

Analog Peripherals

- **12-Bit ADC**
 - ± 1 LSB INL; no missing codes
 - Programmable throughput up to 200 ksp/s
 - Up to 24 external inputs
 - Data dependent windowed interrupt generator
 - Built-in temperature sensor ($\pm 3^\circ\text{C}$)
- **Two 12-Bit Current Mode DACs**
- **Two Comparators**
 - Programmable hysteresis and response time
 - Configurable as wake-up or reset source
- **POR/Brownout Detector**
- **Voltage Reference—1.5, 2.2 V (programmable)**

On-Chip Debug

- On-chip debug circuitry facilitates full-speed, non-intrusive in-system debug (No emulator required)
- Provides breakpoints, single stepping
- Inspect/modify memory and registers
- Complete development kit

Supply Voltage 2.0 to 5.25 V

- Built-in LDO regulator: 2.1 or 2.5 V

High Speed 8051 μC Core

- Pipelined instruction architecture; executes 70% of instructions in 1 or 2 system clocks
- Up to 50 MIPS throughput with 50 MHz system clock
- Expanded interrupt handler

Memory

- 2304 bytes internal data RAM (256 + 2048)
- 32/16 kB Flash; In-system programmable in 512 byte sectors
- 64 bytes battery-backed RAM (smaRTClock)

Digital Peripherals

- 24 port I/O; push-pull or open-drain, up to 5.25 V tolerance
- Hardware SMBus™ (I2C™ Compatible), SPI™, and UART serial ports available concurrently
- Four general purpose 16-bit counter/timers
- Programmable 16-bit counter/timer array with six capture/compare modules, WDT
- Hardware smaRTClock operates down to 1 V with 64 bytes battery-backed RAM and backup voltage regulator

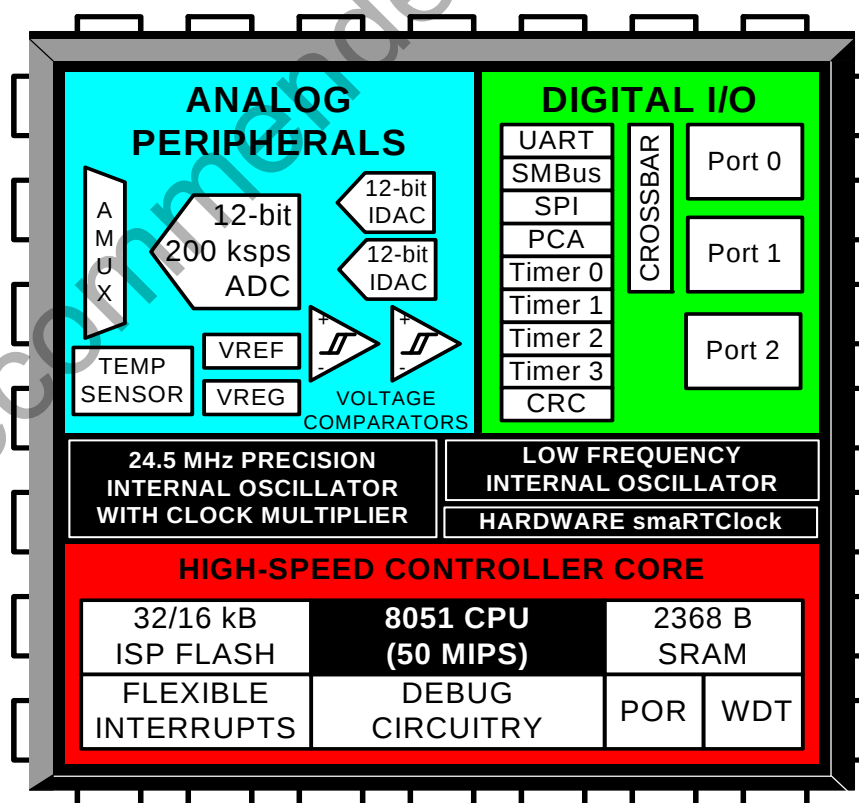
Clock Sources

- Internal oscillators: 24.5 MHz 2% accuracy supports UART operation; clock multiplier up to 50 MHz
- External oscillator: Crystal, RC, C, or Clock (1 or 2 pin modes)
- smaRTClock oscillator: 32 kHz Crystal or self-resonant oscillator
- Can switch between clock sources on-the-fly

Temperature Range: -40 to $+85^\circ\text{C}$

Full Technical Data Sheet

C8051F410/1/2/3



C8051F410-GDI

1. Ordering Information

Table 1.1. Product Selection Guide

Ordering Part Number	MIPS (Peak)	Flash Memory (kB)	RAM (Bytes)	SmaRTClock Real Time Clock	SMBus/I ² C	UART	SPI	Timers (16-bit)	Programmable Counter Array	Digital Port I/Os	12-Bit ADC	Two 12-bit Current Output DACs	Internal Voltage Reference	Temperature Sensor	Analog Comparators	Lead-Free (RoHS-Compliant)	Package	Wafer Thickness
C8051F410-GDI	50	32	2368	✓	1	1	1	4	✓	24	✓	✓	10	✓	1	✓	Tested Die in Wafer Form	12 mil
C8051F410-G1DI	50	32	2368	✓	1	1	1	4	✓	24	✓	✓	10	✓	1	✓	Tested Die in Wafer Form	No back-grind

2. Pin Definitions

Table 2.1 lists the pin definitions for the C8051F410-GDI. For a full description of each pin, refer to the C8051F410/1/2/3 data sheet.

Table 2.1. Pin Definitions for C8051F410-GDI

Name	Physical Pad Number	Type	Description
V_{DD}	10, 11		Core Supply Voltage.
V_{IO}	1, 41		I/O Supply Voltage.
GND	8, 9		Ground.
$V_{RTC-BACKUP}$	5		SmaRTClock Backup Supply Voltage.
V_{REGIN}	12, 13		On-Chip Voltage Regulator Input.
$\overline{RST}/$	2	D I/O	Device Reset. Open-drain output of internal POR or V_{DD} monitor. An external source can initiate a system reset by driving this pin low for at least 15 μs . A 1 k Ω pullup to V_{IO} is recommended.
C2CK		D I/O	Clock signal for the C2 Debug Interface.
P2.7/	39	D I/O	Port 2.7.
C2D		D I/O	Bi-directional data signal for the C2 Debug Interface.
XTAL3	7	A In	smaRTClock Oscillator Crystal Input.
XTAL4	6	A Out	smaRTClock Oscillator Crystal Input.
P0.0/	23	D I/O or A In	Port 0.0.
IDAC0		A Out	IDAC0 Output.
P0.1/	24	D I/O or A In	Port 0.1.
IDAC1		A Out	IDAC1 Output.
P0.2	25	D I/O or A In	Port 0.2.
P0.3	26	D I/O or A In	Port 0.3.

C8051F410-GDI

Table 2.1. Pin Definitions for C8051F410-GDI (Continued)

Name	Physical Pad Number	Type	Description
P0.4/ TX	27	D I/O or A In D Out	Port 0.4. UART TX Pin.
P0.5/ RX	28	D I/O or A In D In	Port 0.5. UART RX Pin.
P0.6/ CNVSTR	29	D I/O or A In D In	Port 0.6. External Convert Start Input for ADC0, IDA0, and IDA1.
P0.7	30	D I/O or A In	Port 0.7.
P1.0/ XTAL1	14	D I/O or A In A In	Port 1.0. External Clock Input. This pin is the external oscillator return for a crystal or resonator.
P1.1/ XTAL2	15	D I/O or A In A O or D In	Port 1.1. External Clock Output. This pin is the excitation driver for an external crystal or resonator, or an external clock input for CMOS, capacitor, or RC oscillator configurations.
P1.2 V _{REF}	16	D I/O or A In A In	Port 1.2. External V _{REF} Input.
P1.3	17	D I/O or A In	Port 1.3.
P1.4	18	D I/O or A In	Port 1.4.
P1.5	19	D I/O or A In	Port 1.5.
P1.6	20	D I/O or A In	Port 1.6.
P1.7	21	D I/O or A In	Port 1.7.

Table 2.1. Pin Definitions for C8051F410-GDI (Continued)

Name	Physical Pad Number	Type	Description
P2.0	31	D I/O or A In	Port 2.0.
P2.1	32	D I/O or A In	Port 2.1.
P2.2	33	D I/O or A In	Port 2.2.
P2.3	34	D I/O or A In	Port 2.3.
P2.4	36	D I/O or A In	Port 2.4.
P2.5	37	D I/O or A In	Port 2.5.
P2.6	38	D I/O or A In	Port 2.6.

C8051F410-GDI

3. Bonding Instructions

Table 3.1. Bond Pad Coordinates (Relative to Center of Die)

Physical Pad Number	Example Package Pin Number (LQFP32)	Package Pin Name	Physical Pad X (um)	Physical Pad Y (um)
1	1	VIO	-1099.49	1063.135
2	2	\RST/C2CK	-1099.49	923.875
3	NA	Reserved*	-1099.49	794.055
4	NA	Reserved*	-1099.49	719.055
5	3	VRTC-BACKUP	-1099.49	232.125
6	4	XTAL4	-1099.49	42.685
7	5	XTAL3	-1099.49	-97.695
8	6	GND	-1099.49	-230.665
9	6	GND	-1099.49	-344.135
10	7	VDD	-1099.49	-445.735
11	7	VDD	-1099.49	-519.735
12	8	VREGIN	-1099.49	-957.615
13	8	VREGIN	-1099.49	-1031.615
14	9	P1.0/XTAL1	-863.93	-1211.435
15	10	P1.1/XTAL2	-430.55	-1211.435
16	11	P1.2/VREF	-244.03	-1211.435
17	12	P1.3	-76.39	-1211.435
18	13	P1.4	290.13	-1211.435
19	14	P1.5	457.77	-1211.435
20	15	P1.6	644.29	-1211.435
21	16	P1.7	811.93	-1211.435
22	NA	Reserved*	951.19	-1211.435
23	17	P0.0/IDAC0	1099.49	-1001.495
24	18	P0.1/IDAC1	1099.49	-833.855
25	19	P0.2	1099.49	-618.575
26	20	P0.3	1099.49	-450.935
27	21	P0.4/TX	1099.49	450.935
28	22	P0.5/RX	1099.49	618.575
29	23	P0.6/CNVSTR	1099.49	833.855

*Note: Pins marked "Reserved" should not be connected.

Table 3.1. Bond Pad Coordinates (Relative to Center of Die) (Continued)

30	24	P0.7	1099.49	1001.495
31	25	P2.0	903.93	1211.435
32	26	P2.1	736.29	1211.435
33	27	P2.2	535.39	1211.435
34	28	P2.3	367.75	1211.435
35	NA	Reserved*	-29.77	1211.435
36	29	P2.4	-198.13	1211.435
37	30	P2.5	-365.77	1211.435
38	31	P2.6	-552.29	1211.435
39	32	P2.7/C2D	-719.93	1211.435
40	NA	Reserved*	-859.19	1211.435
41	1	VIO	-951.19	1211.435

***Note:** Pins marked "Reserved" should not be connected.

C8051F410-GDI

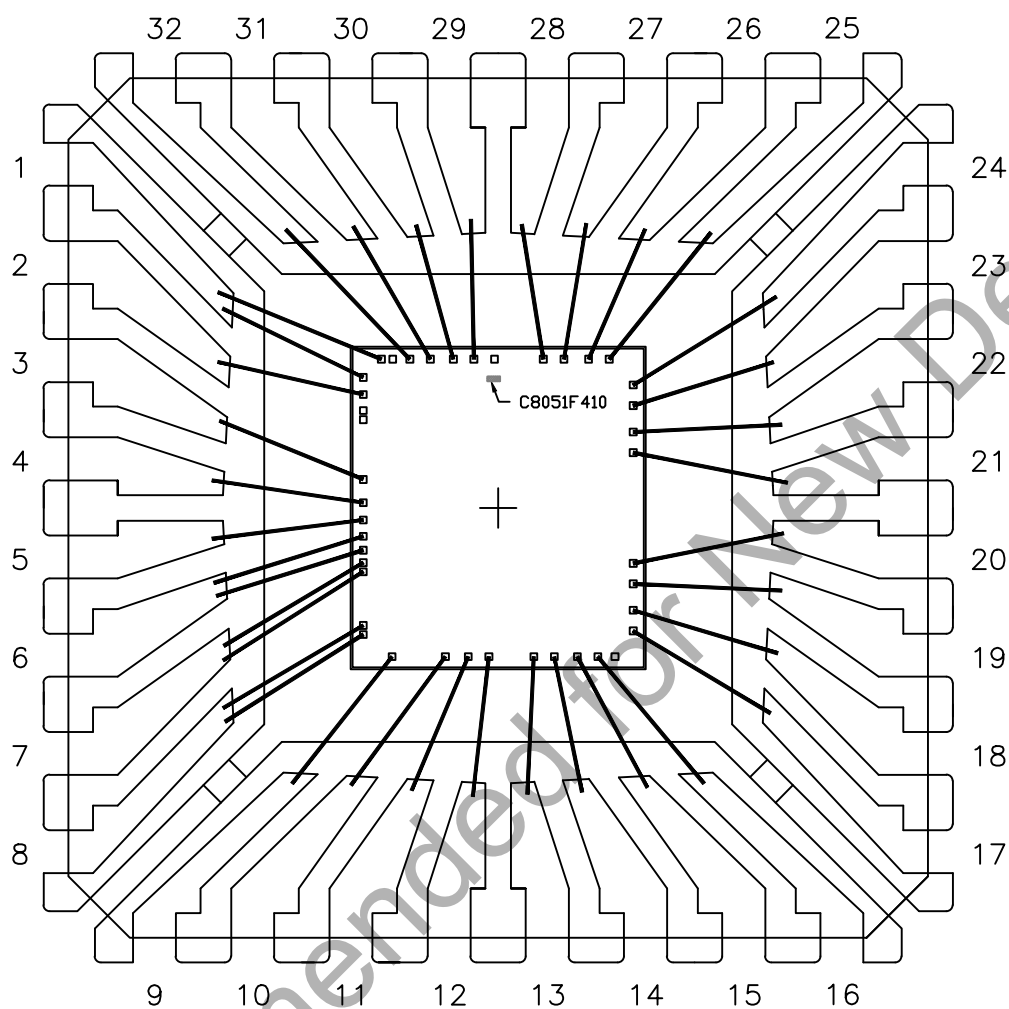


Figure 3.1. Die Bonding (LQFP-32)

Table 3.2. Wafer and Die Information

Wafer Dimensions	8 in
Die Dimensions	2.4 mm x 2.63 mm
Wafer Thickness	12 mil $\pm$ 1 mil (C8051F410-GDI) No backgrind (C8051F410-G1DI)
Wafer Identification	Notch
Scribe Line Width	80 μ m
Die Per Wafer*	Contact Sales for info
Passivation	Standard
Wafer Packaging Detail	Wafer Jar
Bond Pad Dimensions	60 μ m x 60 μ m
Maximum Processing Temperature	250 °C
Electronic Die Map Format	.txt
Bond Pad Pitch Minimum	75 μ m
*Note: This is the Expected Known Good Die yielded per wafer and represents the batch order quantity (one wafer).	

4. Wafer Storage Guidelines

It is necessary to conform to appropriate wafer storage practices to avoid product degradation or contamination.

- Wafers may be stored for up to 18 months in the original packaging supplied by Silicon Labs.
- Wafers must be stored at a temperature of 18–24 °C.
- Wafers must be stored in a humidity-controlled environment with a relative humidity of <30%.
- Wafers should be stored in a clean, dry, inert atmosphere (e.g. nitrogen or clean, dry air).

DOCUMENT CHANGE LIST

Revision 1.0 to Revision 1.1

- Changed Wafer Packaging Detail to “Wafer Jar” in Table 3.2 on page 9.

Revision 1.1 to Revision 1.2

- Added C8051F410-G1DI option in Table 1.1 and Table 3.2.

Simplicity Studio

One-click access to MCU and wireless tools, documentation, software, source code libraries & more. Available for Windows, Mac and Linux!



IoT Portfolio
www.silabs.com/IoT



SW/HW
www.silabs.com/simplicity



Quality
www.silabs.com/quality



Support and Community
community.silabs.com

Disclaimer

Silicon Laboratories intends to provide customers with the latest, accurate, and in-depth documentation of all peripherals and modules available for system and software implementers using or intending to use the Silicon Laboratories products. Characterization data, available modules and peripherals, memory sizes and memory addresses refer to each specific device, and "Typical" parameters provided can and do vary in different applications. Application examples described herein are for illustrative purposes only. Silicon Laboratories reserves the right to make changes without further notice and limitation to product information, specifications, and descriptions herein, and does not give warranties as to the accuracy or completeness of the included information. Silicon Laboratories shall have no liability for the consequences of use of the information supplied herein. This document does not imply or express copyright licenses granted hereunder to design or fabricate any integrated circuits. The products must not be used within any Life Support System without the specific written consent of Silicon Laboratories. A "Life Support System" is any product or system intended to support or sustain life and/or health, which, if it fails, can be reasonably expected to result in significant personal injury or death. Silicon Laboratories products are generally not intended for military applications. Silicon Laboratories products shall under no circumstances be used in weapons of mass destruction including (but not limited to) nuclear, biological or chemical weapons, or missiles capable of delivering such weapons.

Trademark Information

Silicon Laboratories Inc., Silicon Laboratories, Silicon Labs, SiLabs and the Silicon Labs logo, CMEMS®, EFM, EFM32, EFR, Energy Micro, Energy Micro logo and combinations thereof, "the world's most energy friendly microcontrollers", Ember®, EZLink®, EZMac®, EZRadio®, EZRadioPRO®, DSPLL®, ISOmodem®, Precision32®, ProSLIC®, SiPHY®, USBXpress® and others are trademarks or registered trademarks of Silicon Laboratories Inc. ARM, CORTEX, Cortex-M3 and THUMB are trademarks or registered trademarks of ARM Holdings. Keil is a registered trademark of ARM Limited. All other products or brand names mentioned herein are trademarks of their respective holders.



Silicon Laboratories Inc.
400 West Cesar Chavez
Austin, TX 78701
USA

<http://www.silabs.com>

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Silicon Laboratories:

[C8051F410-GQ](#) [C8051F410-TB](#) [TOOLSTICK410PP](#) [C8051F410-GQR](#)