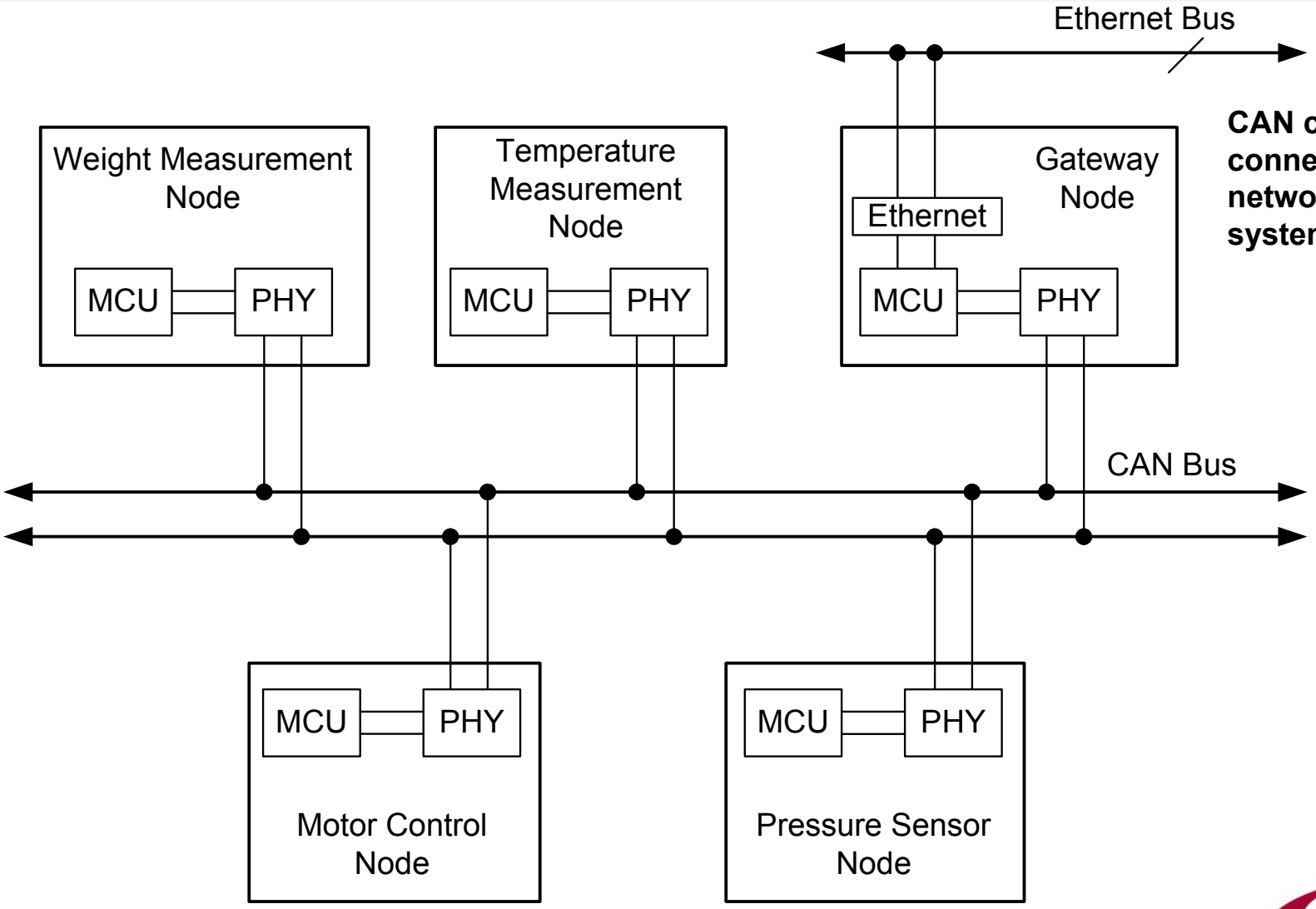
SILICON LABORATORIES

CAN 2.0B Controller



- Supports 2.0A (basic CAN) and 2.0B (full CAN)
- Independent message RAM
- Message handler state machine
- Control registers
- Up to 1 Mbit/second
- 32 message objects with individual identifier masks
- All protocol functions performed by CAN controller

CAN Network: Block Diagram



CAN MCU Competitors

	Silicon Labs C8051F040	Silicon Labs C8051F060	Atmel AT89C51CC03	Microchip PIC18F248	Motorola 68HC08AZ32A/60	Infineon C505
Primary ADC	**12-bit**	**16-bit**	10-bit	10-bit	8-bit	10-bit
60 V Diff. Amp.	Yes	(None)	(None)	(None)	(None)	(None)
2nd ADC (1 Msps 16-bit)	(None)	Yes	(None)	(None)	(None)	(None)
CPU (Max MIPs)	**25 MIPS 8051**	**25 MIPS 8051**	5 MIPS 8051	10 MIPS PIC	3MIPS	3.33 MIPS 8051
Memory	64 k Flash	64 k Flash	64k Flash	32k Flash	32/64 k ROM	32 k ROM/OTP
# Message Objects	**32**	**32**	15	<5	<5	15
Power (mW)	**~40mW**	**~50mW**	~75mW	~100 mW	~150 mW	~150 mW
Temperature Range	-40 °C - 85 °C	-40 °C - 85 °C	-40 °C - 85 °C	-40 °C - 125 °C	-40 °C - 125 °C	-40 °C - 150 °C
Package Footprint	144 mm^2	144 mm^2	64 mm^2	144 mm^2	305 mm^2	169 mm^2

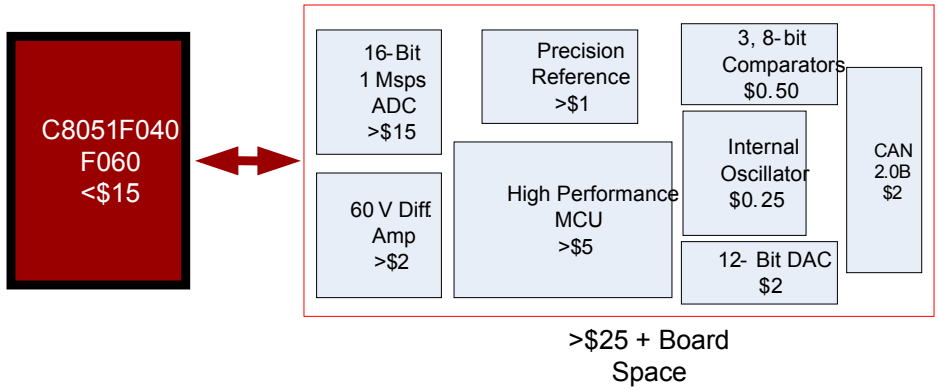
Silicon Labs CAN MCU Advantages

- **Best ADC Performance**
- **Fastest CPU throughput**
- **Lowest power consumption**

SILICON LABORATORIES

CAN Target Customers

- Main value proposition
  - CAN2.0B
  - World class analog
    - Up to 16-Bit, 1 Msps ADC
    - 60 V CM, DIFF Amp
- Applications and Customers
  - Asia
    - Minolta
    - Honda
    - Mitsubishi
  - Americas
    - Allen Bradley
    - Emerson
    - Nellcor
    - Palcolabs
    - Honeywell
    - GM, Ford
  - Europe
    - Phillips Medical Systems
    - Datex-Ohmeda Division
    - Drager Medical AGBWM
    - BMW, VW



>$25 + Board Space

- Collateral and App. Notes
  - Bosch CAN Users Guide
  - AN119: Calculating Settling Time for Switched Capacitor ADCs
  - Third Party High Layer Protocol Support: Vector and Port

SILICON LABORATORIES

SILICON LABORATORIES

XFP Laser Regulator

Featuring the C8051F12x MCU

XFP Laser Regulator Background

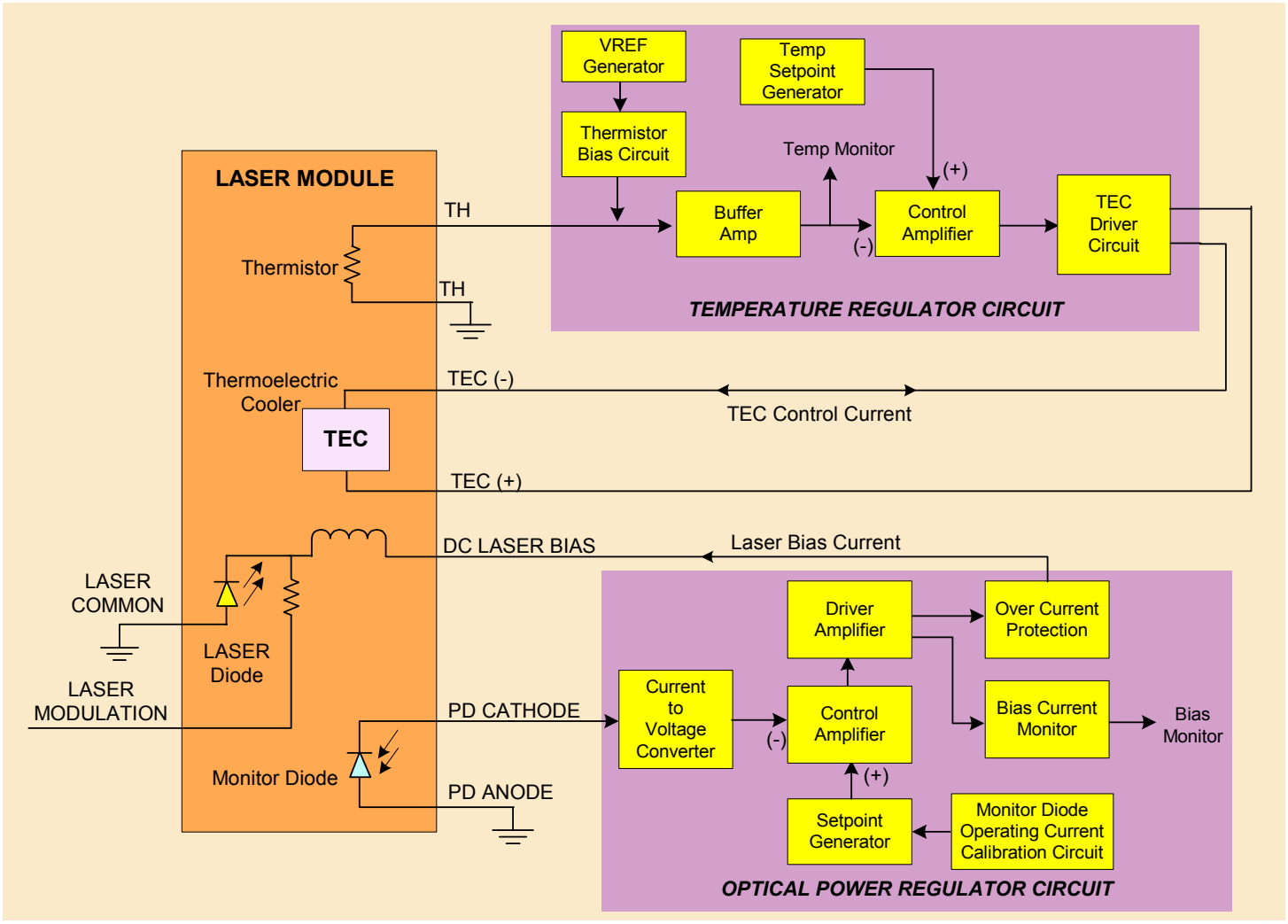
- Fiber optic communication systems
  - Require laser diode; the heart of broadband AM fiber-optic transmitter
  - Require laser stability for proper operation (controlled by MCU)

- Laser diode characteristics vary due to
  - Manufacturing tolerances
  - Temperature
  - Parametric changes with age

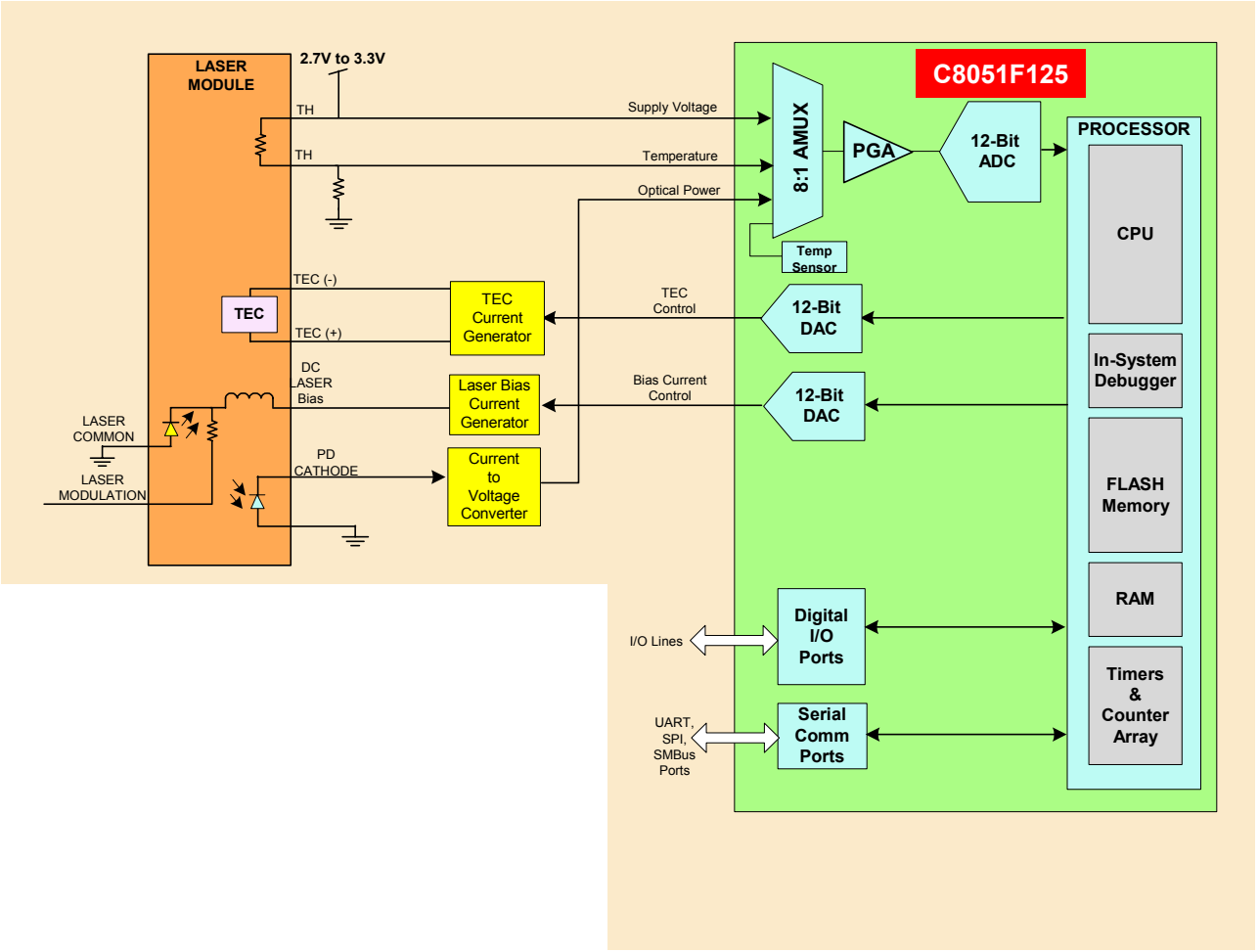
- Fiber optic communication systems
  - Use classic closed-loop feed-back control techniques (implemented by MCU)
  - Require dedicated circuitry to regulate key laser diode parameters
    - Temperature
    - Power

SILICON LABORATORIES

XFP Laser Regulator—Block Diagram



XFP Laser Regulator—Block Diagram w/ F12x



MCU Functions:

- Temperature regulation
- Optical power regulation

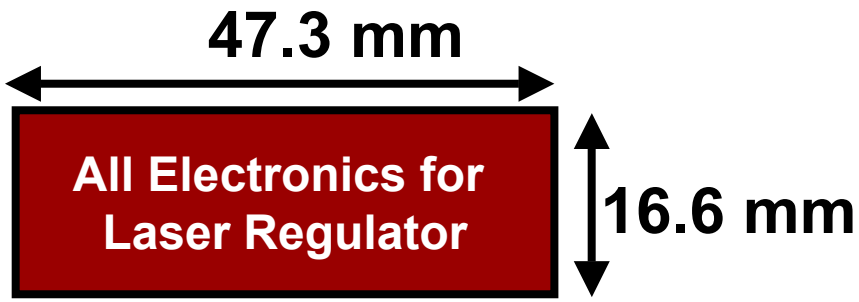
MCU Advantages:

- Up to 100 MIPS throughput
- Small package size
- 12-Bit ADC on-chip
- 12-Bit DACs on-chip

SILICON LABORATORIES

XFP Requires Small Package Size

- XFP MSA (Multi-Source Agreement) Group
  - Consortium chaired by Intel to define standard for laser regulators
  - Defines requirement for small package
  - C8051F12xB in a 8 x 8 mm BGA package to accommodate this standard



XFP Application MCU Competitors

	Silicon Labs C8051F125B	ADI ADuC841	TI MSP430F169
Primary ADC	12-bit	12-bit	12-bit
DACs	2, 12-bit	2, 12-bit	2, 12-bit
CPU (Max MIPs)	**100 MIPS 8051**	20 MIPS 8052	8MIPS, 16-bit RISC
Memory	128k Flash	62k Flash	60k Flash
Power (mW)	~100 mW	~135 mW	~15 mW
Temperature Range	-40 - 85 °C	-40 - 85 °C	-40 °C - 85 °C
Package Footprint	**64 mm^2**	64 mm^2	144 mm^2
Price 10000s	$12.40	$9.64	$7.95

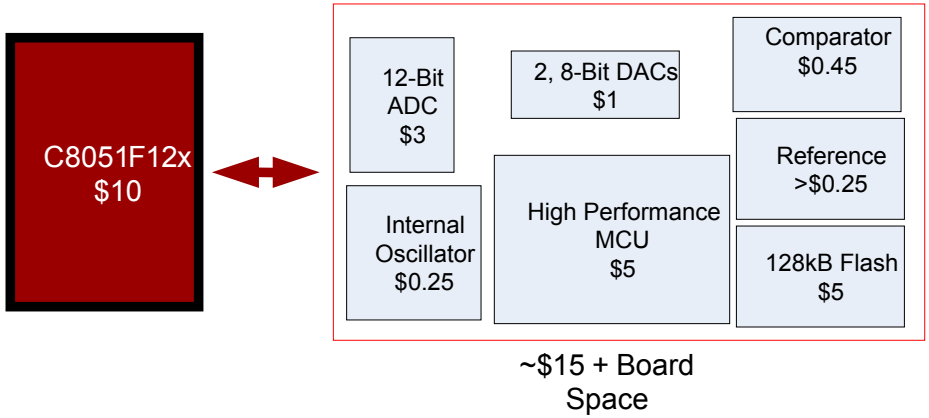
Silicon Labs XFP MCU Advantages

- Fastest CPU throughput
- Small package footprint
- On-chip 2% oscillator (save space and cost)

SILICON LABORATORIES

XFP Target Customers

- Customers
  - Asia
    - Hitachi
    - OpNext
    - Fujitsu
  - Americas
    - Finisar
    - Network Element
    - Bookham(CA)
    - Intel (CA)
    - Avanex
  - Europe
    - Alilent
    - Bookham UK
    - Merge Optics
    - Avanex



- Collateral and App. Notes
  - A118: Improving ADC Resolution by Over-sampling and Averaging
  - AN119: Calculating Settling Time for Switched Capacitor ADC's

SILICON LABORATORIES

Glucose Meters

Featuring the C8051F350/1/2/3

Glucose Meters Application Background

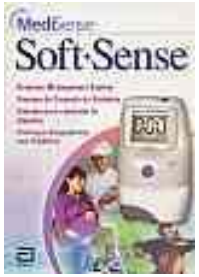
- Glucose meters
  - Measure glucose using a sample of blood on a test strip
  - Allow self-monitoring of blood glucose by user
  - Diabetes check their blood sugar at home, school, work, and play

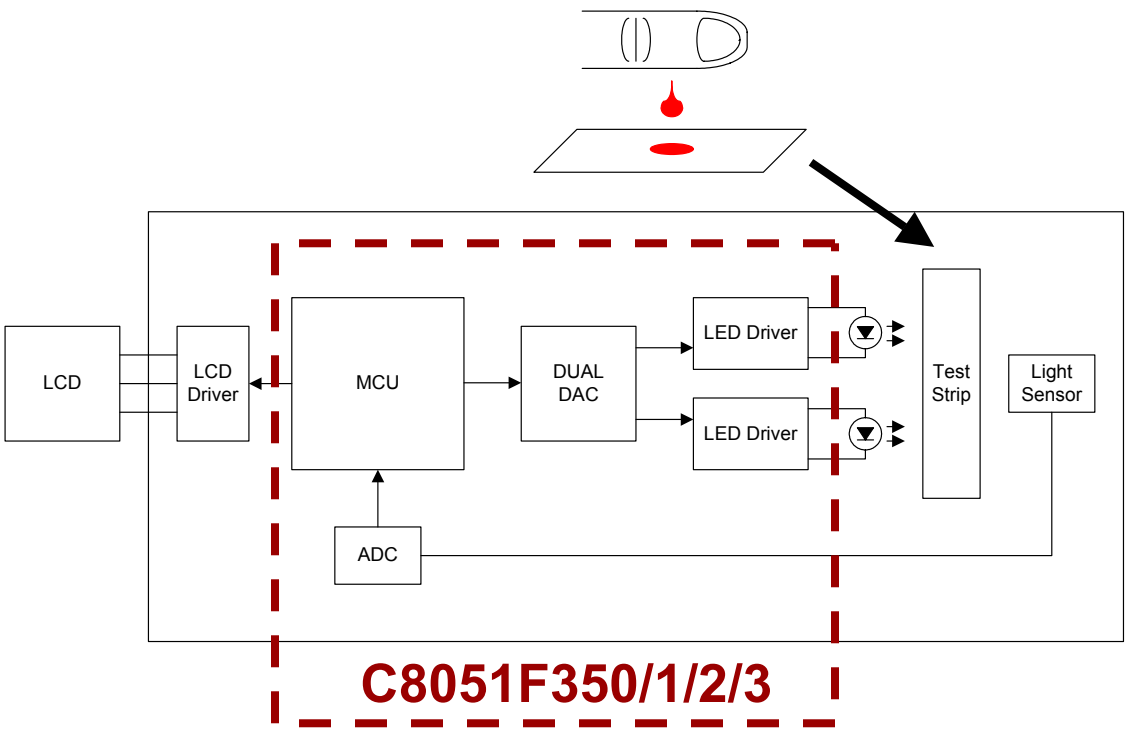
- Glucose test
  - Place sample of blood on test strips coated with chemicals
  - Measure how much light reflects from test strip
  - Displays the glucose level as a number

- For more details, visit
  - http://www.fda.gov/diabetes/glucose.html

SILICON LABORATORIES

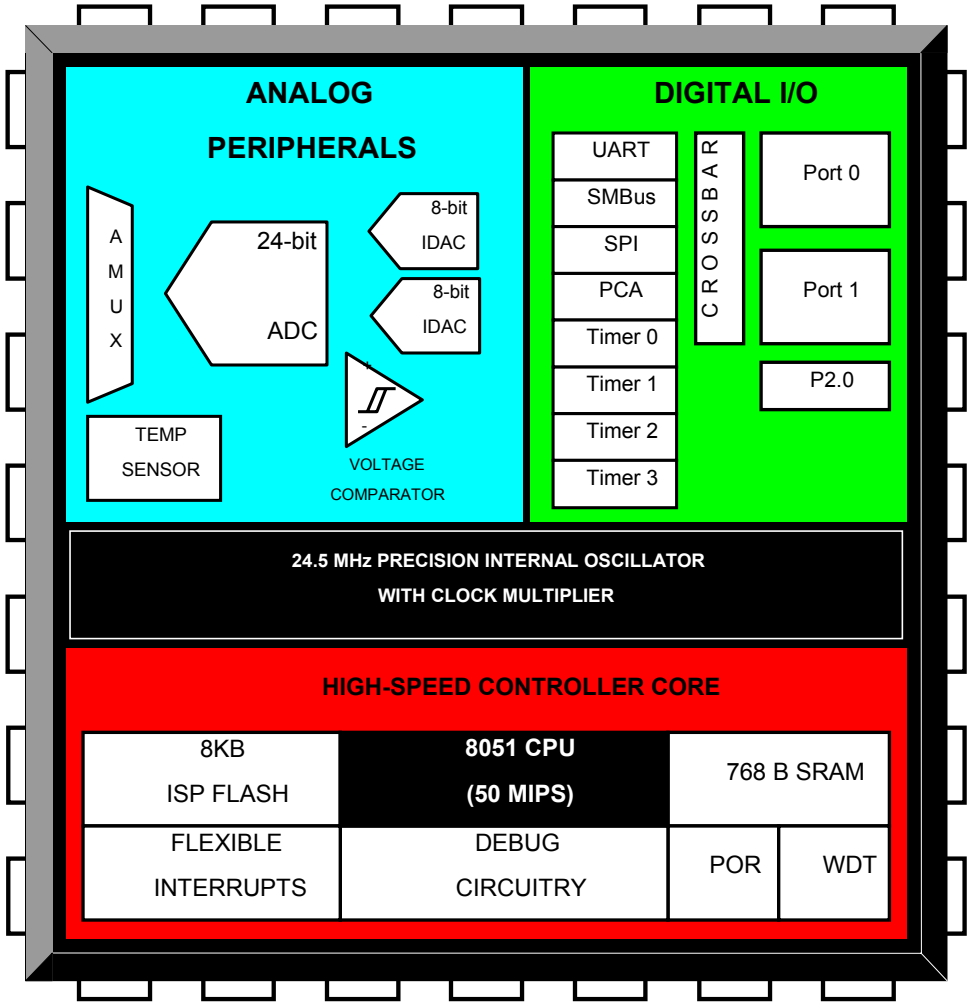
Glucose Meter—Block Diagram





SILICON LABORATORIES

C8051F350 Features and Benefits



- Highest precision ADC available on an MCU
- 50 MIPS CPU can handle complex algorithms
- Price and specification comparable to standalone ADC solutions

MCU and ADC Competition for Glucose Meters

MCU with ADC ⟷ Stand Alone ADCs

	Silicon Labs	ADI	TI	TI	Linear Tech	ADI	Cirrus Logic	Cirrus Logic
	C8051F350	ADuC845	MSC1210	ADS1242	LTC2400	AD7730	CS5522	CS5532
Analog (Noise Free) Bits	17 of 24*	14 of 24*	16 of 24*	16 of 24*	16 of 24*	17 of 24*	15 of 24*	20 of 24*
PGA	1-128	1-128	1-128	1-128	(None)	1-128	1-100	1-64
Analog MUX	8	10	8	8	1	2	4	4
CPU (Max MIPs)	50 MIPS 8051	12 MIPS 8052	8 MIPS 8051	(None)	(None)	(None)	(None)	(None)
Power (mW)	20mW**	150mW**	90mW**	3mW	2mW	125mW	12mW	80mW
Package Footprint	25mm2	64mm2	144mm2	43.5mm2	30mm2	36 mm2	62mm2	62mm2
Price 1000s	$6.28	$13.16	$8.95	$3.60	$8.10	$11.60	$6.20	$8.20

*Performance is for FS input of ~ ±20mV at ~10Sps
** Entire System on Chip

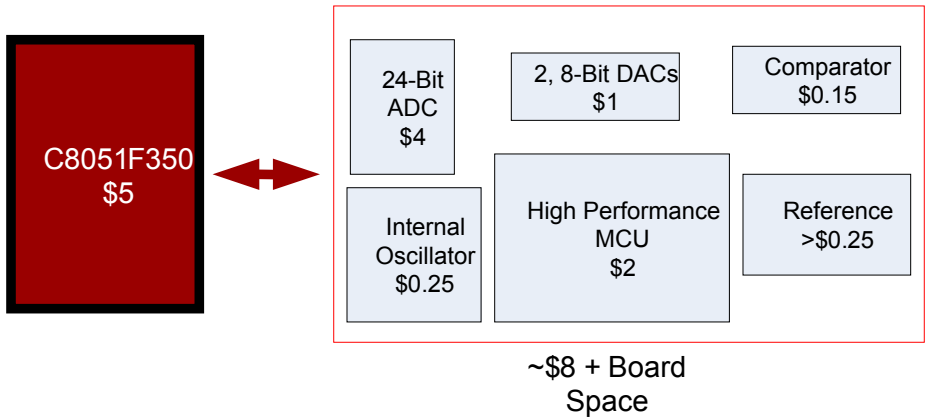
Silicon Labs Glucose Meter MCU Advantages

- Best ADC performance on MCU (17 noise free bits of resolution)
- Fastest CPU
- Lowest power consumption MCU
- Smallest package size
- Lowest MCU pricing

SILICON LABORATORIES

Glucose Meters Target Customers

- Asia
  - **IN-4 Technology**(Taiwan)
  - **Omron** (Japan)
  - **Sanwa Kagaku Kenkyusho Co., Ltd.** (Japan)
- Americas
  - **Abbott Labs: Medisense (MA)** – *Optimum, Softsense*
  - **Johnson & Johnson(FL)** – *Lifescan, One Touch*
  - **Roche Diagnostics(IN)** – *Accu-Chek*
  - **Therasense(CA)** – *Freestyle*
  - **Home Diagnostics Inc. (FL)** - *Prestige, TrueTrack*
  - **Cygnus (CA)** – *Glucowatch*
  - **Bayer Corporation** – **Diagnostics Division (US)** - *Ascensia*
- Europe
  - **Bayer AG(Germany)** - *Ascensia*
  - **Menarini(UK)** – *GlucoMen*
  - **Hypoguard (UK)** – *Supreme Plus*



- Collateral and App. Notes
  - A118: Improving ADC Resolution by Over-sampling and Averaging
  - AN119: Calculating Settling Time for Switched Capacitor ADCs

SILICON LABORATORIES

SILICON LABORATORIES

Weigh Scale Application

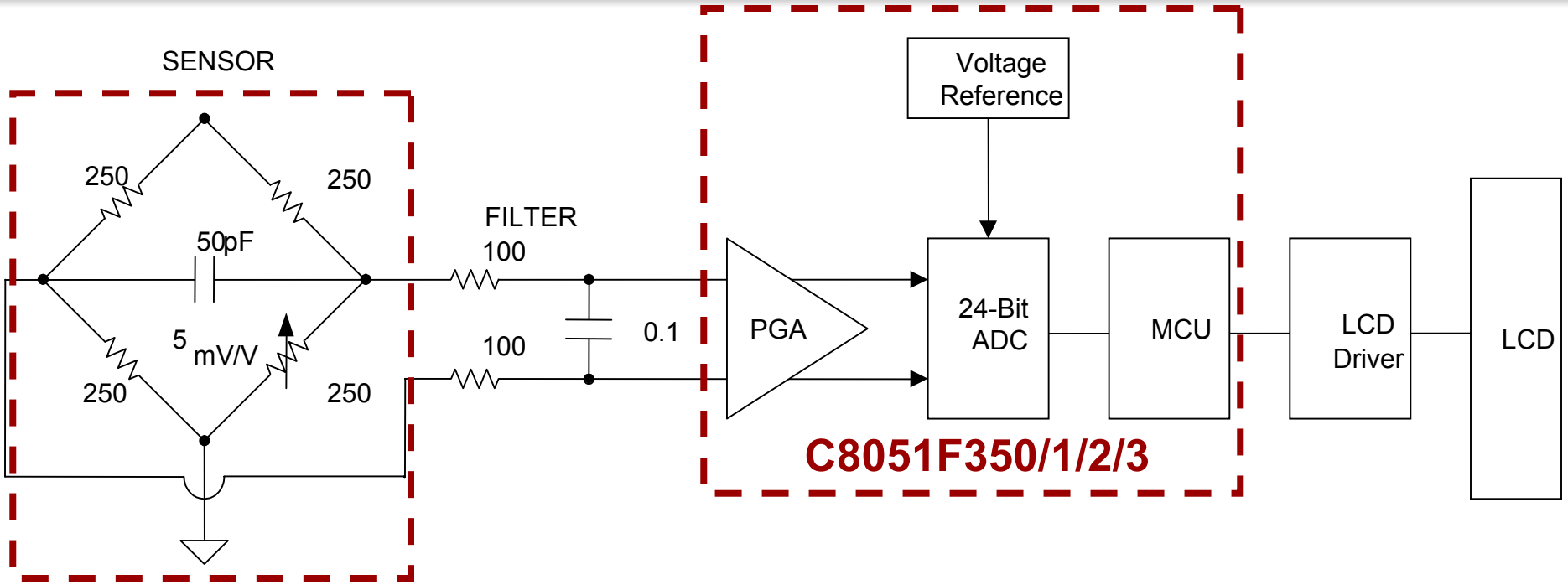
C8051F350 MCU With 24-Bit ADC

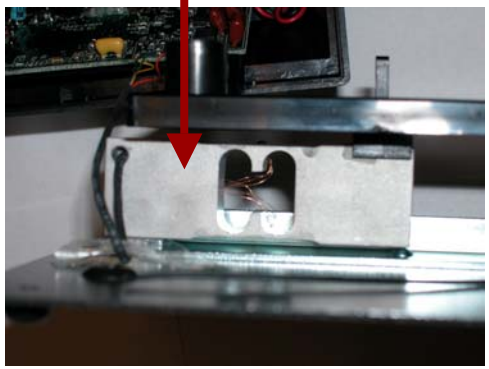
Weigh Scale Application Background

- Weigh scales are common in many systems.
  - Supermarket scales
  - Postal scales
  - Analytical scales
  - Truck scales
  - Hospital beds and other medical-based weigh measurements
  - Elevators
- Sensor/transducer (converts force into a voltage)
  - Load cell (Strain gauge)
  - Bridge transducers
- Scale electronics
  - Conditions voltage from transducer
  - Digitizes voltage and processes information
  - Displays weight on LCD or other display

SILICON LABORATORIES

Weigh Scale Block Diagram



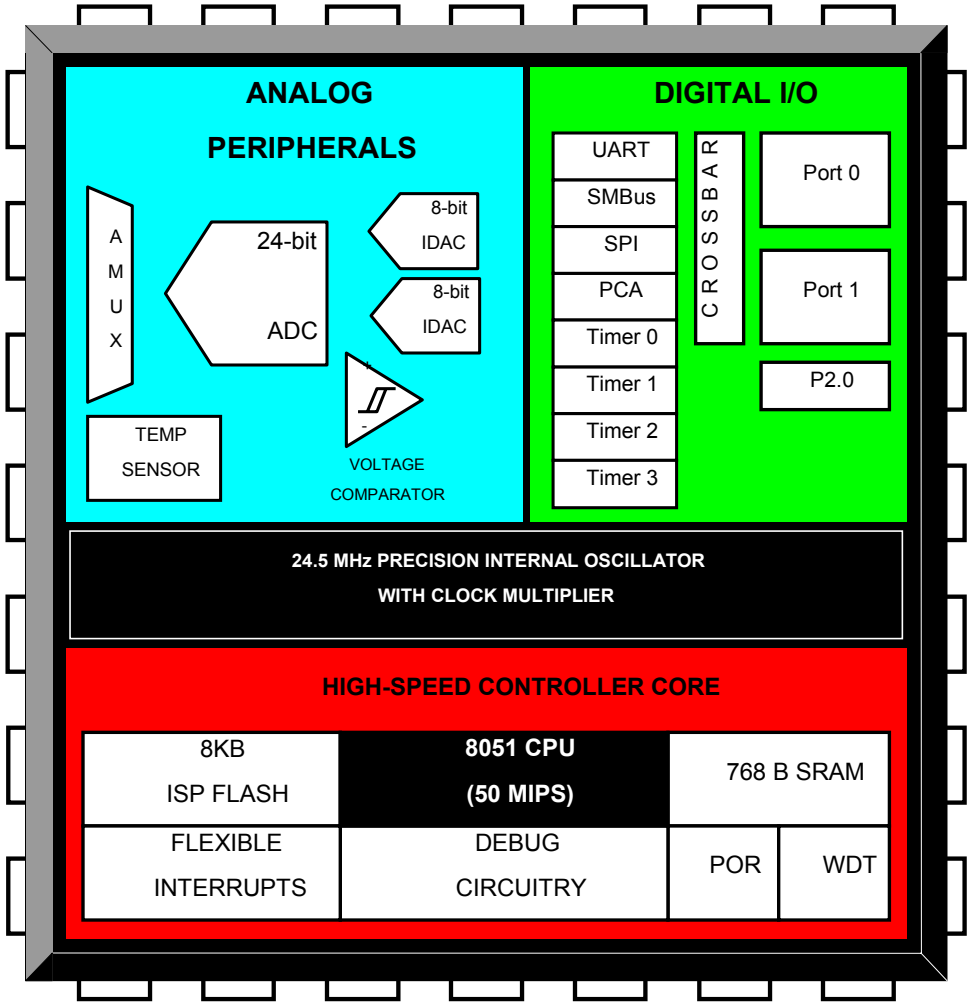


Bridge Transducer

Weigh Scale

SILICON LABORATORIES

C8051F350 Features and Benefits



- Highest precision ADC available on an MCU
- 50 MIPS CPU can handle complex algorithms
- Price and specification comparable to standalone ADC solutions

SILICON LABORATORIES

MCU and ADC Competition for Weigh Scales

MCU with ADC ⟷ Stand Alone ADCs

	Silicon Labs	ADI	TI	TI	Linear Tech	ADI	Cirrus Logic	Cirrus Logic
	C8051F350	ADuC845	MSC1210	ADS1242	LTC2400	AD7730	CS5522	CS5532
Analog (Noise Free) Bits	17 of 24*	14 of 24*	16 of 24*	16 of 24*	16 of 24*	17 of 24*	15 of 24*	20 of 24*
PGA	1-128	1-128	1-128	1-128	(None)	1-128	1-100	1-64
Analog MUX	8	10	8	8	1	2	4	4
CPU (Max MIPs)	50 MIPS 8051	12 MIPS 8052	8 MIPS 8051	(None)	(None)	(None)	(None)	(None)
Power (mW)	20mW**	150mW**	90mW**	3mW	2mW	125mW	12mW	80mW
Package Footprint	25mm2	64mm2	144mm2	43.5mm2	30mm2	36 mm2	62mm2	62mm2
Price 1000s	$6.28	$13.16	$8.95	$3.60	$8.10	$11.60	$6.20	$8.20

*Performance is for FS input of ~ ±20mV at ~10Sps
** Entire System on Chip

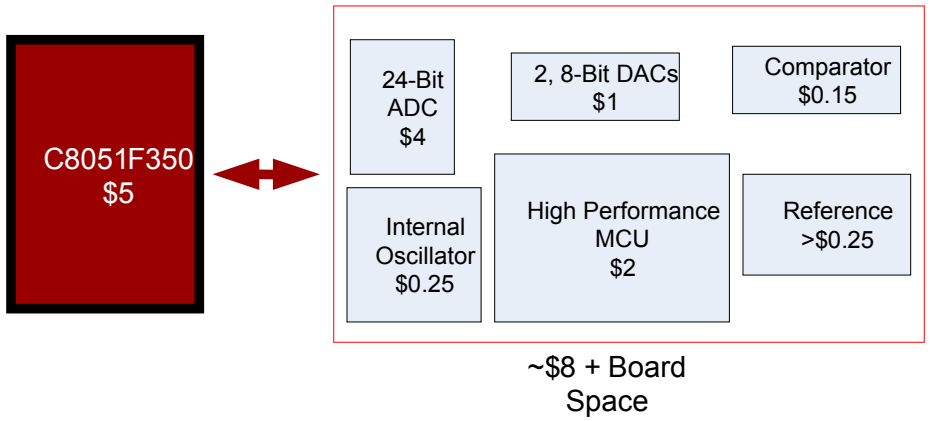
Silicon Labs Weigh Scales MCU Advantages

- Best ADC performance on MCU (17 noise free bits of resolution)
- Fastest CPU
- Lowest power consumption MCU
- Smallest package size
- Lowest MCU pricing

SILICON LABORATORIES

Weigh Scales Target Customers

- Customers
  - Asia
    - Teraoka- China
    - Excell - Taiwan
    - Omron – Japan
  - Americas
    - Mettler Toledo (OH)
    - Cardinal Scale (MO)
    - Filizola(Brazil)
    - Denver Instruments (CO)
  - Europe
    - Mettler Toledo (Germany)
    - Pelouse(France)



- Collateral & App. Notes
  - A118: Improving ADC Resolution by Over-sampling and Averaging
  - AN119: Calculating Settling Time for Switched Capacitor ADCs
  - AN184: Digital Counting Scale

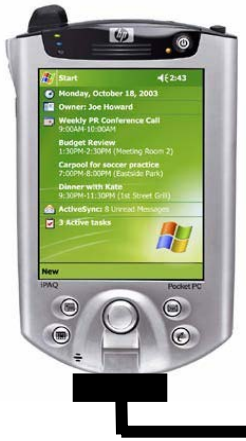
SILICON LABORATORIES

PDA/Cell phone Cable using the CP2101

PDA/Cell Phone Cable Application Background

- PDAs and many cell phones use a cable and cradle to communicate with a host PC for data download and synchronization
- Legacy cables used PC COM Ports, most now use USB.
- Many PDA and cell phone chipsets still do not have integrated USB function controllers, but do have UARTs
- The CP2101 connects directly to PDA/Cell baseband UARTs and provides a single-chip solution for USB connectivity

PDA/Cell Phone Cable Block Diagrams



Legacy COM Cable

UART

RS232 Xcvr Chip

DB9 Connector

USB Cable

UART

CP2101

Front: Top:

4 3 2 1

SILICON LABORATORIES

CP2101 Benefits

- True single-chip solution
  - No external crystal, EEPROM, or VREG required
- Tiny Package
  - Housed in 5 x 5 mm micro lead-frame package (MLP)
- No software development
  - Silicon Labs provides royalty-free USB drivers (PC, MAC, Unix, etc.)

PDA/Cell Phone Cable USB Bridge Competition

Feature	SiLabs CP2101	FTDI FT232BM	Prolific PL-2303	Prolific PL-2303X
USB controller compatibility	USB 2.0	USB 2.0	USB 1.1	USB 1.1
Maximum USB speed	12 Mbps	12 Mbps	12 Mbps	12 Mbps
Integrated 512 byte EEPROM for VID, PID	Yes	No	No	No
Fully integrated transceiver (no external resistors)	Yes	No	No	No
Integrated clock: no external crystal	Yes	No	No	No
Supports all handshaking and modem interface	Yes	Yes	Yes	Yes
Maximum baud rate	921.6 Kbps	3 Mbps	1 Mbps	6 Mbps
Requires no external voltage regulator	Yes	Yes	No	Yes
Separate supply for UART I/O	No	No	No	Yes
Driver software for windows 98 / 2000 / ME / XP	Yes	Yes	Yes	Yes
Driver software for Mac OS9 / OSX	Yes	Yes	Yes	Yes
Package	28-pin MLP	32-pin LQFP	28-pin SOIC	28-pin SSOP
Package size	5 x 5 mm	9 x 9 mm	18 x 10 mm	10 x 8 mm
Bill-of-materials cost (external components)	$0.25	$0.65	$0.75	$0.65
10K pricing	$2.42	$2.45	$1.90	N/A
Total solution price	$2.67	$3.20	$2.65	N/A

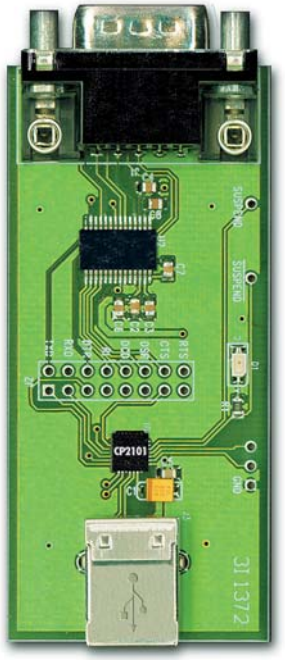
CP2101 Advantages for PDA/Cell phone Cable USB Bridge:

- USB 2.0 Controller capability
- Integrated EEPROM, Transceiver, Clock
- Smallest package footprint

SILICON LABORATORIES

PDA/Cell Phone Cable USB Bridge Targets

- Cell phone and PDA companies
  - APAC: Kyocera, Samsung, Sanyo, LG
  - NA: 3COM, HP, Motorola
  - Europe: Nokia, SonyEricsson



- Cable companies
  - APAC: NCellcom, Golden Bridge, UTsarcom, Bird, NuConnex
  - NA: IO Gear, Belkin, Keyspan, Inside Out Networks
  - Europe: Todos Data Systems

SILICON LABORATORIES

SILICON LABORATORIES

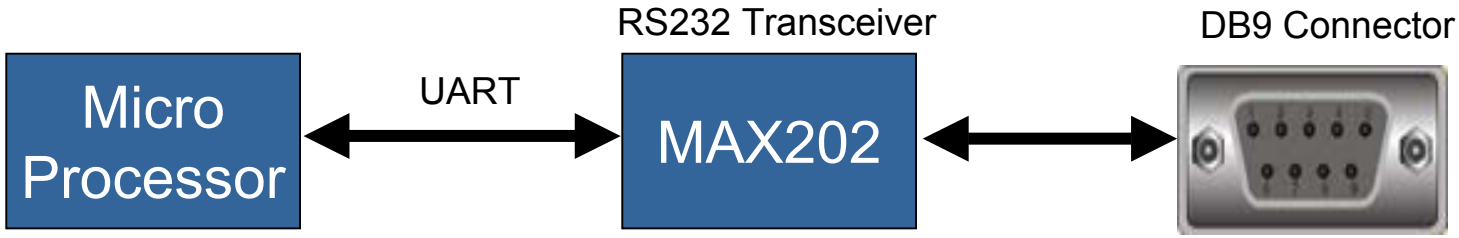
RS-232 Upgrade to USB with CP2101

RS-232 Upgrade to USB Background

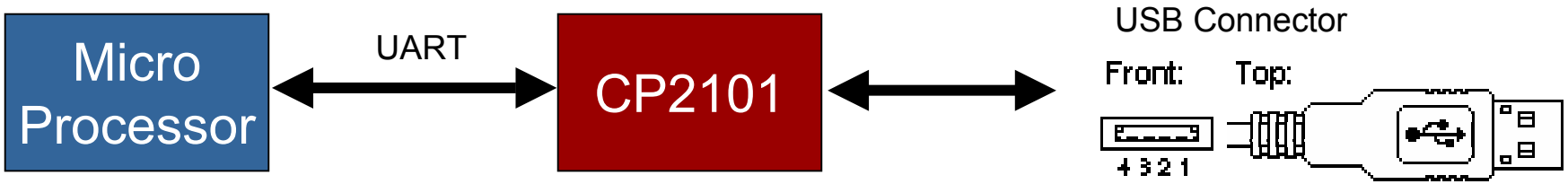
- Much electronic equipment over the years has used RS-232 as a standard communications interface
- Many equipment makers are replacing RS-232 with USB in their next generation equipment
- The CP2101 provides a *one-chip solution* for this application, and requires absolutely *no software redesign!*

RS232 to USB Upgrade Block Diagrams

Legacy RS-232 System



USB System



CP2101 Benefits

- True single-chip solution to upgrade RS-232 to USB
  - No external crystal, EEPROM, or VREG
- No software development
  - Silabs provides royalty-free drivers (PC, MAC, Unix, etc.)
- Tiny package
  - Housed in 5 x 5 mm micro lead-frame package (MLP)

RS-232 to USB Upgrade Competition

Feature	SiLabs CP2101	FTDI FT232BM	Prolific PL-2303	Prolific PL-2303X
USB controller compatibility	USB 2.0	USB 2.0	USB 1.1	USB 1.1
Maximum USB speed	12 Mbps	12 Mbps	12 Mbps	12 Mbps
Integrated 512 byte EEPROM for VID, PID	Yes	No	No	No
Fully integrated transceiver (no external resistors)	Yes	No	No	No
Integrated clock: no external crystal	Yes	No	No	No
Supports all handshaking and modem interface	Yes	Yes	Yes	Yes
Maximum baud rate	921.6 Kbps	3 Mbps	1 Mbps	6 Mbps
Requires no external voltage regulator	Yes	Yes	No	Yes
Separate supply for UART I/O	No	No	No	Yes
Driver software for windows 98 / 2000 / ME / XP	Yes	Yes	Yes	Yes
Driver software for Mac OS9 / OSX	Yes	Yes	Yes	Yes
Package	28-pin MLP	32-pin LQFP	28-pin SOIC	28-pin SSOP
Package size	5 x 5 mm	9 x 9 mm	18 x 10 mm	10 x 8 mm
Bill-of-materials cost (external components)	$0.25	$0.65	$0.75	$0.65
10K pricing	$2.42	$2.45	$1.90	N/A
Total solution price	$2.67	$3.20	$2.65	N/A

CP2101 Advantages for PDA / Cellphone Cable USB Bridge:

- **USB 2.0 Controller capability**
- **Integrated EEPROM, Transceiver, Clock**
- **Smallest package footprint**

SILICON LABORATORIES

Target Customers for RS-232 to USB Upgrade

- Find current users of RS-232 transceivers such as:
  - MAX202, MAX3223 (Maxim); ST202 (ST)
  - ADM202 (ADI); SP202 (Sipex)
- Target any equipment OEMs whose products have COM port (RS-232) connectivity
  - Test Equipment, Bench Supplies
  - Medical equipment, Meters

- Example companies
  - Asia: Kikusui, Yokogawa, HP
  - NA: Agilent, Tektronix, B + K, LeCroy, Fluke
  - Europe: Siemens, Thurlby Thandar (TTi), Chauvin Arnoux

SILICON LABORATORIES

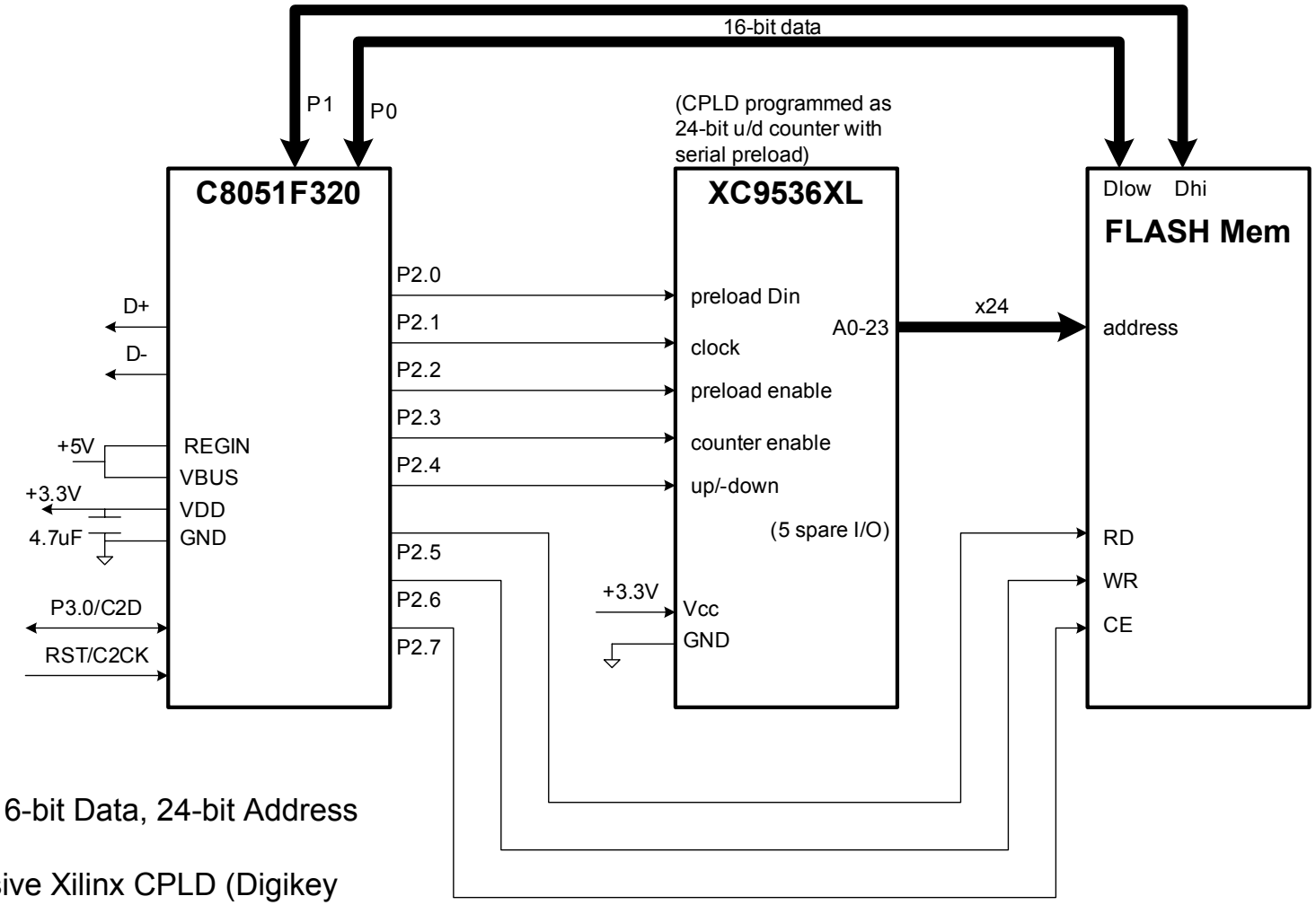
SILICON LABORATORIES

USB-Parallel Memory Interface

USB-Parallel Memory Interface Background

- USB is becoming a standard interface for many removable memory devices
- The C8051F320 can easily be used as a USB 2.0 Full-Speed interface and memory I/O controller
- This solution would be easy to implement and inexpensive

USB-Parallel Memory Interface Block Diagram



- Example is for a 16-bit Data, 24-bit Address Memory
- Uses an inexpensive Xilinx CPLD (Digikey 100pc price $1.07)
- F320 regulator can supply VDD to CPLD and Memory (up to ~100mA)

SILICON LABORATORIES

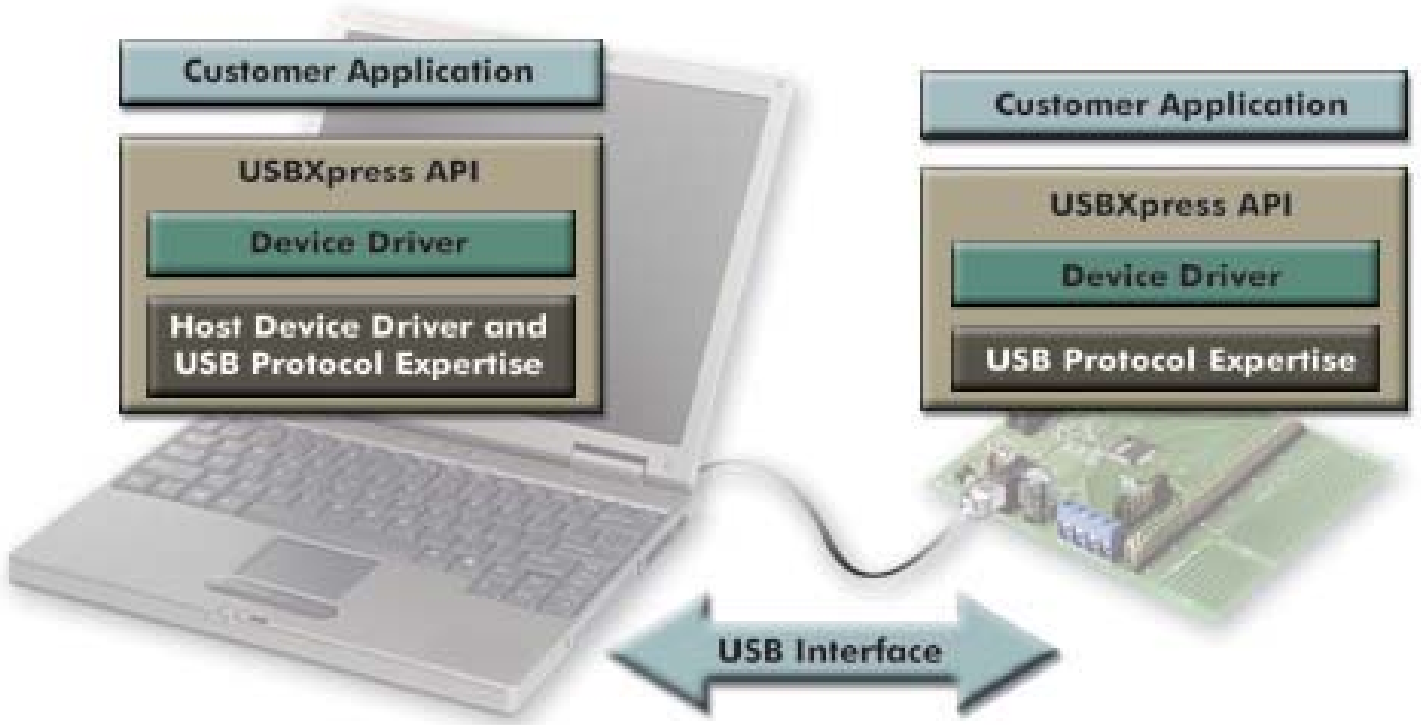
USB-Parallel Memory Interface Applications

C8051F320

- Fewer external components
  - No external crystal or VREG required
- Development tools optimized for USB
  - C8051F320DK ($229)
    - provides IDE, debug HW, assembler/linker, target PCB
  - USBXpress™ Application Programming Interface (API) greatly simplifies software development
    - Less expertise needed in Windows or USB software
    - Royalty free
- Small package
  - Housed in 9 x 9 mm 32-pin LQFP (F320)
  - 5 x 5 mm 28-pin MLP (F321, 4 fewer Dig I/O)

SILICON LABORATORIES

USBXpress Software Development Package



- Complete host and device software solution, including Windows device drivers (royalty free)
- No USB protocol or hardware expertise required to develop application
- API is provided to achieve USB connectivity
- Windows 98, 98SE, 2000 and XP are supported

SILICON LABORATORIES

USB-Parallel Memory Interface MCU Competition

Feature	Silicon Labs C8051F320	Cypress CY7C64613	Microchip PIC16C765
USB 2.0 full speed	✓	✓	X (low speed)
Program memory	**16 kB Flash**	8 kB RAM	8KWord OTP
RAM	**2.25 kB**	(same 8 kB)	256B
MIPS	**24**	12	6
Dig I/O	**25**	40	33
Package	**32-LQFP**	80-PQFP	44-TQFP
ASP (>10 Kμ)	**$3**	$4.50	$3.42
Internal clock	✓	No (+$0.20)	No (+$0.20)
Integrated VREG	✓	No (+$0.15)	No (+$0.15)
I/O expander	**Yes ($0.80)**	No	No
Total solution cost	**$3.80**	**$4.85**	**Low-speed**

F320 MCU advantages for USB parallel memory interface:

- Fast CPU speed
- Integrated voltage regulator, oscillator
- Smallest package footprint

SILICON LABORATORIES

USB-Parallel Memory Interface Targets

- Equipment OEMs who need USB-Parallel Memory Interfaces
  - Asia: Powerglobal Index (PQI), I-Bead
  - NA: Sandisk, Lexar, LHR (Sears Wood Router)
  - Europe: Leica Camera, Altec Computer Systems

SILICON LABORATORIES

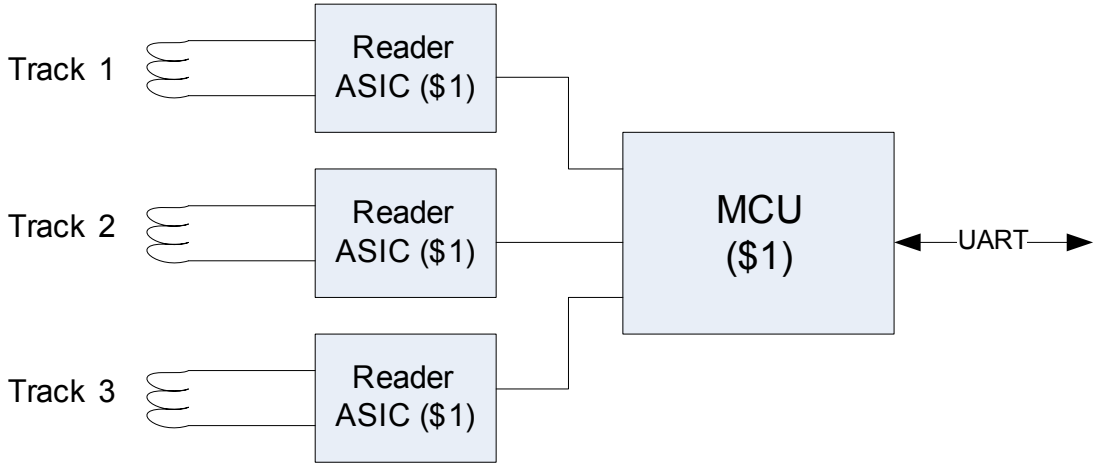
Magnetic Stripe Reader using the C8051F330

Magnetic Stripe Reader Background

- Magnetic card readers use an ASIC to read the tracks on cards, then an external MCU to format the data
- C8051F330 replaces both the ASIC(s) and external MCU
  - Complete Reference Design in AN148
- The F330 is a single-chip, smaller, lower cost solution

Block Diagram

ASIC Solution



C8051F330 Solution

SILICON LABORATORIES

Benefits for Magnetic Stripe Reader

C8051F330

- Less expensive
  - C8051F330 is $2 or less
  - ASICs are at least $1 per track (3 tracks is common) plus a $1 MCU; total solution is $2 to $4
- Single-chip solution; small package
  - C8051F330 is in 4 x 4 mm 20-pin MLP, no external components
  - Others use 1 ASIC per track plus an MCU (2 to 4 chips)
- Programmable
  - Can be tailored to specific applications

Competition for Magnetic Stripe Reader

Feature	Silicon Labs C8051F330	Magtek 21006516	IDTech ME42407
Device type	**MCU**	ASIC	ASIC
Tracks	**1, 2, or 3**	1	1
Idd active	**8 mA**	1 mA	1 mA
Package	**4 x 4 mm; 20-pin**	12 x 5 mm; 16-pin	6 x 5 mm; 8-pin
ASP (>10 Ku)	**$2**	$1.50	$1
external MCU	**No**	$1	$1
Total 3 track cost	**$2**	$5.50	$4

F330 Advantages for Magnetic Stripe Reader Application:

- F330 replaces competitor MCU plus ASICs
- Reduced system cost
- Smallest package footprint

SILICON LABORATORIES

Magnetic Stripe Readers Target Customers

- POS Terminals, ATMs, Gas Pumps, etc
  - Asia: Omron, Castles Technology, Fujitsu
  - NA: NCR, Verifone, IBM
  - Europe: Dione, Cybernet EMEA, Thales e-Transactions, Hypercom

SILICON LABORATORIES

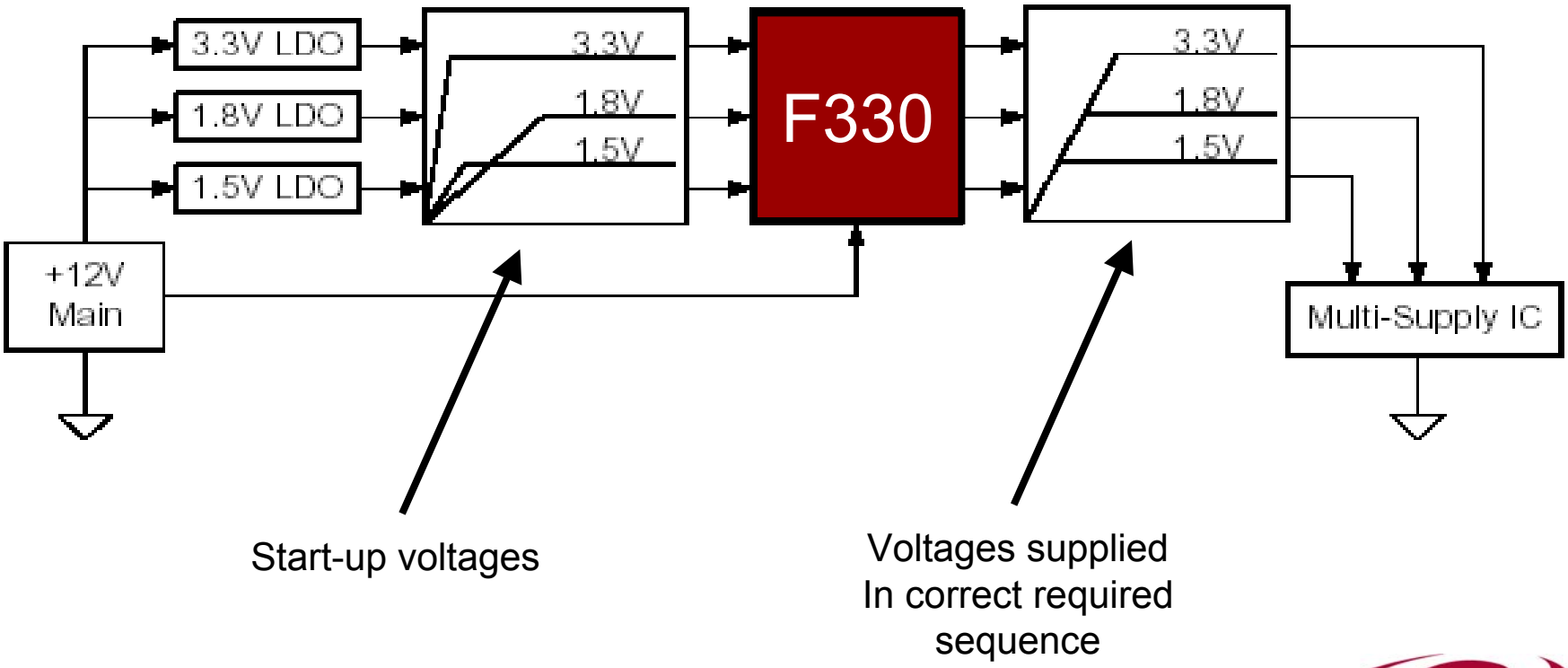
Power Sequencer using the C8051F330

Power Sequencer Background

- Many FPGAs, DSPs, Large Microprocessors, and Communication ICs use two or more supply voltages
- Controlling the ramp and sequence of the supply voltages is required to keep from damaging the ICs
- The C8051F330 can provide low-cost power sequencing and supervision for up to three power supply rails
  - Complete reference design in AN145
- The F330 is a smaller, lower cost, programmable solution versus alternative solutions

Power Sequencer Block Diagram

System Requiring Power Sequencing and Management



C8051F330 Benefits for Power Sequencer

- Less expensive
  - C8051F330 is $2 or less
- Small package
  - C80851F330 is in 4 x 4 mm 20-pin MLP
- Programmable
  - Can program ramp rates
  - Can program sequencing
- Competitive solutions include the following
  - Fixed function ASIC from Xicor, Summit Micro, ADI
    - Not Programmable
  - Programmable CPLD from Altera
    - Programmable, but expensive

SILICON LABORATORIES

Competitor Solutions for Power Sequencer

Feature	Silicon Labs C8051F330	Xicor X80200	SummitMicro SMT2002
Device Type	**MCU**	ASIC	ASIC
Programmable	**Yes**	No	No
Supply Rails controlled	**1, 2, or 3**	1, 2, or 3	1 or 2
Package	**20-pin MLP**	20-pin TSSOP	16-pin SSOP
Size	**4 x 4 mm**	6.5 x 6.5 mm	6 x 5 mm
ASP (>10 Ku)	**$2**	$2	$2

F330 Advantages for Power Sequencer Application:

- F330 replaces power sequencer ASIC
- F330 is programmable therefore flexible
- Smallest package footprint
- Reference design reduces customer development time

Power Sequencer Target Customers

- Communications (Hubs, Routers, Switches, Line Cards); Servers; Cellular Base Stations
  - Asia: Samsung, Sanyo, Compal, Acer
  - NA: Cisco, JDSU, HP, Dell, Globespan
  - Europe: SonyEricsson, Nokia

SILICON LABORATORIES

Targeting for C8051F2xx General Purpose MCUs

Background on F2xx General Purpose MCU

- The C8051F22x and F23x MCUs are good replacements for popular general purpose Atmel, Microchip, and TI MCUs

- The C8051F206 can replace MCUs and 12-bit serial ADCs
  - 12-bit ADCs are commonly found in instrumentation, test equipment, and medical equipment
  - 12-bit ADCs have 16 times more resolution than an 8-bit ADC !

F22x Benefits

- The F22x and F23x MCUs have similar features to many popular Flash MCUs, but with some key advantages
  - High-speed CPU (25 MIPS)
  - High-speed timer/counters (40 ns resolution)
  - 2 comparators
  - In-system reprogrammable Flash (512B sectors)
  - Non-intrusive, in-system JTAG Debug
  - Good ratio of RAM to Flash—well suited for high level languages
- The F22x and F23x can be offered as “better” general purpose MCUs at the same price

Competitive F22x Matrix

Feature	Silicon Labs C8051F226	Atmel AT90S8515	Microchip PIC16LF877A	TI MSP430F1232
Flash memory	8KB	8 kB	8 K x 14	8 kB
RAM	**1.25KB**	512B	368B	256B
EEPROM	—	512B	256B	—
MIPS (at 2.7 V)	**25**	4	1	4
Dig I/O	32	32	33	22
ADC	8-bit; 32ch	—	10-bit; 8ch	10-bit; 8ch
Comparators	2	1	2	—
Package	48-TQFP	44-TQFP	44-TQFP	32-QFN
Size	9 x 9 mm	12 x 12 mm	12 x 12 mm	5 x 5 mm
In-system debug	✓	—	✓	✓
ASP (>10 Ku)	$2	$2	$2.50	$2

F2xx Advantages over competitor MCUs:

- More RAM included – better suited for high level languages
- Faster CPU
- 2 on-chip programmable comparators
- JTAG-based debug

SILICON LABORATORIES

F206 Strategy

- The F206 is a low cost MCU with a high performance 12-bit ADC on-chip
- Only TI's MSP430 has an equivalent 12-bit ADC in its MCU family
- The F206 is often **<** the price of popular stand-alone 12-bit ADCs from companies such as Maxim or Linear Tech
- Find the TI, Maxim, LTC parts and win the business !

SILICON LABORATORIES

Competitive F206 Matrix

Feature	Silicon Labs C8051F206	TI MSP430F133	Maxim MAX1237	Linear Tech LTC1288
Flash Memory	8 kB	8 kB	—	—
RAM	1.25 kB	256 B	—	—
EEPROM	—	—	—	—
MIPS (at 2.7V)	25	4	—	—
Dig I/O	32	48	—	—
ADC	12-bit; 32ch	12-bit; 8ch	12-bit; 4ch	12-bit; 2ch
Comparators	2	1	—	—
Package	48-TQFP	64-TQFP	8-uMAX	8-SOIC
Size	9 x 9 mm	12 x 12 mm	3 x 5 mm	6 x 5 mm
In-system Debug	✓	✓	—	—
ASP (>10 Ku)	$2.50	$2.50	$2.50	$4

F2xx Advantages over competitor MCUs:

- ADC has more channels than standalone ADCs from Maxim and LTC
- Price very competitive with standalone ADCs
- Fast CPU and memory on-chip
- 2 on-chip programmable comparators

SILICON LABORATORIES

MCU Marketing Overview

- MCU contacts
- Positioning and product differentiation
- Product family and roadmap
- MCU target applications
- Competition
- New product—F350 and F353
- New product—F41x
- New product—F064 and F067
- MCU sales tools
- 2004 Marcom plan
- Summary

SILICON LABORATORIES

Best-in-Class Integrated ADCs

	MCU					ADC	
	Silicon Labs C8051F060	**Silicon Labs C8051F005**	TI MSP430F148	MicroChip PIC16C77x	ADI ADuC814	MicroChip MCP3204	Maxim MAX1245
Resolution	**16-bit**	**12-bit**	12-bit	12-bit	12-bit	12-bit	12-bit
Speed (sps)	**1M**	**100k**	200k	20k	200k	50 ksps	100 ksps
SINAD (dB)	**89**	**66**	no spec	no spec	62.5	72	68
INL (LSB)	**±1**	**±1**	±2	±2	±2	±1	±0.5
DNL (LSB)	**±0.5**	**±1**	±1	+2/-1	±4	±1	±1
Offset	**0.1 mV**	**±1 LSB**	±4 LSB	±2 LSB	±5 LSB	±3 LSB	±4 LSB
Gain	**0.008%FS**	**±3 LSB**	±2 LSB	±2 LSB	±5 LSB	±5 LSB	±4 LSB
Vref (V)	**2.4**	**2.4**	2.2	4	2.5	5	2.0

Advantages of Silicon Labs ADCs on MCUs:

- Performance of ADCs on Silabs MCUs comparable or better than standalone ADCs
- Performance of ADCs on Silabs MCUs better than competitors MCUs

Flash MCU Competitive Overview

Attribute	Silicon Labs C8051Fxxx	Microchip PICxxx	TI MSP430	Atmel AVR	Motorola 68HC08
CPU throughput	20 → 100 MIPs	5, 10 MIPS	8 MIPS	1 → 16 MIPS	2 → 8 MIPS
A/D converter	SAR 8,10,12,16-bit, Sigma-Delta 24-bit	SAR 8,10,12-bit	SAR 10,12-bit	SAR 10-bit	SAR 8,10-bit
A/D performance	✓ ✓ ✓	✓	✓ ✓ ✓	—	—
D/A converter	10-bit, 12-bit	NONE	12-bit	NONE	NONE
Serial connectivity	UART, SPI, I2C, USB 2.0, CAN	UART, SPI, I2C, CAN	UART, I2C	UART, SPI, I2C	UART, SPI, I2C, USB1.1
Low power	✓ ✓ ✓	✓	✓ ✓✓	✓	✓
Smallest package	11-pin 9 mm^2	8-pin 27 mm^2	20-pin 95 mm^2	8-pin 45 mm^2	8-pin 25 mm^2
FLASH (max)	128 kB	64 kB	60 kB	128 kB	62 kB
RAM (max)	8 kB	3.8 kB	10 kB	4 kB	4 kB

Advantages of Silicon Labs Flash MCUs:

- Fastest 8-Bit CPU on the market, best analog integration
- Smallest packages on the market

SILICON LABORATORIES

Tier 1 Competitors Weaknesses

Competitor	Strengths	Weaknesses
Microchip PIC	1. Large product line 2. Focus on 8-Bit MCUs 3. Good manufacturing reputation 4. Low cost	**1. Lots of flash and oscillator errata** **2. Need 13 V for flash programming** **3. 6 MIPS at 3.3 V**
Atmel AVR	1. Broad Flash product line 2. Low cost if memory sales are weak	**1. Reported ESD problems in field** **2. Reputation for raising prices when fabs get full with memories**
Texas Instruments MSP430	1. Low-voltage, Low power 2. Good ADC performance 3. Flash and ROM options = low cost 4. Good Fab (TSMC)	**1. Poor support for 'low volume' business** **2. Lots of MCU product errata**
Renesas	1. VERY low cost 2. High volume capacity 3. Entrenched with Asia customers	**1. Poor analog capability** **2. Unclear product roadmap due to Hitachi and Mitsubishi merger**

Tier 2 Competitors Weaknesses

Competitor	Strengths	Weaknesses
Motorola 68HC08	1. Automotive and Tier 1 customers 2. CSIC programs	**1. Poor analog** **2. Low clock speeds** **3. Little focus on 'low volume' business**
ST	1. Automotive and Tier 1 customers 2. Low cost	**1. Poor analog** **2. Low clock speeds**
Phillips 8051	1. Entrenched Euro supplier 2. Low cost	**1. No on-chip debugging** **2. Few/No new MCU products**
ADI ADuC8xxx	1. Good ADC/DAC performance 2. ADI reputation	**1. No on-chip debugging** **2. Limited product line**

Tier 3 Competitors Weaknesses

Competitor	Strengths	Weaknesses
CypressMicro PSoC	1. Turn-key apps engineering 2. Novel technology	**1. Inferior features, performance** **2. Complex development environment**
Cypress EZUSB	1. Good tools 2. Flexible platform	**1. Expensive** **2. RAM-based solution (must boot-load)**
Infineon	1. CAN product line 2. Automotive focus	**1. Mostly OTP/ROM** **2. 32-Bit Automotive focus**
Zilog Z8	1. Updated Flash Z8 product line 2. Fast CPU	**1. Poor market presence (bankruptcy)** **2. Limited product range**
Dallas	1. Fast 8051 CPU 2. Legacy Intel 8051 footprint	**1. Expensive** **2. Few / No new products**

Beat the Competition

1) Engage early in design cycle—define the rules of the game!
   - We will both win if we can influence system partitioning
   - Competitors products are interchangeable and commodity-like

2) Use the reference designs and the application notes!
   - These tools reduce customers development effort

3) Encourage customers to purchase low-cost tools!
   - Silicon Labs MCU dev tools are ‘best-in-class’
   - Demonstrating the tools leads to good results

4) Set-up customer seminars. Invite target customers!
   - Educate customers on our products
   - Provide low-cost development tools

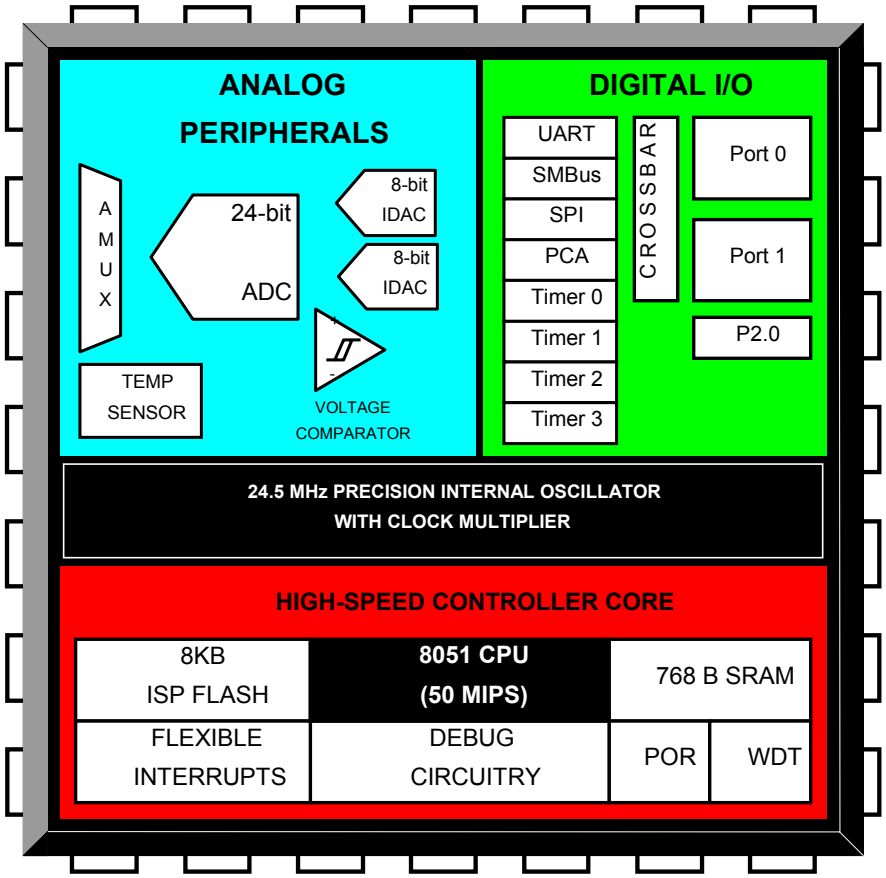
SILICON LABORATORIES

MCU Marketing Overview

- MCU contacts
- Positioning and product differentiation
- Product family and roadmap
- MCU target applications
- Competition
- New product—F350 and F353
- New product—F41x
- New product—F064 and F067
- MCU sales tools
- 2004 Marcom plan
- Summary

SILICON LABORATORIES

C8051F350 Features



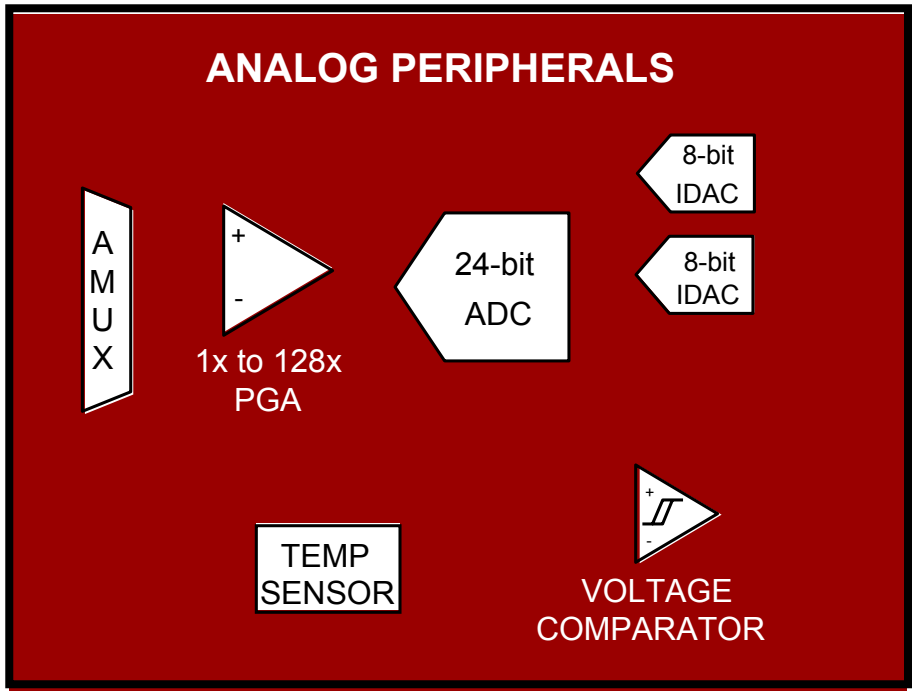
- Highest precision ADC available on an MCU
- 50 MIPS CPU can handle complex algorithms
- Price and specification comparable to standalone ADC solutions

SILICON LABORATORIES

C8051F35x Family

Device	Bits	Linearity	I/O ; Analog	Package
C8051F350	24	0.015%	17/8	LQ32
C8051F351	24	0.015%	17/4	MLP28
C8051F352	16	0.03%	17/8	LQ32
C8051F353	16	0.03%	17/4	MLP28

Analog Peripherals on F350



- 24 or 16-Bit ADC
  - No missing codes
  - Programmable conversion rates up to 1k sps
  - 8-Input multiplexer
  - 1x to 128x PGA
  - Built-in Temperature Sensor
- Two 8-Bit current output DACs
- Comparator
  - Programmable hysteresis and response time
  - Configurable as interrupt or reset

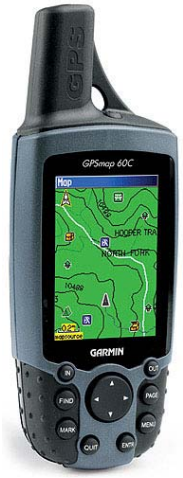
Sensor-Based Product Examples

Body Fat Scale

Smart Sensor

Gas Detector

Oximeter



GPS System

Retail Scale

Digital Thermometer

Cholesterol Meter

Glucose Meter

SILICON LABORATORIES

Target Applications for F350

- Customers who need an interface to sensors
- Customers who use stand-alone sigma-delta ADCs
  - Linear Technologies LTC24xx
  - Cirrus CS55xx
  - Analog Devices Adxx,xx,xx,xx
- Users of ADI ADuC824, ADuC816 MCUs
- Companies that make
  - Weigh scales
  - Medical instruments
  - GPS systems
  - Seismic equipment
  - Process automation
  - Compass systems
  - Lab instrumentation
  - Test systems
  - Detection systems
  - Body fat meters

F350 Competition

	ADI ADuC845	Texas Instruments MSC1200	Linear Tech* LTC2400	C8051F350
Resolution	24-Bits	24-Bits	24-Bits	**24-Bits**
CPU	13 MIPS 8051	8 MIPS 8051	(none)	**50 MIPS 8051**
Package Footprint	64 mm^2	81 mm^2	30 mm^2	**25 mm^2**

4X faster

1/3 smaller

*typical stand-alone 24-bit ADC

SILICON LABORATORIES

Key Competitor—Texas Instruments

	Texas Instruments MSC1200	Silicon Labs C8051F351
Flash	8KB	**8 kB**
RAM	128B	**768B**
8051 MIPS (Peak)	8	**50**
IDD	2.5mA/MIPS	**0.5 mA/MIPS**
ADC	24-bit, 8 ch.	**24-bit, 8 ch.**
DAC	8-bit, 1 ch.	**8-bit, 2 ch.**
VREF, Temp Sen	yes, yes	**yes, yes**
Internal Clock (2%)	No	**Yes**
Serial Buses	UART, SPI, I2C	**UART, SPI, SMBus/I2C**
Dig I/O	16	**17**
VDD	2.7–5.25	**2.7–3.6**
Package	TQFP48 (9x9 mm)	**MLP28 (5x5 mm)**
Price (1Ku)	$6.45	**$5.92**

More RAM
Faster CPU

No external crystal required

Smaller package

SILICON LABORATORIES

C8051F350 Key Benefits

- Complete data acquisition solution in a single chip
  - Need wide dynamic range ADC and high speed MCU on single-chip
- Single-chip data acquisition and processing
- 50 MIPS CPU can handle signal processing

- Very small solution footprint
  - MCU, ADC, DAC, and crystal swept into one chip
  - 5x5mm MLP Package; smaller than discrete 24-bit ADCs
- Competitive price
  - Rivals cost of discrete 24-bit ADCs!

SILICON LABORATORIES

MCU Marketing Overview

- MCU contacts
- Positioning and product differentiation
- Product family and roadmap
- MCU target applications
- Competition
- New product—F350 and F353
- New product—F41x
- New product—F064 and F067
- MCU sales tools
- 2004 Marcom plan
- Summary

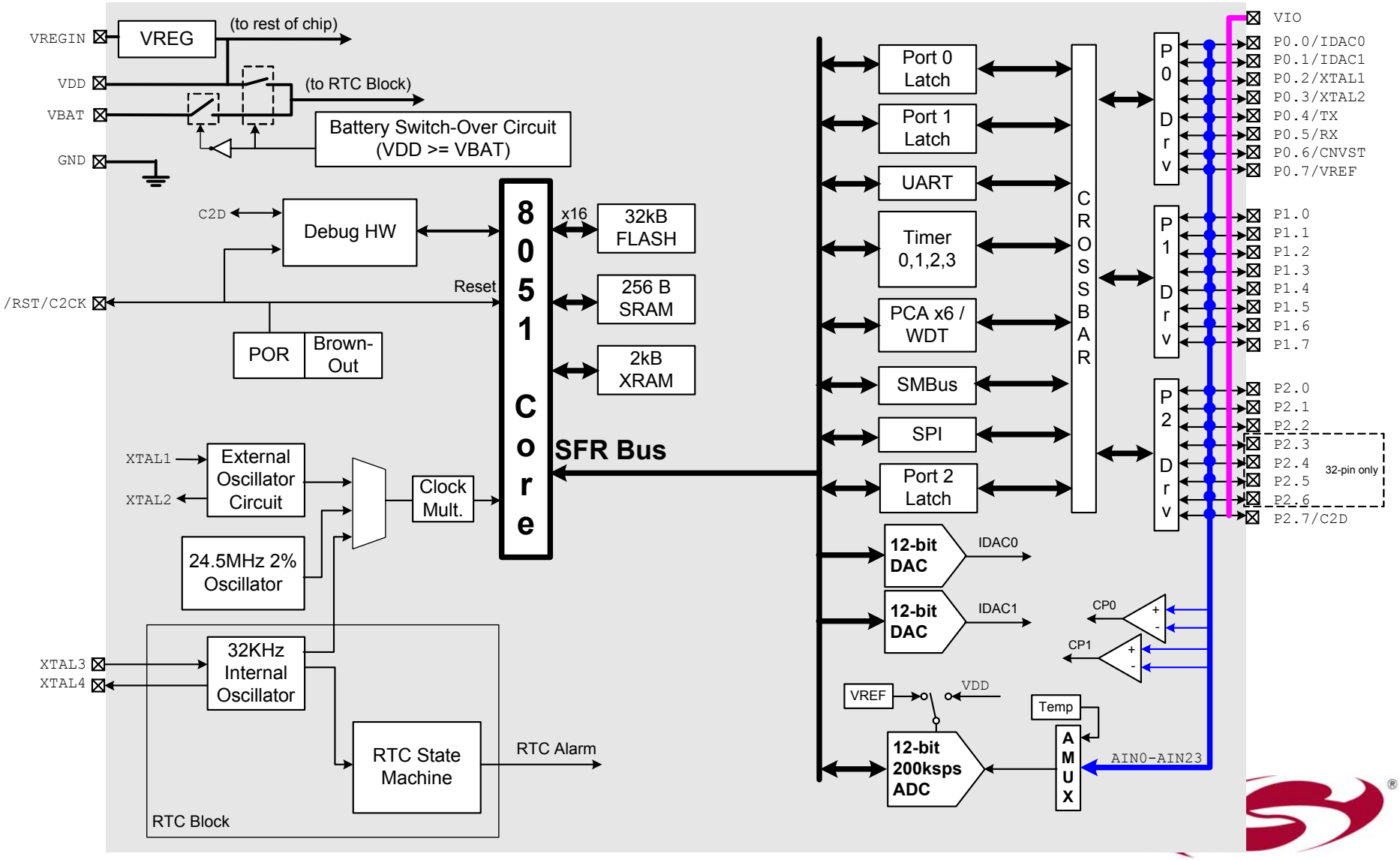
SILICON LABORATORIES

C8051F41x Overview

- Low-power, low voltage mixed-signal MCU
  - 1.8–5.5 V VDD Input Range
  - Low IDD: 150 µA/MHz for VDD=1.8 V (This is lower than MSP430!)
  - RAM retention=0.1 µA, RTC approx. = 1µA (This is equivalent to MSP430!)
  - Flash read/write/erase over full VDD range
  - 66MIPS 8051 CPU
  - 12-bit ADC and 12-bit DACs
  - Integrated real-time clock
  - Small PCB footprint
  - 5x5 mm MLP 28-pin package (32-pin LQFP also available)
- Target portable/battery powered applications
- Product launch October/November 2004

SILICON LABORATORIES

C8051F41x Block Diagram



F41x Key Competitor—Texas Instruments

	TI MSP430F147	Silicon Labs C8051F41x
Flash/RAM	32 kB, 1 kB	**32 kB, 2.25 kB**
CPU (VDD=2 V)	4 MIPS RISC	**66 MIPS 8051**
IDD	250 µA/MHz	**150 µ A/MHz**
ADC	12-bit, 8 ch.	**12-bit, 20 ch.**
DAC	No	**12-bit, 2 ch.**
VREG, VREF, temp Sen	No, no, no	**Yes, yes, yes**
Real-time clock with battery backup	No	**Yes (1.0 V, Idd = 5 µA)**
Internal Clock (2%)	No	**Yes**
Timers and PCA	2 16-bit	**4 16-bit, 6ch PCA**
Serial buses	2 USARTs	**UART, SPI, SMBus/I2C**
Dig I/O (max voltage)	48, (VDD)	**20-24, (5.5 V no pullup)**
Package	TQFP64 (12x12 mm)	**MLP28 (5x5 mm)**
Price (10 Kµ)	$5.05	**~$4**

Faster CPU

On-chip resources

No external crystal required

Smaller package

Lower price

SILICON LABORATORIES

Target Applications for F41x MCU

- Battery powered equipment
- Handheld/portable electronics
- Personal medical devices (blood pressure, temperature)
- Portable instrumentation
- Utility meters
- Smart sensor interface
- Digital camera
- Mini-disc players, MP3 players
- Smoke detectors
- Security equipment

MCU Marketing Overview

- MCU contacts
- Positioning and product differentiation
- Product family and roadmap
- MCU target applications
- Competition
- New product—F350 and F353
- New product—F41x
- New product—F064 and F067
- MCU sales tools
- 2004 Marcom plan
- Summary

SILICON LABORATORIES

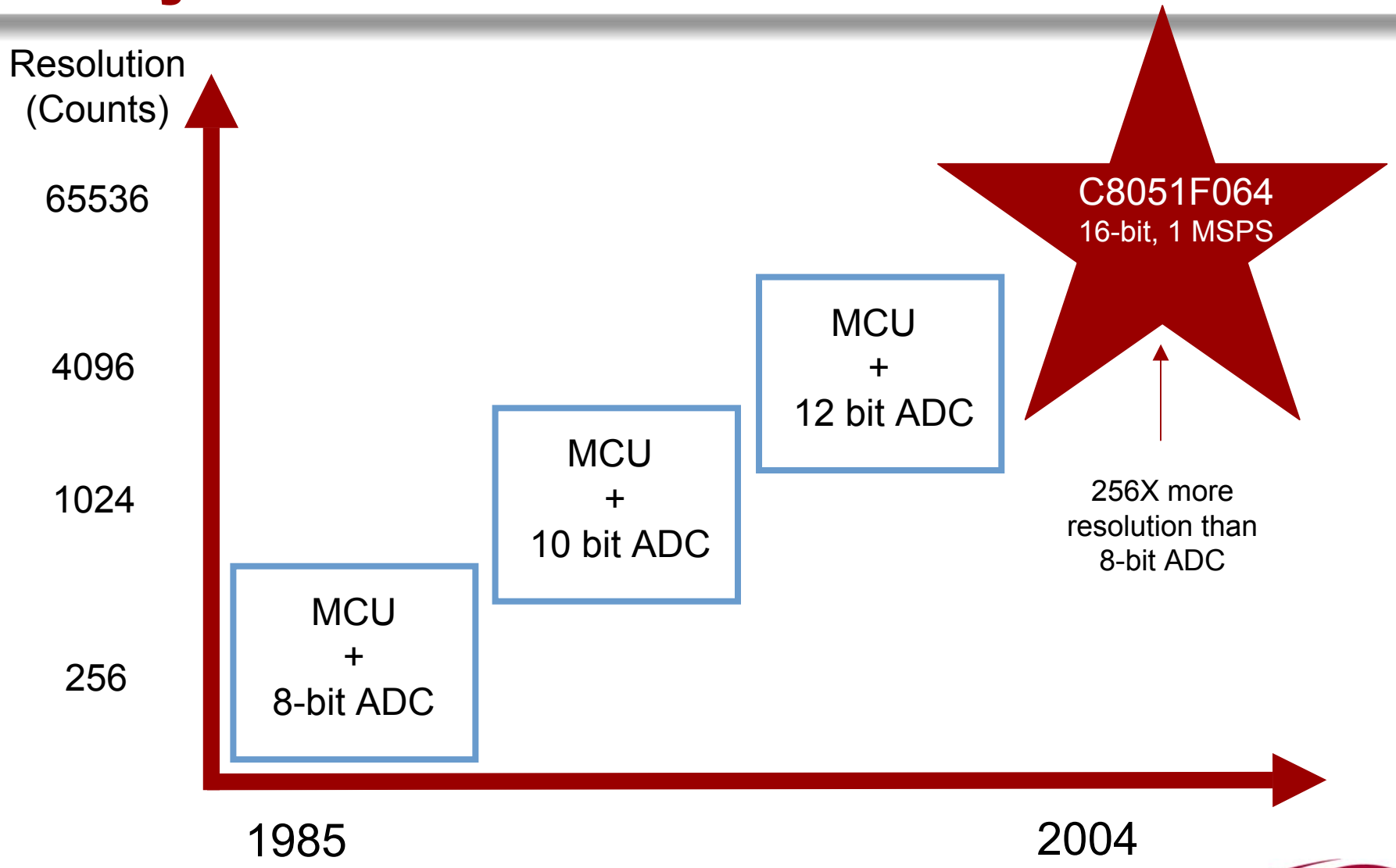
World's First MCU Family with High Speed 16-bit ADC

To be announced - July 2004

Key Message

- Only MCU in the market with16-bit, 1MSPS ADC
- Replaces at least two external components and reduces software Overhead
- Ideal solution for
  - Battery powered electronics
  - Signal analysis applications
  - Performance upgrade solutions
- Low price
  - Equivalent/lower price to existing stand alone 16-bit ADCs

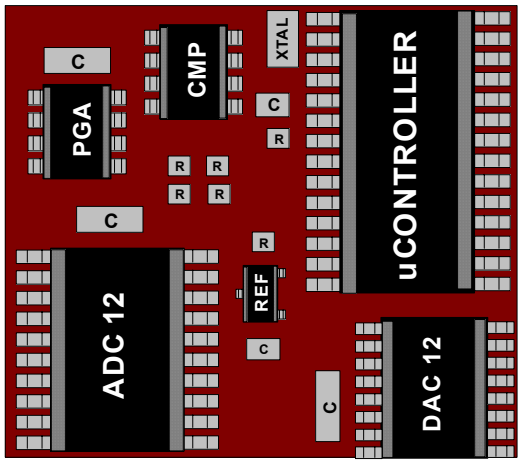
Only 16-Bit SAR ADC MCU on Market



SILICON LABORATORIES

Replaces At Least Two Chips

19.4 x 16.5 mm =320 mm ^{2}



C8051F064

12 x 12 mm = 144 mm^2

Integration:

- Reduces Board Space
- Reduces Power Consumption
- Increases Performance
- Increases Reliability
- Reduces Development Time
- Reduces System cost

SILICON LABORATORIES

Battery Powered Applications

Applications
Medical Instruments Scientific Instruments Multi-meters

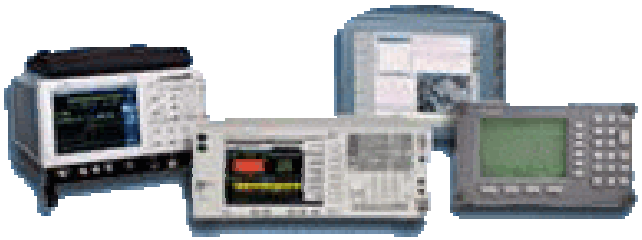
Requirements	C8051F064 Features
Very High Accuracy Low Power Small Size	±0.75 LSB, 16-bit ADC 20mW/ADC 12x12 mm

SILICON LABORATORIES

Signal Analysis Applications

Applications
Telecommunication Digital Signal Processing Spectrum Analysis Imaging Systems Wireless Base Station

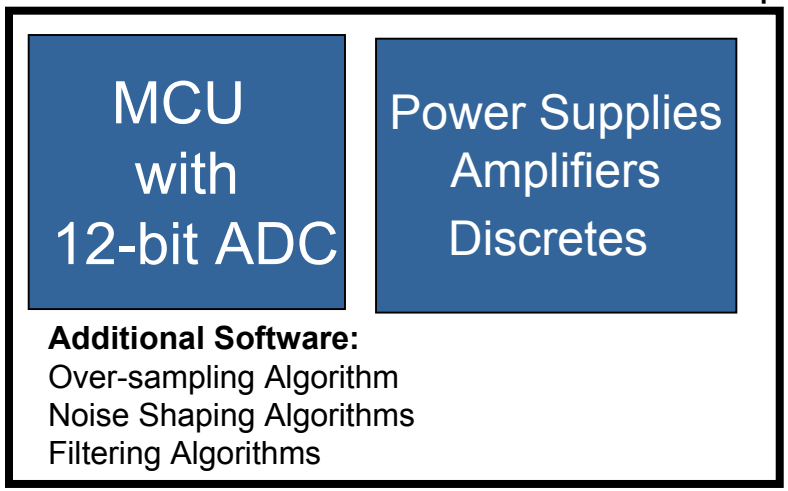
Requirements	C8051F064 Features
Low Noise	89 dB SINAD
High Speed Conversion	1MSPS16-bit ADC
Small Size	12x12 mm



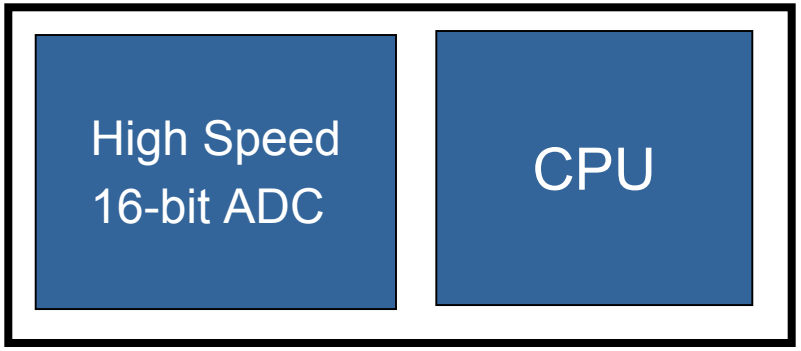
SILICON LABORATORIES

Performance Upgrade Solutions

MCU with 12-Bit ADC and external components



MCU with standalone 16-Bit ADC



Typical Applications:

- High-speed Data Acquisition
- Industrial Controls
- Automatic Test Equipment (ATE)
- Process Control

C8051F064

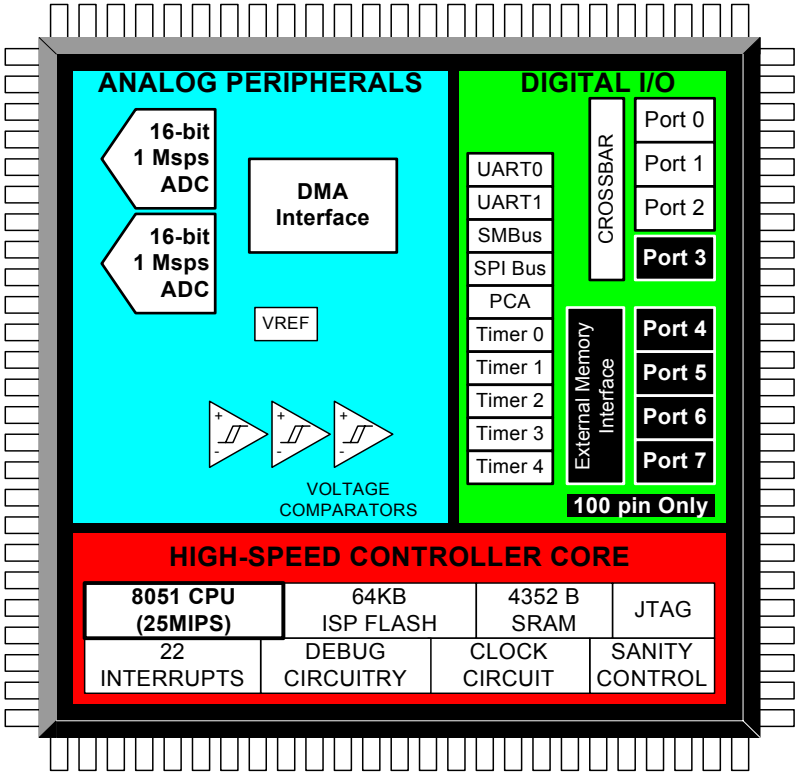
Benefits:

- Better System Performance
- Fewer components (less space)
- Higher CPU bandwidth
- Less software to develop
- Faster time-to-market
- Lower Cost

SILICON LABORATORIES

Single Chip High-Performance Data Acquisition

- Features
  - Analog
    - Dual, 16-bit 1MSPS ADCs
    - 3 Analog Comparators
    - Voltage Reference
  - Digital
    - 25 MIPS 8051 CPU
    - Up to 64kB In-system Programmable Flash
    - 4352 B SRAM
    - Flexible Reconfiguration Port
    - 2% Clock (No Crystal Needed)
  - Debug
    - JTAG Debug & Development

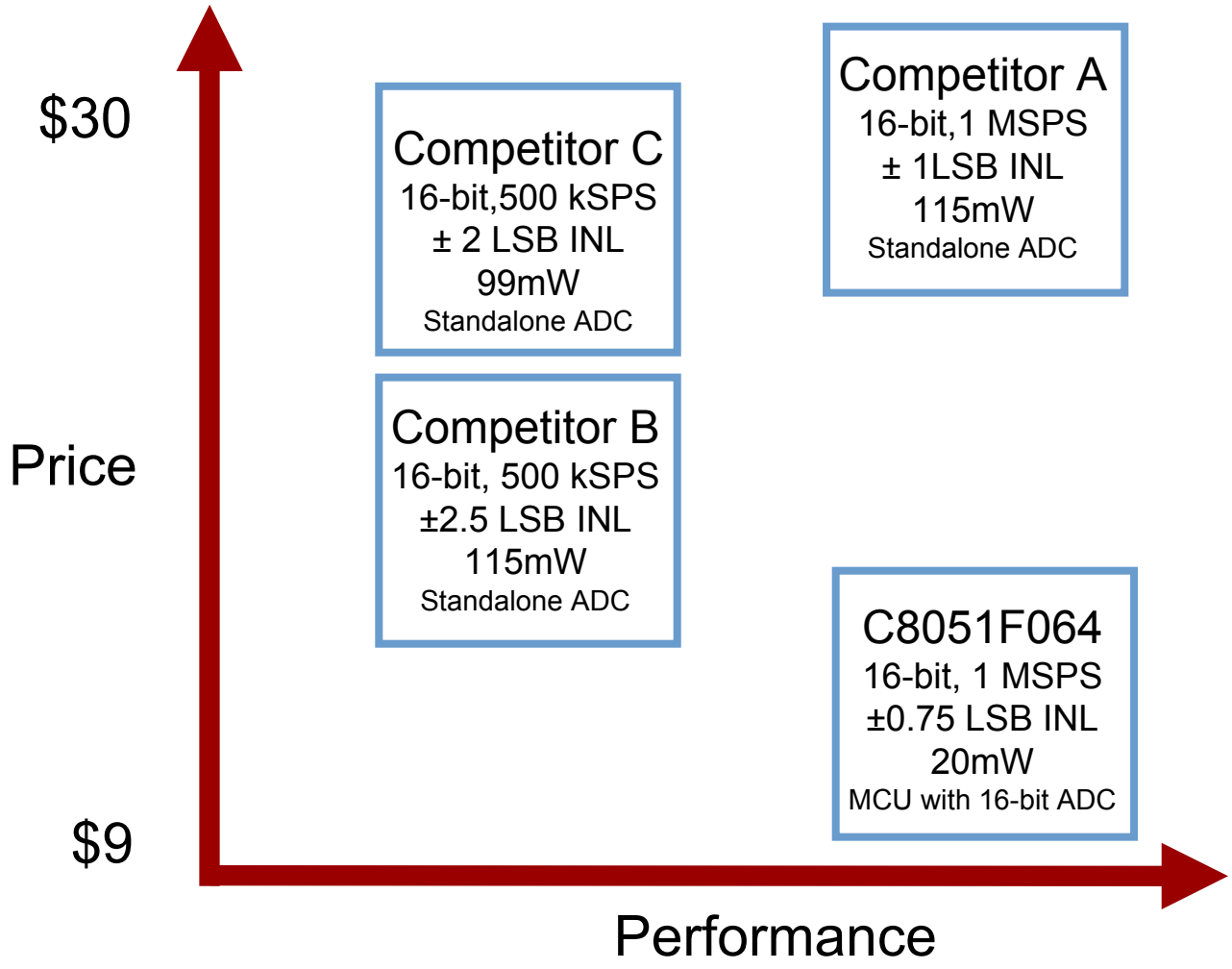


SILICON LABORATORIES

Family Differentiation

Device	Memory	ADC/ Linearity	I/O ; Analog	Package
C8051F064	64kB	16-bit ±0.75 LSB	59/2	TQFP100
C8051F065	64kB	16-bit ±0.75 LSB	24/2	TQFP64
C8051F066	32kB	16-bit ±0.75 LSB	59/2	TQFP100
C8051F067	32kB	16-bit ±0.75 LSB	24/2	TQFP64

Stand Alone ADC Competition



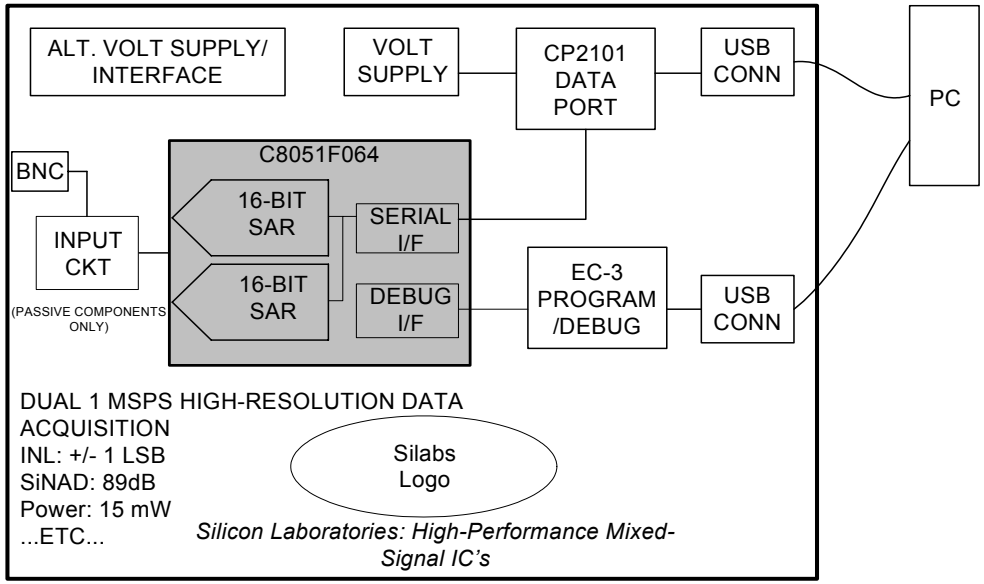
Key Features

- Industry Leading ADC
  - Up to 2.5x better INL
- Lowest Power
  - 1/5th the power
- Free MCU w/ ADC

SILICON LABORATORIES

$25 Evaluation

- Self-contained USB powered demo:
  - Self Demo – Easily demonstrate 16-bit performance
  - Performance demo—input external signal for evaluation
  - Software tools ‘Test Drive’



$25 Evaluation Kit

Summary

- Worlds first MCU with high speed 16-bit ADC on-chip
- Replaces multiple chips in system
- Significantly more accurate than existing MCU Technology
- Ideal for battery powered, signal analysis and performance upgrade solutions
- $25 evaluation tool available

- Give the evaluation tool to your customers !

SILICON LABORATORIES

Alternative Solutions

	Silicon Labs C8051F067*	ADI AD7677	ADI AD7664	LTC LT1608A
Bits	16	16	16	16
Peak Throughput	1MSPS	1MSPS	500kSPS	500kSPS
Throughput Specs	@ 500 kMSPS	@ 800 kSPS	@ 500 kSPS	@ 500 kSPS
INL (LSBs)	±1	±1	±2.5	±2
SINAD	89	94 dB	89 dB	90 dB
CPU (Max MIPs)	25 MIPS 8051	(None)	(None)	(None)
Memory	64 kB Flash	(None)	(None)	(None)
ADC Power (mW)	18 mW	115mW	115mW	270 mW
Package Footprint	144mm2	49mm2	49mm2	99mm2
Price 5,000s	$9.98	~$30	~$17.50	~$20

Discrete ADCs

Competitive advantages

- Complete SOC: ADC, MCU, Memory, etc.
- Better/equal analog
- Lowest power ADC, 1/5th closest competitor
- Price beats Discrete ADCs, ½ closet competitor
- No competing Integrated Solutions Exist at this Time

SILICON LABORATORIES

MCU Marketing Overview

- MCU contacts
- Positioning and product differentiation
- Product family and roadmap
- MCU target applications
- Competition
- New product—F350 and F353
- New product—F41x
- New product—F064 and F067
- MCU sales tools
- 2004 Marcom plan
- Summary

SILICON LABORATORIES

Product Briefs—Give These to Customers!

Available:

Precision Mixed-Signal Microcontrollers
USB Microcontrollers
CAN Interface Microcontrollers
General Purpose Microcontrollers
CP2101 Single-Chip USB to UART Bridge
Small Form Factor Microcontrollers
Microcontroller Development Tools

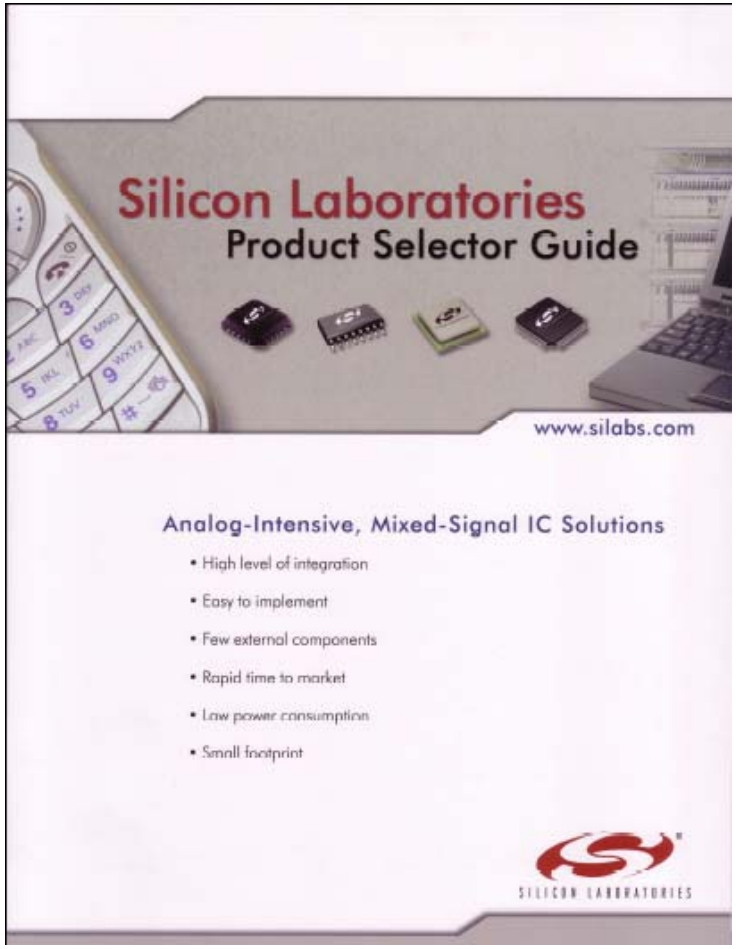
Take these on customer calls!

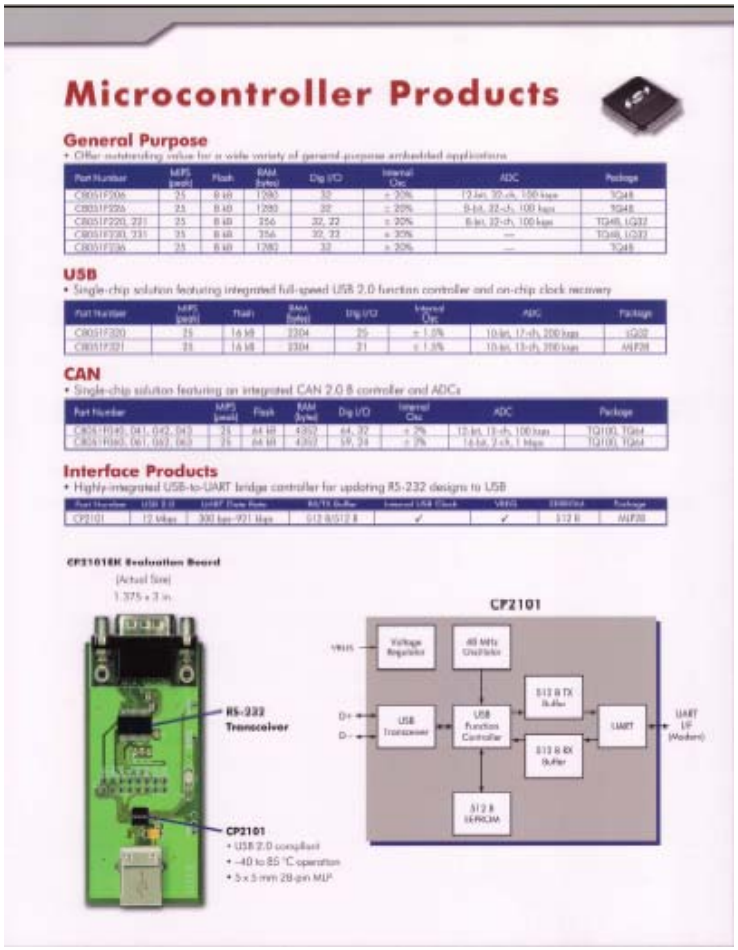
Leave a copy with customers!

Occupy customer desk space!

SILICON LABORATORIES

Selector Guide

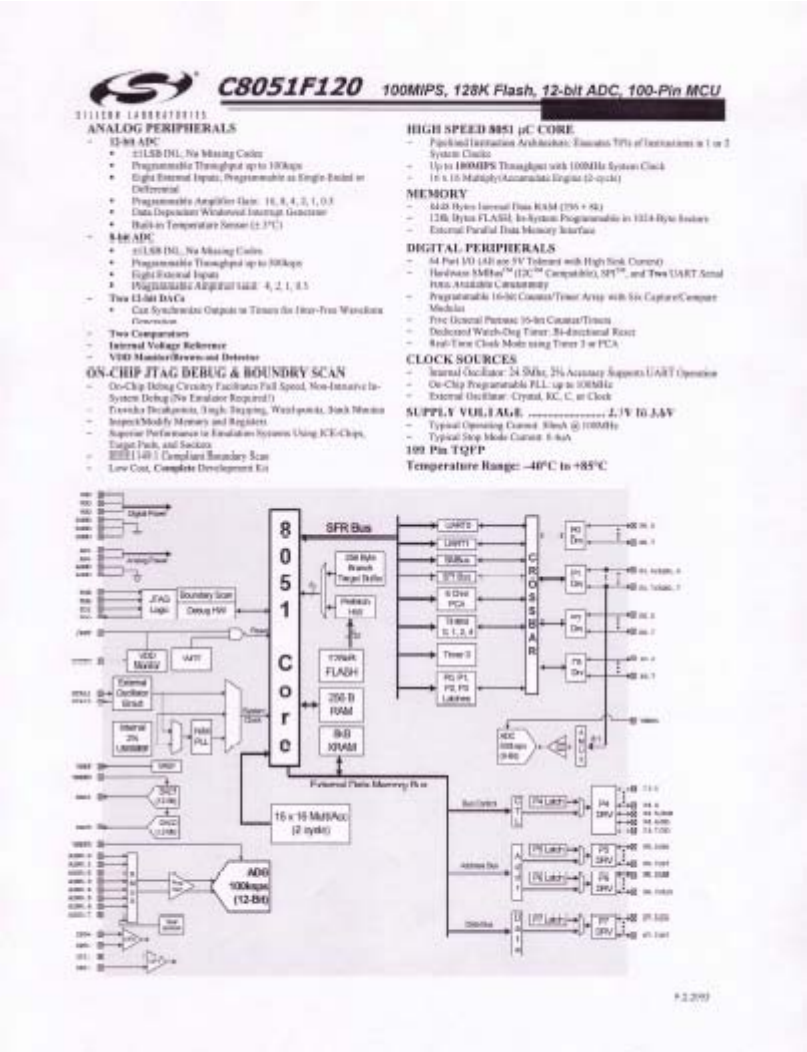




This is a good reference showing product features clearly.

SILICON LABORATORIES

Data Short – Two Page Spec Overview



C8051F120 100MIPS, 128K Flash, 12-bit ADC, 100-Pin MCU

ANALOG PERIPHERALS

- 12-bit ADC
  - ±1LSB INL, No Missing Codes
  - Programmable Throughput up to 100ksps
  - Eight External Inputs; Programmable as Single-Ended or Differential
  - Programmable Amplifier Gain: 16, 8, 4, 2, 1, 0.5
  - Data-Dependent Windowed Interrupt Generator
  - Built-in Temperature Sensor (±3°C)
- 8-bit ADC
  - ±1LSB INL, No Missing Codes
  - Programmable Throughput up to 500ksps
  - Eight External Inputs
  - Programmable Amplifier Gain: 4, 2, 1, 0.5
- Two 12-bit DACs
  - Can Synchronize Outputs to Timers for Jitter-Free Waveform Generation
- Two Comparators
- Internal Voltage Reference
- VDD Monitor/Brown-out Detector

ON-CHIP JTAG DEBUG & BOUNDRY SCAN

- On-Chip Debug Circuitry Facilitates Full Speed, Non-Intrusive In-System Debug (No Emulator Required!)
- Provides Breakpoints, Single Stepping, Watchpoints, Stack Monitor
- Inspect/Modify Memory and Registers
- Superior Performance to Emulation Systems Using ICE-Chips, Target Pods, and Sockets
- IEEE1149.1 Compliant Boundary Scan
- Low Cost, Complete Development Kit

HIGH SPEED 8051 µC CORE

- Pipelined Instruction Architecture; Executes 70% of Instructions in 1 or 2 System Clocks
- Up to 100MIPS Throughput with 100MHz System Clock
- 16 x 16 Multiply/Accumulate Engine (2-cycle)

MEMORY

- 8448 Bytes Internal Data RAM (256 + 8k)
- 128k Bytes FLASH; In-System Programmable in 1024-Byte Sectors
- External Parallel Data Memory Interface

DIGITAL PERIPHERALS

- 64 Port I/O (All are 5V Tolerant with High Sink Current)
- Hardware SMBus™ (I2C™ Compatible), SPI™, and Two UART Serial Ports Available Concurrently
- Programmable 16-bit Counter/Timer Array with Six Capture/Compare Modules
- Five General Purpose 16-bit Counter/Timers
- Dedicated Watch-Dog Timer; Bi-directional Reset
- Real-Time Clock Mode using Timer 3 or PCA

CLOCK SOURCES

- Internal Oscillator: 24.5MHz, 2% Accuracy Supports UART Operation
- On-Chip Programmable PLL: up to 100MHz
- External Oscillator: Crystal, RC, C, or Clock

SUPPLY VOLTAGE ..... 2.7V TO 3.6V

- Typical Operating Current: 80mA @ 100MHz
- Typical Stop Mode Current: 0.4uA

100 Pin TQFP

Temperature Range: -40°C to +85°C

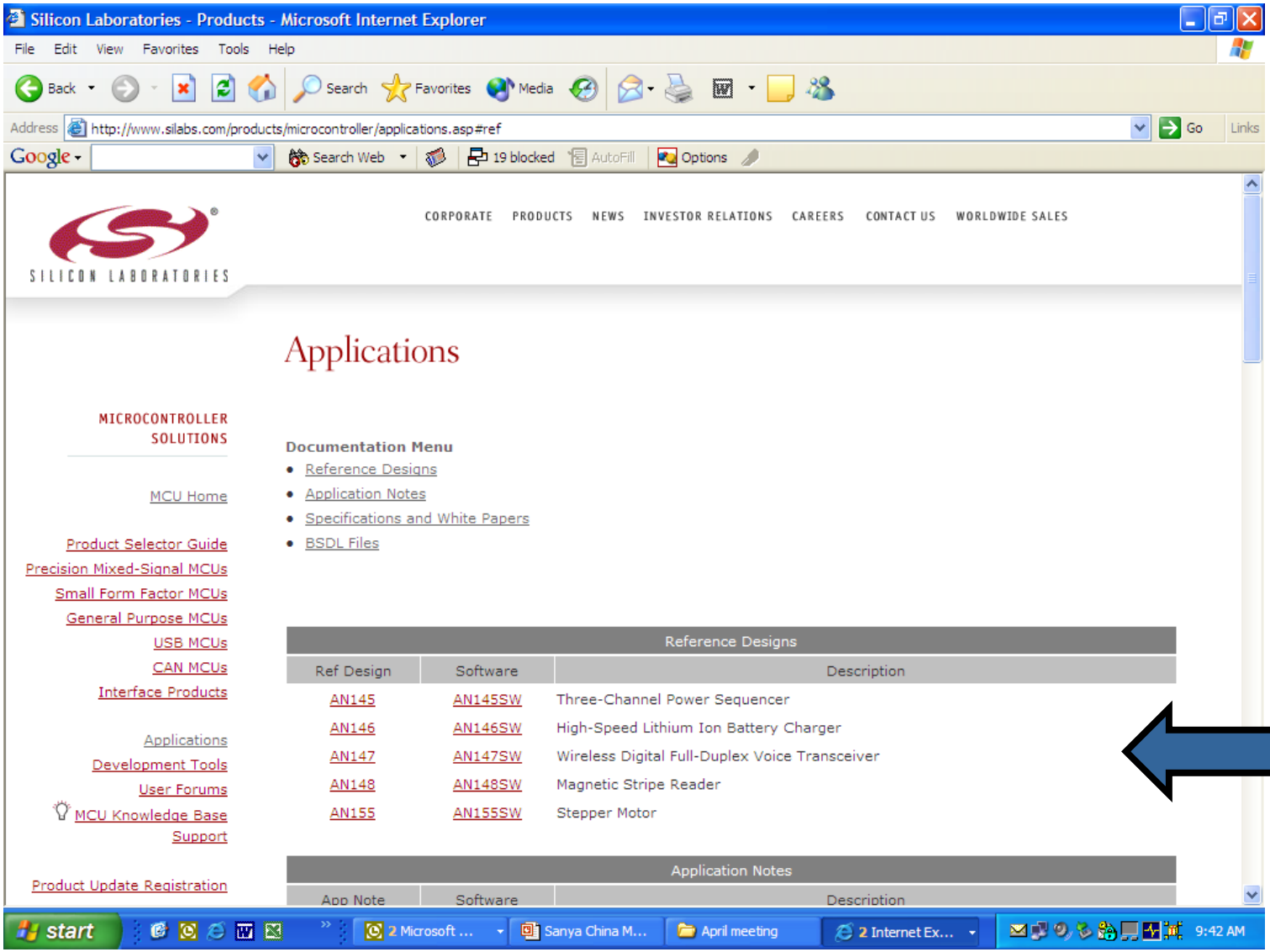
- Available for all MCU Products
- Downloadable from website
- Includes good technical details
- Leave a copy with customer!

SILICON LABORATORIES

What is a Reference Design?

- Complete system design example
- Includes theory of design/usage documentation
- Schematic, PCB layout, BOM
- All software
- We have built the demo system, and it works!

Available Reference Designs



Download From Website !

Current Reference Designs

- Three channel power sequencer (F330)
  - Controls multiple power-rail systems
- High-speed lithium-ion battery charger (F300)
- Wireless digital full-duplex voice transceiver (F330)
  - Voice quality audio headset
- Magnetic stripe reader (F330)
  - Two channel
  - Reads credit cards, ATM cards, drivers licenses, etc
- Stepper motor control (F300)

MCU Marketing Overview

- MCU contacts
- Positioning and product differentiation
- Product family and roadmap
- MCU target applications
- Competition
- New product—F350 and F353
- New product—F41x
- New product—F064 and F067
- MCU sales tools
- 2004 Marcom plan
- Summary

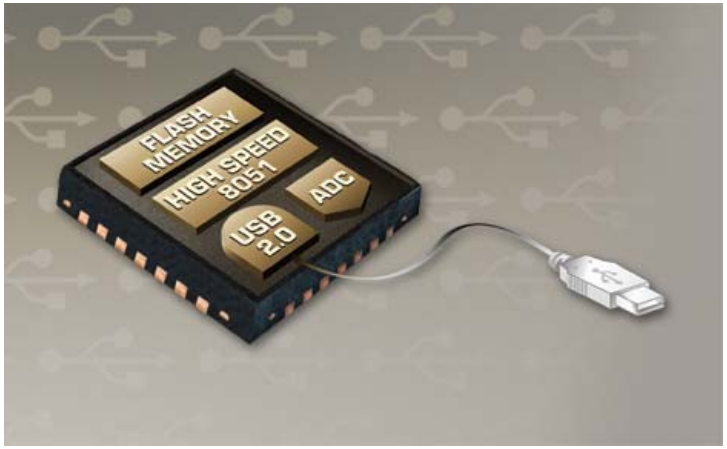
SILICON LABORATORIES

2004 MCU Marcom Plan

Date	Activity
January–February	Global Branding Ad Campaign
March	F350 (16/24-bit ADC) Product launch
March	MCU Design-in contest
April	MCU product collateral complete, distributed to sales
April–June	Global Product Ad Campaign including focus on Computex
June	F12x Lower cost 100 MIPS MCU (only 8-Bit ADC)
July	Global Low-cost 16-Bit ADC F06x product launch
August	F044 32K CAN derivative product launch
October–November	Global F41x ‘Ultra Low Power’ Product launch

MCU Marketing Overview

- MCU contacts
- Positioning and product differentiation
- Product family and roadmap
- MCU target applications
- Competition
- New product—F350 and F353
- New product—F41x
- New product—F064 and F067
- MCU sales tools
- 2004 Marcom plan
- Summary

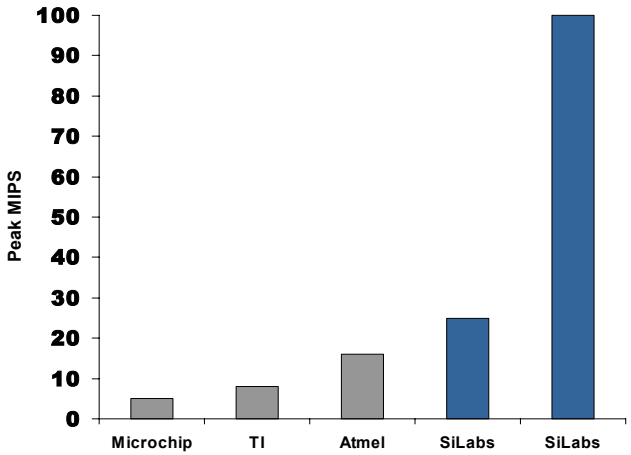


SILICON LABORATORIES

Summary

Best Analog.

Smallest.



Fastest.

SILICON LABORATORIES

Call to Action

- Tell all your customers about Silicon Labs MCUs
  - Smallest. Fastest. Best Analog.
- Give copies of the Product Briefs to your customers
  - Order more from https://sales.silabs.com
- If a customer is currently using a competitors MCU, they will recognize clear benefits with Silicon Labs MCUs
  - Smaller. Faster. Better Analog
  - Increased integration—less external components
  - Specifications competitive with standalone ADCs

Precision Mixed Signal Products Reference

Precision Mixed-Signal MCU

Part Number	MIPS (peak)	Flash Memory (bytes)	RAM (bytes)	Ext Mem I/F	Digital Port I/O Pins	Serial Buses	Timers (16-bit)	PCA Chnls	Internal Osc	ADC1	ADC2	DAC	Temp Sensor	VREF	Comparators	Other	Package	Eval Kit
C8051F120	100	128KB	8448	Y	64	2 UARTs, SMBus, SPI	5	6	±2%	12-bit, 8ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	2	16x16 MAC	TQFP100	C8051F120DK
C8051F121	100	128KB	8448	Y	32	2 UARTs, SMBus, SPI	5	6	±2%	12-bit, 8ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	2	16x16 MAC	TQFP64	C8051F120DK
C8051F122	100	128KB	8448	Y	64	2 UARTs, SMBus, SPI	5	6	±2%	10-bit, 8ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	2	16x16 MAC	TQFP100	C8051F120DK
C8051F123	100	128KB	8448	Y	32	2 UARTs, SMBus, SPI	5	6	±2%	10-bit, 8ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	2	16x16 MAC	TQFP64	C8051F120DK
C8051F124	50	128KB	8448	Y	64	2 UARTs, SMBus, SPI	5	6	±2%	12-bit, 8ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	2	-	TQFP100	C8051F124DK
C8051F125	50	128KB	8448	Y	32	2 UARTs, SMBus, SPI	5	6	±2%	12-bit, 8ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	2	-	TQFP64	C8051F124DK
C8051F126	50	128KB	8448	Y	64	2 UARTs, SMBus, SPI	5	6	±2%	10-bit, 8ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	2	-	TQFP100	C8051F124DK
C8051F127	50	128KB	8448	Y	32	2 UARTs, SMBus, SPI	5	6	±2%	10-bit, 8ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	2	-	TQFP64	C8051F124DK
C8051F020	25	64KB	4352	Y	64	2 UARTs, SMBus, SPI	5	5	±20%	12-bit, 8ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	2	-	TQFP100	C8051F020DK
C8051F021	25	64KB	4352	Y	32	2 UARTs, SMBus, SPI	5	5	±20%	12-bit, 8ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	2	-	TQFP64	C8051F020DK
C8051F022	25	64KB	4352	Y	64	2 UARTs, SMBus, SPI	5	5	±20%	10-bit, 8ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	2	-	TQFP100	C8051F020DK
C8051F023	25	64KB	4352	Y	32	2 UARTs, SMBus, SPI	5	5	±20%	10-bit, 8ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	2	-	TQFP64	C8051F020DK
C8051F000	20	32KB	256	-	32	UART, SMBus, SPI	4	5	±20%	12-bit, 8ch., 100ksps	-	12-bit, 2ch.	Y	Y	2	-	TQFP64	C8051F000DK
C8051F001	20	32KB	256	-	16	UART, SMBus, SPI	4	5	±20%	12-bit, 8ch., 100ksps	-	12-bit, 2ch.	Y	Y	2	-	TQFP48	C8051F000DK
C8051F002	20	32KB	256	-	8	UART, SMBus, SPI	4	5	±20%	12-bit, 4ch., 100ksps	-	12-bit, 2ch.	Y	Y	1	-	LQFP32	C8051F000DK
C8051F005	25	32KB	2304	-	32	UART, SMBus, SPI	4	5	±20%	12-bit, 8ch., 100ksps	-	12-bit, 2ch.	Y	Y	2	-	TQFP64	C8051F005DK
C8051F006	25	32KB	2304	-	16	UART, SMBus, SPI	4	5	±20%	12-bit, 8ch., 100ksps	-	12-bit, 2ch.	Y	Y	2	-	TQFP48	C8051F005DK
C8051F007	25	32KB	2304	-	8	UART, SMBus, SPI	4	5	±20%	12-bit, 4ch., 100ksps	-	12-bit, 2ch.	Y	Y	1	-	LQFP32	C8051F005DK
C8051F010	20	32KB	256	-	32	UART, SMBus, SPI	4	5	±20%	10-bit, 8ch., 100ksps	-	12-bit, 2ch.	Y	Y	2	-	TQFP64	C8051F010DK
C8051F011	20	32KB	256	-	16	UART, SMBus, SPI	4	5	±20%	10-bit, 8ch., 100ksps	-	12-bit, 2ch.	Y	Y	2	-	TQFP48	C8051F010DK
C8051F012	20	32KB	256	-	8	UART, SMBus, SPI	4	5	±20%	10-bit, 4ch., 100ksps	-	12-bit, 2ch.	Y	Y	1	-	LQFP32	C8051F010DK
C8051F015	25	32KB	2304	-	32	UART, SMBus, SPI	4	5	±20%	10-bit, 8ch., 100ksps	-	12-bit, 2ch.	Y	Y	2	-	TQFP64	C8051F015DK
C8051F016	25	32KB	2304	-	16	UART, SMBus, SPI	4	5	±20%	10-bit, 8ch., 100ksps	-	12-bit, 2ch.	Y	Y	2	-	TQFP48	C8051F015DK
C8051F017	25	32KB	2304	-	8	UART, SMBus, SPI	4	5	±20%	10-bit, 4ch., 100ksps	-	12-bit, 2ch.	Y	Y	1	-	LQFP32	C8051F015DK
C8051F018	25	16KB	1280	-	32	UART, SMBus, SPI	4	5	±20%	10-bit, 8ch., 100ksps	-	-	Y	Y	2	-	TQFP64	C8051F015DK
C8051F019	25	16KB	1280	-	16	UART, SMBus, SPI	4	5	±20%	10-bit, 8ch., 100ksps	-	-	Y	Y	2	-	TQFP48	C8051F015DK
C8051F350	50	8KB	768	-	17	UART, SMBus, SPI	4	3	±2%	24-bit, 8ch., 1ksps	-	8-bit, 2ch.	Y	-	1	-	LQFP32	C8051F350DK
C8051F351	50	8KB	768	-	17	UART, SMBus, SPI	4	3	±2%	24-bit, 8ch., 1ksps	-	8-bit, 2ch.	Y	-	1	-	MLP28	C8051F350DK
C8051F352	50	8KB	768	-	17	UART, SMBus, SPI	4	3	±2%	16-bit, 8ch., 1ksps	-	8-bit, 2ch.	Y	-	1	-	LQFP32	C8051F350DK
C8051F353	50	8KB	768	-	17	UART, SMBus, SPI	4	3	±2%	16-bit, 8ch., 1ksps	-	8-bit, 2ch.	Y	-	1	-	MLP28	C8051F350DK

CAN Products Reference

CAN MCU

Part Number	MIPS (peak)	Flash Memory (bytes)	RAM (bytes)	Ext Mem I/F	Digital Port I/O Pins	Serial Buses	Timers (16-bit)	PCA Chnls	Internal Osc	ADC1	ADC2	DAC	Temp Sensor	VREF	Comparators	Other	Package	Eval Kit
C8051F040	25	64KB	4352	Y	64	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	12-bit, 13ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	3	±60V PGA	TQFP100	C8051F040DK
C8051F041	25	64KB	4352	Y	32	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	12-bit, 13ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	3	±60V PGA	TQFP64	C8051F040DK
C8051F042	25	64KB	4352	Y	64	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	10-bit, 13ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	3	±60V PGA	TQFP100	C8051F040DK
C8051F043	25	64KB	4352	Y	32	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	10-bit, 13ch., 100ksps	8-bit, 8ch., 500ksps	12-bit, 2ch.	Y	Y	3	±60V PGA	TQFP64	C8051F040DK
C8051F060	25	64KB	4352	Y	59	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	16-bit, 2ch., 1Msps	10-bit, 8ch., 200ksps	12-bit, 2ch.	Y	Y	3	DMA	TQFP100	C8051F060DK
C8051F061	25	64KB	4352	Y	24	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	16-bit, 2ch., 1Msps	10-bit, 8ch., 200ksps	12-bit, 2ch.	Y	Y	3	DMA	TQFP64	C8051F060DK
C8051F062	25	64KB	4352	Y	59	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	16-bit, 2ch., 1Msps	10-bit, 8ch., 200ksps	12-bit, 2ch.	Y	Y	3	DMA	TQFP100	C8051F060DK
C8051F063	25	64KB	4352	Y	24	CAN2.0B, 2 UARTs, SMBus, SPI	5	6	±2%	16-bit, 2ch., 1Msps	10-bit, 8ch., 200ksps	12-bit, 2ch.	Y	Y	3	DMA	TQFP64	C8051F060DK

General Purpose Products Reference

General Purpose MCU

Part Number	MIPS (peak)	Flash Memory (bytes)	RAM (bytes)	Ext Mem I/F	Digital Port I/O Pins	Serial Buses	Timers (16-bit)	PCA Chnls	Internal Osc	ADC1	ADC2	DAC	Temp Sensor	VREF	Comparators	Other	Package	Eval Kit
C8051F206	25	8KB	1280	-	32	UART, SPI	3	-	±20%	12-bit, 32ch., 100ksps	-	-	-	-	2	-	TQFP48	C8051F206DK
C8051F220	25	8KB	256	-	32	UART, SPI	3	-	±20%	8-bit, 32ch., 100ksps	-	-	-	-	2	-	TQFP48	C8051F226DK
C8051F221	25	8KB	256	-	22	UART, SPI	3	-	±20%	8-bit, 32ch., 100ksps	-	-	-	-	2	-	LQFP32	C8051F226DK
C8051F226	25	8KB	1280	-	32	UART, SPI	3	-	±20%	8-bit, 32ch., 100ksps	-	-	-	-	2	-	TQFP48	C8051F226DK
C8051F230	25	8KB	256	-	32	UART, SPI	3	-	±20%	-	-	-	-	-	2	-	TQFP48	C8051F226DK
C8051F231	25	8KB	256	-	22	UART, SPI	3	-	±20%	-	-	-	-	-	2	-	LQFP32	C8051F226DK
C8051F236	25	8KB	1280	-	32	UART, SPI	3	-	±20%	-	-	-	-	-	2	-	TQFP48	C8051F226DK

SILICON LABORATORIES

Small Form Factor Products Reference

Small Form Factor MCU

Part Number	MIPS (peak)	Flash Memory (bytes)	RAM (bytes)	Ext Mem I/F	Digital Port I/O Pins	Serial Buses	Timers (16-bit)	PCA Chnls	Internal Osc	ADC1	ADC2	DAC	Temp Sensor	VREF	Comparators	Other	Package	Eval Kit
C8051F300	25	8KB	256	-	8	UART, SMBus	3	3	±2%	8-bit, 8ch., 500ksps	-	-	Y	-	1	-	MLP11	C8051F300DK
C8051F301	25	8KB	256	-	8	UART, SMBus	3	3	±2%	-	-	-	-	-	1	-	MLP11	C8051F300DK
C8051F302	25	8KB	256	-	8	UART, SMBus	3	3	±20%	8-bit, 8ch., 500ksps	-	-	Y	-	1	-	MLP11	C8051F300DK
C8051F303	25	8KB	256	-	8	UART, SMBus	3	3	±20%	-	-	-	-	-	1	-	MLP11	C8051F300DK
C8051F304	25	4KB	256	-	8	UART, SMBus	3	3	±20%	-	-	-	-	-	1	-	MLP11	C8051F300DK
C8051F305	25	2KB	256	-	8	UART, SMBus	3	3	±20%	-	-	-	-	-	1	-	MLP11	C8051F300DK
C8051F330	25	8KB	768	-	17	UART, SMBus, SPI	4	3	±2%	10-bit, 16ch., 200ksps	-	10-bit, 1ch.	Y	Y	1	-	MLP20	C8051F330DK
C8051F331	25	8KB	768	-	17	UART, SMBus, SPI	4	3	±2%	-	-	-	-	-	1	-	MLP20	C8051F330DK
C8051F310	25	16KB	1280	-	29	UART, SMBus, SPI	4	5	±2%	10-bit, 21ch., 200ksps	-	-	Y	-	2	-	LQFP32	C8051F310DK
C8051F311	25	16KB	1280	-	25	UART, SMBus, SPI	4	5	±2%	10-bit, 17ch., 200ksps	-	-	Y	-	2	-	MLP28	C8051F310DK

USB Products Reference

USB MCU

Part Number	MIPS (peak)	Flash Memory (bytes)	RAM (bytes)	Ext Mem I/F	Digital Port I/O Pins	Serial Buses	Timers (16-bit)	PCA Chnls	Internal Osc	ADC1	ADC2	DAC	Temp Sensor	VREF	Comparators	Other	Package	Eval Kit
C8051F320	25	16KB	2304	-	25	USB 2.0, UART, SMBus, SPI	4	5	±1.5%	10-bit, 17ch., 200ksps	-	-	Y	Y	2	-	LQFP32	C8051F320DK
C8051F321	25	16KB	2304	-	21	USB 2.0, UART, SMBus, SPI	4	5	±1.5%	10-bit, 13ch., 200ksps	-	-	Y	Y	2	-	MLP28	C8051F320DK

Interface Products Reference

Interface Products

Part Number	MIPS (peak)	Flash Memory (bytes)	RAM (bytes)	Ext Mem I/F	Digital Port I/O Pins	Serial Buses	Timers (16-bit)	PCA Chnls	Internal Osc	ADC1	ADC2	DAC	Temp Sensor	VREF	Comparators	Other	Package	Eval Kit
CP2101	-	512	1KB	-	13	UART to USB Bridge	-	-	Y	-	-	-	-	-	-	Volt Reg	MLP28	CP2101EK

SILICON LABORATORIES

SILICON LABORATORIES

www.silabs.com