

ADI 音频产品和解决方案介绍

Henry Long



内容介绍

- ▶ 无处不在的ADI音频产品
- ▶ ADI公司音频DSP、处理器产品
- ▶ ADI汽车音频总线
- ▶ ADI ANC应用音频编解码器
- ▶ ADI ATMOS 应用的SHARC DSP产品
- ▶ ADI D类音频功放产品

无处不在的ADI音频产品

Automotive

- Head unit
- Audio amplifiers
- Infotainment
- ANC



Digital Home

- AVRs
- Soundbar
- Active speaker
- Wifi/BT speaker
- Docking
- multimedia accessories
- Media servers
- Karaoke effect



Pro-Audio Segment

- Professional recording, broadcast, film and live sound
- Stage audio installations
- Musical instruments
- Audio effects processors
- DJ equipment
- Audio matrix
- Conference system

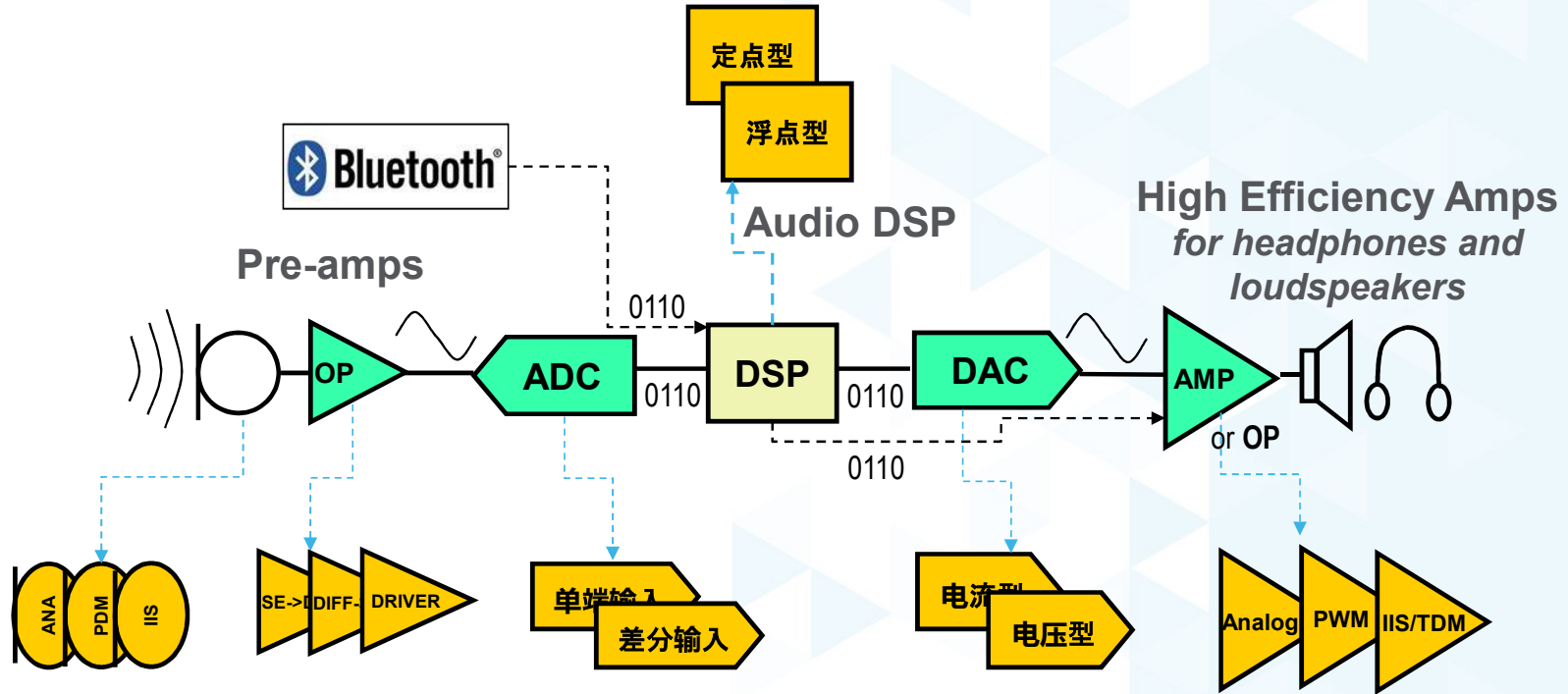


Portable Audio

- Multimedia accessories
- headphones/headsets
- VoIP phones
- Hifi Phone/Tablet
- Personal recording



典型的音频系统框图/信号链



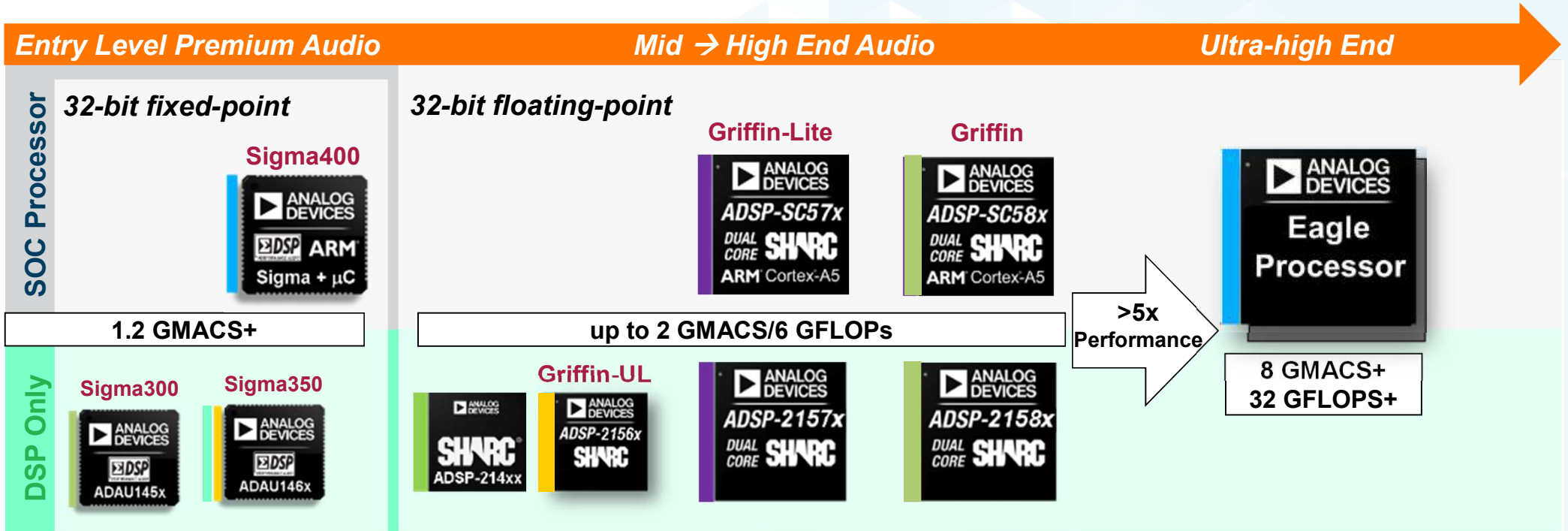


ADI 音频 SIGMADSP/SHARC DSP

SigmaDSP 产品选型对比表

	ADAU1701 ADAU1401A	ADAU1702	ADAU1761	ADAU1781	ADAU1442 ADAU1445 ADAU1446	ADAU1450/51/52	ADAU1462 ADAU1466	ADAU1463 ADAU1467
Core Frequency (MHz)	50	25	50	50	172	294 ADAU1450: 147	294	294
Program RAM (kWord)	1	0.5	1	0.5	3.5	8	24	24
Instructions per sample @ 48 kHz	1024	512	1024	1024	3584	6144 (SIMD)	6144 (SIMD)	6144 (SIMD)
Parameter RAM (kWord)	1	1	1	0.5	4	ADAU1450: 8 ADAU1451: 16 ADAU1452: 40	ADAU1462: 48 ADAU1466: 80	ADAU1463: 48 ADAU1467: 80
Data RAM (kWord)	2	0.5	4	0.5	8	Shared with Parameter RAM	Shared with Parameter RAM	Shared with Parameter RAM
ADC / DAC Channels	2 / 4	2 / 4	2 / 2	2 / 2	0 / 0	0 / 0	0 / 0	0 / 0
Digital I/O Channels	8 / 8	8 / 8	8 / 8 2 x Digital Mics	8 / 8 2 x PDM Mics	24 / 24	48 / 48	48 / 48	48 / 48
Aux ADC	4 ch, 8-bit	4 ch, 8-bit			4 ch, 10-bit	6 ch, 10-bit	6 ch, 10-bit	8 ch, 10-bit
GPIOs	12	12	4	5	12	14	14	26
Selfboot	I2C	I2C			I2C	I2C / SPI	I2C / SPI	I2C / SPI
Master Port						I2C / SPI	I2C / SPI	I2C / SPI
ASRCs (Channels / Sample Rates)	No	No	No	No	ADAU1442: 16 / 8 ADAU1445: 16 / 2	ADAU1450: No ADAU1451: 16 / 8 ADAU1452: 16 / 8	16 / 8	16 / 8
S/PDIF						1450: No 1451/52 :I/O 96 kHz	In/Out (192 kHz)	In/Out (192 kHz)
Package	48-Lead LQFP 7 x 7 mm	48-Lead LQFP 7 x 7 mm	32-Lead LFCSP 5 x 5 mm	32-Lead LFCSP 5 x 5 mm	100-lead TQFP & LQFP 14 x 14mm	72-Lead LFCSP 10 x 10 mm	72-Lead LFCSP 10 x 10 mm	88-Lead LFCSP 12 x 12 mm

ADI公司音频DSP、处理器产品路标图

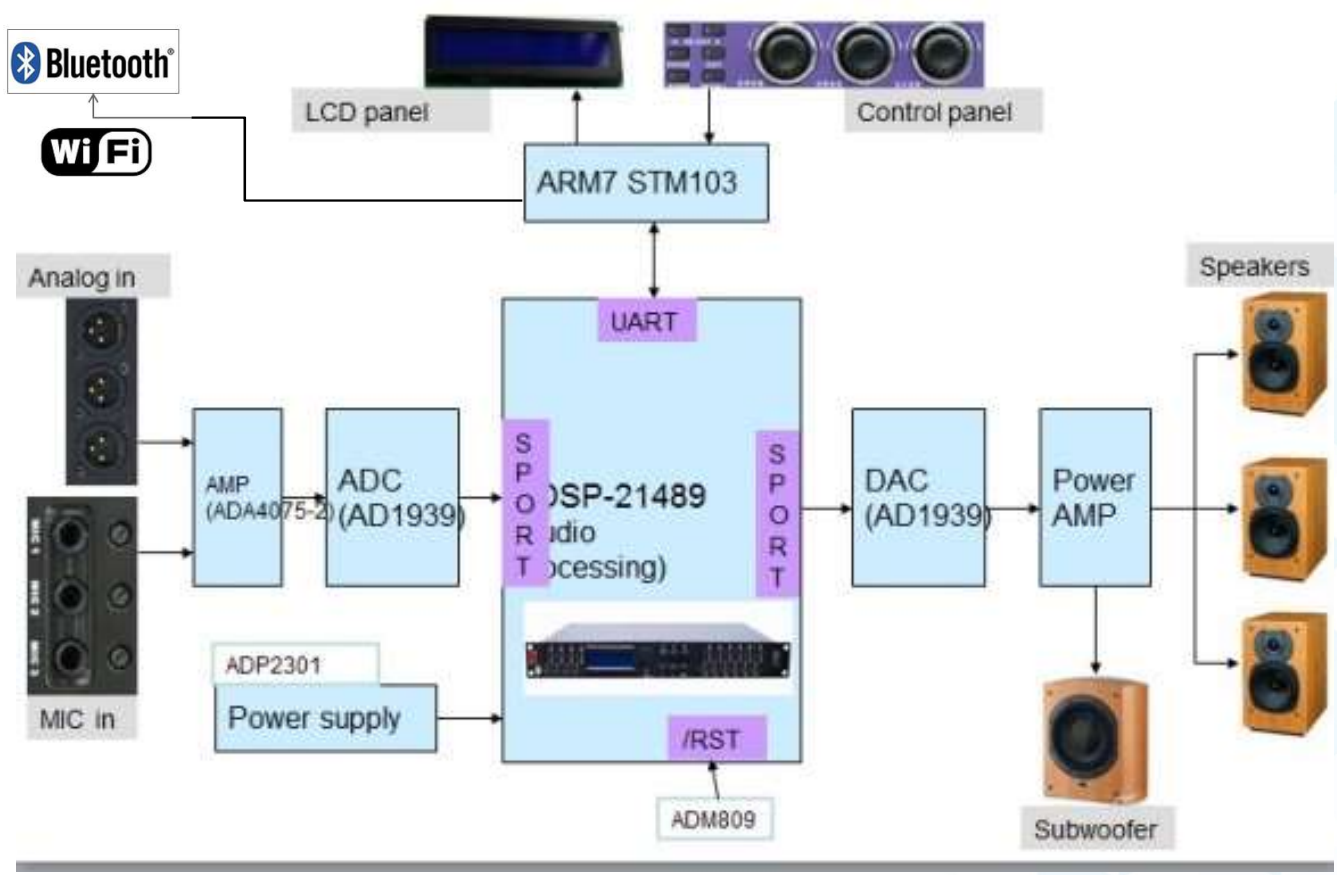


- In Concept
- In Design
- Sampling
- In Production

Connectivity Options include : **CAN** **Ethernet AVB** **MOST150** **PCI EXPRESS** **AB Automotive Audio Bus**

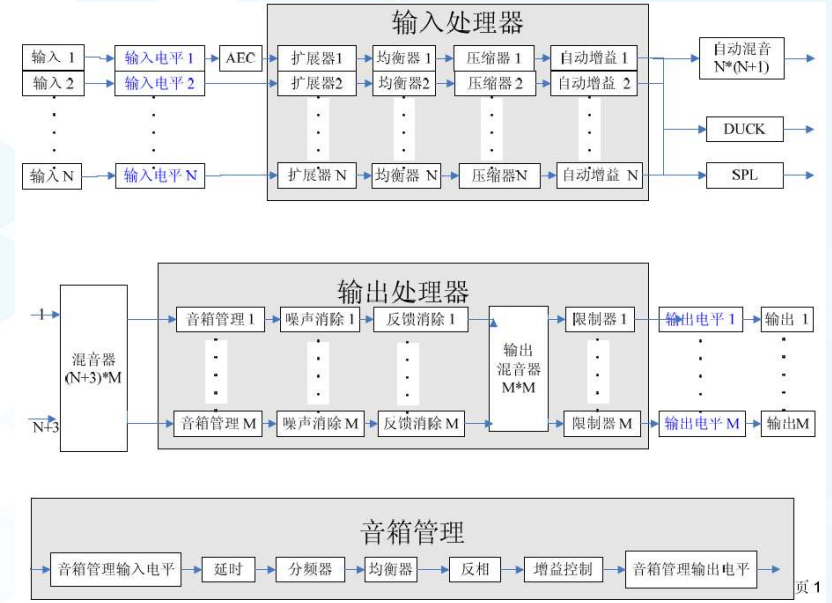
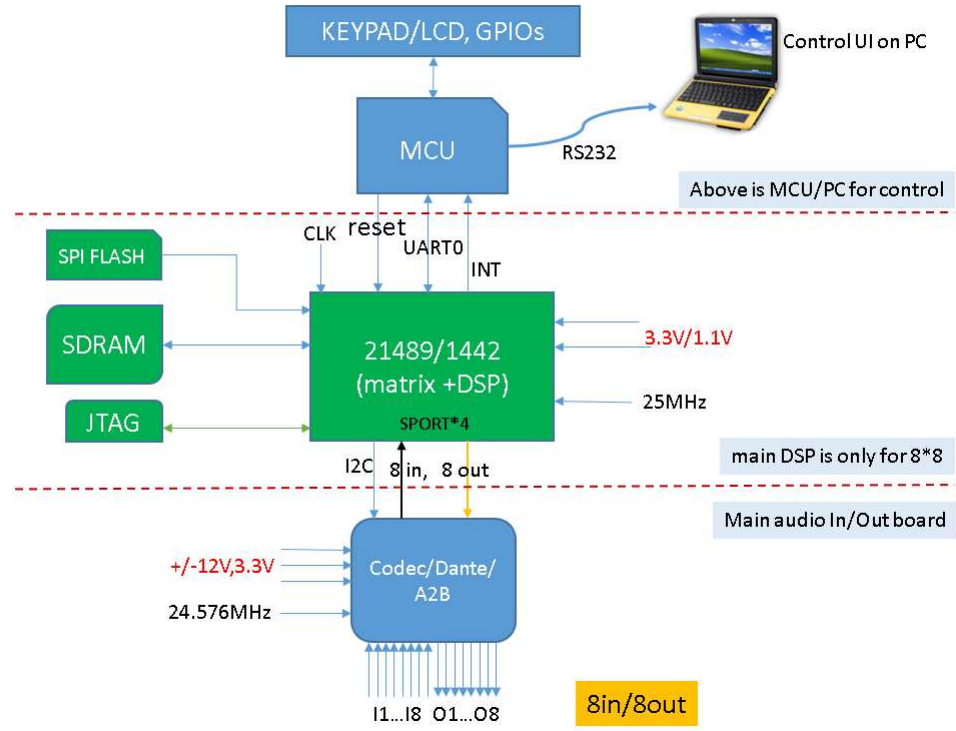
SigmaStudio Software Tools and Optimized Algorithms

卡拉OK效果器，直播声卡，小调音台，K歌亭 (21479/21489)



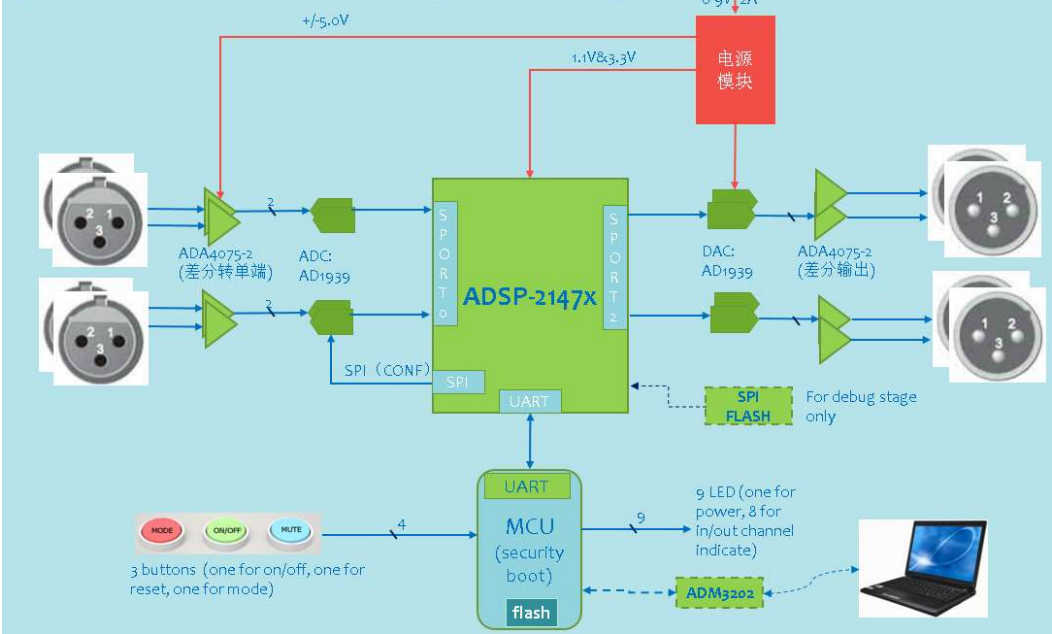
数字音频矩阵, 大型调音台(N进*M出)

8*8 audio mixer system diagram



反馈抑制器(2/4/8通道)

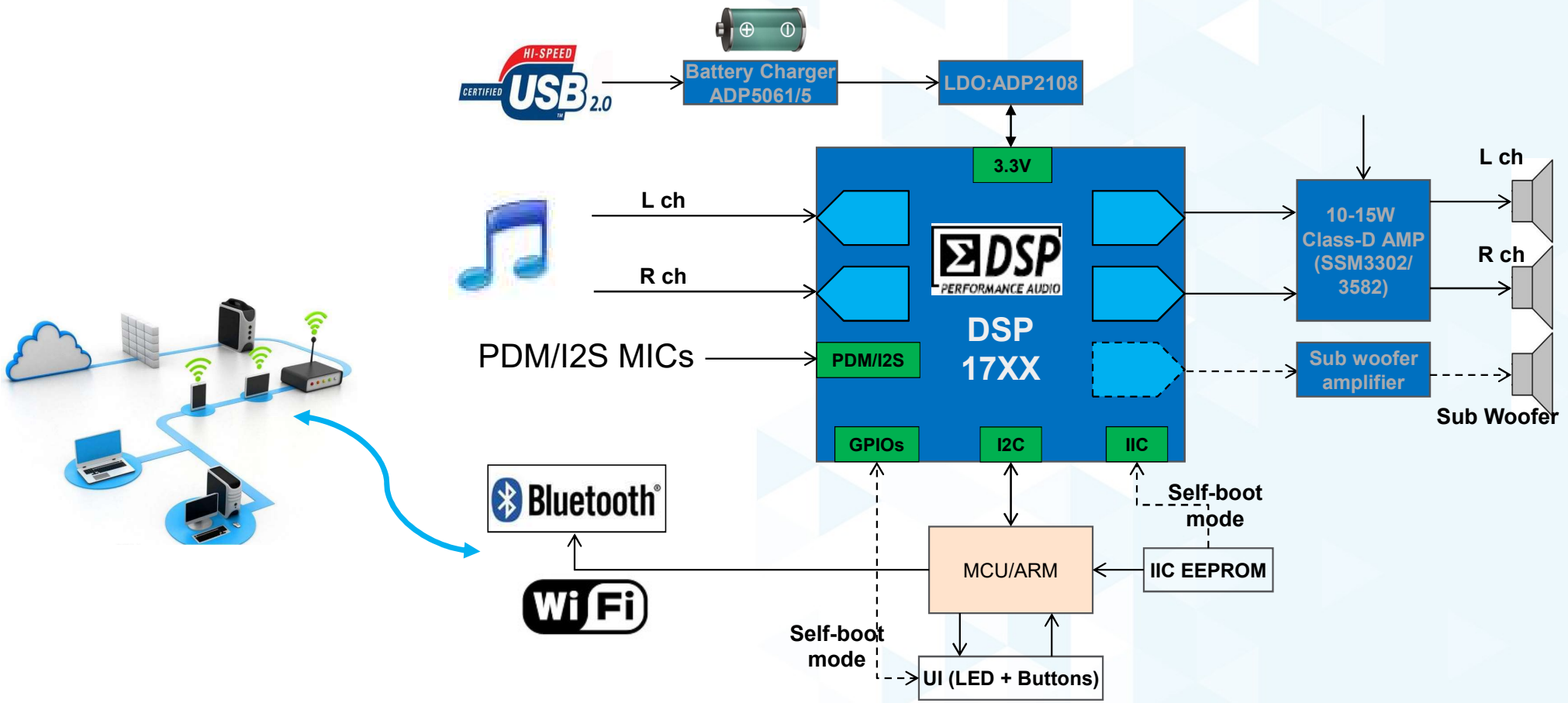
(4ch feedback compressor):



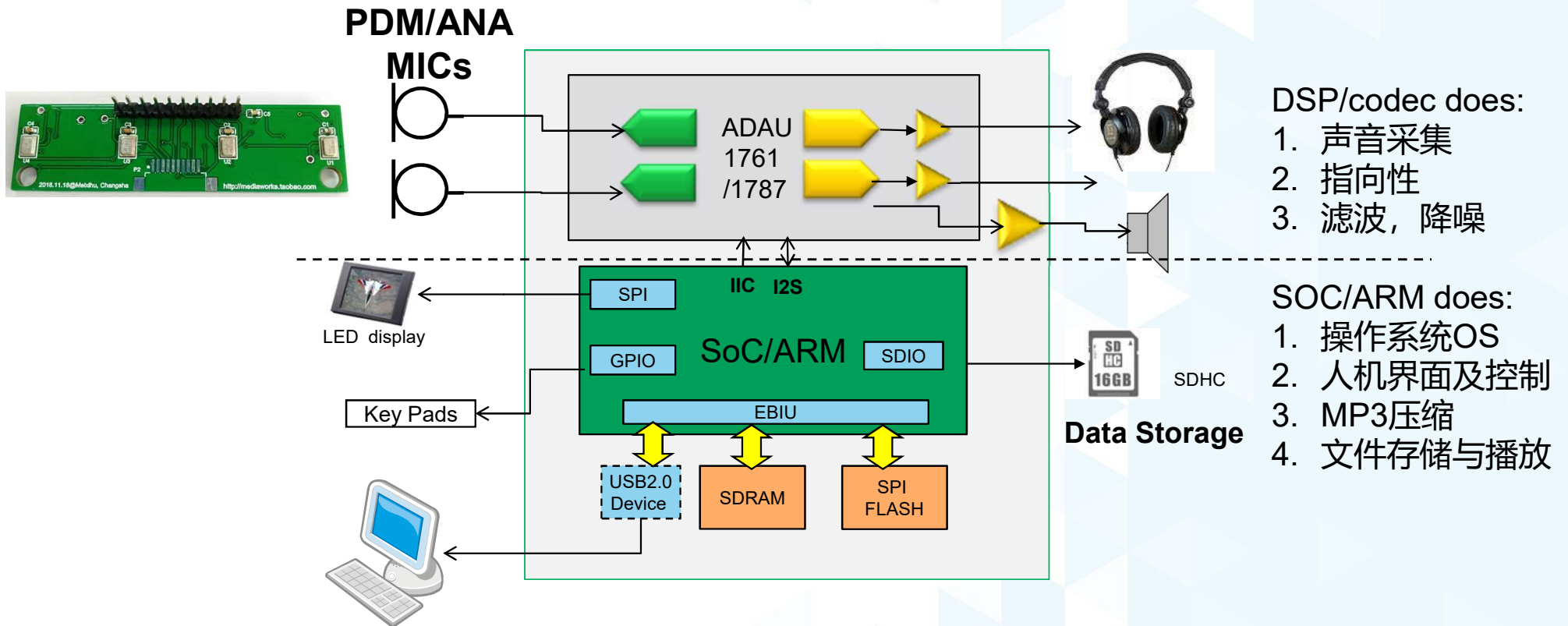
SOC方案, LOW COST
1. 移频
2. 陷波器



BT蓝牙/Wi-Fi 音箱系统 → 智能无线音箱



专业拾音器、辅助听力设备/录音设备



吉他效果器/乐器效果器



SHARC+codec

LINE 6 M13 STOMPBOX MODELER



KORG

BF592/700+codec

ADAU1761



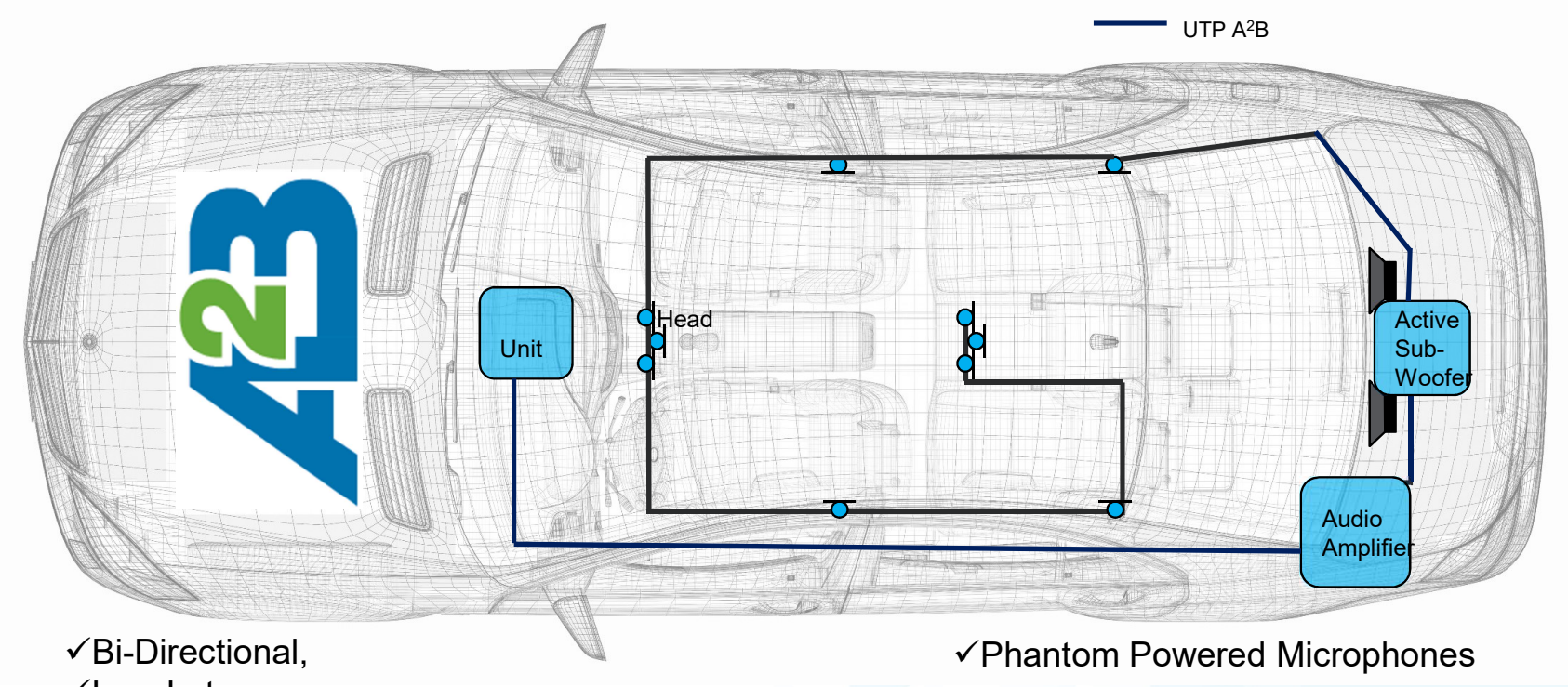


ADI汽车音频总线A2B

汽车音频总线 A²B (Automotive Audio Bus)

- ✓Cheaper Cables and less wires
- ✓Less Weight → Less CO₂

- ✓Digital Connections, more robust

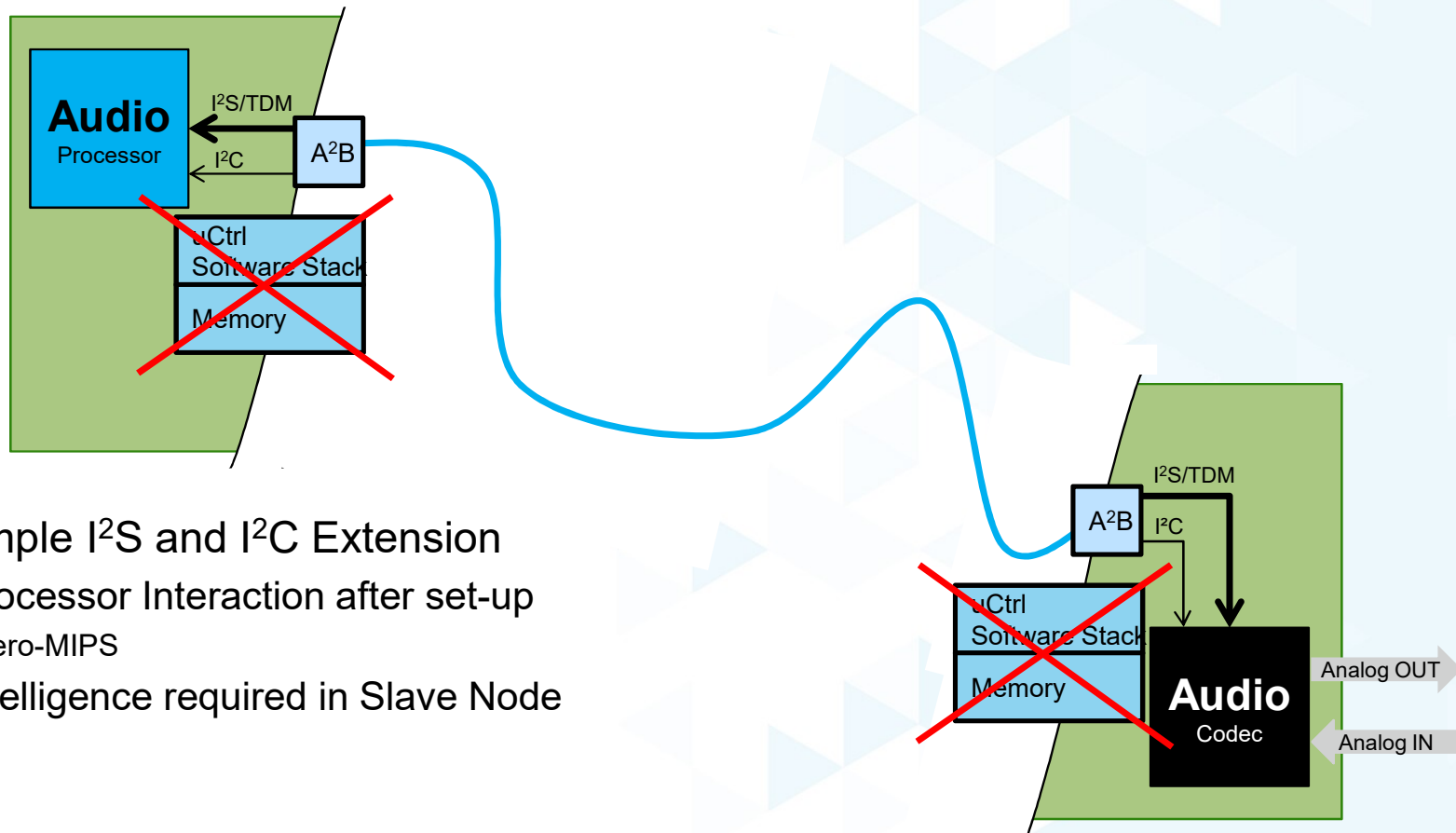


- ✓Bi-Directional,
- ✓Low-Latency
- ✓High Bandwidth

- ✓Minimum # Connections

- ✓Phantom Powered Microphones
- ✓Automotive EMC, ESD

在A2B总线上可同时传I2S/TDM/I2C/GPIO等信号



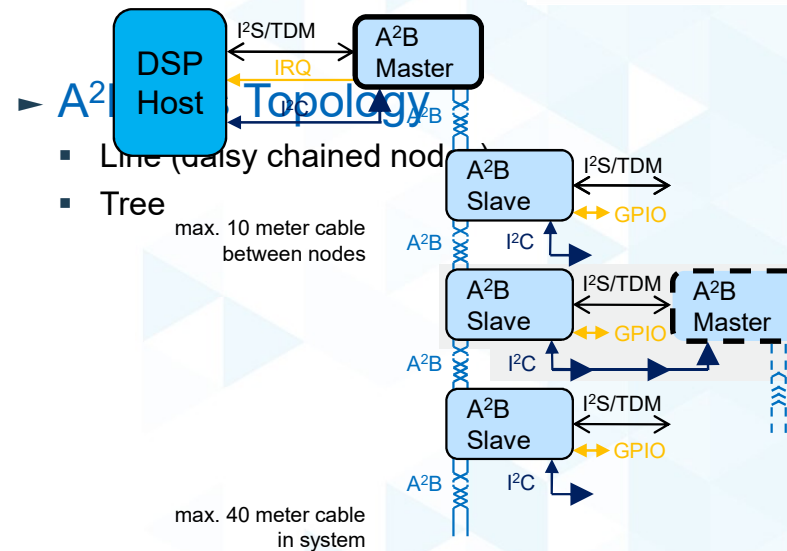
- ▶ A²B Simple I²S and I²C Extension
 - No Processor Interaction after set-up
 - Zero-MIPS
 - No Intelligence required in Slave Node

A²B总线的关键指标和选型表

- ▶ I²S to I²S over Distance
 - 48kHz - 44.1kHz (96kHz, 192kHz)
 - Unshielded Twisted-Pair Wire
 - Multi-Channel I2S (TDM)
 - Up to 32 Audio Channels upstream and downstream
 - Combinations of microphones and speakers
 - Single Master – Multiple Slaves
 - Up to 11 Nodes (10 Slaves)
 - 49.152 Mbit/s
 - Less than 50 μs Latency
- ▶ Clock on same Bus
 - Audio Clock Synchronous System
- ▶ Power-Supply on same Bus
- ▶ I²C to I²C over Distance
- ▶ Optional Branch
- ▶ Interrupt Requests, GPIO
- ▶ 30V Robust, Line Diagnostics
- ▶ ESD, EMC for Automotive

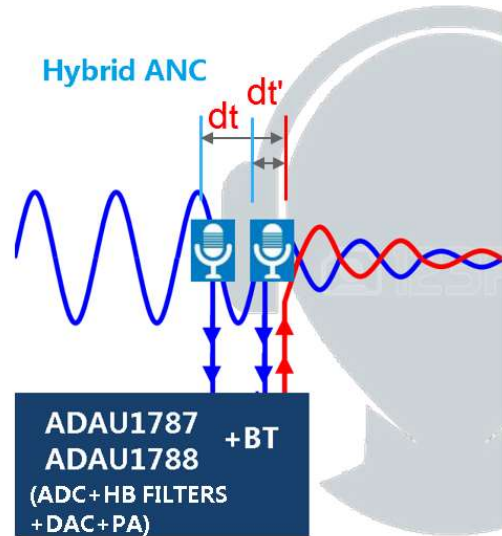
Table 1. Product Comparison Guide

Feature	AD2426W	AD2427W	AD2428W
Master capable	No	No	Yes
Functional TRX blocks	A only	A + B	A + B
I ² S/TDM support	No	No	Yes
PDM microphone inputs	4 mics	4 mics	4 mics
Max node to node cable length	15 m	15 m	15 m



48kHz / Channel, Bandwidth Examples:

slave nodes	channels/node	bits/channel	channels
2	32	12	64
6	7	16	42
2	25		50
1	51	24	51
6	5		30
2	17	34	34
1	34		34



ADI 主动降噪 (ANC) 音频编解码器

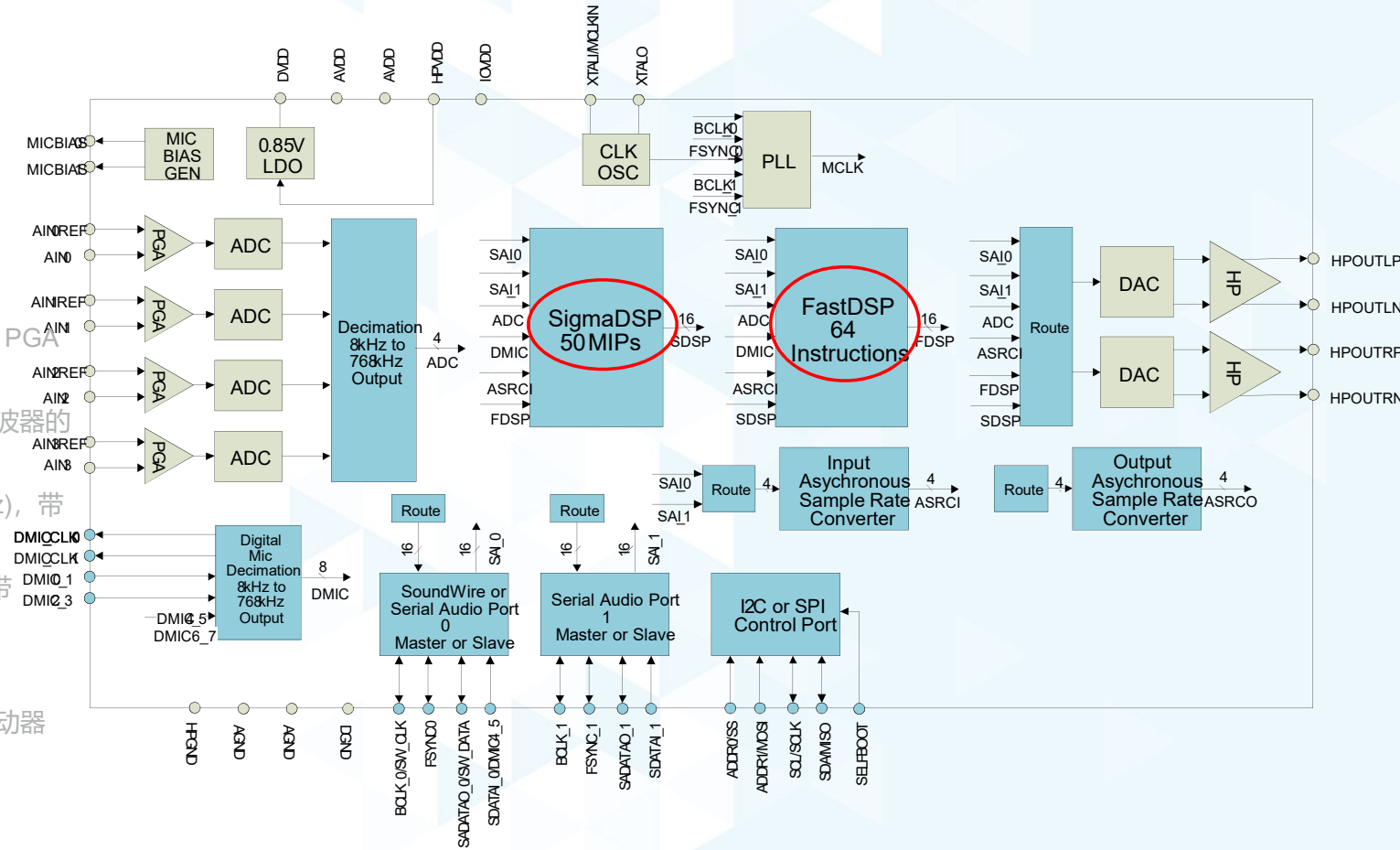
低功耗的 (主动降噪) 音频编解码器

	ADAU1361	ADAU1761	ADAU1372	ADAU1772	ADAU1777	ADAU1787	ADAU1788
Analog Input	Stereo mic Stereo input	Stereo mic Stereo input	Quad mic or line input	Quad mic or line input	Quad mic or line input	Quad mic or line input	Stereo mic or line input
Digital Mic Input	2	2	4	4	4	8	4
ADC/DAC	2/2	2/2	4/2	4/2	4/2	4/2	2/1
Sampling Rate	8kHz - 96kHz	8kHz - 96kHz	8kHz - 192kHz	8kHz - 192kHz	8kHz - 768kHz	8kHz - 768kHz	8kHz - 768kHz
Integrated Headphone Driver	Yes	Yes	Yes Class AB	Yes Class AB	Yes Class AB	Yes Class AB	Yes Class AB
PLL	Yes 8MHz-27MHz	Yes 8MHz-27MHz	Yes 8kHz-27MHz	Yes 8kHz-27MHz	Yes 8kHz-27MHz	Yes 30kHz-27MHz	Yes 30kHz-27MHz
Audio Processing	None	SigmaDSP	None	Programmable biquad filter DSP, 2 coeff banks	Programmable biquad filter DSP, 3 coeff banks, low latency ANC	SigmaDSP+ FastDSP (64 Low-Latency Biquads, 3 Banks)	SigmaDSP+ FastDSP (64 Low-Latency Biquads, 3 Banks)
Package Type	32-LFCSP	32-LFCSP	40-LFCSP	40-LFCSP	36-WLCSP	42-WLCSP	42-WLCSP

ADAU1787:[4*ADC+2*DAC+2*IIS+ASRC+3*banks]



- 2.7mm x 2.325mm 晶圆级封装
- 最低5us 端到端延迟, 提供更精确降噪的可能
- 可编程的 FastDSP 音频处理器
 - 高达 768 kHz 的采样率
 - 双二阶滤波器、限制器、音量控制、混频
- 28 位 SigmaDSP 音频处理内核, 50 MIPS
- 低延迟 24 位 ADC 和 DAC.
 - 96 dB SNR (信号通过具有 A 加权滤波器的 PGA 和 ADC)
 - 105 dB 综合 SNR (信号通过具有 A 加权滤波器的 DAC 和耳机)
- 模拟输入至模拟输出的群延时为 5 μ s ($f_s = 768$ kHz), 带 FastDSP 旁路 (零指令)
- DMIC至模拟输出的群延时为7 μ s ($f_s = 768$ kHz), 带 FastDSP 旁路 (零指令)
- 4 个单端模拟输入, 8 个数字麦克风输入
- 2 个模拟差分音频输出, 可配置为线路输出/MIC驱动器
- 低功耗 (典型立体声 ANC 设置为 11.079 mW)

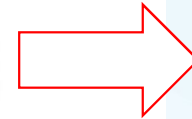
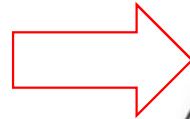


ANC耳机方案和成功案例

Many customers and IDHs (like **HTA/ASKA/Goertek** etc.) adopted ADI's low-power and low-latency ANC SoC ADAU1777/1787 for the **ANC headphone/ TWS** solutions.

They choose it 'cause:

- ▶ Very low A-A latency
- ▶ 2/3 banks for diff modes
- ▶ Low power consumption
- ▶ Small package for TWS
- ▶ High flexibility
- ▶ High production consistency



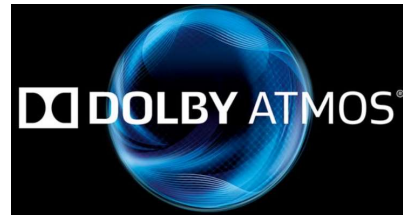
BOSE

B&W
Bowers & Wilkins

 **HUAWEI**

1MORE
万魔耳机

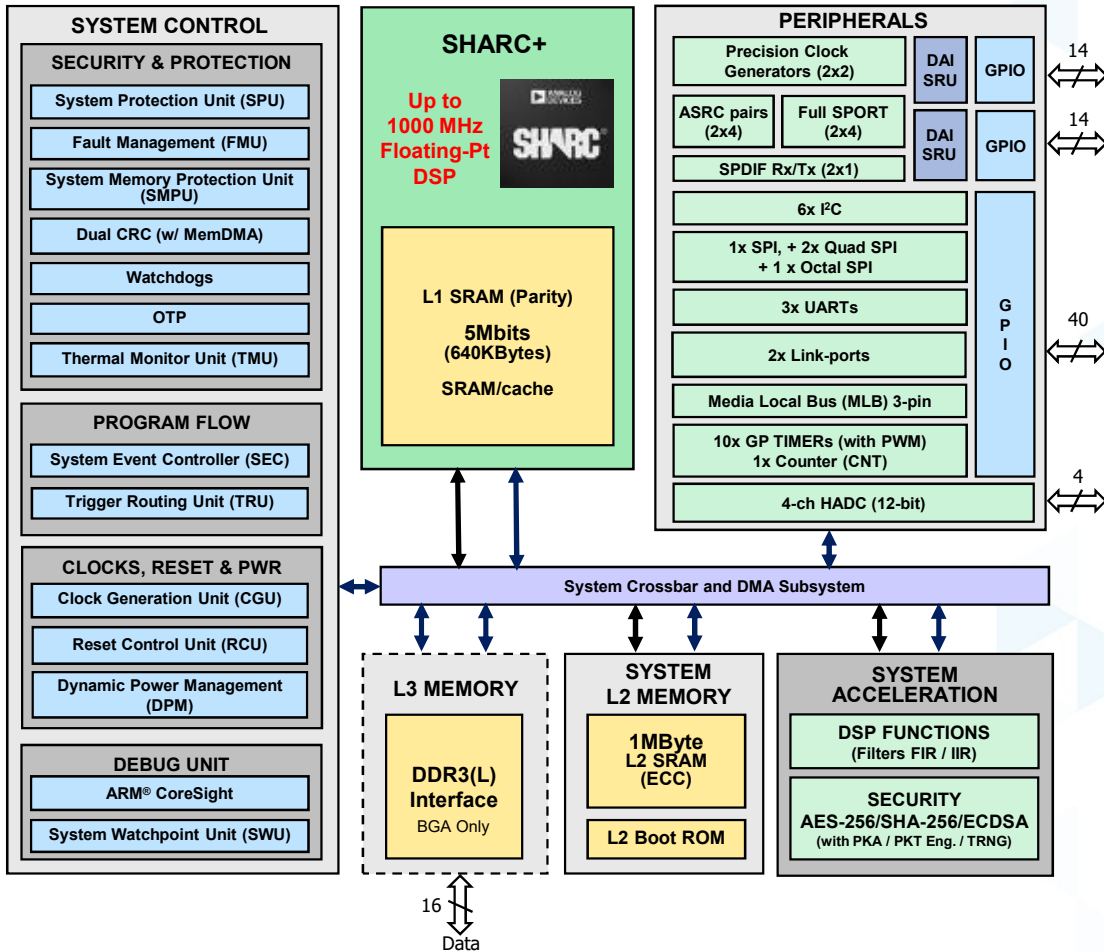
 **LIBRATONE**



ADI ATMOS 音箱应用的 GRIFFIN DSP 产品

ADSP-2156x 音频处理器(Griffin-UL DSP)

Low-cost High Performance SHARC DSP



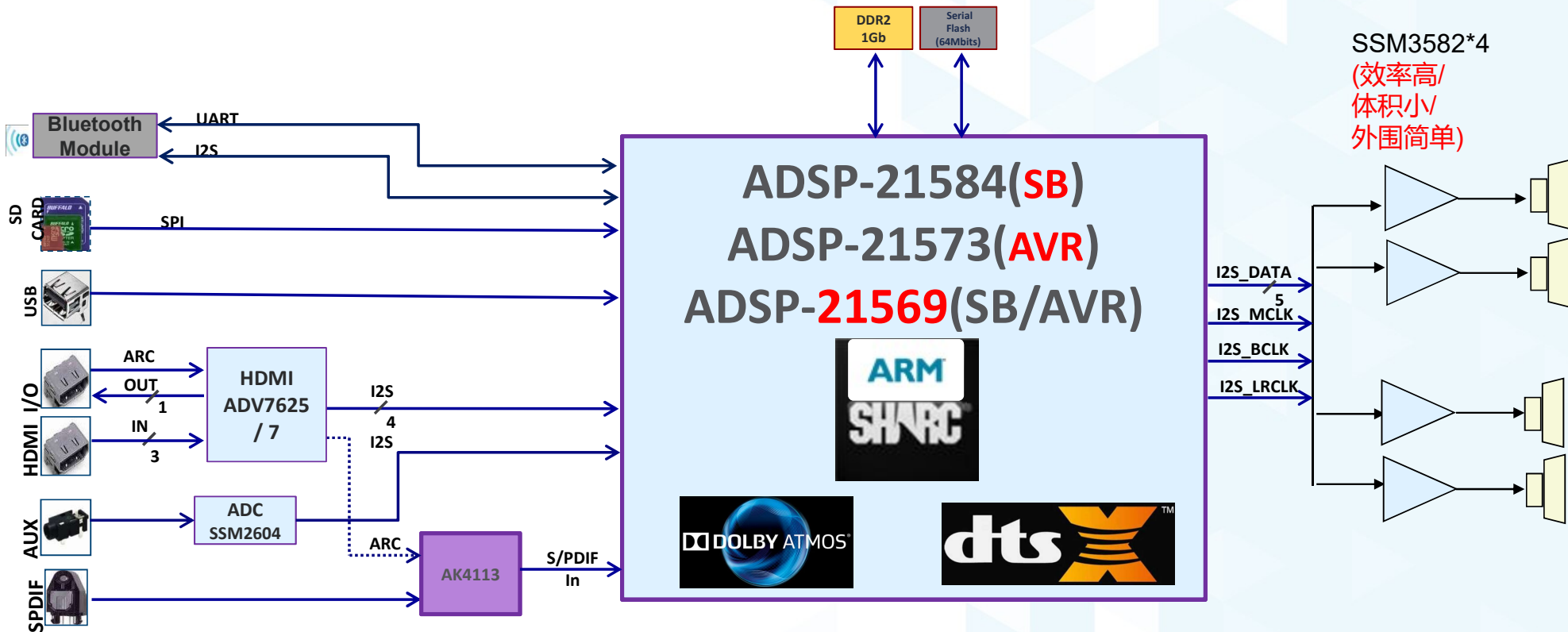
- ▶ **High Performance Single-core SHARC+ (28nm)**
 - Targeting up to 1GHz performance
- ▶ **Large Integrated On-chip Memory**
 - 640KByte L1 SRAM/cache (w/parity)
 - 1MByte L2 SRAM (w/ECC)
- ▶ **Audio connectivity as ADSP-2158x (up to 8 full-SPORTS)**
- ▶ **Higher Performance Accelerators (vs. ADSP-215xx)**
 - Upgraded FIR/IIR (CCLK operating freq., 8x FIR performance)
 - Upgraded Security Engines (up to 4x clock for faster secure boot)
- ▶ **DDR3(L) options (16-bit)**
- ▶ **3.3V or 1.8V I/O support**
- ▶ **Low cost packaging options & 125°C T_{junction} support**
 - 400-BGA for full peripherals options and high-speed DDR
 - 120-LQFP with reduced peripheral options
 - Pin-group alignment to ADSP-2148x
- ▶ **Target Release Schedule**

▪ Eng. Samples	4Q2018
▪ Final silicon	MID2019
▪ RTS	2H2019

支持3D音效技术-DOLBY ATMOS/DTS:X/MPEG-H



ATMOS和DTS-X的单芯片（单核）解决方案



国内方案商: **Tonewinner/Hualu/Tonly/Tymphany...**

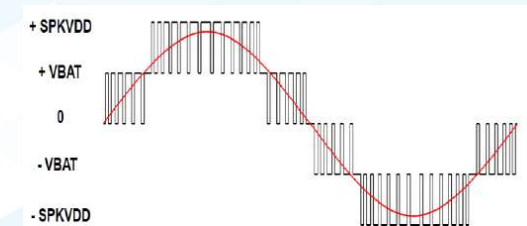
已量产客户: **SONY/LG/SAMSUNG/Damson/B&O/Hisense/...**



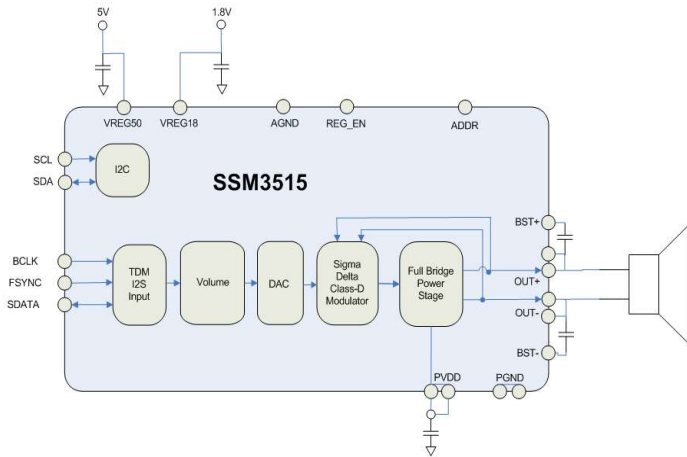
ADI D类音频功放

ADI D类功放技术简介

- ▶ Unique 3/5-Level Sigma-Delta PDM Class-D Modulation
 - Surpasses PWM technology with lowest noise and best THD/IMD performance
 - Lowest real word power consumption, lowest quiescent power, high efficiency
 - Allows inductor-less design with minimal passives
 - Inherently spread spectrum and edge rate control for low EMI
 - High loop gain throughout audio spectrum for flat THD and high PSRR
 - Higher bandwidth versus PWM allows true 192kHz fs reproduction
 - Judged by “golden ears” as having superior audio quality
- ▶ Low power boosted power (5V) stage for single cell battery applications, and medium power (4.5~17V) stage technology for multi-cell or regulated applications
- ▶ Analog and digital (TDM/I2S/PDM/SoundWire) inputs
- ▶ High performance output current and voltage sensing
 - Allows speaker manager processing using on-chip sensing ADCs, with or without ADI’s embedded DSP
- ▶ Smallest PCB Footprint
- ▶ Over 300M units shipped



单通道数字D类功放: SSM3515 (用在苹果Mac/iPad)



- Of Digital Input Mid-Power Class-D Amplifiers on the Market
 - Smallest per Channel
 - Highest SNR
 - Lowest THD
 - Lowest Power
 - Only Single Supply

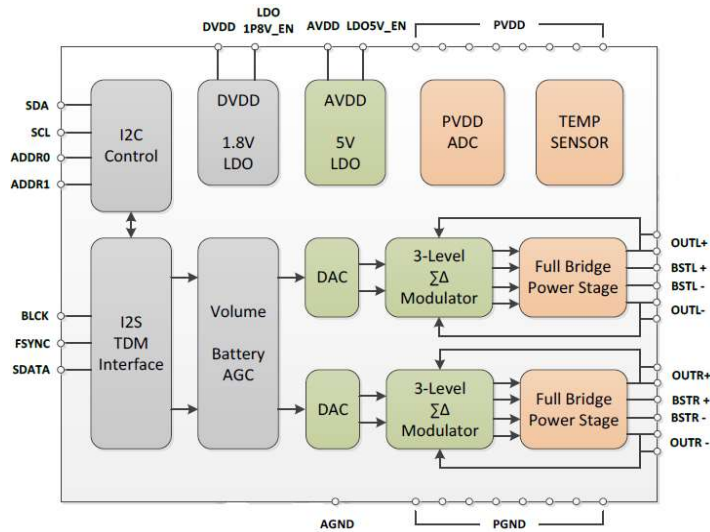
Package

20-ball, 0.4mm pitch WLCSP
(2.2x1.84mm)

-40 to +85C Operation

- ▶ **Filterless** digital input mono Class D amplifier with Σ - Δ modulation
- ▶ Operates from a single **4.5 V** to 17 V supply, such as a 2- or 3-cell battery
- ▶ 15W Output power with 12V supply and 4 Ω load at <1% THD
- ▶ 31.3W Output power with 17V supply and 4 Ω load at <1% THD
- ▶ **>93%** power efficiency (8ohm load)
- ▶ 45 μ V A-Weighted Noise
- ▶ I2C control
- ▶ TDM, I²S or left-justified slave
- ▶ Digital interface supports sample rates from 8 kHz to 192 kHz
- ▶ Flexible digital and analog gain adjustment
- ▶ Flexible supply monitoring AGC function
- ▶ 11 mA quiescent current with single 12V PVDD supply
- ▶ Short-circuit and thermal protection, thermal warning
- ▶ Pop-and-click suppression
- ▶ User-selectable ultralow EMI emissions mode

双通道数字D类功放: SSM3582 (用在HOME POD)



- Of Digital Input Mid-Power Class-D Amp on the Market
 - Smallest per Channel
 - Highest SNR
 - Lowest THD
 - Lowest Power (4.5V~16V)
 - Only Single Supply(LDO for 1.8V/5V)

Package

40-lead, 0.5mm pitch LFCSP (6x6mm)
-40 to +85C Operation

- ▶ **Filterless** digital input mono Class D amplifier with Σ - Δ modulation
- ▶ Operates from a single 5 V to 16 V supply
- ▶ 2x15W Output power with 12V supply and 4 Ω load at <1% THD
- ▶ Mono mode 1x35W Output power with 16V supply and 3 Ω load at <1% THD
- ▶ **>90%** power efficiency
- ▶ 45 μ V A-Weighted Noise
- ▶ I2C control and stand alone mode operations
- ▶ TDM, I²S or left-justified slave
- ▶ Digital interface supports sample rates from 8 kHz to 192 kHz
- ▶ Flexible digital and analog gain adjustment
- ▶ Flexible supply monitoring AGC function
- ▶ High power efficiency - 12 mA quiescent current with single 12V PVDD supply
- ▶ Short-circuit and thermal protection, thermal warning
- ▶ Pop-and-click suppression
- ▶ User-selectable ultralow EMI emissions mode
- ▶ Auto power down function

市面上D类功放的官方指标对比表 (仅供参考)

Features	ADI SSM3582	TI TAS311x	TI TAS571x
Additional Components Needed	No	DAC	no
Input	Digital(I2S/TDM)	Analog	Digital(I2S)
Loop	Closed	Closed	Open
Modulation	3L SD PDM	3L BD-PWM	2/3L PWM
Output Channels	2	2	2, 2.1
Package Area (mm ²)	36, QFN40	88, HTSSOP32	88, QFP48
Supply Range	4.5-16V	4.5V-26V	8-26V
Output Filter	2FB, 2C	2FB, 2C	2L, 12C, 8R
Low EMI Mode	Yes	No	No
Control	I2C/SA	No	I2C
SNR	-107	-102	-106
Noise	38uV	65uV	44uV
THD 1W/1KHz	0.0004%	0.02%	0.01%
THD 1W/5KHz	0.01%	0.20%	0.13%
PSRR 1KHz	88dB	72dB	Open loop
PSRR 20KHz	61dB	55dB	Open loop
Idle Power (12V eqv)	175mW	240mW	518mW

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