ADI Digital ANC SoC Solution

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ADI consumer BU

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ANALOG
DEVICES

AHEAD OF WHAT'S POSSIBLE™

Agenda

▸ 1. A brief of <u>N</u>oise <u>C</u>ancelation technology

  ▪ PNC vs. ANC

  ▪ Analog ANC vs. Digital ANC

  ▪ Three kinds of main technology of ANC

▸ 2. ADI ANC SOCs and features

  ▪ ANC headphone trends and challenges

  ▪ ADAU1777 vs. 1787 vs. 1788

▸ 3. Success stories sharing

▸ 4. ADI ANC support strategy & 3rd party resources

A brief of Noise Cancelation technology

➤ Noise Cancelation headphone is a kind of earphone which can reduce ambient noise by physical or electronic ways or both.

➤ There are two kinds of noise cancelation technology

- Passive Noise Cancelation (**PNC**)
  - Passive noise Cancelation mainly by enclose the ear to form a closed space, or use silicone ear-bugs and other sound insulation materials to **BLOCK** external noise (hi-f noise).
- Active Noise Cancelation (**ANC**)
  - The Active Noise Cancelation is to neutralize the noise by generating the **REVERSE** sound-wave equal to the external noise through the electronic noise reduction system, so as to achieve the effect of noise reduction. (low-f noise)

➤ Where we need a **Noise Cancelation Headphone?**
- • In plane/helicopter or subway or limo
- • Period low-frequency noise in factory/construction field
- • Airport ground service team

➤ The 1ˢᵗ ANC headphone was designed by Dr. Amar G. Bose in 1988.
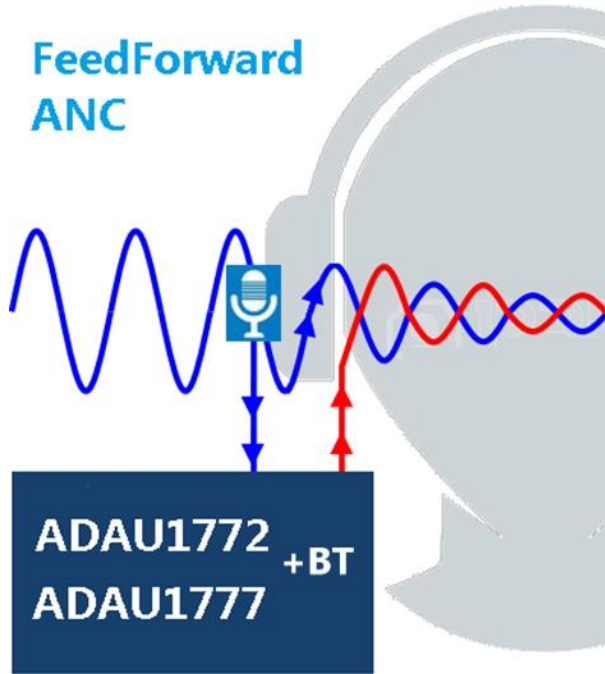
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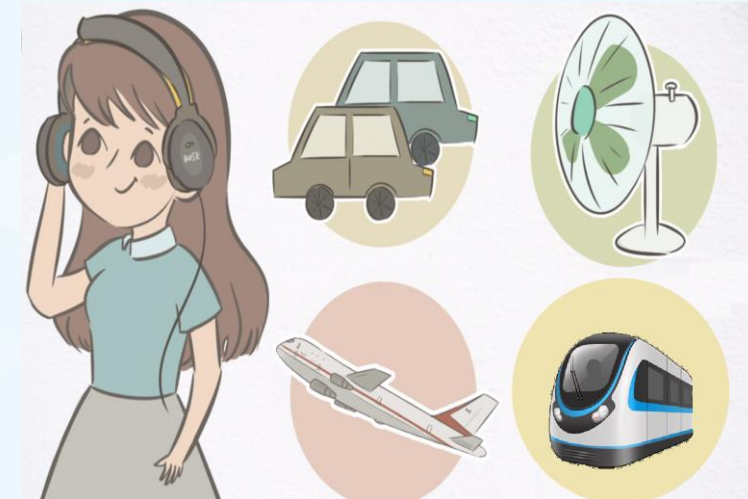
Analog ANC VS. Digital ANC
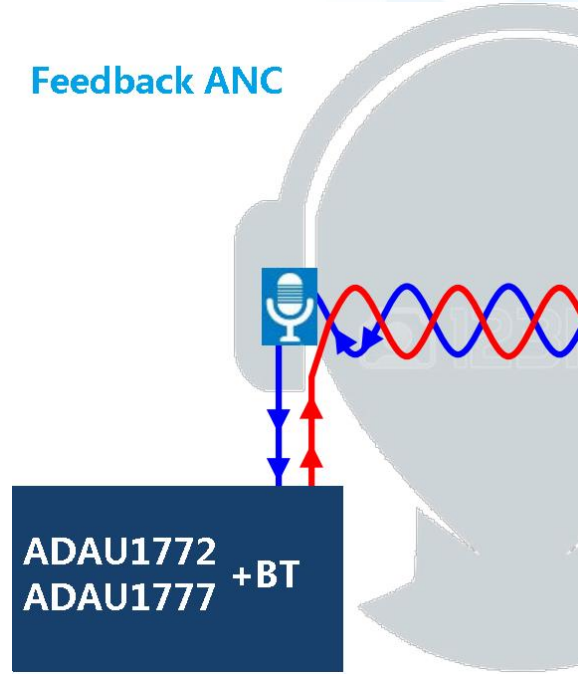
▸ ANC technology includes analog ANC and digital ANC.

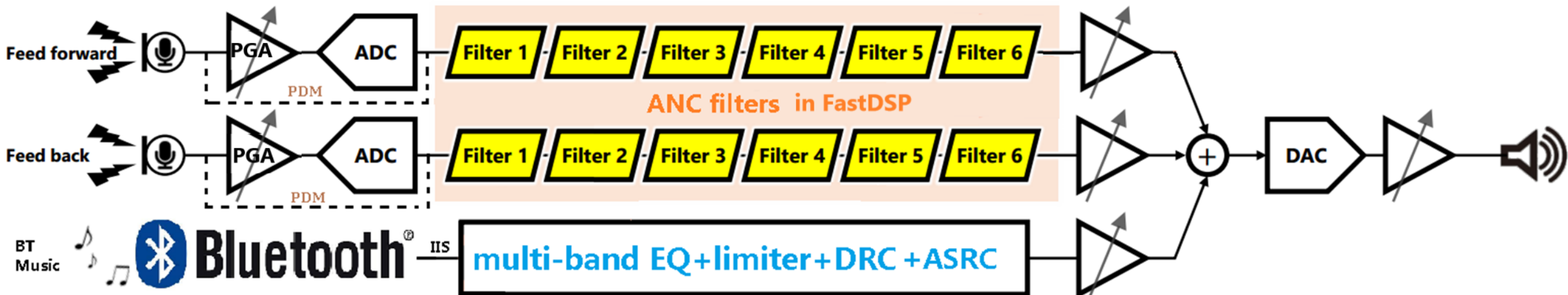|	Analog ANC	Digital ANC
Circuit/PCB	OPs+RESs+Caps/big	Digital IC /smaller
Latency	none	short
Flexibility	very limited (EQ only)	variable
Consistency	poor	good
Calibration	difficult	easy
BOM cost	low	little higher
MP cost	much high	low

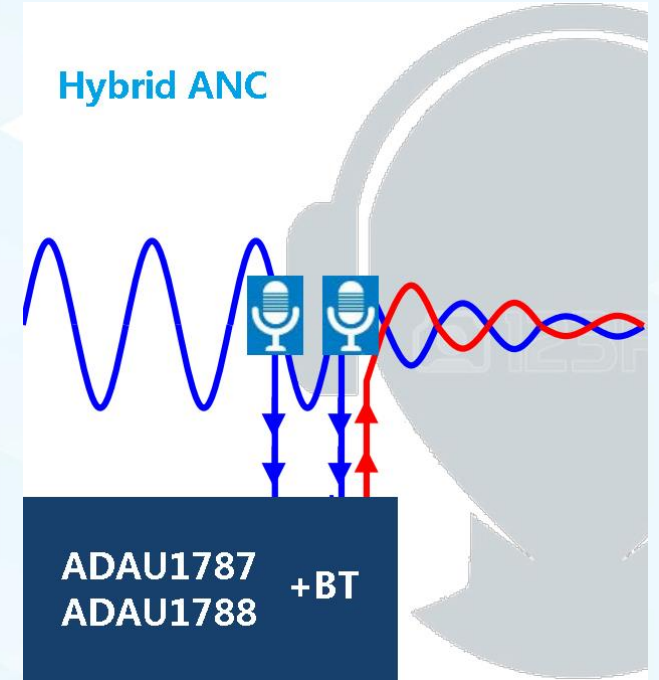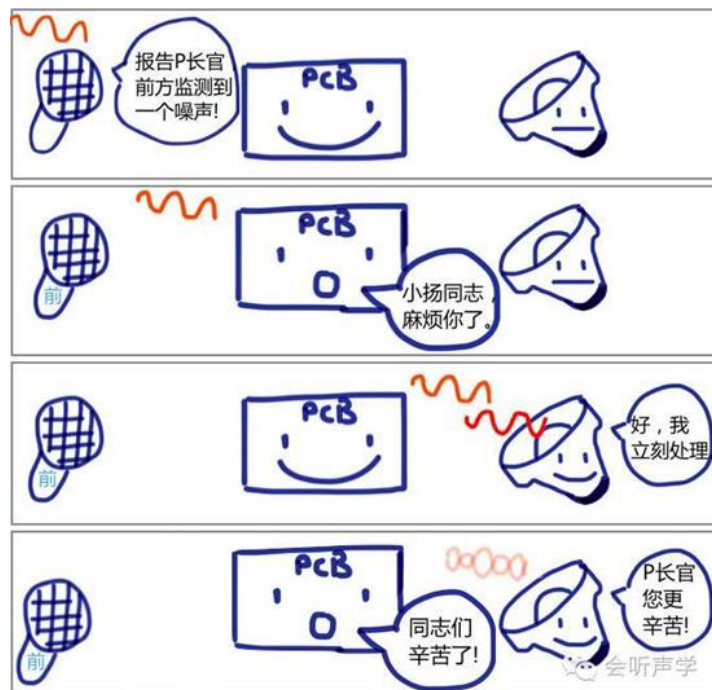# 3 kinds of ANC implement technology

Three kinds of ANC technology

Feed-Forward (FF)

Feedback (FB)

Hybrid (FF+FB)
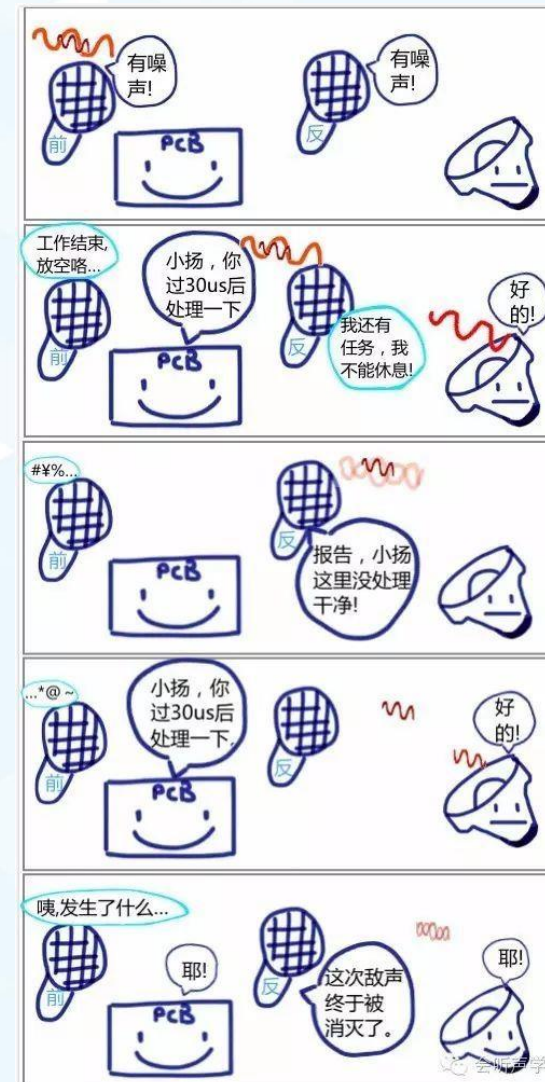

前馈降噪频段宽、深度小
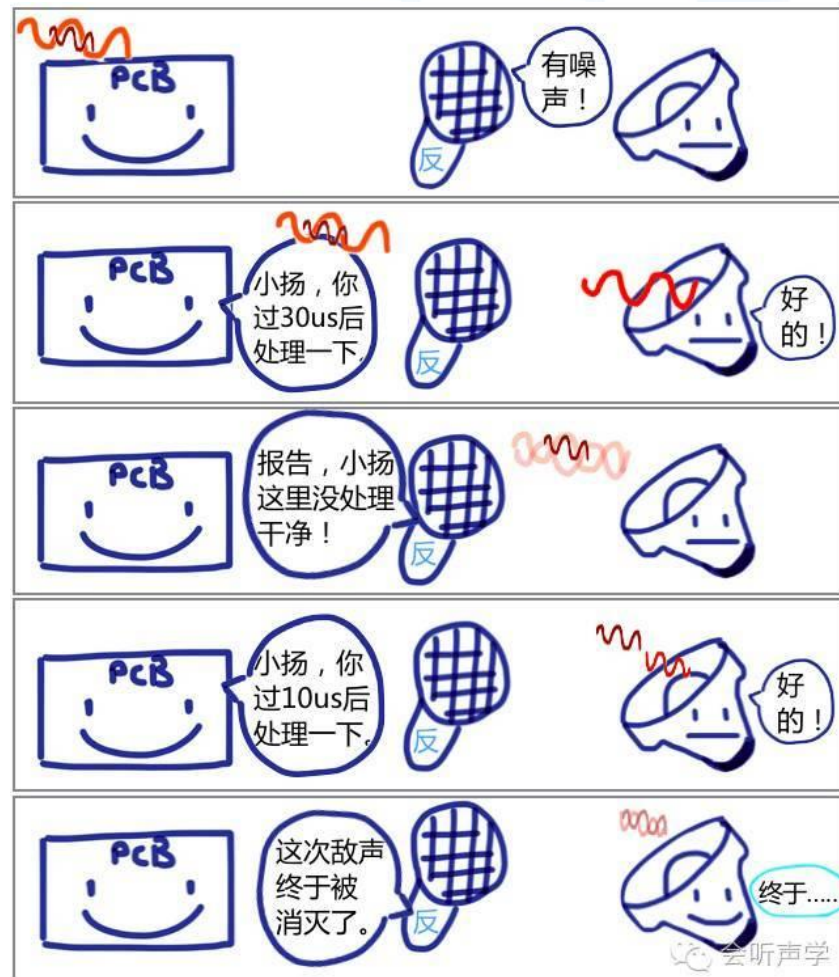
反馈降噪频段短、深度大

ANC headphone market trends and tech. challenges

‣ Feature trends: better looking, more convenient, portable and longer life, adaptive…

‣ Technical challenges: ultra-low latency and ultra-low power, smaller package, while more powerful…

ADAU1777 ANC Audio SoC [4*ADC+2*DAC+1*IIS+2*banks(32*2 inst.)]

▸ Programmable Audio Processing Engine
- Up to 768kHz sample rate with slow base rate path
- Biquad filters, limiters, volume, and mixing

▸ 4-channels single-ended input
- 102dB SNR 24-Bit ADC and PGA paths

▸ Stereo 107dB SNR 24-Bit DAC + HP amp
- Diff-out to avoid pop noise

▸ 5us analog-to-analog latency

▸ 4 PDM MICs input

▸ I2C/SPI control with EEPROM self-boot

▸ Integrated LDO, Mic Bias, and PLL

▸ 3.2mm*3.8mm, 36-bump WLCSP package
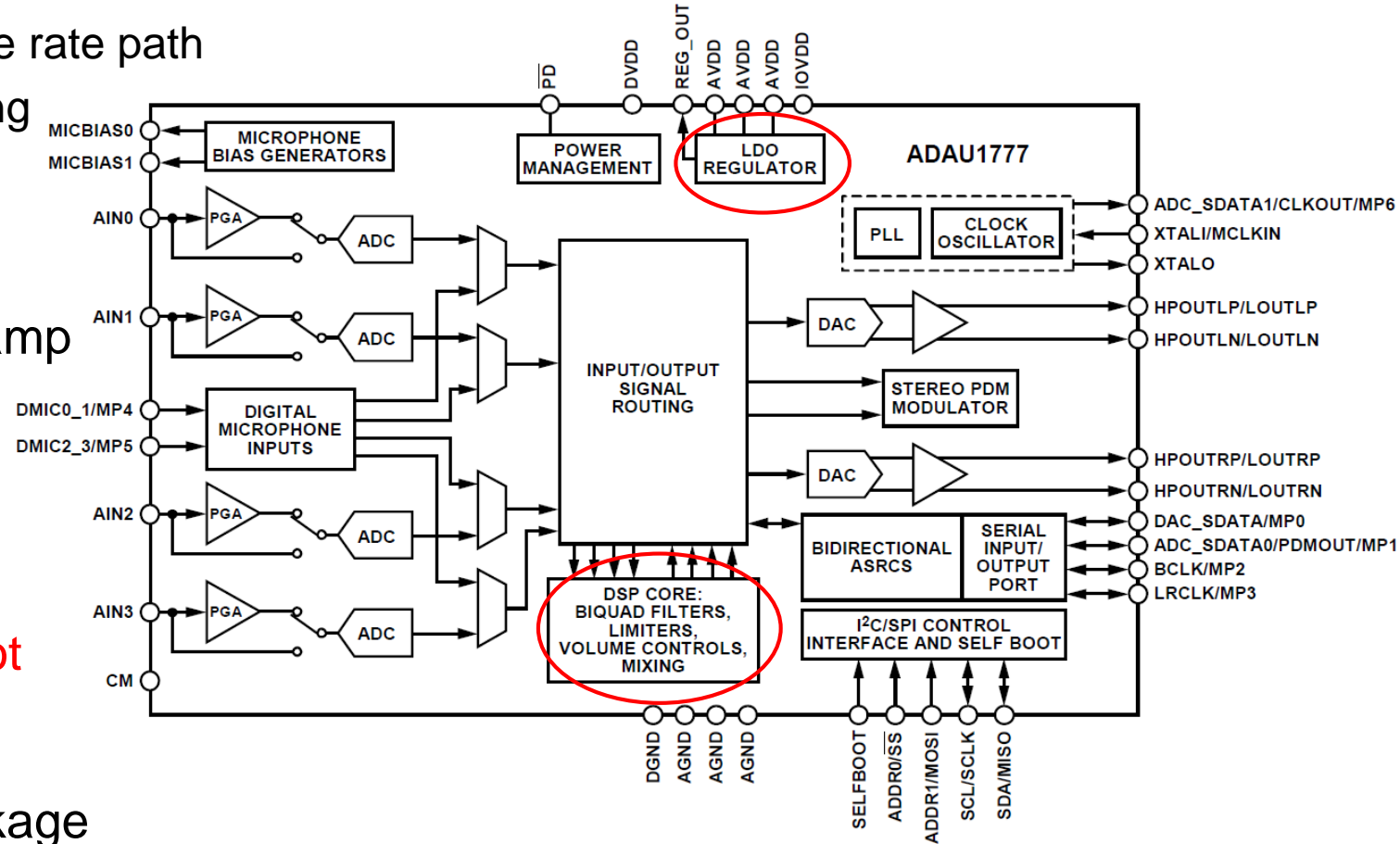
ADAU1787 ANC SoC
[4*ADC+2*DAC+2*IIS+ASRC+3*banks(64*3 inst.)]

Package:2.7mm*2.325mm
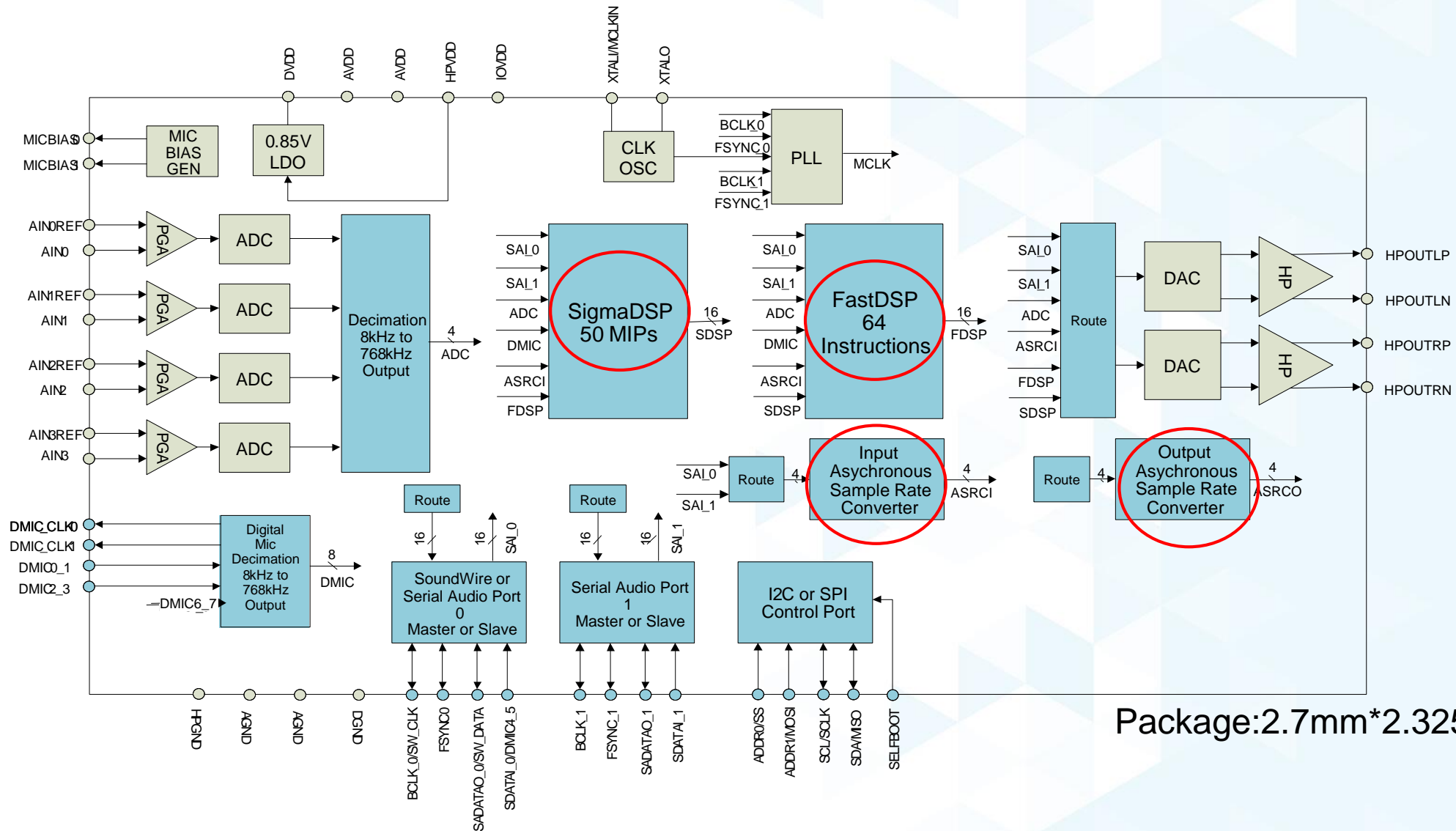
Low cost version of 1787→ADAU1788 (2*ADC+1*DAC+1*IIS + others are same)
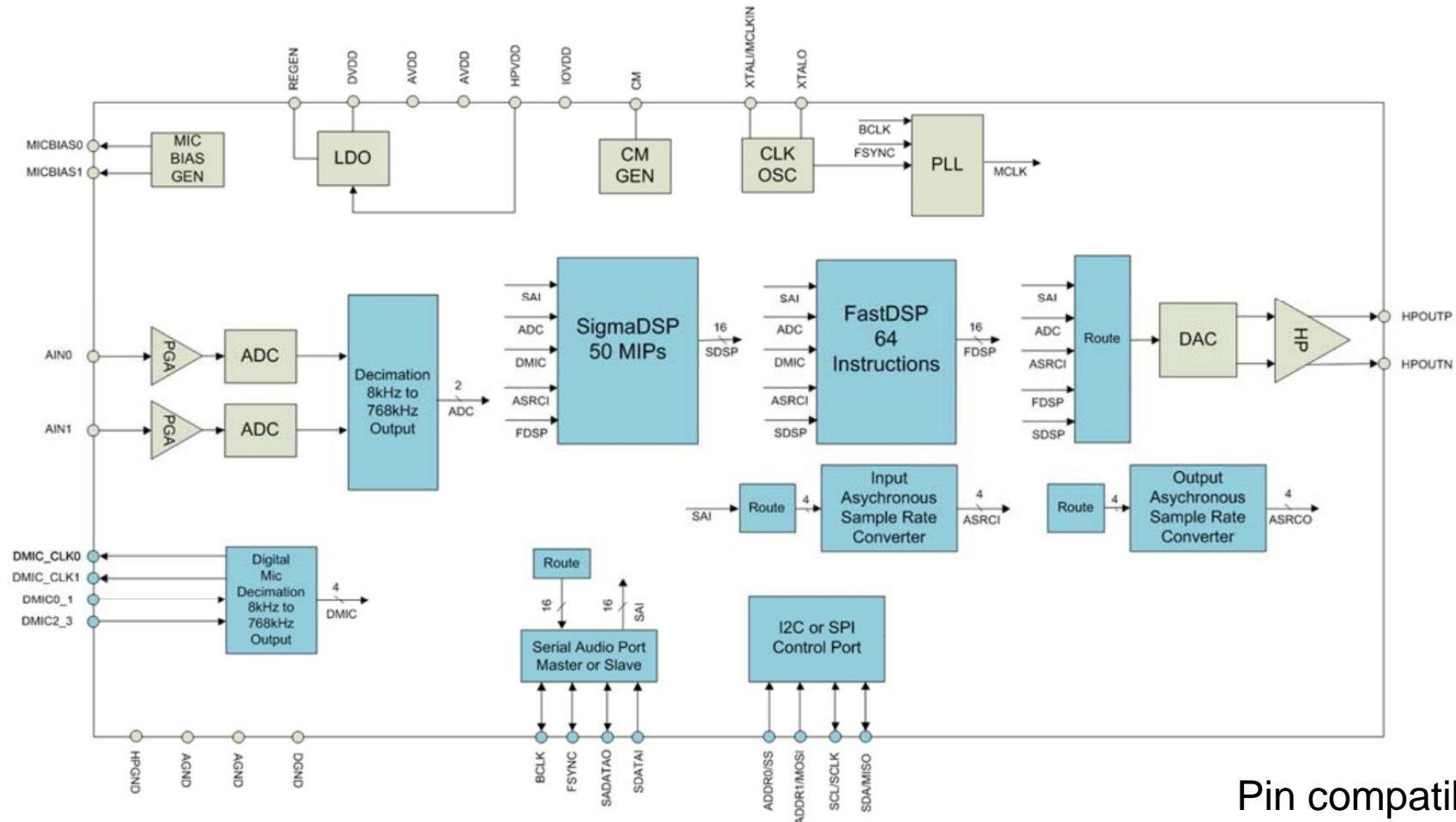

FUNCTIONAL BLOCK DIAGRAM

Pin compatible with 1787

ADAU1777 VS. ADAU1787 VS. ADAU1788

	ADAU1777	ADAU1787	ADAU1788
MCLK工作频率	12.288MHz	24.576MHz	24.576MHz
Max. ADC SR	768K	768k	768k
PLL IN	8MHz~27MHz	30KHz~27MHz	30KHz~27MHz
Sub-Banks #	2	3	3
FastDSP指令数	32	64	64
SigmaDSP	0	50MIPS	50MIPS
IIS通道数	1 IN/ 1 OUT	2 IN/2 OUT	1 IN/1 OUT
ASRC	2	4	4
最小时延@768K	5us	5us	5us
ADC通道数	4	4	2
ADC SNR	102	96	96
DSP input Ch#	4	6	6
DAC通道数	2	2	1
DAC SNR	108	104	104
PDM MIC IN	4	8	8
AVDD	1.8V~3.3V	1.8V	1.8V
IOVDD	1.8V~3.3V	1.2V~1.8V	1.2V~1.8V
DVDD	1.1V	0.9V	0.85V
典型功耗	14mW	11mW	8mW
MP date	2017	2018	2019H2

Other features for ANC and roadmap for future ANC

- ▸ ASRCs
  - Fully independent 4-ch input and output ASRC
  - 8-192kHz to 8-192kHz conversion
- ▸ DSP banks for variable <u>ANC cases</u>
  - 1777 has 2 DSP banks
  - 1787/1788 has 3 DSP banks
- ▸ Headphone output
  - Differential output support only.
  - 32mW into 32Ω at <0.1% THD
 - 41mW into 16Ω at <0.1% THD
- ▸ 1 or 2 pairs of IIS for music in

In the future, ADI will integrated a hi-fi core with FDSP & other better analog features in future ADI ANC SoC to support adaptive ANC application.

Development tools - SigmaStudio

What is SigmaStudio?

- **Graphical programming**, development, and **tuning** software

- **Schematic audio signal flow development**

- **Abstracts assembly code**
  - **NO DSP coding required to implement a design**

- **Supports SigmaDSP & FastDSP etc.**

- **Full in-circuit and real-time develop & tuning**

- **Custom algorithm modules - supported**

- **Includes a library of 100+ optimized, production-ready audio and general purpose algorithms**
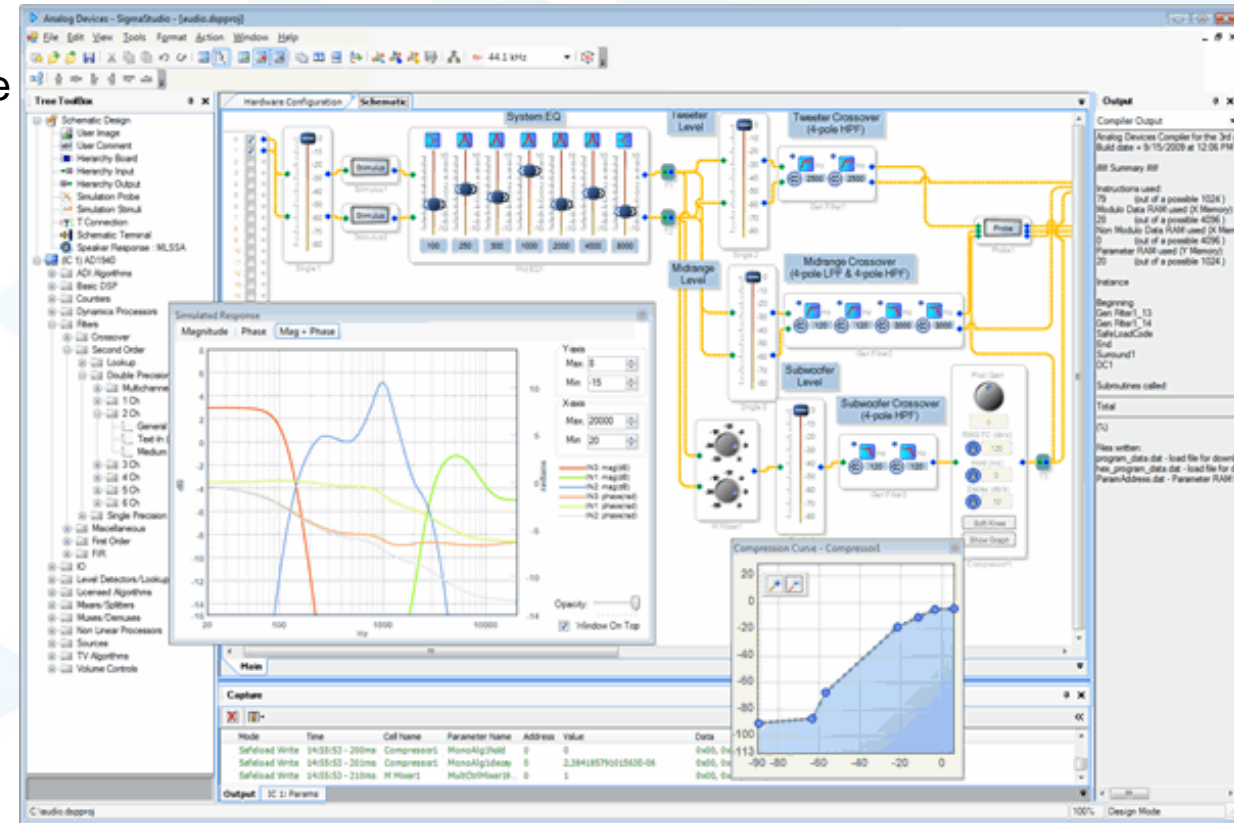
Success Stories

- ▸ BOSE based on ADAU1772/1777
- ▸ B&W based on ADAU1777
- ▸ Beijing Libratone based on ADAU1777 & ADAU1787
- ▸ Zhuhai HiVi based on ADAU1777
- ▸ On-going…big projects

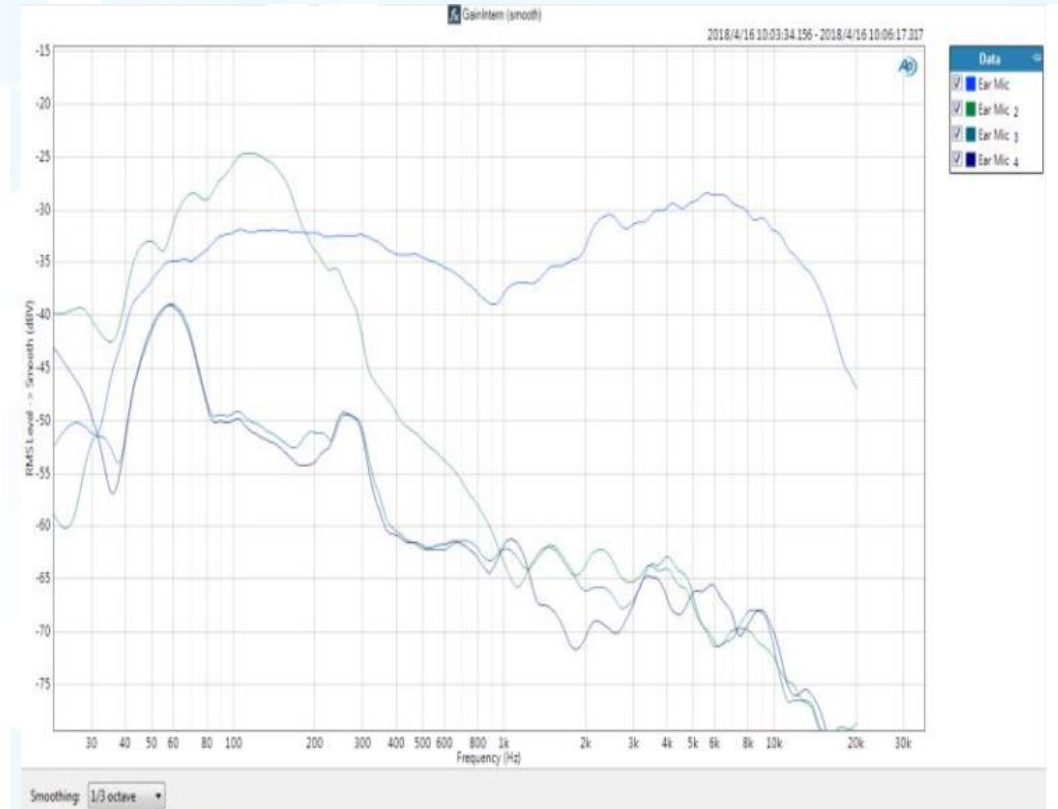◆ Some self-design customers has their own ANC algorithm and design experience or work with 3rd party
◆ Instead of total solution, ADI only provide chip level support to key customers and 3rd parties
◆ How about other customers?

ADI ANC 3rd party for customers who have no ANC design capability

▸ **Beijing HT acoustics**

- Turn-key adaptive ANC solution (high-performance + high yield + easy MP)
- Provide ANC modules and ANC/ PNC design consultant
- Good ANC ecosystem with OEM factories
- Headphone calibration & MP services
- http://www.ht-acoustics.com

ADI ANC 3rd party for customers who have no ANC design capability

▸ **Dongguan ASKA**

- High performance ANC headphone solutions with good mass production test tools

- Provide ANC headphone ODM service and PNC/ANC design consultant

- ANC headset mass production services

- http://www.askalab.com/

Experts serve for OEM & ODM & JDM

Wireless Audio Product Development Experience over 15 years
Acoustic Lab equipped with B&K/AP testing system
Aska own patent *A²NC* digital technology by using ADI DSP+Aska Algorithm

A²NC   ANALOG DEVICES — AHEAD OF WHAT'S POSSIBLE™

· Hybrid ANC up to **40dB** 高达40dB混合降噪效果
· **Amplification** 拾音增强
· **Hearing protection** 听力保护
· **High noise suppression** 高噪声抑制

Products Roadmap
· Bluetooth Headphone+ANC
· Gaming Headphone+ANC
· Neckband Earphones+ANC
· TWS Earphones+ANC
· Hearing Products

BSCI — Business Social Compliance Initiative
SCAN — Supplier Compliance Audit Network
MFi — Apple MFi Authorised Manufacture
ISO — ISO certification for 2015

Q&A (?→!)

ENJOY & THANKS!