Hello, and welcome to this presentation of the STM32U5 embedded operational amplifier. It covers the features of this IP, which is widely used for conditioning analog signals.

OPAMP

- Features
  - 2 OPAMPs
  - Very similar to STM32L5
  - PGA gain 2,4,8,16
  - Offset calibration
  - High speed mode

SYMBOL	Parameter	U5 Typical	L5 Typical	Unit
VDDA	Analog supply voltage	1.60 ~ 3.6	1.8 ~ 3.6	V
CMIR	Common mode input range	0 ~ VDDA	0 ~ VDDA	V
Vos	Offset voltage	3.0(max)	1.5	mV
Gain bandwidth (GBW)	Normal mode	2	1.6	MHz
	Low power mode	0.5	0.42	MHz
SlewRate	High speed mode	3.2	-	V/µs
	Normal mode	1	0.7	V/µs
	Low power mode	0.25	0.18	V/µs
Output Current	Normal mode	500	500	uA
	Low power mode	100	100	uA
Power supply rejection Ratio (PSRR)	Normal mode	75	85	dB
	Low power mode	69	90	dB
WakeUp Time	Normal mode	10 (max)	10 (max)	µs
	Low power mode	40 (max)	30 (max)	µs

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The STM32U5 integrates two OPAMP modules, which are very similar to the STM32L5.
These are general-purpose analog amplifiers, which reduce the need for an external stand-alone OPAMP.
As these OPAMPs can be configured in stand-alone mode with all terminals available for the user, it is possible to use them as a voltage follower, non-inverting and inverting amplifiers, as well as analog filters such as low- or high-pass filters.
They can also act as a pre-amplifier for the ADC input.
The table shows performance parameters for the STM32U5's and STM32L5's OPAMPs
Compared to the STM32L5, the analog supply voltage range of the STM32U5 is extended: from 1.6 to 3.6 volt.

The gain bandwidth is also extended to 2 MHz in normal mode and 0.5 MHz in low power mode.
Note that the OPAMP module present in the STM32U5 supports a high speed mode, that is activated by setting a control bit.
The slew rate characteristics are improved in the STM32U5's OPAMP module.
By using an internal feedback resistor, the OPAMP can also be used as a Programmable Gain Amplifier, or PGA. When enabled, it can be in calibration mode, all input and output of the OPAMP are then disconnected, or in functional mode.
To facilitate PCB design, a spice simulation model will be provided upon demand.

OPAMP input/output configuration

OPAMP	VINPx		VINMx		VOUTx	
	External	Internal	External	Internal	External	Internal
OPAMP1	PA0	DAC1_OUT1	PA1 (or dedicated)	PGA feedback	PA3	ADC1_IN8
OPAMP	PA6	DAC1_OUT2	PA7(or dedicated)	PGA feedback	PB0	ADC1_IN15

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This table shows the internal and external connections of the OPAMP inputs and outputs.
Each OPAMP module has two inputs (inverting and non-inverting) and one output.
The non-inverting inputs can be connected to either a GPIO pad or internally to a DAC output.
The inverting input is used for feedback when PGA mode is selected or can be connected to a GPIO pad.
The output is either connected to a GPIO pad or to an ADC input.
By connecting the OPAMP to its dedicated inputs, it can be used as a transimpedance amplifier.
A transimpedance amplifier is a current to voltage converter.

Thank you

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In addition to this presentation, you can refer to the following presentations for the peripherals connected to the STM32U5's operational amplifiers:
-Analog-to-digital converter (ADC) and Digital-to-analog converter (DAC)
-General purpose input output (GPIO).