ADI Digital ANC SoC Solution

Henry Long

ADI consumer BU

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ANALOG DEVICES

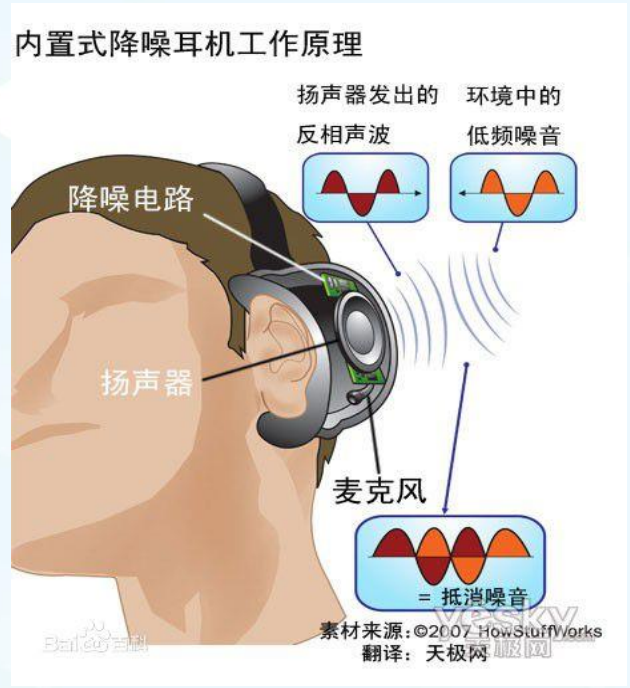
AHEAD OF WHAT'S POSSIBLE™

Agenda

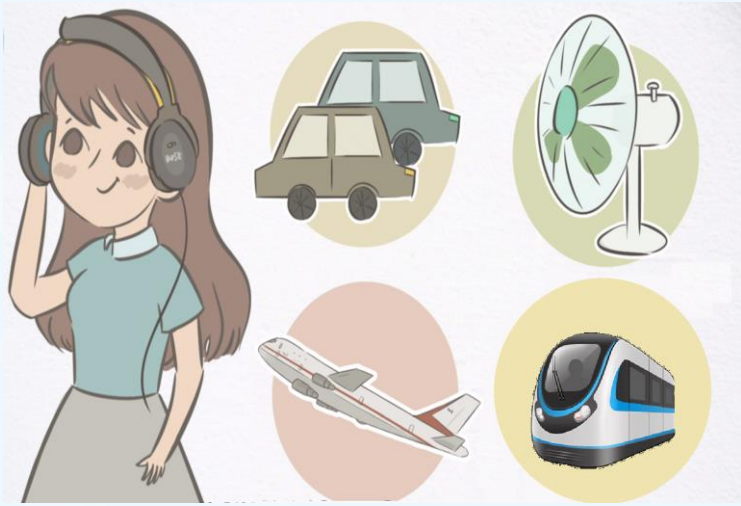
- 1. A brief of Noise Cancelation technology
  - PNC vs. ANC
  - Analog ANC vs. Digital ANC
  - Three kinds of main technology of ANC
- 2. ADI ANC SOCs and features
  - ANC headphone trends and challenges
  - ADAU1777 vs. 1787 vs. 1788
- 3. Success stories sharing
- 4. ADI ANC support strategy & 3rd 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



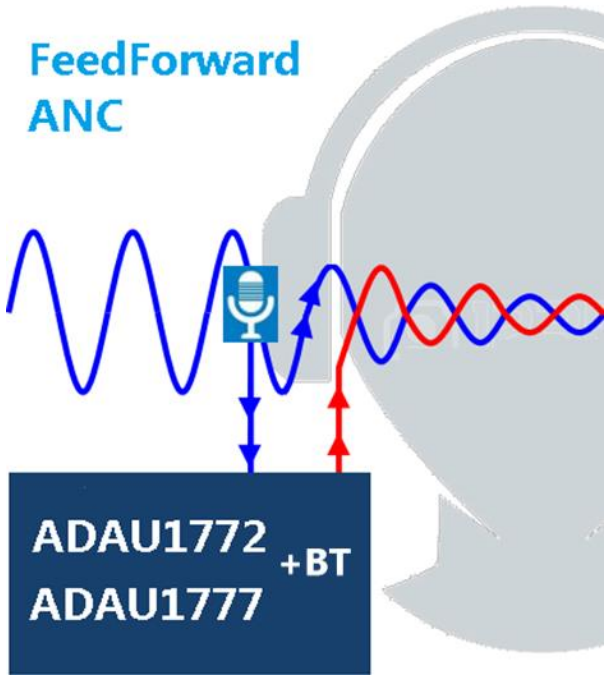
- The 1st ANC headphone was designed by Dr. Amar G. Bose in 1988.

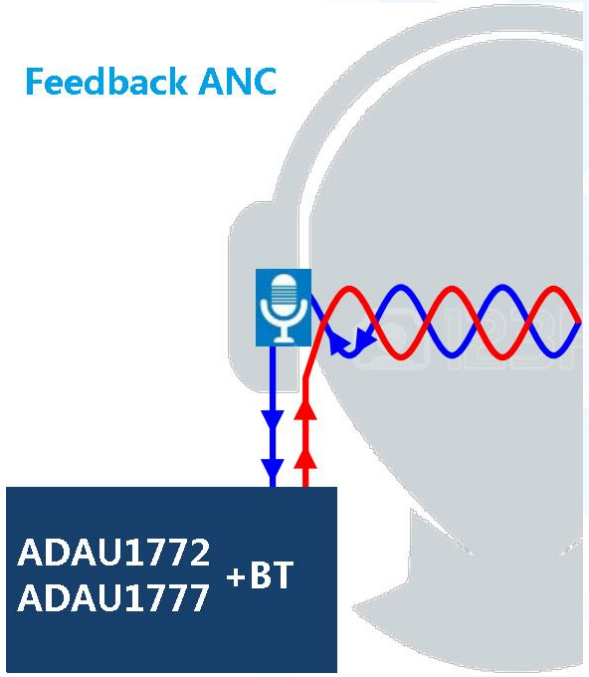
Analog ANC VS. Digital ANC

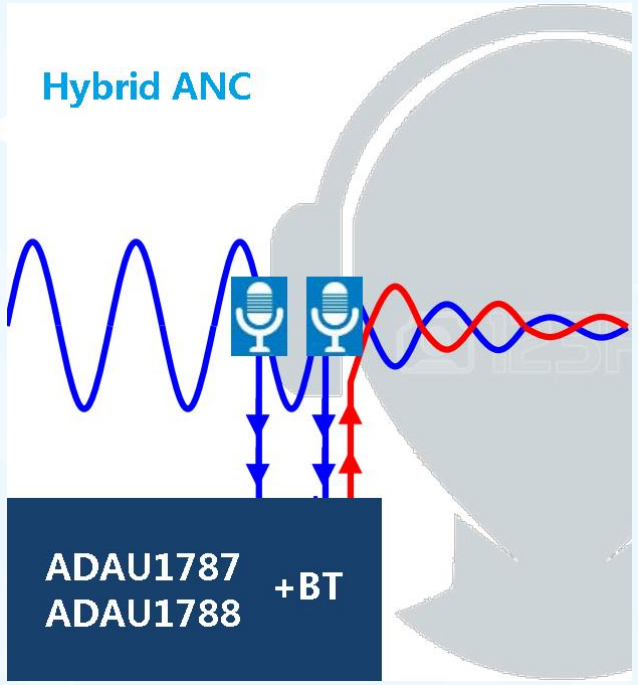
- ANC technology includes analog ANC and digital ANC.

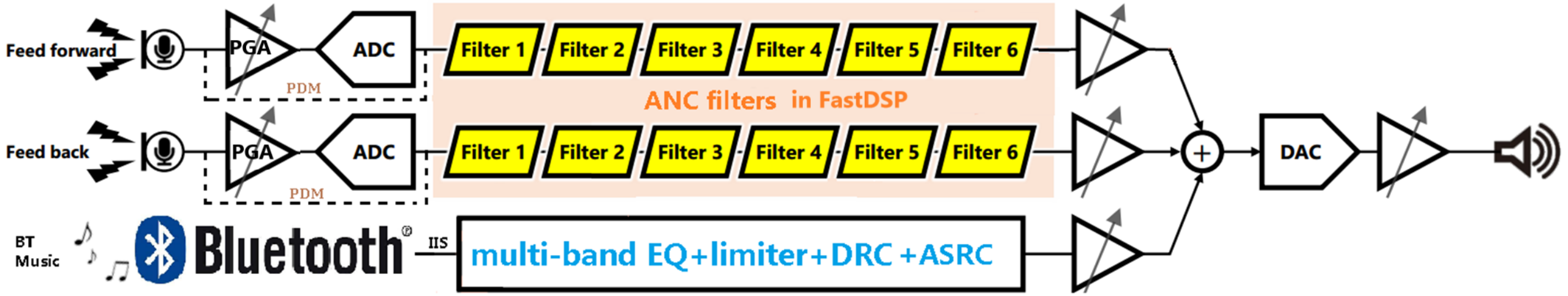
	Analog ANC	Digital ANC
Circuit/PCB	OPs+RESs+Caps/big	Digital IC /smaller
Latency	none	short
Flexibility	very limited (EQ only)	variable
Consistency	poor	good
Calibration	difficult	easy
BOM cost	low	little higher
MP cost	much high	low

3 kinds of ANC implement technology



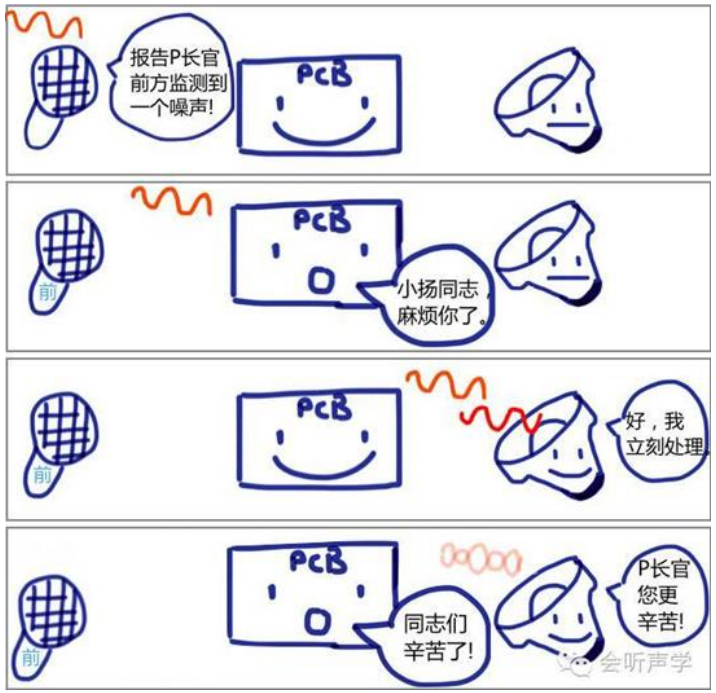






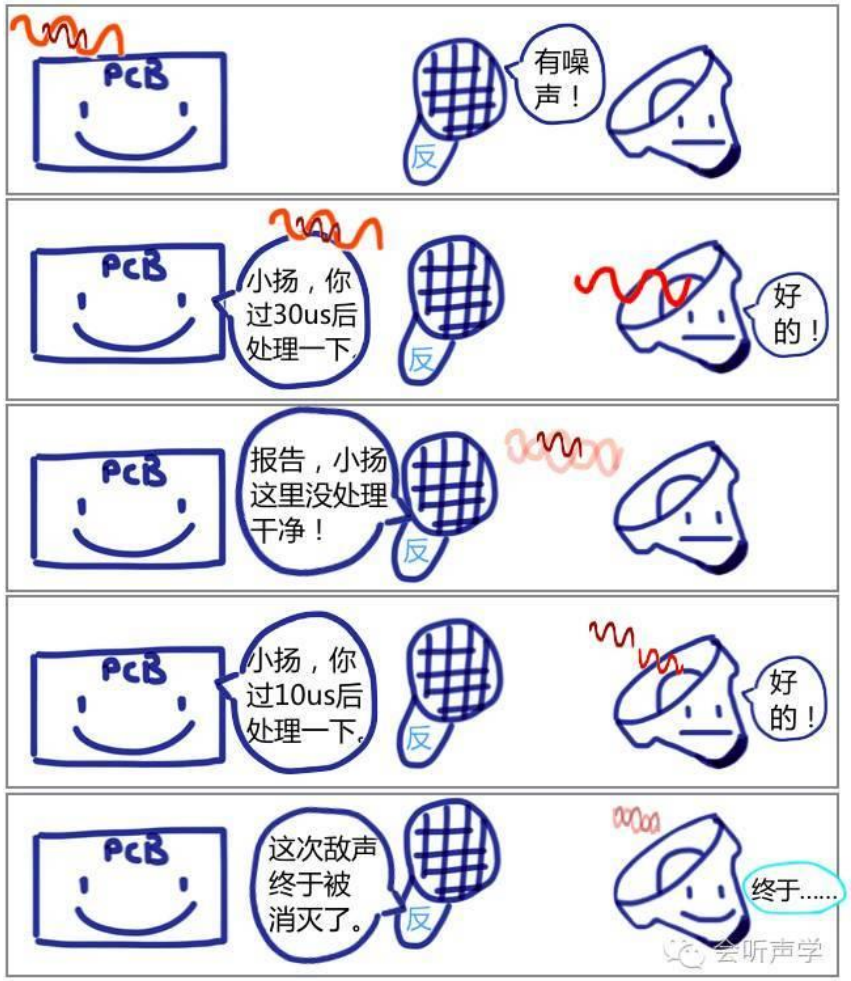
Three kinds of ANC technology

Feed-Forward (FF)



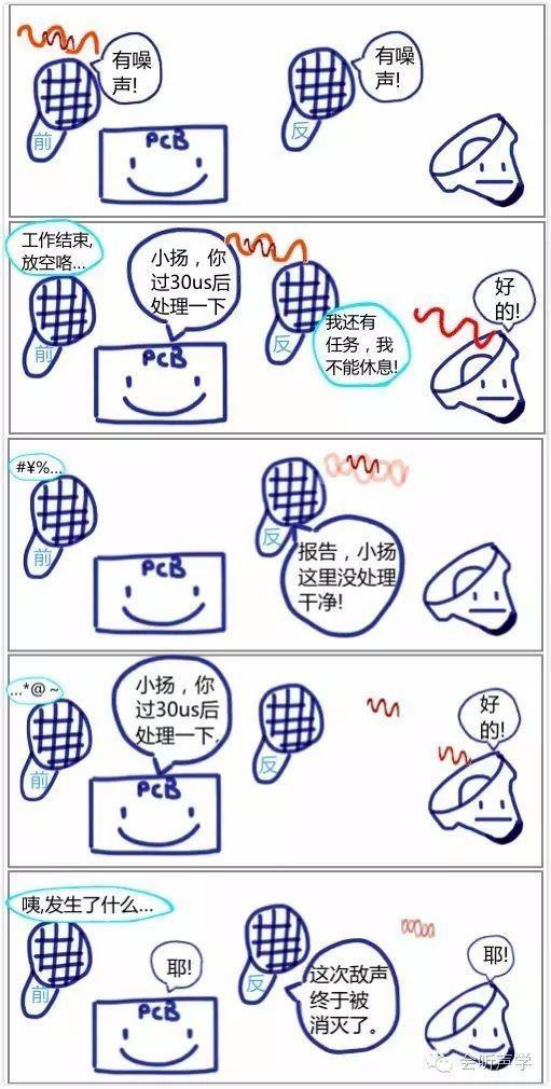
前馈降噪频段宽、深度小

Feedback (FB)



反馈降噪频段短、深度大

Hybrid (FF+FB)

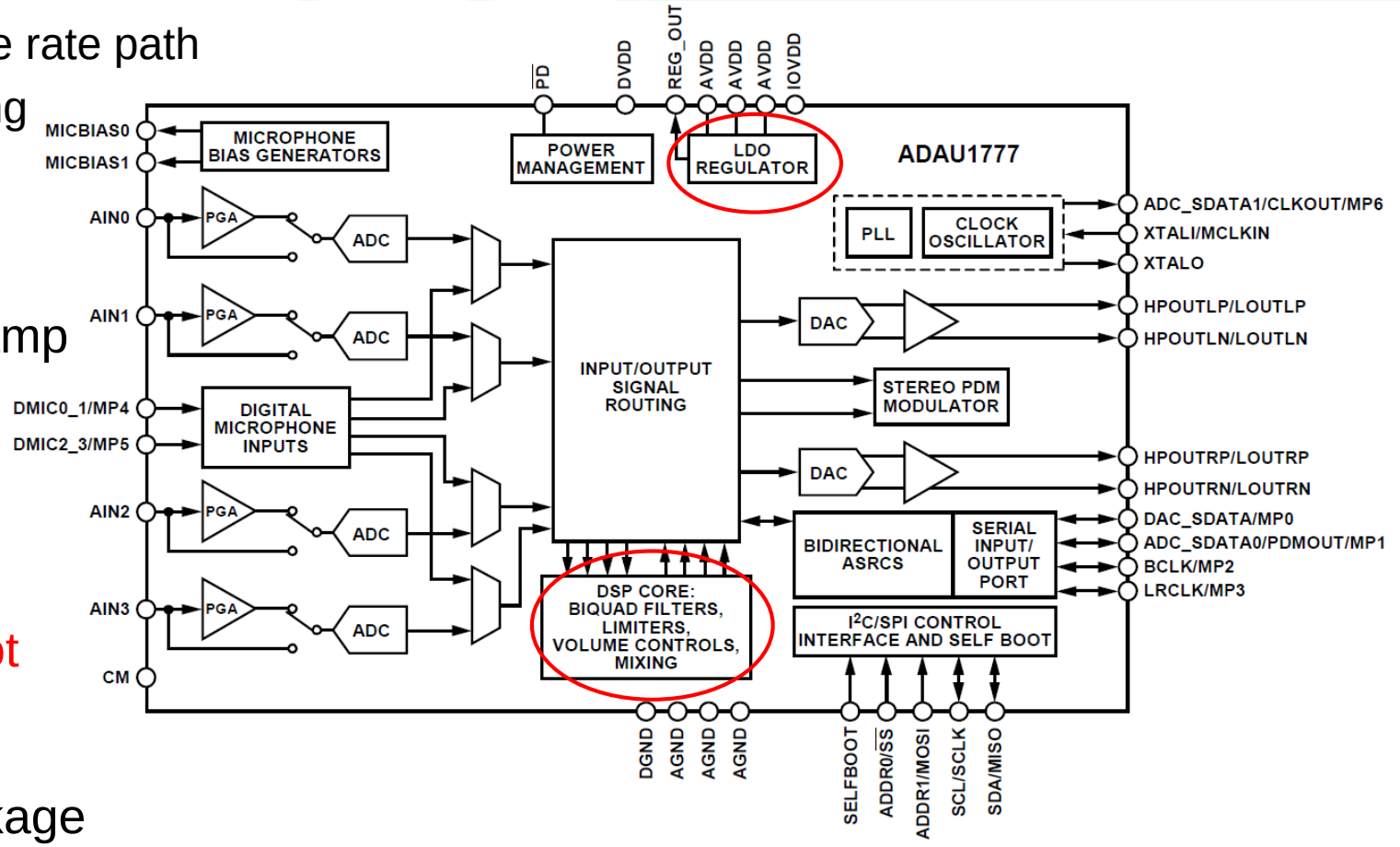


ANC headphone market trends and tech. challenges

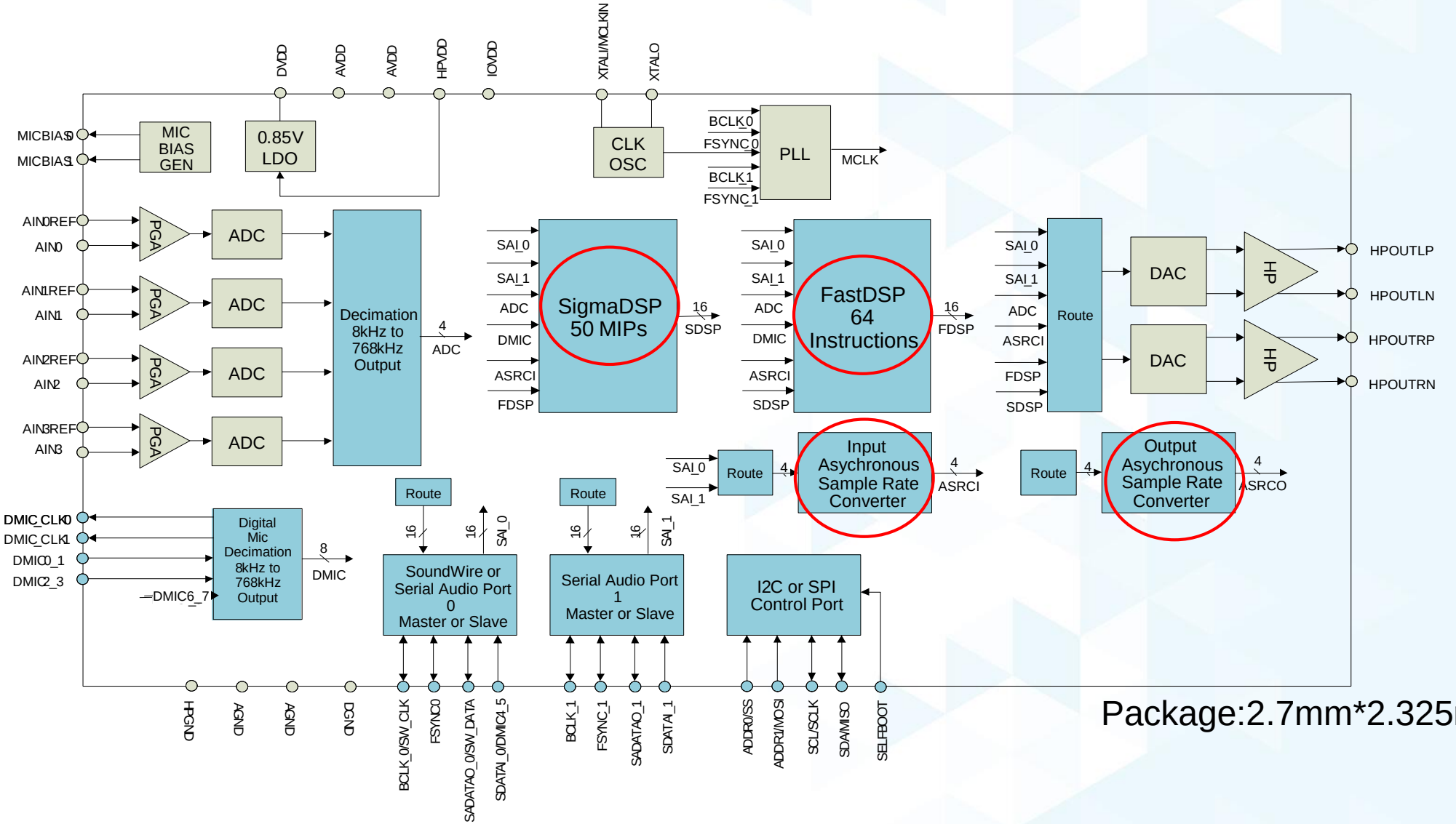
- Feature trends: better looking, more convenient, portable and longer life, adaptive…
- Technical challenges: ultra-low latency and ultra-low power, smaller package, while more powerful…

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

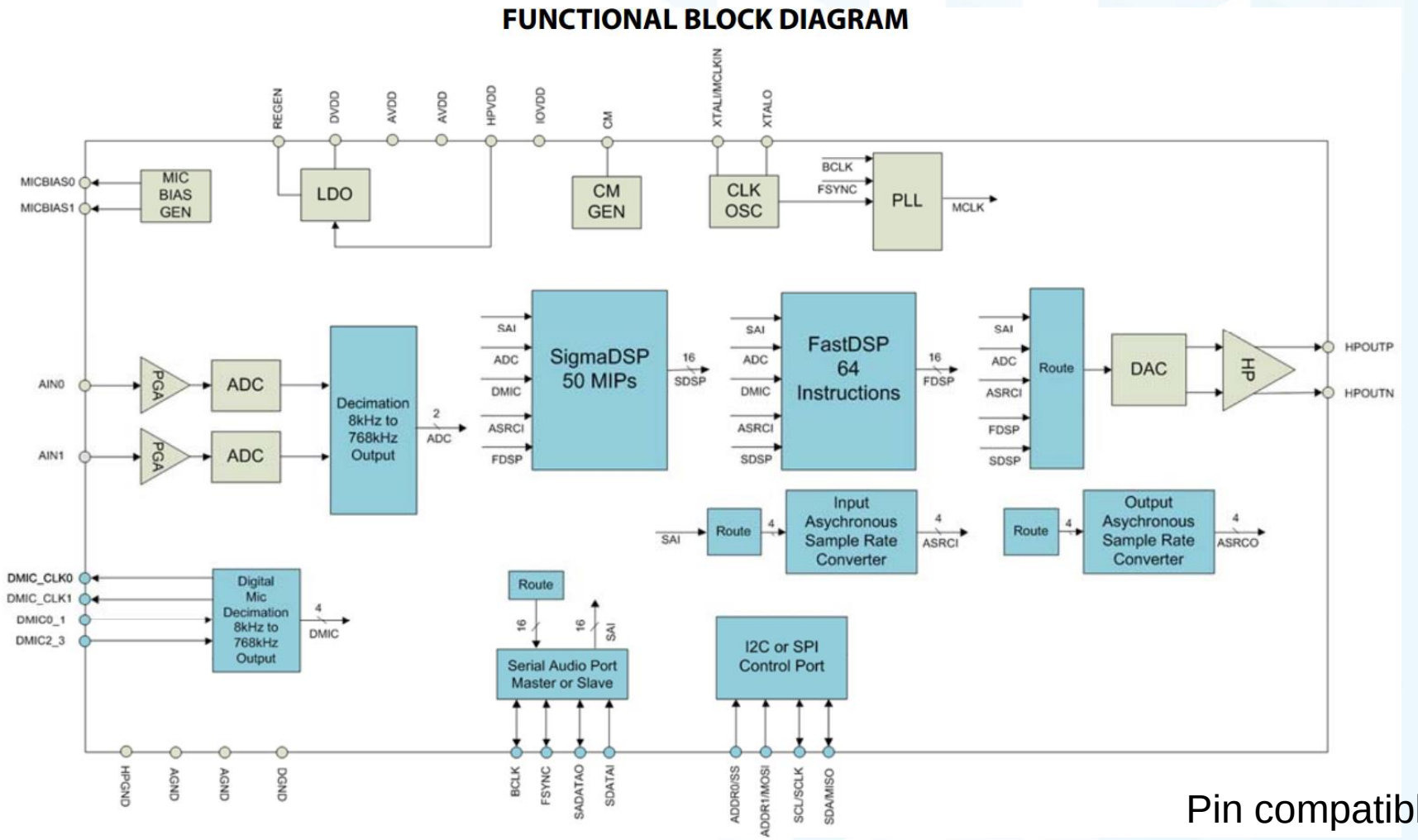


ADAU1787 ANC SoC [4*ADC+2*DAC+2*IIS+ASRC+3*banks(64*3 inst.)]



Package:2.7mm*2.325mm

Low cost version of 1787→ADAU1788 (2*ADC+1*DAC+1*IIS + others are same)



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

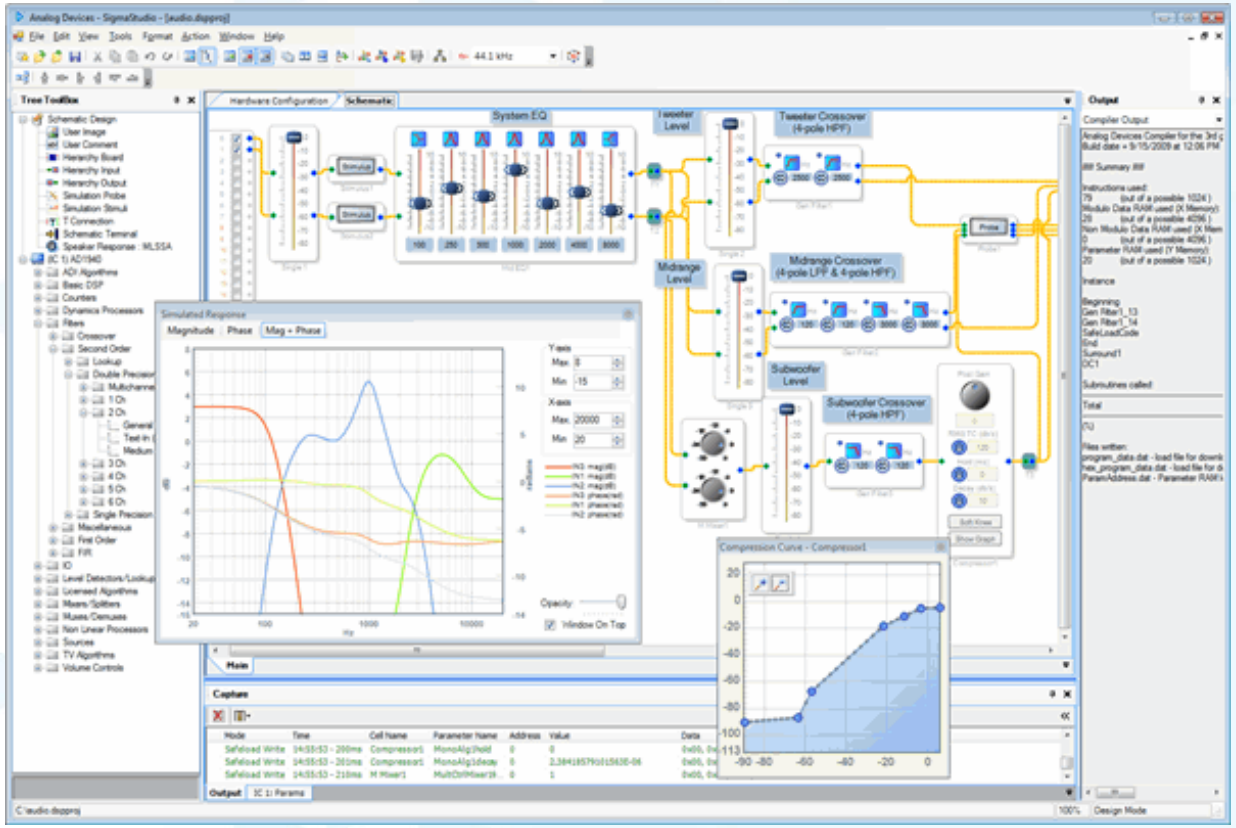
- ASRCs
  - Fully independent 4-ch input and output ASRC
  - 8-192kHz to 8-192kHz conversion
- DSP banks for variable ANC cases
  - 1777 has 2 DSP banks
  - 1787/1788 has 3 DSP banks
- Headphone output
  - Differential output support only.
  - 32mW into 32Ω at <0.1% THD
  - 41mW into 16Ω at <0.1% THD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

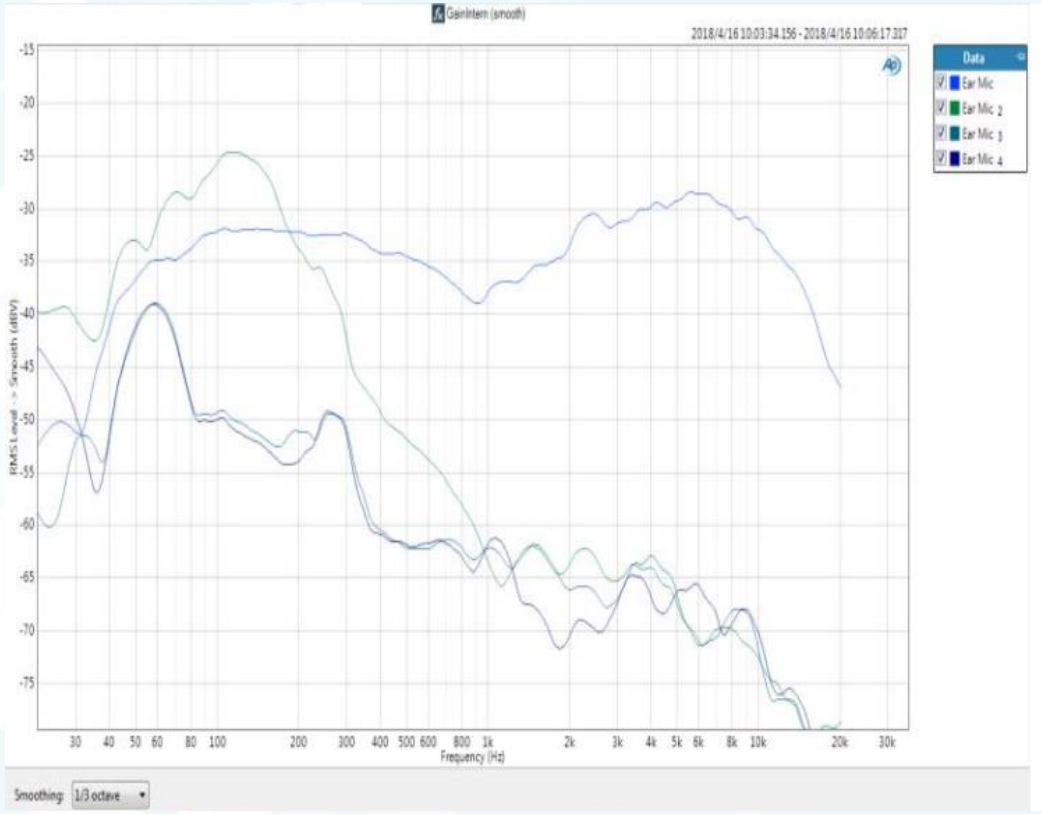
What is SigmaStudio?

- **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/

Q&A (?→!)

ENJOY & THANKS!