

MSPM0 amplifier module introduction —

MSPM0 peripheral training series

Presented by Luke Ledbetter

MCU level overview - MSPM0Lxx series

MSPM0L13x3/4/5/6 1.62 - 3.6V
-40 to 125 C

CPU ARM Cortex-M0+ 32 MHz NVIC / 3-ch DMA	Power & Clocking POR / BOR / SVS Internal LF 32kHz (3%) Internal HF 4-32MHz (1%)	Precision Analog 12-bit SAR ADC 1.68-Msps (10-ch) Comparator w/ 8-bit DAC Zero-drift chopper op-amps (2) General purpose amp Internal ADC reference (1.5%) Temperature sensor
On-chip Memory 8, 16, 32 or 64 kB flash 2 or 4 kB SRAM	Communication UART w/ LIN (1) UART (1) SPI (1) I2C (2) w/ FastMode+	Timers Low power 16-bit 2 CC (4) Windowed watchdog
Data Integrity & Security CRC accelerator (16 and 32 bit)	IO Up to 28 GPIO Up to 2 low Ib OPA inputs	
Programming & Debug ARM SWD interface UART & I2C bootloader		

Leaded packages: SOT-16, VSSOP-20/28
No-lead packages: WQFN-16, VQFN-24/32

Amplifiers

- Zero-drift chopper op-amps (OPA)
- General purpose amp (GPAMP)

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

MSPM0 OPA overview

Key Features

High flexibility:

- Configurable amplifier modes
- Rich selection of external/internal input options
- Output to ADC, OPA and comparator
- Programmable gain amplifier (PGA) up to 32x
- Burnout current source to detect sensor status

High performance:

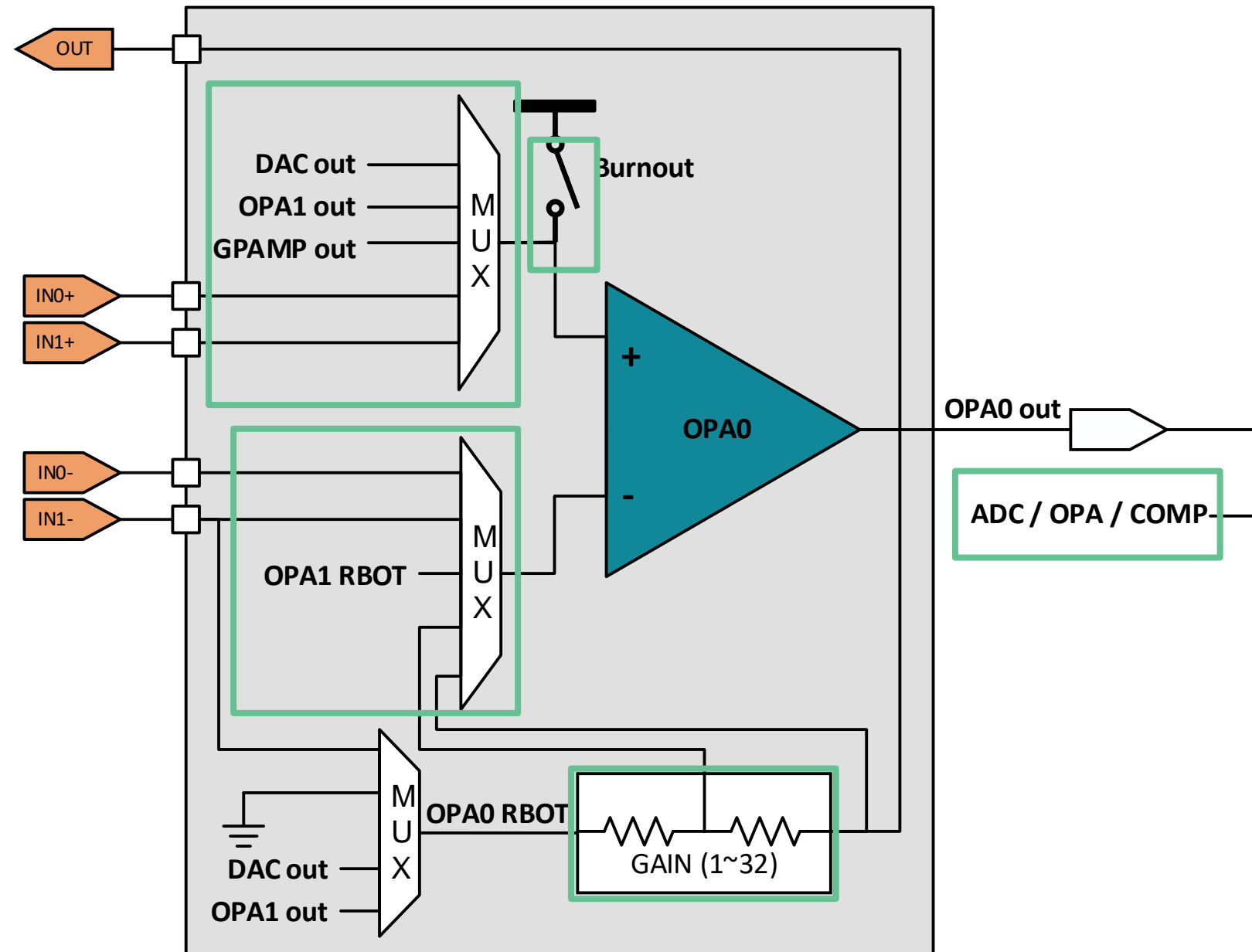
- **Chopper stabilization** to reduce offset, drift, and 1/f noise, $\sim 0.1 \text{ mV Vos}$, $\sim 1 \mu\text{V}/^\circ\text{C Vos}$ drift with chopping
- Rail-to-rail input & output
- **6MHz GBW**
- Lower to **100 μA** quiescent current

Some Use Cases

- Use internal OPAs to replace external OPAs
- Switch between IOs to use one OPA to realize two OPA functions
- Dynamic change OPA settings to calibrate voltage offset and internal Gain with ADC and DAC

Differences between G and L MCUs

- MSPM0L134x has dedicated IN- pin to reach **6pA** bias current for TIA (Transactional amplifier) application

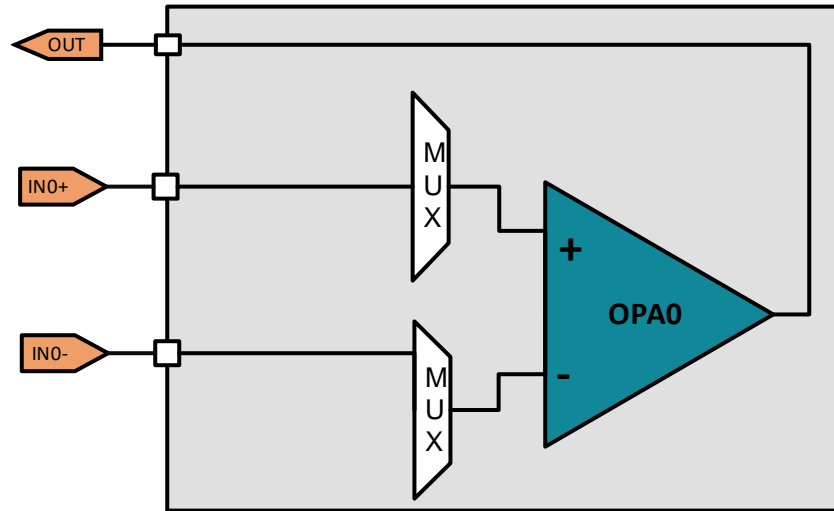


OPA key parameters summary

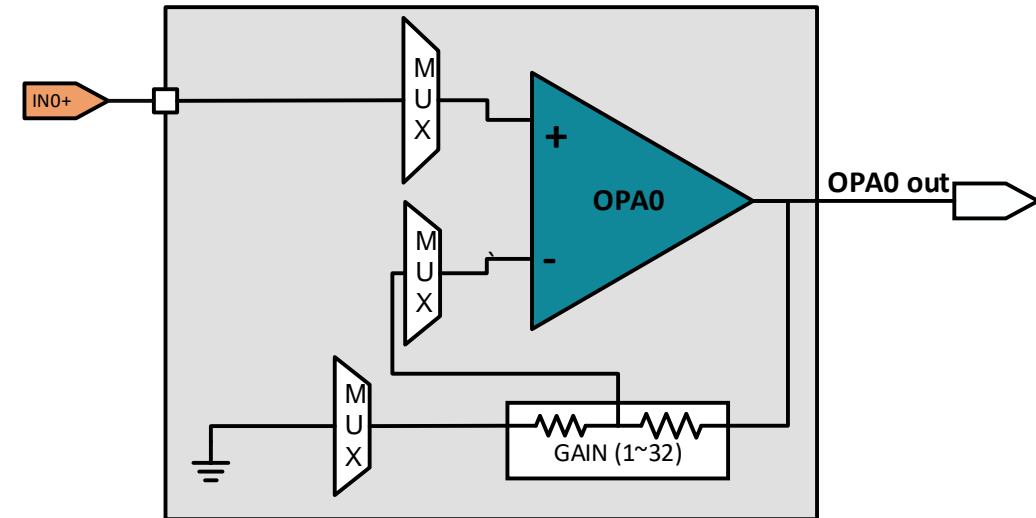
Parameters	Value without chopper	Value with chopper	Unit
Rail-to-rail	-0.1 to VDD-0.3		V
GBW (typ)	6	0.125/Gain	MHz
Slew rate (typ)	4.9		V/ μ s
Vos (25°C max)	± 2	± 0.3	mV
Offset drift (typ)	± 5.2	± 0.5	μ V/ $^{\circ}$ C.
Input Voltage density at 1 kHz (typ)	240	NA	nV/ $\sqrt{\text{Hz}}$
Input bias current (25°C typ)	50 (Shared OPA pin) 6 (Dedicated OPA pin)	400 (Shared OPA pin) 400 (Dedicated OPA pin)	pA
CMRR (typ)	89	102	dB
I Load (typ)	30		mA
Iq per op-amp(typ)	100		μ A
Internal Gain	0~32		V/V.

OPA flexibility

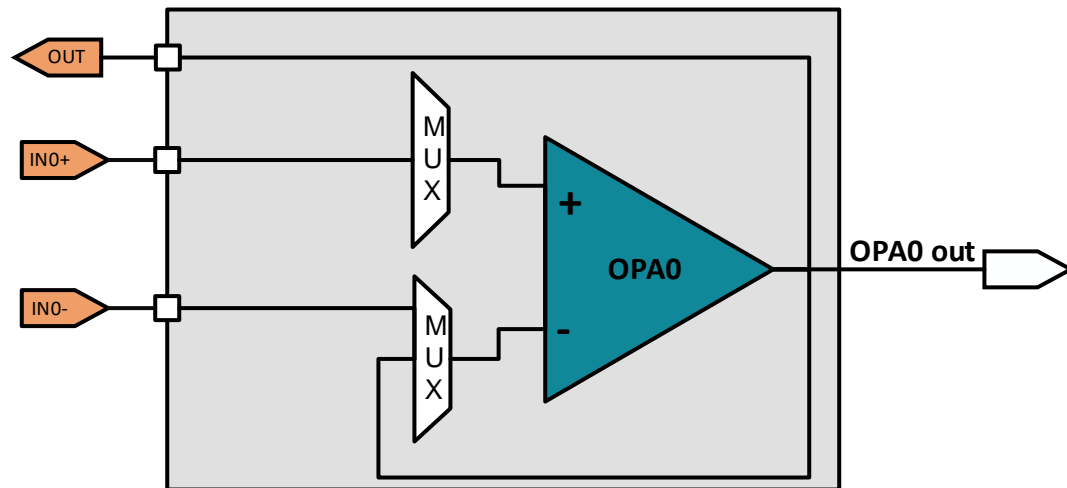
General-Purpose Mode:



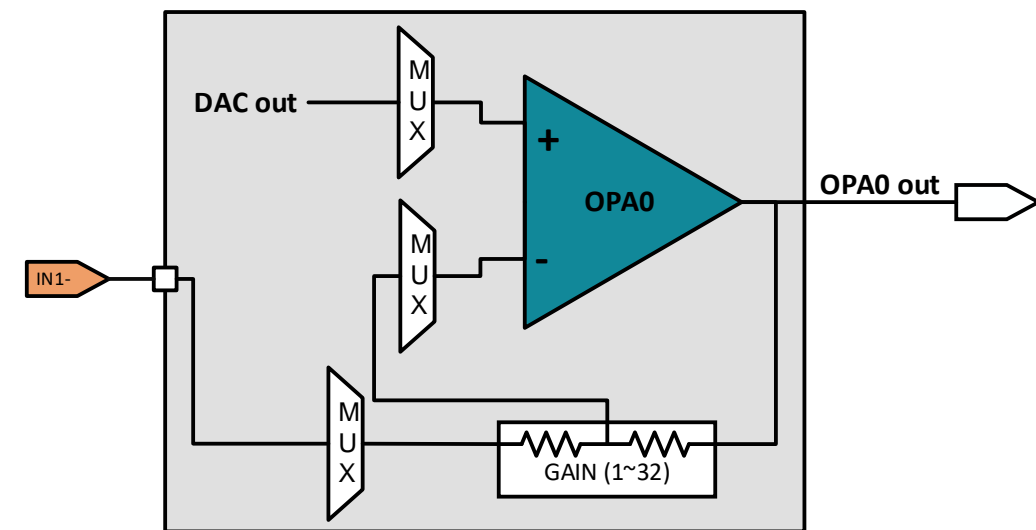
Non-inverting PGA Mode:



Buffer Mode:

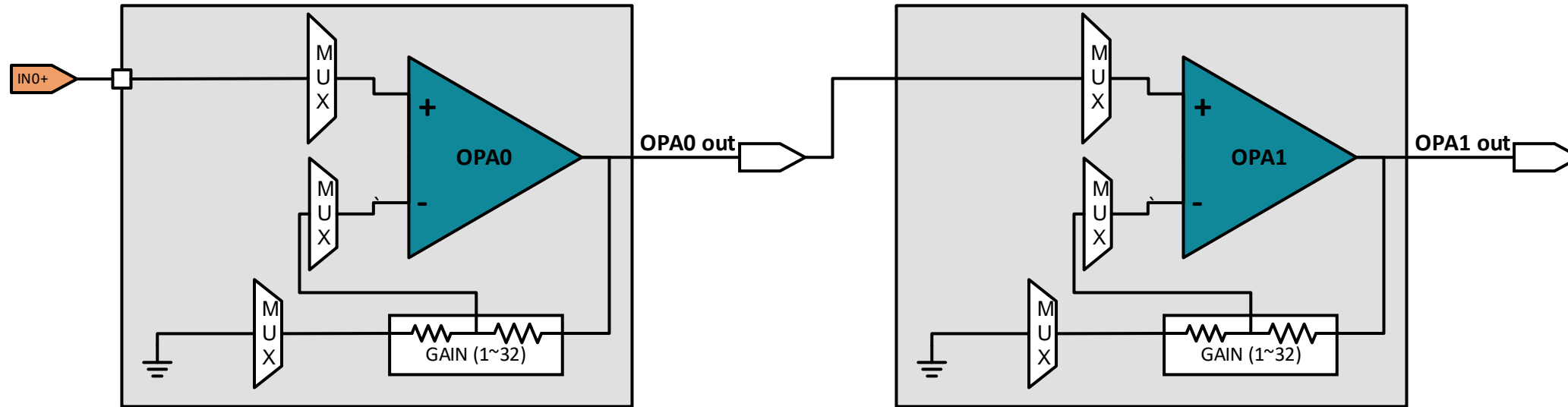


Inverting PGA Mode:

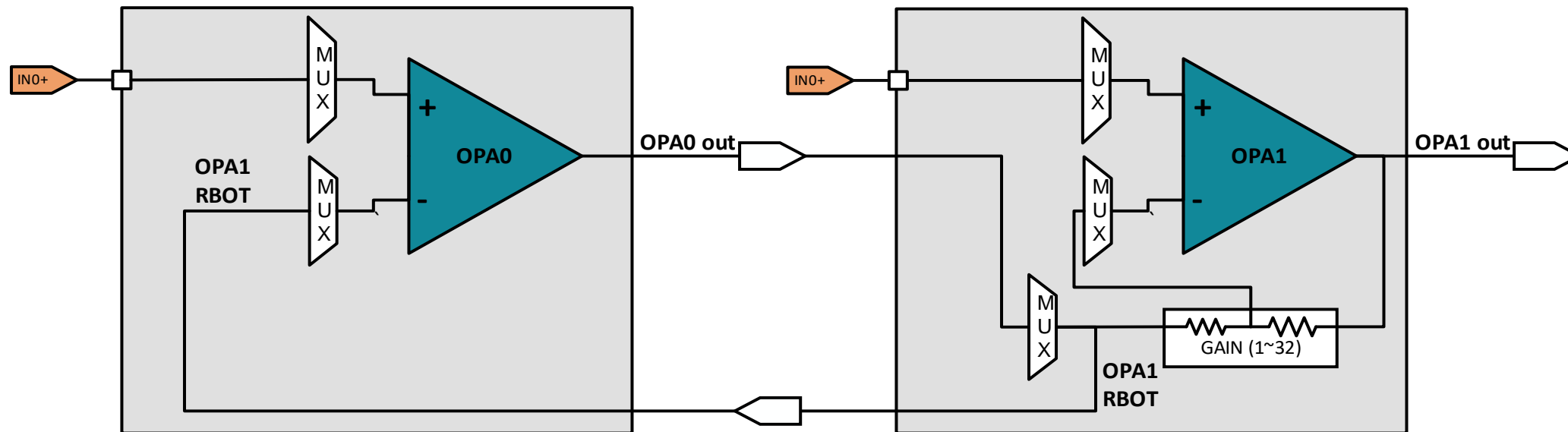


OPA flexibility

Cascade Amplifier Mode:



Difference Amplifier Mode:



MSPM0 GPAMP overview

Key Features

Flexibility:

- Output to ADC and OPA
- Programmable internal unity gain feedback loop

Performance:

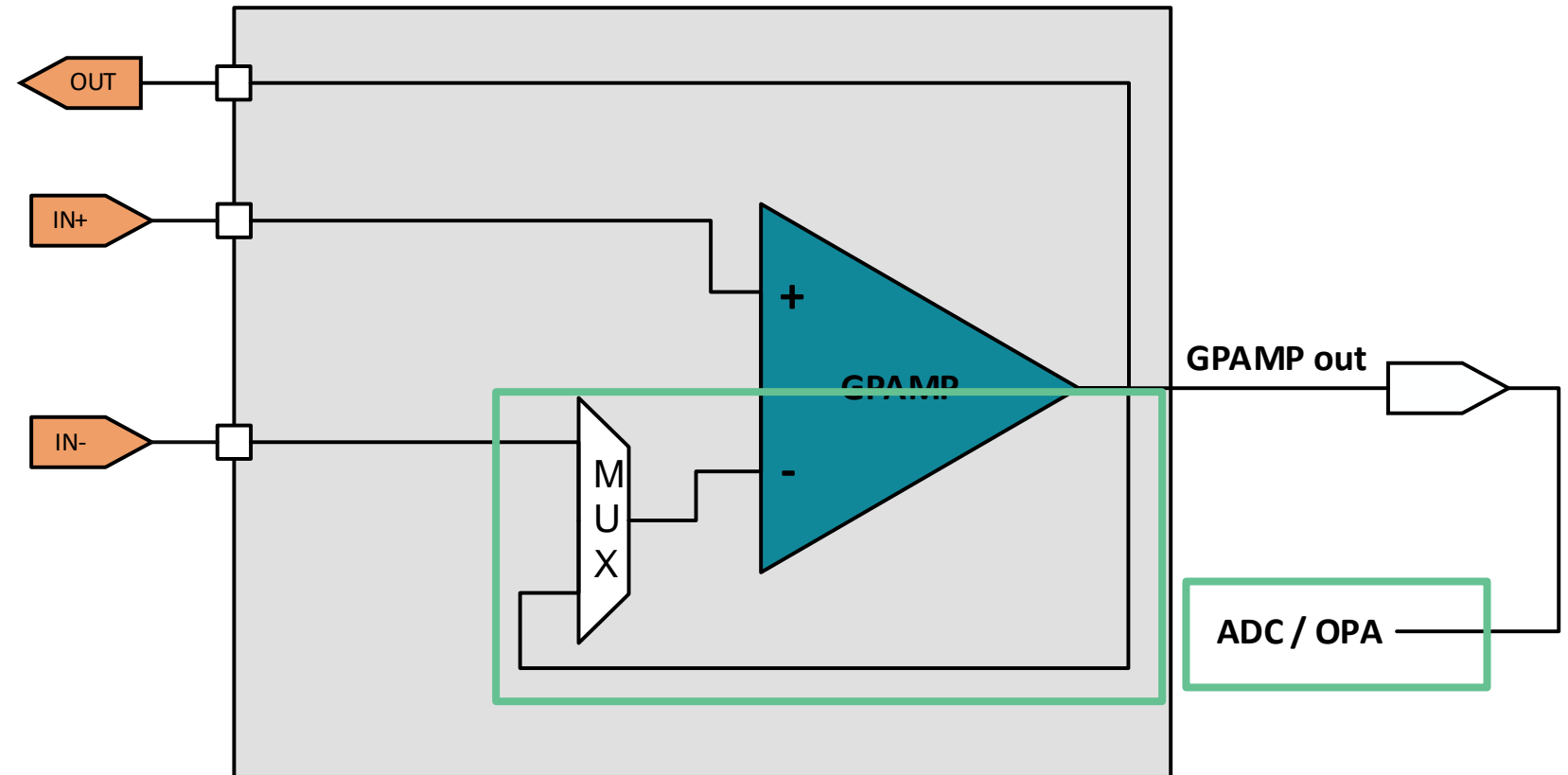
- **Chopper stabilization** to reduce offset, drift, and 1/f noise
- Rail-to-rail input & output
- 350KHz GBW

Some Use Cases

- General purpose amplifier
- Signal buffer

OPA vs GPAMP

	Parameter	OPA	GPAMP
Flexibility	Input MUX	External/ADC/DAC /Ref/OPA/GPAMP	External /GPAMP
	PGA	1-32	1
	Burnt current source	Support	NA
Performance	GBW	6MHz	320KHz
	Quiescent current	100uA	93uA
	Vos with chopper	<0.3mV	<0.4mV
	Ios no chopper	50pA	16pA



OPA module quick start

Academy

[OPA introduction lab](#)

Driverlib Examples

MSPM0G350x:

- opa_dac8_output_buffer
- opa_general_purpose_rri
- opa_inverting_pga_with_dac
- opa_non_inverting_pga
- opa_signal_chain_to_adc

MSPM0L13xx:

- opa_dac8_output_buffer
- opa_general_purpose_rri
- opa_non_inverting_pga

Related Links

[MSPM0 online resource](#)

[MSPM0 quick start guide](#)

[MSPM0 Sysconfig user's guide](#)

[MSPM0G350x datasheet](#)

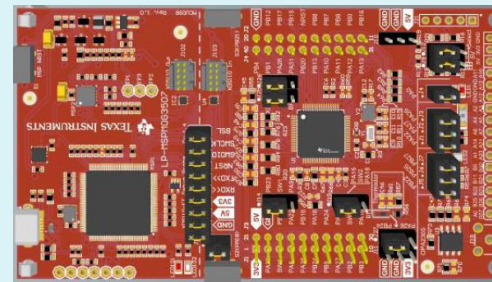
[MSPM0L13xx datasheet](#)

[MSPM0Gxx technical reference manual](#)

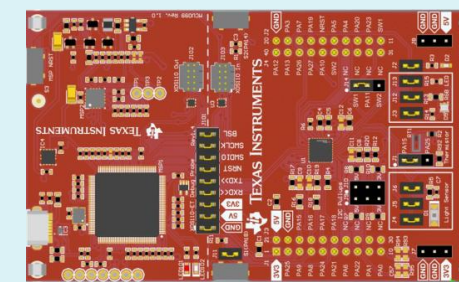
[MSPM0Lxx technical reference manual](#)

Launchpad

[LP-MSPM0G3507](#)



[LP-MSPM0L1306](#)



Sysconfig Entry for OPA Setting

The screenshot shows the Sysconfig tool interface. On the left, a tree view lists various peripherals under categories like ANALOG, COMMUNICATIONS, and TIMERS. The 'OPA' peripheral is highlighted with a green checkmark and a plus sign, indicating it has been selected. On the right, the configuration details for 'OPA_0' are shown, including the 'Selected Peripheral' as 'OPA0' and various configuration options like 'Non-Inverting Channel (PSEL)', 'Inverting Channel (NSEL)', 'Input MUX (MSEL)', and 'Gain'. A red box highlights the 'ADD' button, and a blue box highlights the 'REMOVE ALL' button. The text 'Step 1:' and 'Step 2:' are overlaid on the image to guide the user through the process.

To learn more about MSPM0, please visit:

- [MSPM0 MCUs](#)
- [MSPM0 SDK](#)
- [MSPM0 Academies](#)