

2014 TI 模拟邀请赛赛前培训

TI 单片机及模拟器件使用注意事项

崔萌

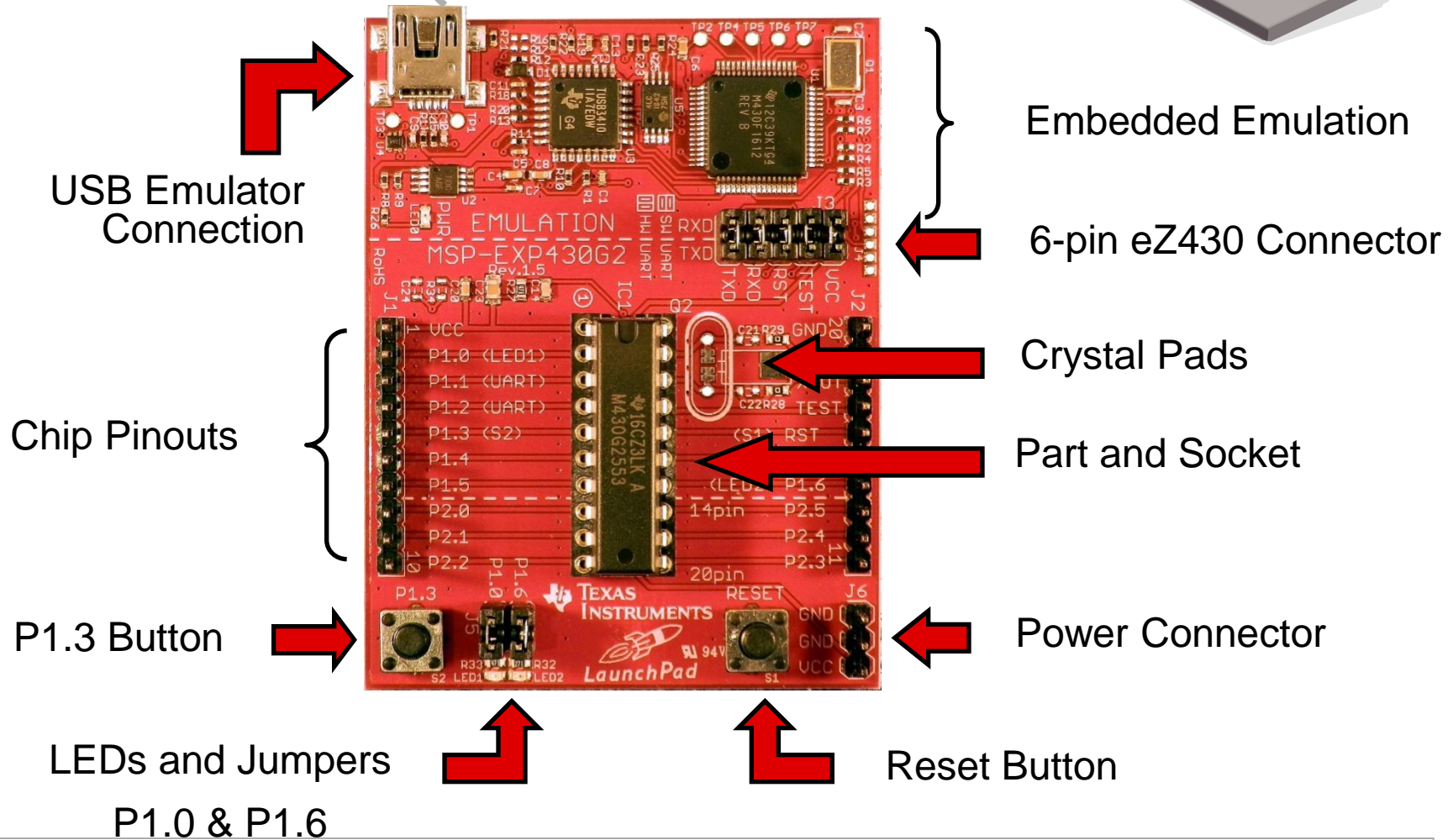
Regina-cui@ti.com

021-23073589

Agenda

- MSP430 外设及基本使用方法
- Tiva 使用注意事项
- TI 数据手册阅读指南
- TI 模拟设计软件使用建议

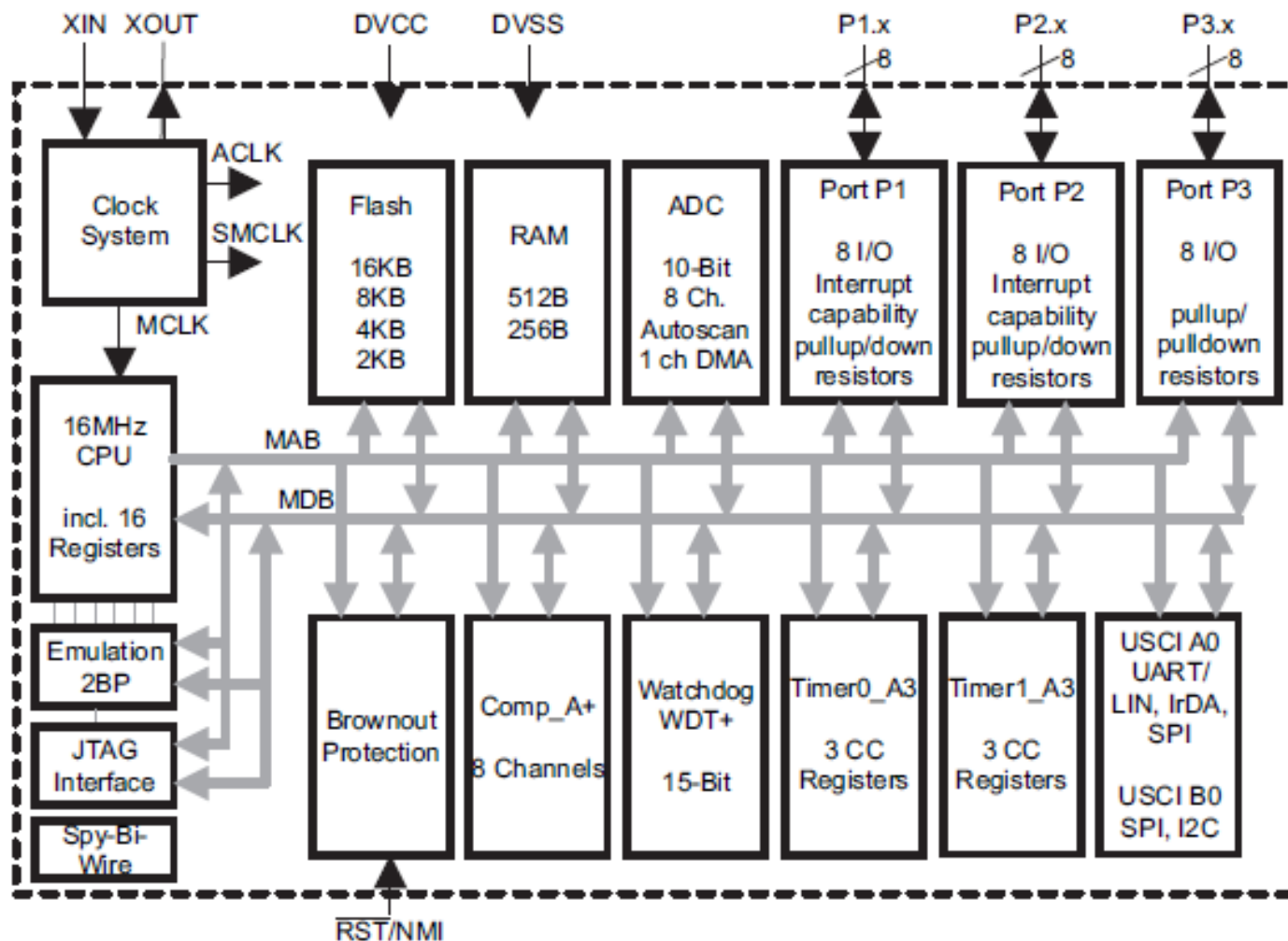
LaunchPad—Pocket Lab



Value Line 外设



Functional Block Diagram, MSP430G2x53



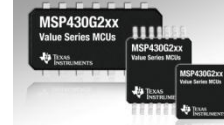
注：Port3
仅在28pin
和32pin的
产品中可用

Value Line 外设



- **通用I/O**
 - 独立可编程
 - 可以对输出，输入以及中断（触发边沿选择）进行控制
 - 所有寻址指令均可对端口控制寄存器进行读/写访问
 - 每个I/O都有一个可独立编程的上拉/下拉电阻
 - 触摸按键模块(PinOsc, CapTouch)
- **16-位 Timer_A3**
 - 3 捕获/比较寄存器
 - 丰富的中断功能
- **WDT+ 看门狗定时器**
 - 同时也可用作普通定时器
- **欠压复位（Brownout Reset）**
 - 在上电和断电时提供准确的复位信号
 - 功耗包括在基本功耗（最低功耗LPM4）的电流计算中

Value Line 外设



- 串行通讯
 - USCI支持I2C, SPI及UART (G2553, 自动波特率检测)
 - USI支持I2C, SPI
- 比较器_A+
 - 反相或同相输入
 - 可选的RC输出滤波器
 - 可直接输出至Timer_A2捕获输入
 - 中断支持
- **8通道/10位 200ksps SAR ADC**
 - 8个外部通道
 - 内置电压和温度传感器通道
 - 参考电压可编程控制
 - DTC模块
 - 中断支持

从430Ware开始，简化单片机开发



CCS Edit - TI Resource Explorer - Code Composer Studio

File Edit View Navigate Project Run Scripts Window Help

Project Explorer TI Resource Explorer

Packages: MSP430ware Devices: All Topics: All

enter search keyword Address:

Devices

Development Tools

- MSP-EXP430G2 (LaunchPad)
 - Quick Start Guide
 - User's Guide
 - Design Files
 - User Experience Project
 - User Experience GUI
- Examples
 - MSP430G2210 Code Examples
 - MSP430G2230 Code Examples
 - MSP430G2x01 Code Examples
 - MSP430G2x11 Code Examples
 - MSP430G2x21 Code Examples
 - MSP430G2x31 Code Examples
 - MSP430G2x02 Code Examples
 - MSP430G2x12 Code Examples
 - MSP430G2x32 Code Examples
 - MSP430G2x52 Code Examples
 - MSP430G2x03 Code Examples
 - MSP430G2x13 Code Examples
 - MSP430G2x33 Code Examples
 - MSP430G2x53 Code Examples
- MSP-EXP430F5529LP

MSP-EXP430G2

The MSP-EXP430G2 LaunchPad is an easy-to-use flash programmer and debugging tool for the MSP430G2xx Value Line microcontrollers. It features everything you need to start developing on an MSP430 microcontroller device. It has on-board emulation for programming and debugging and features a 14/20-pin DIP socket, on-board buttons and LEDs & BoosterPack-compatible pinouts that support a wide range of plug-in modules for added functionality such as wireless, displays & more.

The MSP-EXP430G2 LaunchPad also comes with 2 MSP430 device, with up to 16kB Flash, 512B RAM, 16MHz CPU speed and integrated peripherals such as 8ch 10-bit ADC, timers, serial communication (UART, I2C & SPI) & more!

Console

No consoles to display at this time.

Problems Advice

0 items

Description	Resource	Pat
-------------	----------	-----

Licensed

430Ware



TI Resource Explorer

Packages: MSP430ware Devices: All Topics: All

enter search keyword

Address:

One-Click Projects View C-Files View Assembler Files

One-Click Projects	View C-Files	View Assembler Files
msp430g2xx3 flashwrite_01		Flash In-System Programming, Copy SegC to SegD
msp430g2xx3 LFxtal_nmi		LFXT1 Oscillator Fault Detection
msp430g2xx3 lpm3		Basic Clock, LPM3 Using WDT ISR, 32kHz ACLK
msp430g2xx3 lpm3_vlo		Basic Clock, LPM3 Using WDT ISR, VLO ACLK
msp430g2xx3 nmi		Basic Clock, Configure RST/NMI as NMI
msp430g2xx3 P1_01		Software Poll P1.4, Set P1.0 if P1.4 = 1
msp430g2xx3 P1_02		Software Port Interrupt Service on P1.4 from LPM4
msp430g2xx3 P1_03		Poll P1 With Software with Internal Pull-up
msp430g2xx3 P1_04		P1 Interrupt from LPM4 with Internal Pull-up
msp430g2xx3 pinosc_01		Capacitive Touch, Pin Oscillator Method, 1 button
msp430g2xx3 pinosc_02		Capacitive Touch, Pin Oscillator Method, 4-buttons
msp430g2xx3 pinosc_03		Capacitive Touch, Pin Oscillator Method, 4-buttons, ACLK for CCR
msp430g2xx3 pinosc_04		Capacitive Touch, Pin Oscillator Method, 8 buttons, UART
msp430g2xx3 ta_01		Timer_A, Toggle P1.0, CCR0 Cont. Mode ISR, DCO SMCLK
msp430g2xx3 ta_02		Timer_A, Toggle P1.0, CCR0 Up Mode ISR, DCO SMCLK
msp430g2xx3 ta_03		Timer_A, Toggle P1.0, Overflow ISR, DCO SMCLK
msp430g2xx3 ta_04		Timer_A, Toggle P1.0, Overflow ISR, 32kHz ACLK
msp430g2xx3 ta_05		Timer_A, Toggle P1.0, CCR0 Up Mode ISR, 32kHz ACLK
msp430g2xx3 ta_06		Timer_A, Toggle P1.0, CCR1 Cont. Mode ISR, DCO SMCLK

Console

No consoles to display at this time.

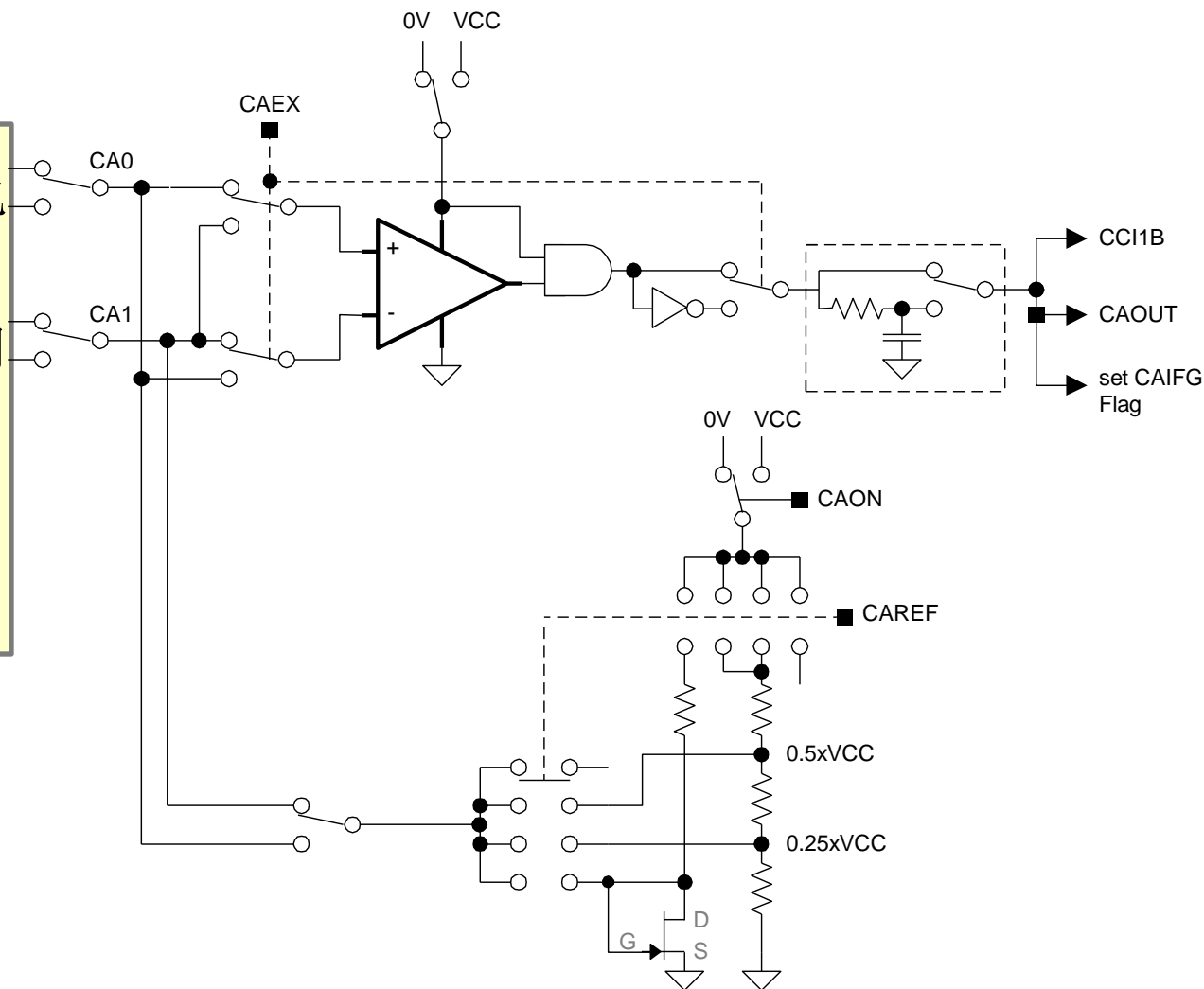
Problems Advice

0 items

Comparator_A



- 可用内部电压参考，也可从外部接入
- 内建低通滤波器可利用软件来选择开或关
- 多路输入选择开关
- 具有中断功能





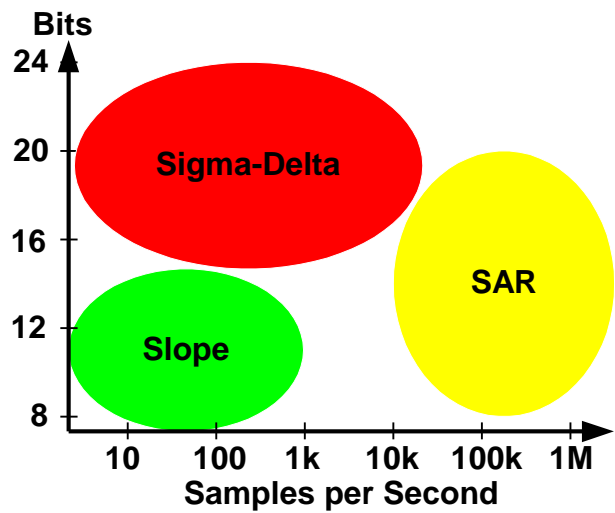
430Ware举例

选择一款 MSP430 ADC



	通道数	f_{SAMPLE} (ksp/s)		分辨率	SINAD (典型值)	A_{IN}	基准			触发	增益	特性
		最小值	最大值				Ref _{IN}	Ref _{OUT}	Ref _{I_OUT}			
ADC10	8	34	200+	10	57	Vss 至 Vref	1.4-3.6	1.5/2.5V	+/-1mA	SW/定时器/计数器	N/A	DTC
ADC12	12	34	200+	12	68	Vss 至 Vref	1.4-3.6	1.5/2.5V	+/-1mA	SW/定时器/计数器	N/A	转换存储器
SD16	3 个独立	约 4		16	85	+/-600mV	1.0-1.5	1.2V	+/-1mA	SW/计数器	至32倍	预加载
SD16 A	4 个复用	约 0.03	约 5	16	85	+/-600mV	1.0-1.5	1.2V	+/-1mA	SW/计数器	至32倍	缓冲输入

- 需要测量的电压范围是多少？
- 针对 A_{IN} 的最大频率是多少？
- 分辨率是多少？
- 是否采用差分输入？
- 基准范围是多少？
- 是否具有多个通道？



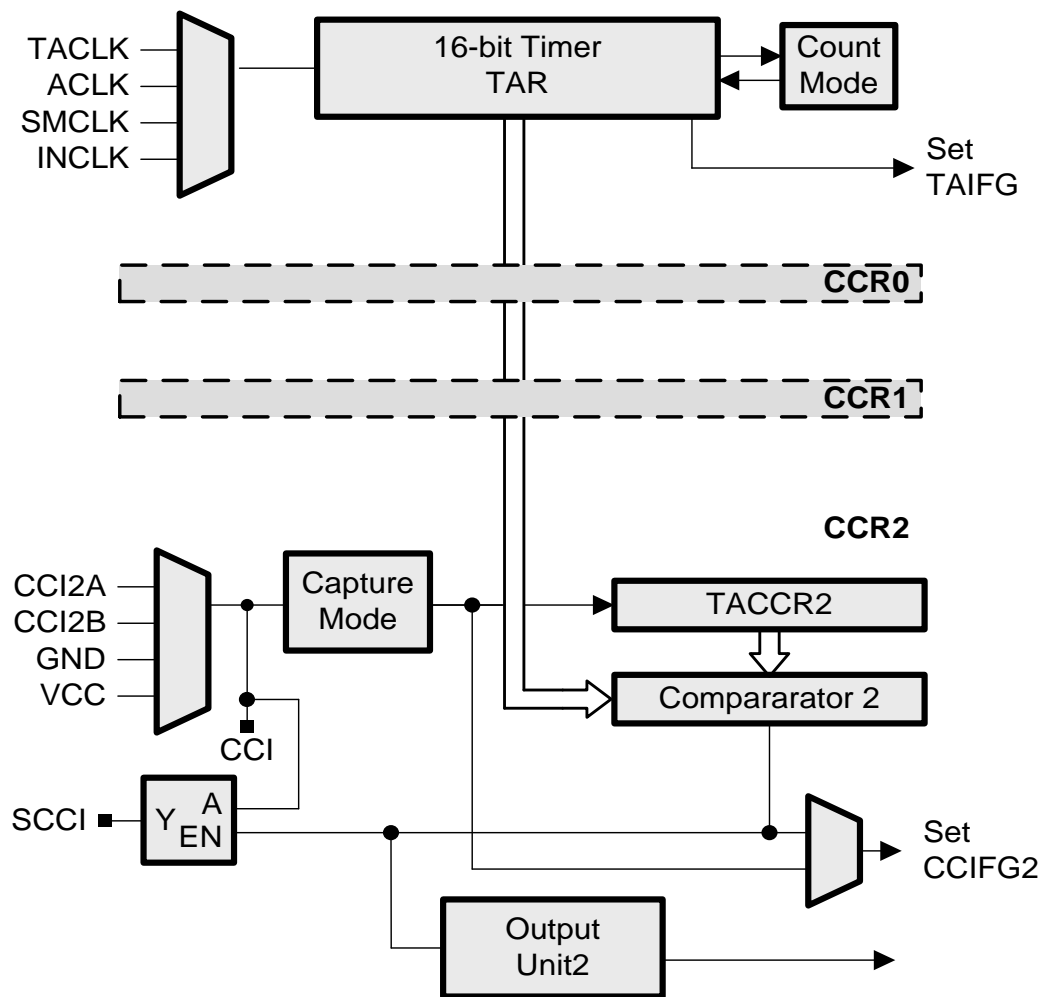


430Ware举例

Timer_A



- 异步16位定时器/计数器
- 4种计数模式
- 3个可配置捕获/比较寄存器
- PWM 输出
- 中断向量寄存器，快速中断响应
- 可触发DMA
- 多个时钟源可选
- 所有430均有Timer_A



Timer_A 计数模式



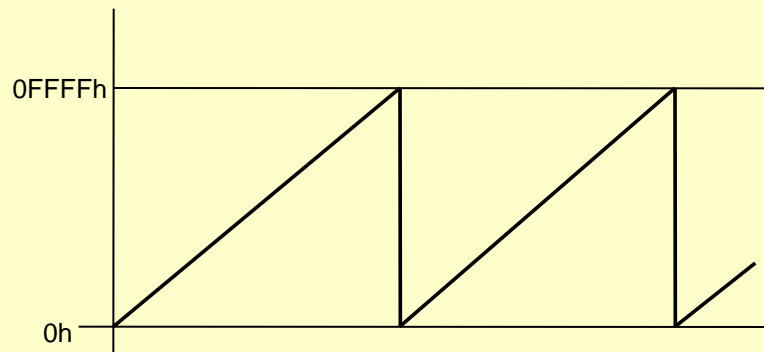
Stop/Halt

定时器停止



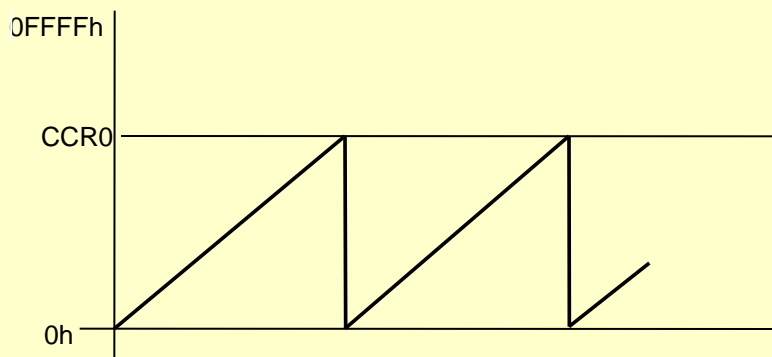
Continuous

定时器连续递增计数至FFFF



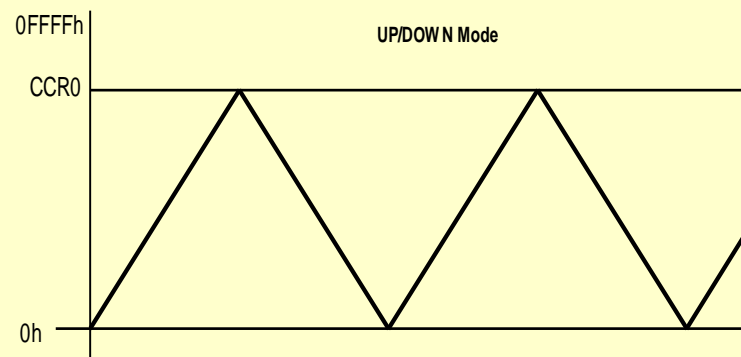
Up

定时器连续递增至CCR0



Up/Down

定时器递增至CCR0后递减至0



CCR – Count Compare Register

Timer_A 中断

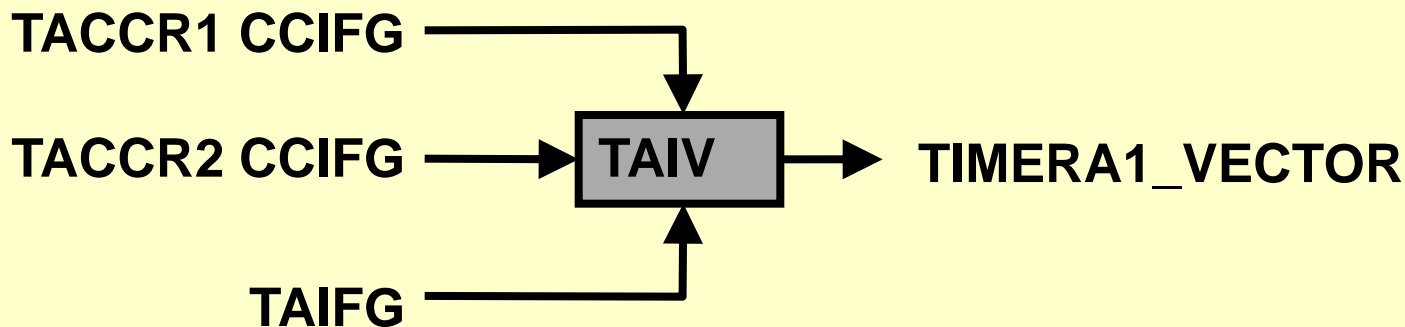


Timer_A 捕获/比较寄存器 **TACCR0** 能够产生一个单独的中断向量

TACCR0 CCIFG → **TIMERA0_VECTOR**

无需额外的处理程序

TACCR1, TACCR2 以及 TA 中断标志进行优先级处理，组成 **TAIV** 中断向量。

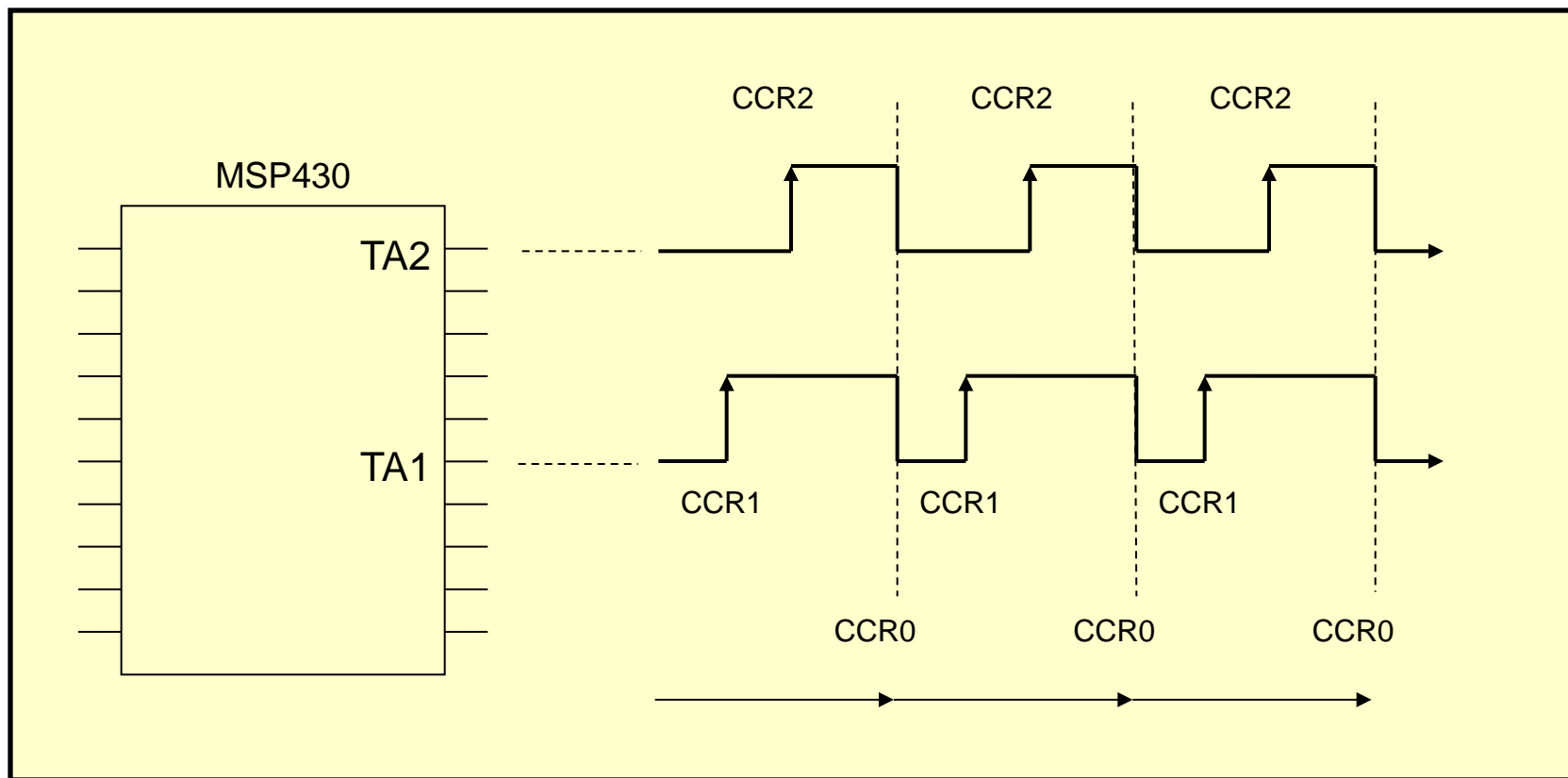


需要程序判断中断的触发源



430Ware举例

Timer_A 产生PWM



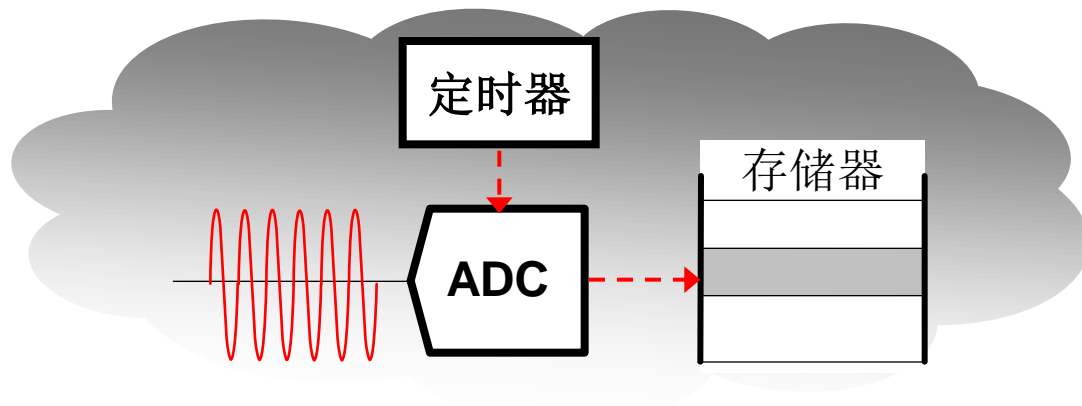
- PWM完全自动产生
- 通过对每个CCR寄存器参数单独配置，可以产生不同占空比的PWM
- 可以在网上找到参考程序



430Ware举例

<u>msp430g2xx3 ta 16</u>	Timer_A, PWM TA1-2, Up Mode, DCO SMCLK
<u>msp430g2xx3 ta 17</u>	Timer_A, PWM TA1, Up Mode, 32kHz ACLK
<u>msp430g2xx3 ta 19</u>	Timer_A, PWM TA1, Up/Down Mode, DCO SMCLK
<u>msp430g2xx3 ta 20</u>	Timer_A, PWM TA1, Up/Down Mode, 32kHz ACL

定时器触发采样



<i>// Interrupt</i>	<u>CPU cycles</u>
; MSP430 ISR to start conversion	6
BIS #ADC12SC,&ADC12CTL0 ; Start conversion	5
RETI ; Return	5
;	16

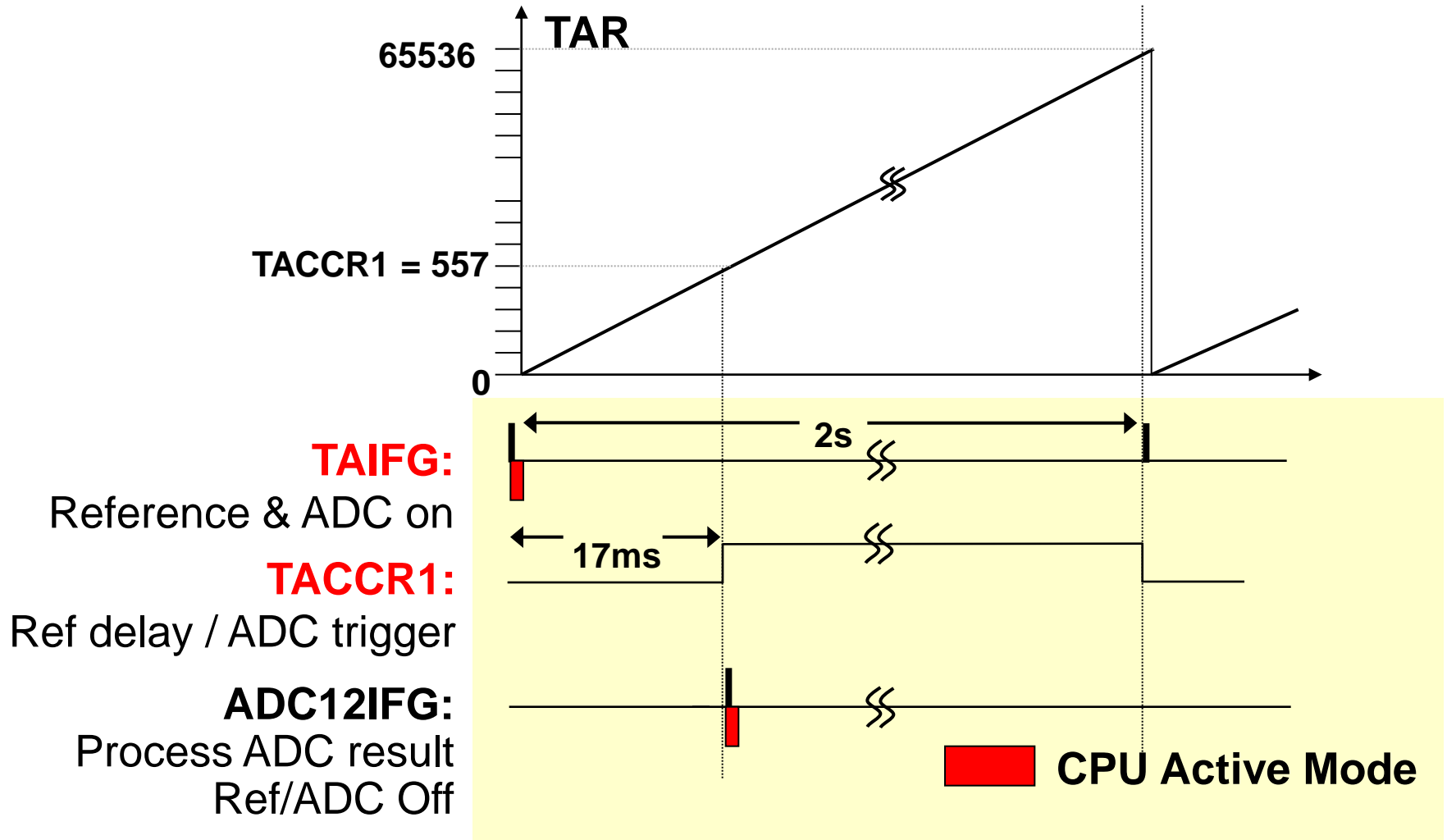


定时器触发的中断 – 无软件等待循环

采用Timer_A直接进行硬件控制




ADC10





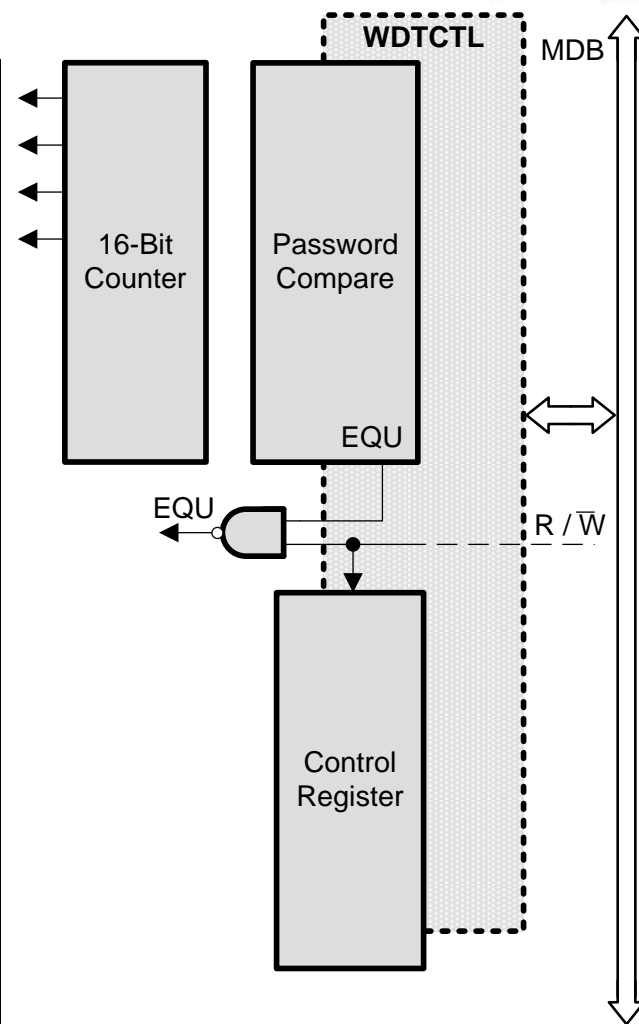
430Ware举例

 [msp430g2x33_adc10_12](#)

ADC10, Sample A7, 1.5V, TA1
Trig, Ultra-Low Pwr

WDT+ 模块

- 所有430中均有WDT
- 两种模式
 - 看门狗定时器
 - 间隔定时器
- 访问密码保护
- 单独的中断向量
- ACLK 或 SMCLK提供时钟源
- 控制 RST/NMI 引脚模式
- WDT+ 增加了故障保护时钟



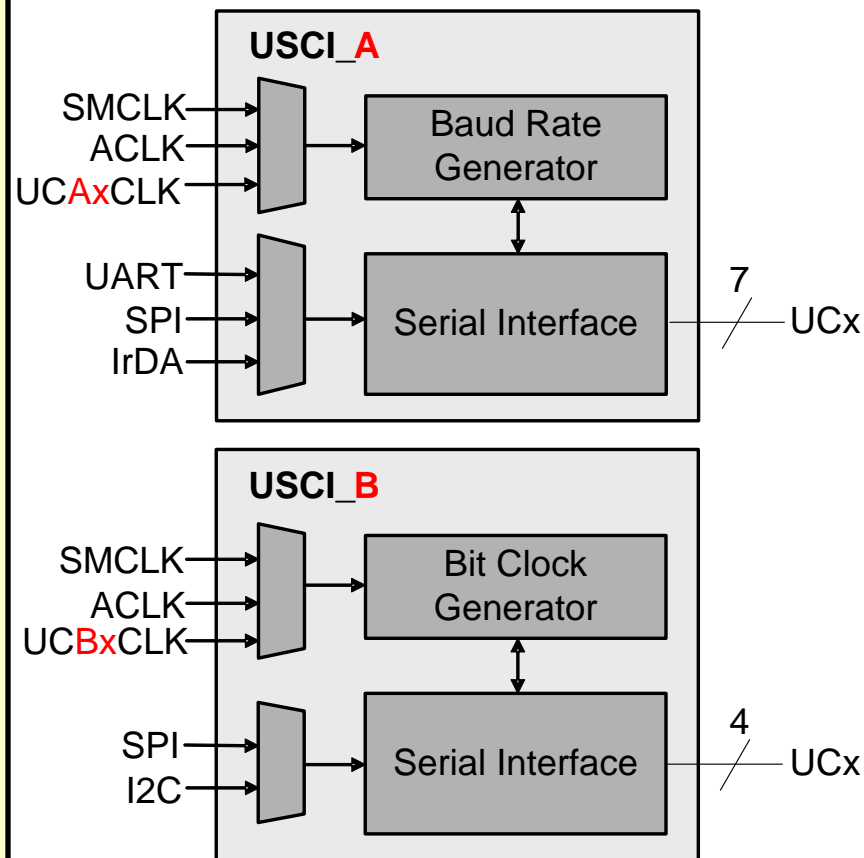


430Ware举例

USCI



- 专为超低功耗而精心设计：
 - 可从任意低功耗模式自动启动
- 两个专用模块：
 - **USCI_A**:
UART 或 SPI
 - **USCI_B**:
SPI 或 I2C
- 双缓冲发送 (TX) / 接收 (RX)
- 波特率/位时钟发生器：
 - 自动波特率检测
 - 灵活的时钟脉冲源
- 接收 (RX) 干扰抑制
- DMA 被启用
- 误差检测





430Ware举例

TivaWare

project0 example

模拟电路设计难? TI 来帮忙!



My products

- TLV5616: Datasheet | Compare | Get Sample | Buy Now
- TS12A12511: Datasheet | Compare | Buy Now

My technical documents

- Dual-Supply Low ON-State Resistance SPST CMOS A...
- TS12A12511 +/-6 V/12 V, Single SPDT Switch (Rev....

My searches

- OPA333
- msp430gcc

TI's SimpleLink™ Wi-Fi® family >: Connect to the IoT today

TI Home > Search results

OPA333

Advanced search >

Everything Products Technical documents Support Cross reference

数据手册

1-10 of about 1290

OPA333 | Zero Drift Precision Amplifier | Operational Amplifier (Op Amp) | Description & parametrics

http://www.ti.com/product/opa333

Download a datasheet or document on TIs OPA333 Operational Amplifier (Op Amp), from the Zero Drift Precision Amplifier collection of analog and digital product folders.# Added. ... OPA333 (ACTIVE). ...

OPA2333 | Zero Drift Precision Amplifier | Operational Amplifier (Op Amp) | Description & parametrics

http://www.ti.com/product/opa2333

... The OPA333 series of CMOS operational amplifiers use a proprietary auto-calibration technique to simultaneously provide very low offset voltage (10 μ V, max) and near-zero drift over time and temperature. ... OPA2333 OPA333. 2 1. ...

OPA333 (ACTIVE) ★★★★★
1.8V, 17 μ A, microPower, Precision, Zero Drift CMOS Op Amp



Download datasheet

- Sample & buy
- Technical documents
- Description & parametrics
- Support & community

Product matches

Part number	Description	Part type	Status
-------------	-------------	-----------	--------

1.8-V, *micro*Power, CMOS Operational Amplifiers, Zero-Drift SeriesCheck for Samples: **OPA333, OPA2333****FEATURES**

- Low Offset Voltage: 10 μV (max)
- Zero Drift: 0.05 $\mu\text{V}/^\circ\text{C}$ (max)
- 0.01-Hz to 10-Hz Noise: 1.1 μV_{pp}
- Quiescent Current: 17 μA
- Single-Supply Operation
- Supply Voltage: 1.8 V to 5.5 V
- Rail-to-Rail Input/Output
- *micro*Size Packages: SC70 and SOT23

APPLICATIONS

- Transducers
- Temperature Measurements
- Electronic Scales
- Medical Instrumentation
- Battery-Powered Instruments
- Handheld Test Equipment

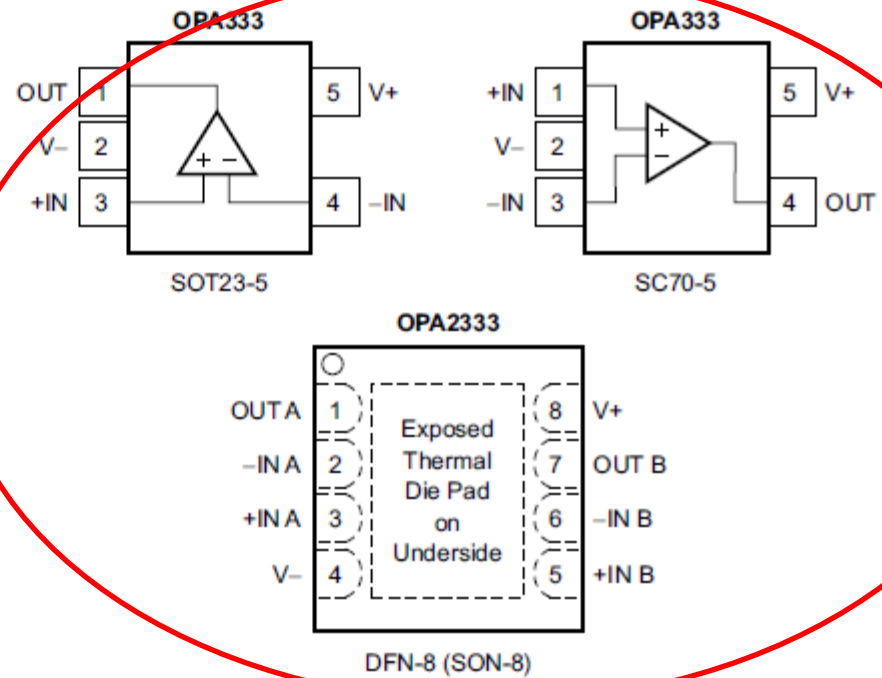
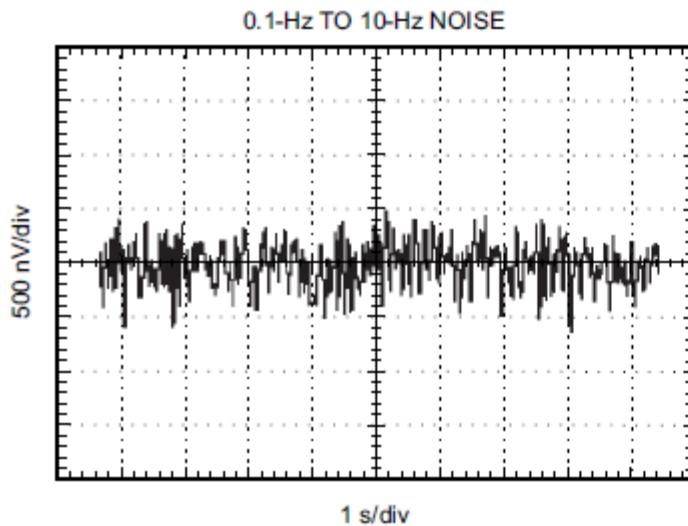
②芯片基本
特性及其应用
场景**DESCRIPTION**

The OPA333 series of CMOS operational amplifiers use a proprietary auto-calibration technique to simultaneously provide very low offset voltage (10 μV , max) and near-zero drift over time and temperature. These miniature, high-precision, low quiescent current amplifiers offer high-impedance inputs that have a common-mode range 100 mV beyond the rails, and rail-to-rail output that swings within 50 mV of the rails. Single or dual supplies as low as +1.8 V (± 0.9 V) and up to +5.5 V (± 2.75 V) can be used. These devices are optimized for low-voltage, single-supply operation.

The OPA333 family offers excellent CMRR without the crossover associated with traditional complementary input stages. This design results in superior performance for driving analog-to-digital converters (ADCs) without degradation of differential linearity.

The OPA333 (single version) is available in the SC70-5, SOT23-5, and SO-8 packages. The OPA2333 (dual version) is offered in DFN 8 (2 mm x

SC70-5, SOT23-5, and SO-8 packages. The OPA2333 (dual version) is offered in DFN-8 (3 mm × 3 mm), MSOP-8, and SO-8 packages. All versions are specified for operation from -40°C to $+125^{\circ}\text{C}$.



③ 芯片引脚分布



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

ORDERING INFORMATION⁽¹⁾

- (1) For the most current package and ordering information see the Package Option Addendum at the end of this document, or visit the device product folder at www.ti.com.

④基本电气特性

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

		VALUE	UNIT
Voltage	Supply	+7	V
	Signal input terminals ⁽²⁾	-0.3 to (V+) + 0.3	V
Current	Signal input terminals ⁽²⁾	±10	mA
	Output short-circuit ⁽³⁾	Continuous	mA
Temperature	Operating, T _A	-40 to +150	°C
	Storage, T _{stg}	-65 to +150	°C
	Junction, T _J	+150	°C
Electrostatic discharge (ESD) ratings	Human body model (HBM)	4000	V
	Charged device model (CDM)	1000	V
	Machine model (MM)	400	V

- (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not supported.

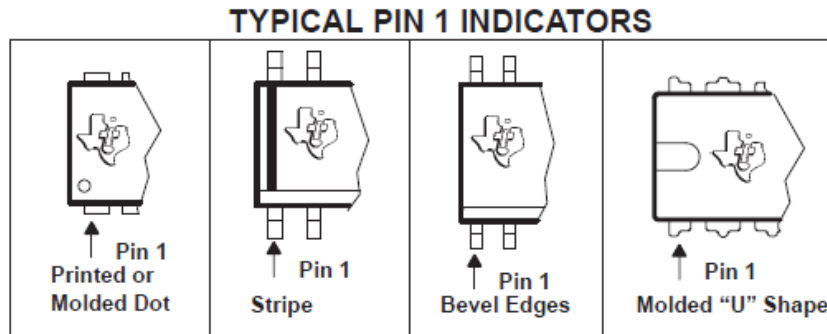
ELECTRICAL CHARACTERISTICS: $V_S = +1.8\text{ V}$ to $+5.5\text{ V}$

At $T_A = +25^\circ\text{C}$, $R_i = 10\text{ k}\Omega$ connected to $V_S / 2$, $V_{CM} = V_S / 2$, and $V_{OUT} = V_S / 2$, unless otherwise noted.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFFSET VOLTAGE						
V_{OS}	Input offset voltage	$V_S = +5\text{ V}$		2	10	μV
dV_{OS}/dT	Input offset voltage drift	$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		0.02	0.05	$\mu\text{V}/^\circ\text{C}$
PSRR	Power-supply rejection ratio	$V_S = +1.8\text{ V}$ to $+5.5\text{ V}$, $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		1	5	$\mu\text{V}/\text{V}$
	Long-term stability ⁽¹⁾			See note ⁽¹⁾		μV
	Channel separation, dc			0.1		$\mu\text{V}/\text{V}$
INPUT BIAS CURRENT						
I_B	Input bias current			± 70	± 200	pA
		$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		± 150		pA
I_{OS}	Input offset current			± 140	± 400	pA
NOISE						
	Input voltage noise	$f = 0.01\text{ Hz}$ to 1 Hz		0.3		μV_{PP}
		$f = 0.1\text{ Hz}$ to 10 Hz		1.1		μV_{PP}
i_n	Input current noise	$f = 10\text{ Hz}$		100		$\text{fA}/\sqrt{\text{Hz}}$
INPUT VOLTAGE						
V_{CM}	Common-mode voltage range		$(V_-) - 0.1$		$(V_+) + 0.1$	V
CMRR	Common-mode rejection ratio	$(V_-) - 0.1\text{ V} < V_{CM} < (V_+) + 0.1\text{ V}$, $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$	106	130		dB
INPUT CAPACITANCE						
	Differential			2		pF
	Common-mode			4		pF
OPEN-LOOP GAIN						
A_{OL}	Open-loop voltage gain	$(V_-) + 100\text{ mV} < V_O < (V_+) - 100\text{ mV}$, $R_i = 10\text{ k}\Omega$, $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$	106	130		dB

⑤具体电气特性

如何识别芯片“1”号引脚



NOTE: (1) If there is not a Pin 1 indicator, turn device to enable reading the symbol from the left to right. Pin 1 is at the lower left corner of the device.

TLV2372 datasheet

设计仿真软件加速简化电路

滤波器设计软件 – FilterPro 3.1

Spice仿真软件 – TINA-TI 9.1



<http://focus.ti.com/docs/toolsw/folders/print/filterpro.html>

<http://focus.ti.com/docs/toolsw/folders/print/tina-ti.html>

免费!

Thanks