MSPM0 ADC module introduction
—— MSPM0 peripheral training series

Presented by Yuhao Zhao
MCU level overview

--- MSPM0Lxxx series

**MSPM0L13x3/4/5/6**

- CPU: ARM Cortex-M0+ 32 MHz
- On-chip Memory: 8, 16, 32 or 64 kB flash, 2 or 4 kB SRAM
- Data Integrity & Security: CRC accelerator (16 and 32 bit)
- Programming & Debug: ARM SWD interface, ROM UART & I2C BSL
- Power & Clocking: POR / BOR / SVS, Internal LF 32kHz (5%), Internal HF 4-32MHz (1%)
- Communication: UART w/ LIN (1), SPI (1), I2C (2) w/ FastMode+
- Timers: General purpose 16-bit 2 CC (4)
- Precision Analog: 12-bit SAR ADC, 1Msps (1)
- ADC: 12-bit zero-drift op-amps (2)
- General purpose amp (1)
- Internal ADC reference (2.5%)
- Temperature sensor
- IO: Up to 28 GPIO, Up to 2 low I/O pin inputs
- Lead free packages: SOT-16, VSSOP-20/28
- No-lead packages: WQFN-16, WQFN-24/32

32 MHz MCU with up to 64kB flash, 32 pins, 12-bit ADC, dual zero-drift OPA/PGA, COMP

--- MSPM0Gxxx series

**MSPM0G350x/310x/150x/110x**

- CPU: Arm Cortex-M0+ 80 MHz
- On-chip Memory: 32, 64, or 128 kB flash [ECG], 16 or 32 kB SRAM [ECC]
- Data Integrity & Security: CRC accelerator (16 and 32 bit), AES256 accelerator + TRNG
- Programming & Debug: ARM SWD interface, UART & I2C bootloader
- Power & Clocking: POR / BOR / SVS, External LF 32kHz XTAL, External HF 4-48MHz XTAL, Internal HF 32kHz (3%)
- Communication: UART w/ LIN (1), UART (3), SPI (2), I2C (2) w/ FastMode+
- Precision Analog: 12-bit ADC 4Msps (9-ch), 12-bit ADC up to 80 MHz
- Comparators w/ 6-bit DACs (3), 12-bit 1 Msps buffered DAC (1), Zero-drift op-amps (2)
- PLL (up to 80 MHz), Internal reference (1.5%)
- General purpose amp (1), Temperature sensor
- IO: Up to 60 GPIO
- Lead free packages: VSSOP-20/28, LFQP-48/64
- No-lead packages: VQFN-24/32/48, nFBGA-64, WQFN-28

80 MHz MCU with up to 128kB flash, 64 pins, advanced analog, AES/TRNG, CAN-FD
**MSPM0 ADC module introduction**

### Key Features
- **12-bit resolution ADC**
- **14-bit 250ksps with H/W oversampling**
- **DMA support** with interrupt
- Operates in **RUN, SLEEP and STOP low-power modes**
- Full scale operating range: **1.62V – 3.6V**
- **11.2-bit ENOB**

### Key Differences between G and L MCUs
- **MSPM0G350x MCUs** have **2 simultaneous ADC modules** and **MSPM0L30x MCUs** have one ADC module
- **Dedicated 80MHz** oscillator is equipped to enhance ADC conversion rate on MSPM0G350x MCUs; Up to 32MHz ADCLK is used on MSPM0L30x MCUs.
- **12-bit 4MSPS conversion rate** on MSPM0G350x MCUs
- **12 ADC result FIFO** is equipped on MSPM0G350x MCUs

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**Diagram:**
- VDD Supply Voltage
- Internal reference (1.4V / 2.5 V)
- External reference
- REFSEL
- Up to 16 external input channels
- Sample directly from insides zero-drift opamps (OPAs) and general purpose amplifier (GPAMP)
- All internal channel selections
- Temp Sensor Output
- DAC12 Output
- OPA0 Output
- OPA1 Output
- GP Amplifier Output
- Supply Monitor
- Programable 12/10/8 bit ADCx
- Sample Timer
- SYSCLK
- ULPCLK
- HFXTAL
- ADCCLK
- 12 Result FIFO for MSPM0Gxx MCUs
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## Operating Mode

<table>
<thead>
<tr>
<th>Operating Mode</th>
<th>RUN</th>
<th>SLEEP</th>
<th>STOP</th>
<th>STANDBY</th>
<th>SHUTDOWN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RUN0</td>
<td>RUN1</td>
<td>RUN2</td>
<td>SLEEP0</td>
<td>SLEEP1</td>
</tr>
<tr>
<td>ADC</td>
<td>OPT</td>
<td></td>
<td></td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>DAC12</td>
<td>OPT</td>
<td></td>
<td></td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

OPT: The function is optional in the specified mode, and remains enabled if configured to be enabled.
NS: The function is not automatically disabled in the specified mode, but its use is not supported.

## Diagram
- **Run**: Full speed CPU, PD1, PD0 on
- **Sleep**: Full speed PD1, PD0 on
- **Stop**: 4MHz max PD0 on
- **Standby**: 32kHz max PD0 on
- **Shutdown**: No clocks VCORE off
- **BOR wake**
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### Bit Field Value

<table>
<thead>
<tr>
<th>Bit Field Value</th>
<th>AVGN Settings (number of samples accumulated)</th>
<th>AVGD Settings (number of bits to right shift)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0x1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>0x2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>0x3</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>0x4</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>0x5</td>
<td>32</td>
<td>5</td>
</tr>
<tr>
<td>0x6</td>
<td>64</td>
<td>6</td>
</tr>
<tr>
<td>0x7</td>
<td>128</td>
<td>7</td>
</tr>
</tbody>
</table>
ADC module quick start

Academy
ADC introduction lab

Examples

MSPM0G350x:
- adc12_48bit_resolution_250kops
- adc12_max_freq_dma
- adc12_max_freq_dma_8bit
- adc12_monitor_supply
- adc12_simultaneous_trigger_event
- adc12_simultaneous_trigger_event_stop
- adc12_single_conversion
- adc12_single_conversion_vref_external
- adc12_single_conversion_vref_internal
- adc12_triggered_by_timer_event
- adc12_triggered_by_timer_event_stop
- adc12_window_comparator

MSPM0L13xx:
- adc12_max_freq_dma
- adc12_max_freq_dma_8bit
- adc12_monitor_supply
- adc12_single_conversion
- adc12_single_conversion_vref_external
- adc12_single_conversion_vref_internal
- adc12_triggered_by_timer_event
- adc12_triggered_by_timer_event_stop
- adc12_window_comparator

Related Links
MSPM0 online resource
MSPM0 quick start guide
MSPM0 Sysconfig user's guide
MSPM0G350x datasheet
MSPM0L13xx datasheet
MSPM0Gxx technical reference manual
MSPM0Lxx technical reference manual

Launchpad
LP-MSPM0G3507
LP-MSPM0L1306

Sysconfig Entrance for ADC Setting

Step1:
ADC12 (1 of 2 Added)
Name: ADC12_0
Selected Peripheral: ADC0
Quick Profiles
Step2:
Basic Configuration
Advanced Configuration
To find more MSPM0 training series, please visit:

- TI.com.cn
- WeChat (德州仪器公众号)
- Bilibili
- 21IC