

Agenda

- **HDA Audio**
- **Soundwire Audio**
- **Audio Amplifier**
- **Audio DSP**
- **USB Audio**



HDA Audio

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HD Audio Roadmap (Laptop PC)



SMART Amp



2Vrms



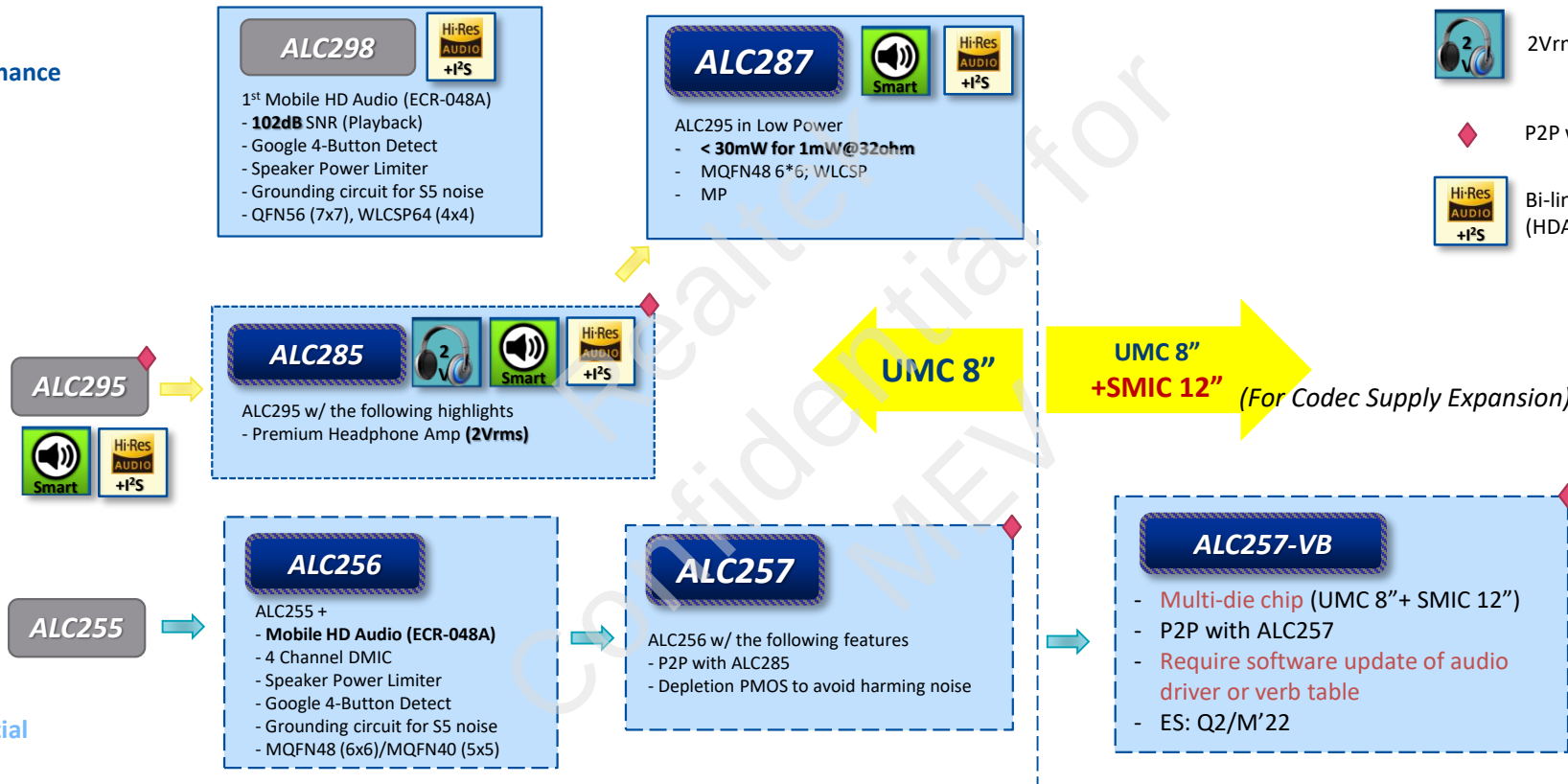
P2P w/ ALC295



Bi-lingual
(HDA + I2S)

Performance

Essential



|~2018

|2019-21

|2022-23



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SoundWire Audio

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SdW Audio Roadmap

Speaker Protection Feature

2Vrms Headphone Amp



MP

Developing

Planned

Mic Codec / DSP + Codec

ALC714-VC
ALC715-VC

- 8ch AMIC (diff. & Single)
- 8ch DMIC (DLCK*2)
- Hardware-offloaded VAD
- Ultrasound Detector
- built-in 128kB buffer memory
- QFN32 (3x6), WLCSP32 (2*4)

ALC5575

Mic + DSP + NPU

- HiFi 5 (300MIPS, FPU)
- NPU 150GOPS
- 4MB RAM
- Open platform for 3rd party algo
- I2S/PCM/TDM I/Fs
- 4xAMICs/ 8xDMICs I/Fs
- WLCSP 4x4mm
- ES: Q1'23

ALC714-VB/715-VB

Universal Jack Codec

ALC711-VD

- USB2.0 Mux
- 4ch DMIC
- 2ch VAD w/ 64KB buffer
- QFN48 (6x6); WLCSP

ALC713

Jack Codec

- USB2.0 Mux
- 4ch DMIC
- 2Vrms Headphone Amp at 600Ω load
- DAC/ADC SNR = 110dB/90dB
- QFN48 / (WLCSP)

ALC713-VB/717-VB

Audio/Haptic Smart Amplifier

(SdW & I2S Bilingual)

ALC1316

- Stereo 10W smart amp
- I/V sense w/ built-in Rs
- QFN48 (6x6)

ALC1318

- Stereo 10W smart amp
- DSPu for speaker protection
- I/V sense w/ built-in Rs
- QFN48 (6x6)
- MP: Q4'22

ALC1318-VB

ALC1017

- Mono 5W Boost smart amp
- DSPu for speaker protection
- I/V sense w/ built-in Rs
- WLCSP54

Full Function Codec

ALC712

- 2W/ch Stereo Smart Amp
- 2Vrms headphone amp
- Analog HP via type-C Jack
- Near End Ultrasound detect
- QFN56 / (WLCSP)

ALC722

ALC222/256 in SdW
Multi-lane IP
ES: Q4'22

ALC722-VB

ALC797

Multi-jack
codec

SDCA v0.6 r04

SDCA v0.6 r40

SDCA v1.0

| 2020

| 2021

ADL

| 2022

RPL

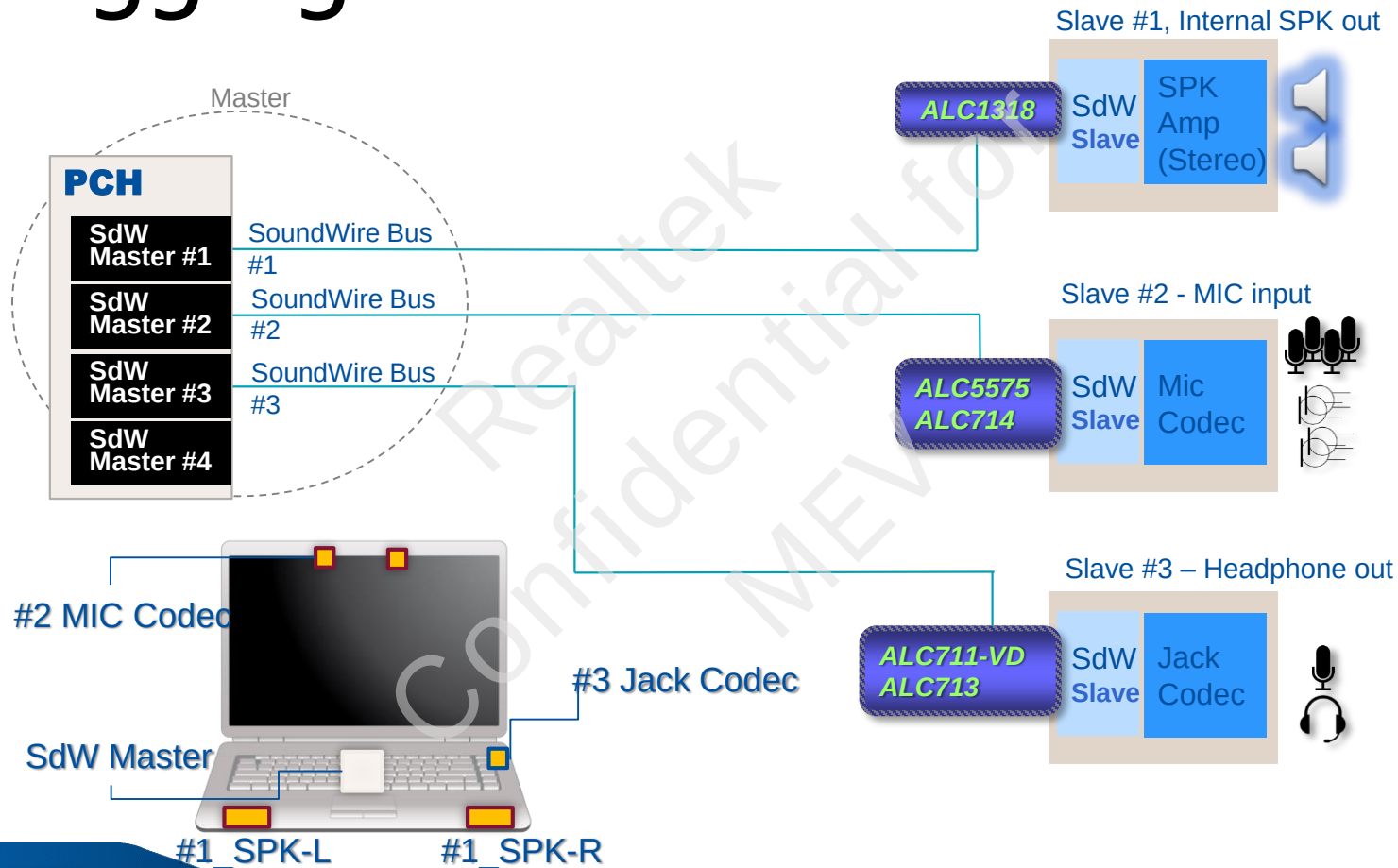
| 2023

MTL

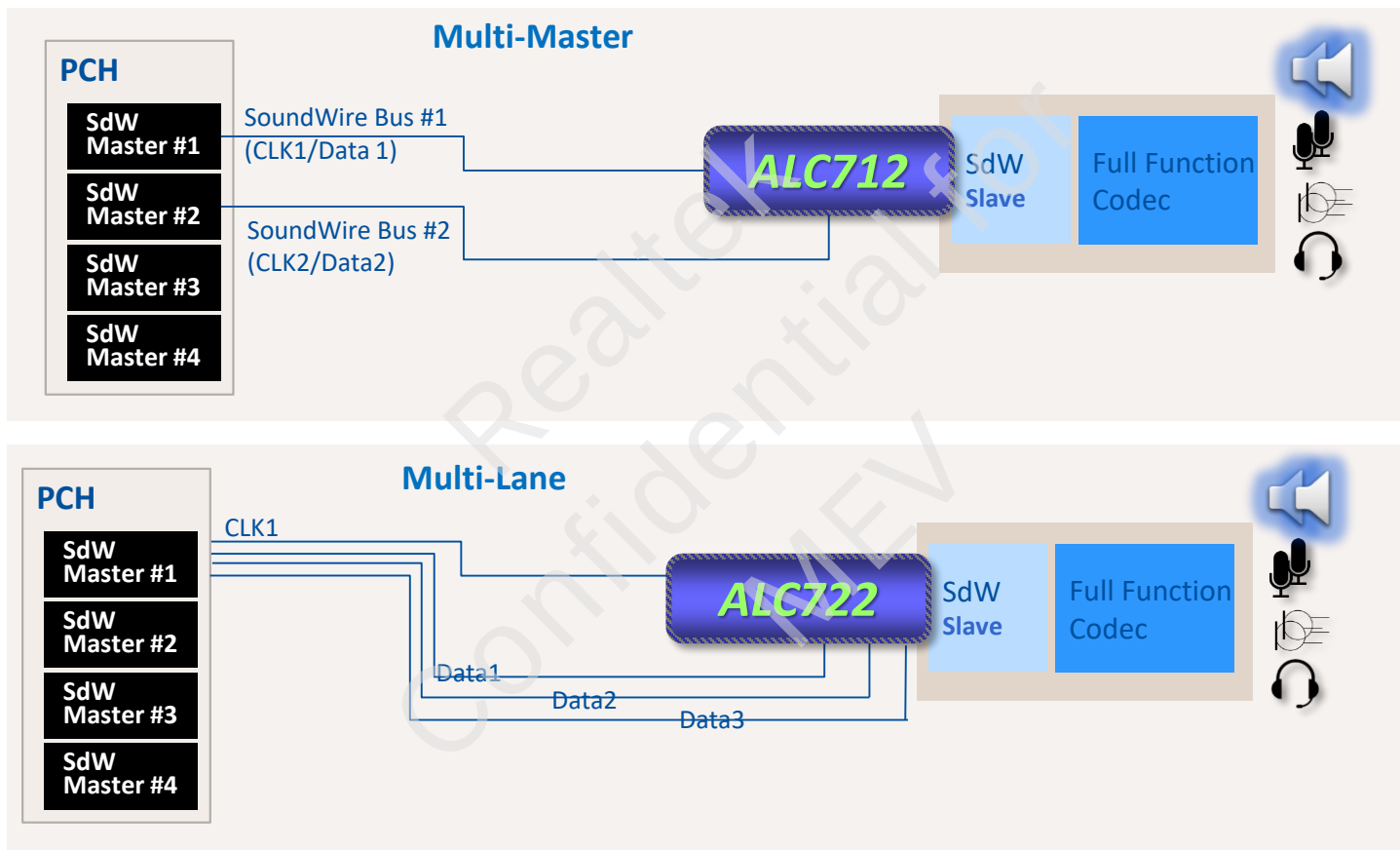
SoundWire (SdW) as HDA Successor

Audio Interface	HDA	HDA ECR048A	SoundWire
Lower Power	Audio Link Clock Option		
	24MHz	24MHz 12MHz 6MHz	12MHz 2.4/4.8/6/9.6MHz
	Simplified Power Rail		
	Codec Power 1.5V/3.3V/5V	Codec Power 1.8V/5V	Codec Power 1.8V/5V
	Link Power 1.5V ~ 3.3V	Link Power 1.5V ~ 3.3V	Link Power 1.8V
Reduced Wire (5 pins → 4 pins → 2 pins)	RST# BCLK SYNC SDO SDI	BCLK SYNC SDO SDI	SdW_CLK SdW_DATA

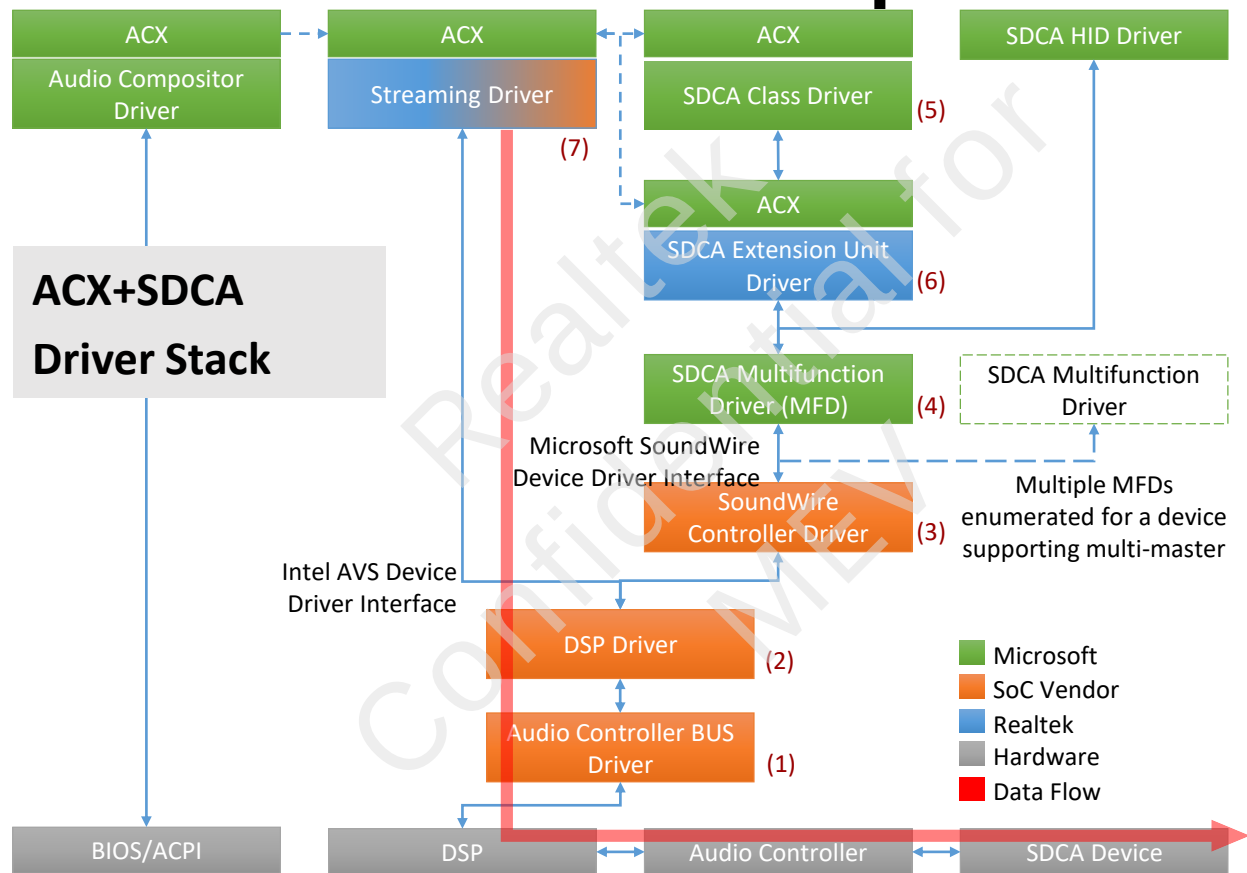
Disaggregated Audio Architecture



Monolithic Audio Architecture



ACX Driver Role & Responsibility





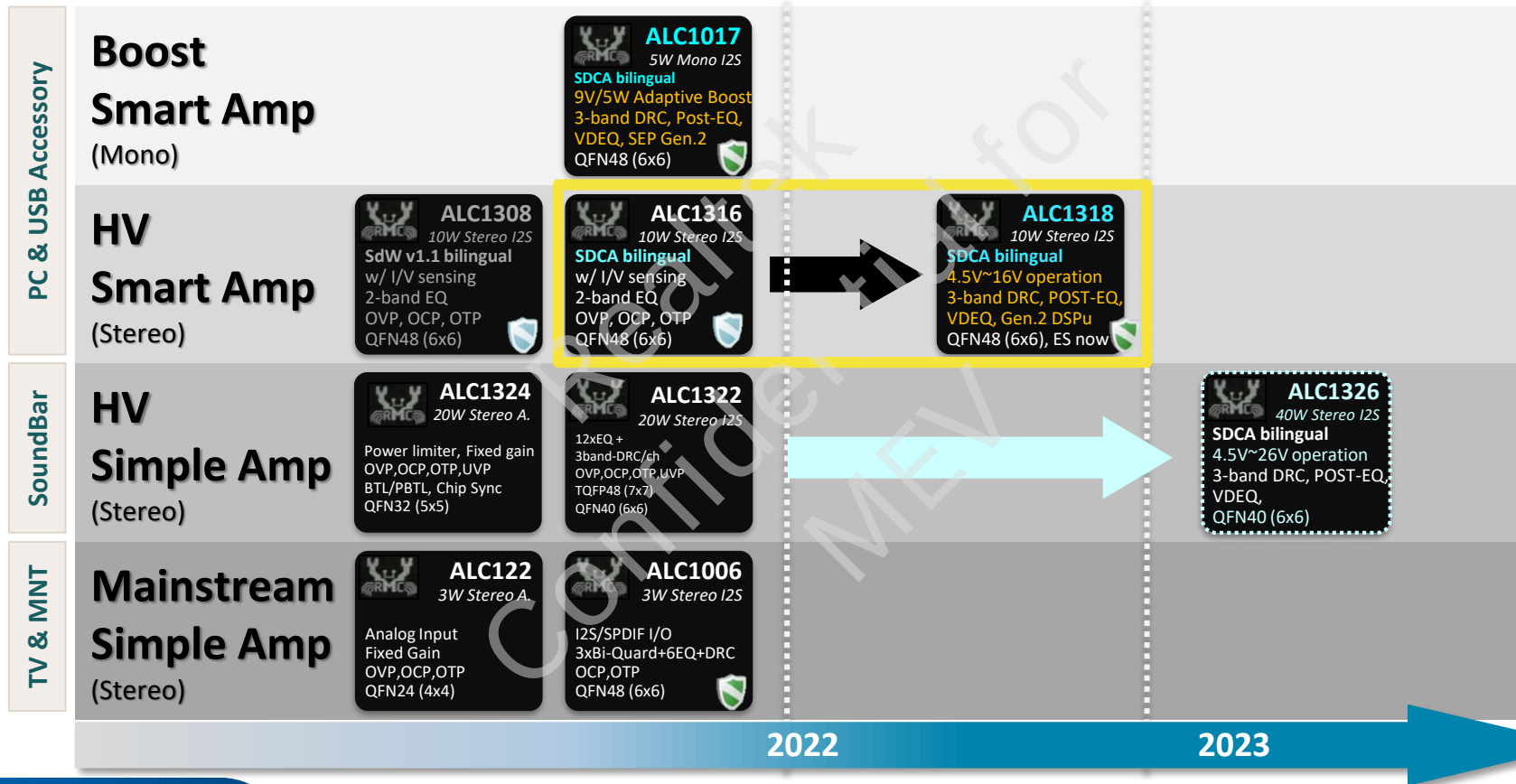
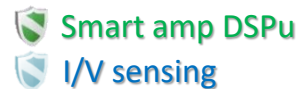
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Audio Amplifier

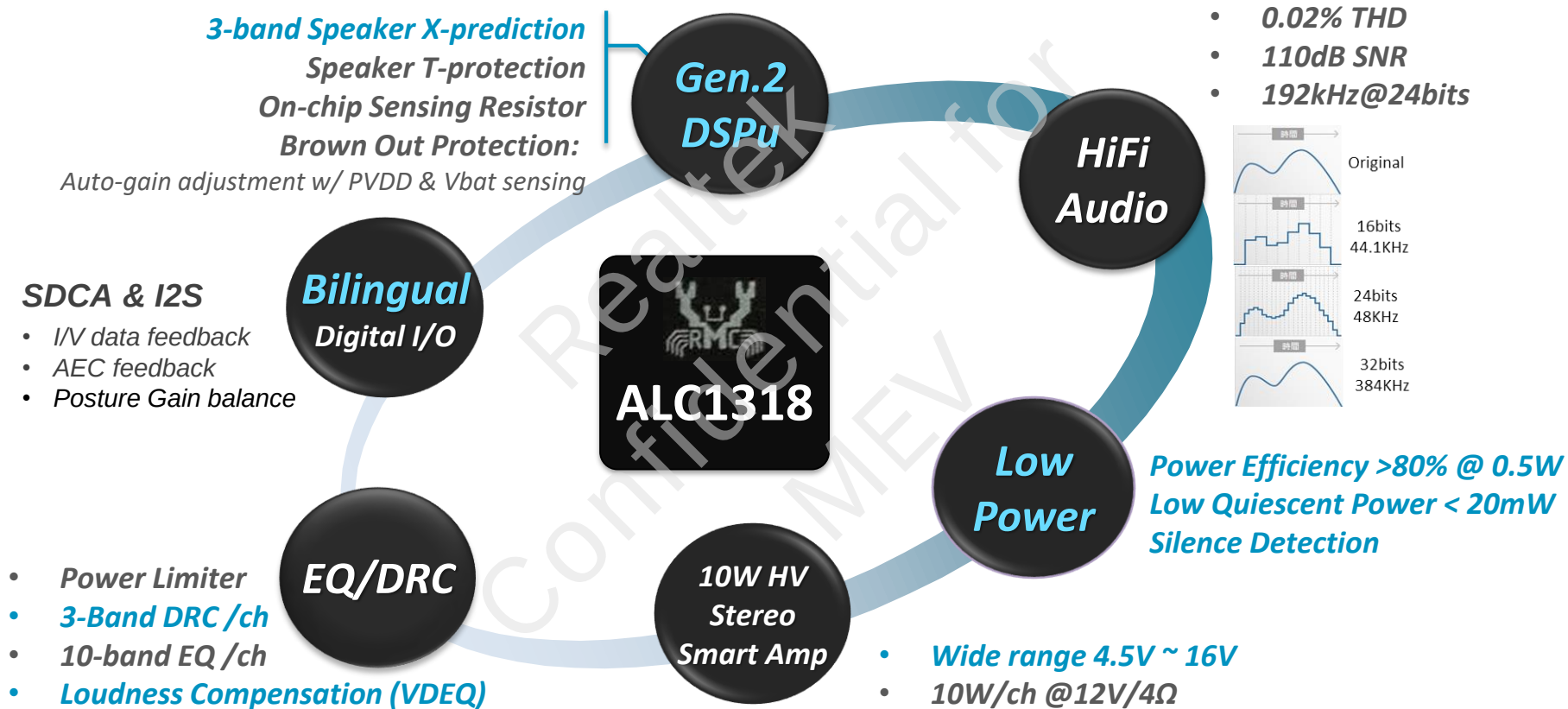
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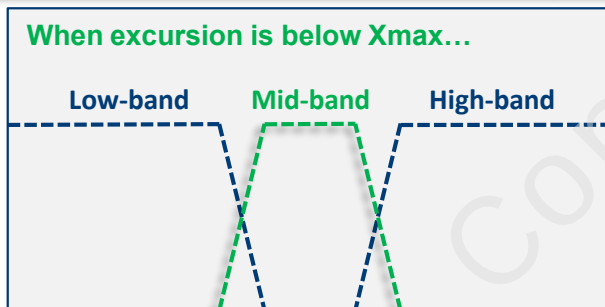
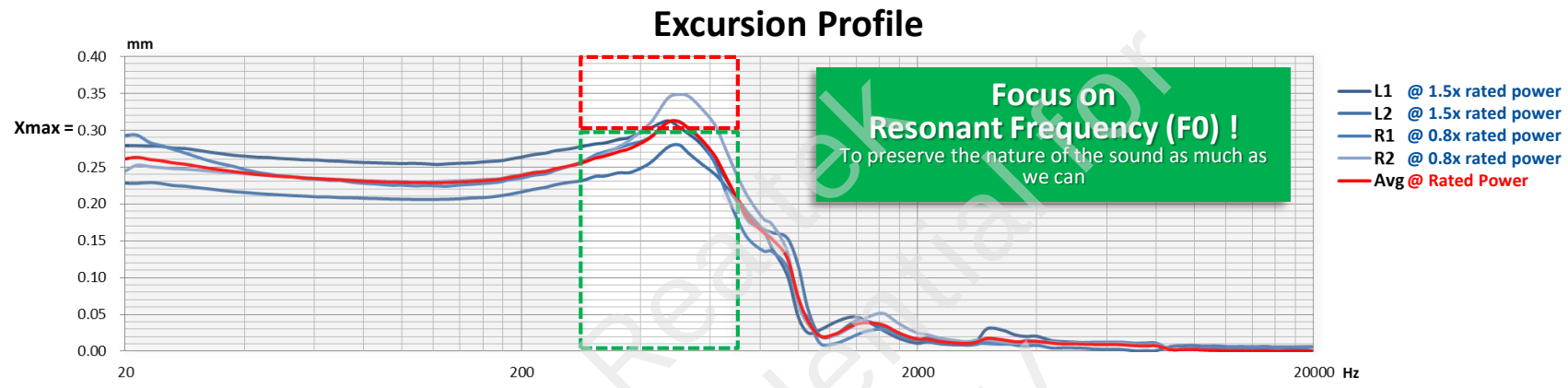
PC Amplifier Roadmap



ALC1318 – HV Smart Amp (built-in I/V sensor & Protection DSPu)



Gen.2 DSPu: 3-band X-protection



Post EQ – ALC1318/ALC1017 Unique Features: Tuner Friendly EQ/DRC design

Current audio IC's digital signal chain (EQ>DRC)



Studio Engineer's common setting (DRC>EQ)



ALC1318 Unique Design

Tuner Friendly digital Signal Chain (EQ>DRC>EQ)

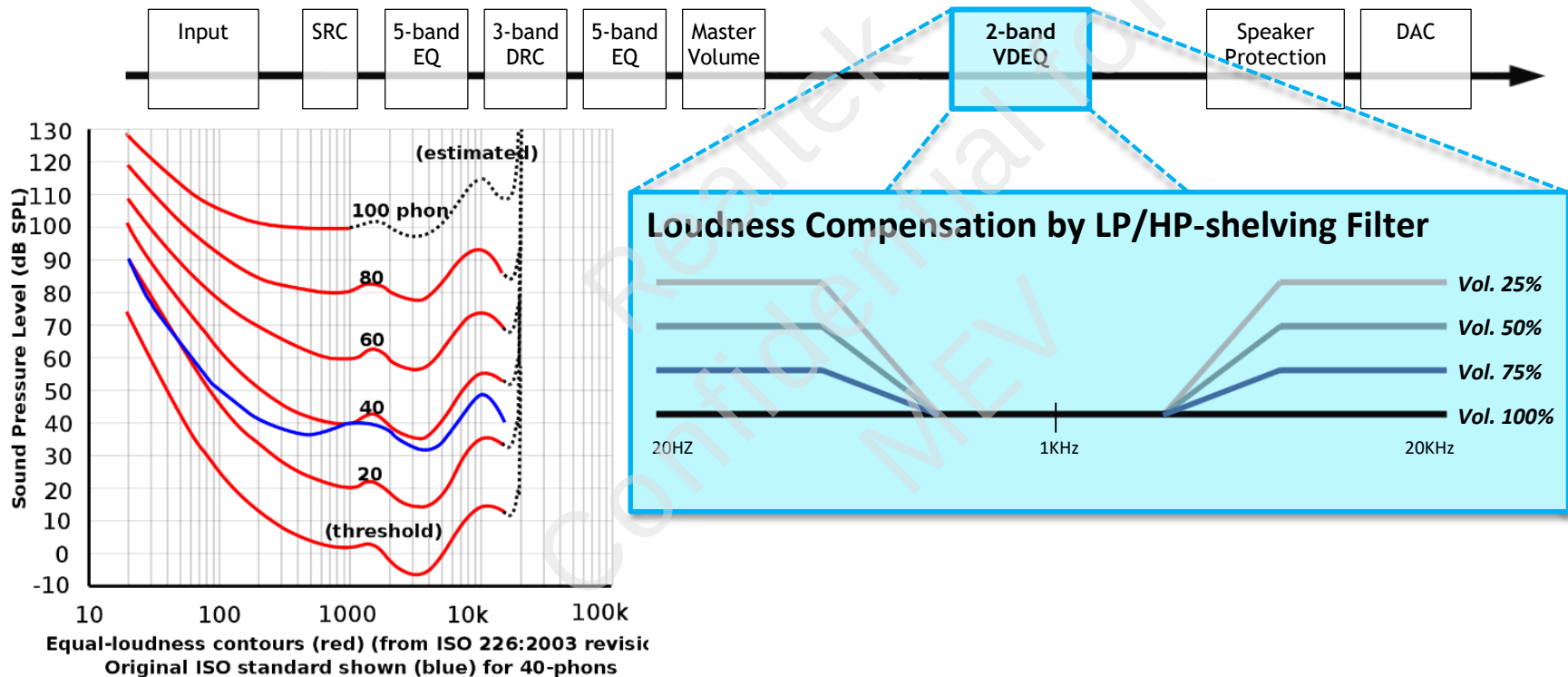


Clean unwanted signal

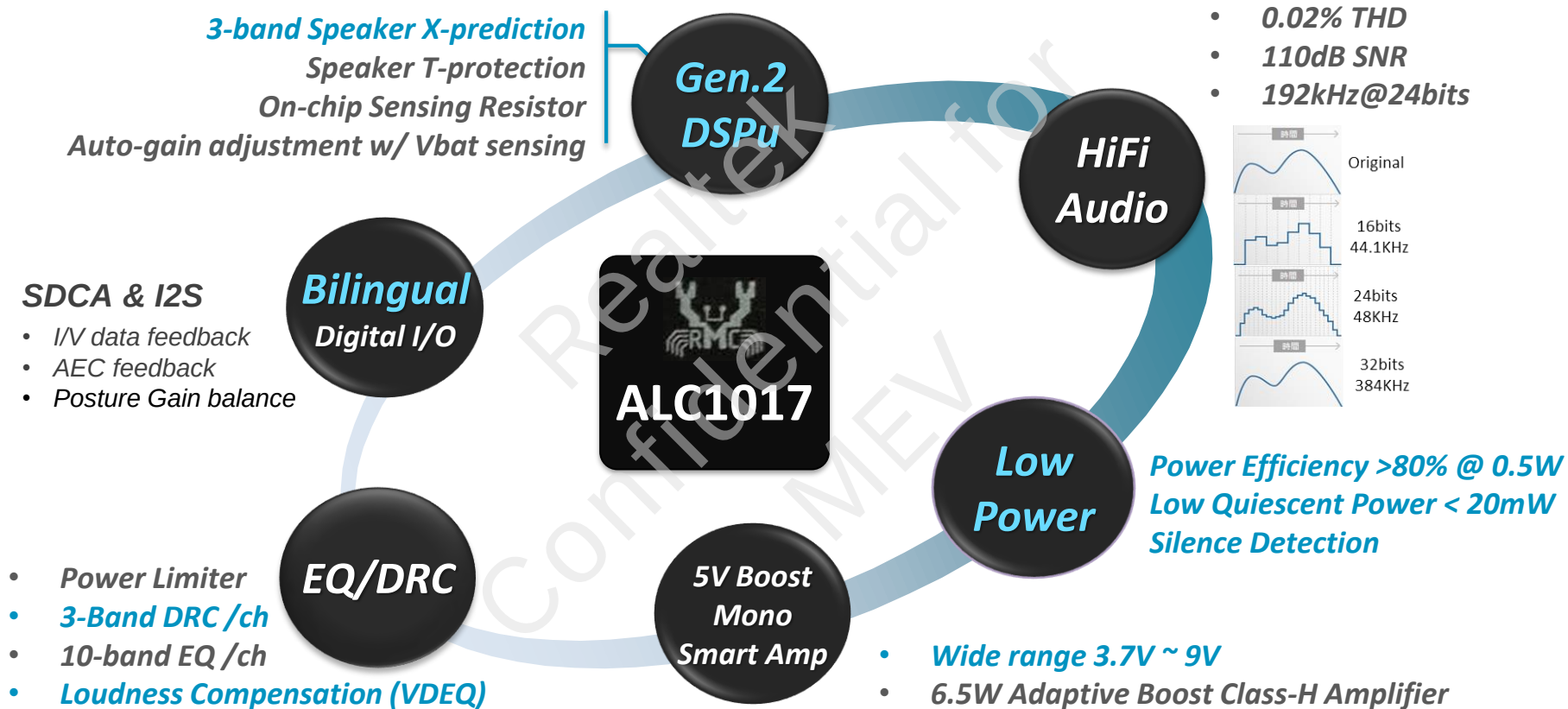
Polish signal for making more natural sound

ALC1318 – VDEQ (Equal-loudness Contour EQ)

- Enable loudness compensation without driver installation on various OS



ALC1017 – Class-H Smart Amp *(built-in I/V sensor & Protection DSPu)*





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Audio DSP

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PC DSP Product Roadmap

● Released ● Development ● Concept

~2020

2021

2022

2023



Headphone /
head-mounted device

ALC5676

- Hi-Fi EP DSP (310MIPS)
- 768KB SRAM
- 2x AMICs/2x DMICs
- LQFP-78; 7x7

ALC5679

- Hi-Fi 3 & Mini DSPs
- 568KB SRAM
- Mono Earpiece amp
- WLCSP-113; 4.4x4.4

ALC5516

- Hi-Fi Mini DSP (70Mips)
- USB codec
- 416KB SRAM
- In-house NS algorithm
- QFN-76; 9x9

ALC5526 (AI DSP)

- Hi-Fi 3z DSP (300MIPS), NNA
- 1.5MB SRAM
- Realtek ANC Engine
- In house AI audio algorithm
- Stereo HP AMP
- WLCSP-81, 3.6x3.6 (est.)
- QFN Package (est.)



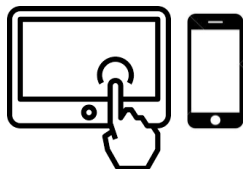
Remote Education / Smart Home
Conference Device

ALC5520

- Dual-Core Hi-Fi 3 DSP (350MIPS each)
- Fusion F1 DSP (100MIPS)
- 1.3MB SRAM
- 3x 32bits I2S/PCM/TDM I/Fs
- 6x AMICs/8x DMICs
- In-house ENC algorithm
- QFN-68; 8x8

ALC5575 (AI DSP)

- Hi-Fi-5 DSP (max. 400MIPS) + NPU (max 150 GOPS)
- 4MB SRAM
- SoundWire & I2S bi-lingual I/Fs
- 4x A-mics/ 8x D-mics
- In house AI audio algorithm
- WLCSP-81; 4.5x4.5 (est.)
- LQFP Package, 0.5mm pin pitch (est.)



Tablet / Phone

ALC5513/ 5514

- Hi-Fi Mini DSP (70MIPS)
- 416KB SRAM
- Wakeword detection
- WLCSP-27; 2.2x2.6 (ALC5513)
- QFN-32; 4x4 (ALC5514; 7x7)

ALC5518

- Hi-Fi Mini DSP (70MIPS)
- 368KB SRAM
- Wakeword detection
- QFN-24; 4x4

ALC5575 Overview

■ Performance DSP

- 400 MIPS Hi-Fi 5 DSP
- 150 GOPS In-house NPU
- 4MB Embedded RAM

■ High Quality CODEC & Multi I/O

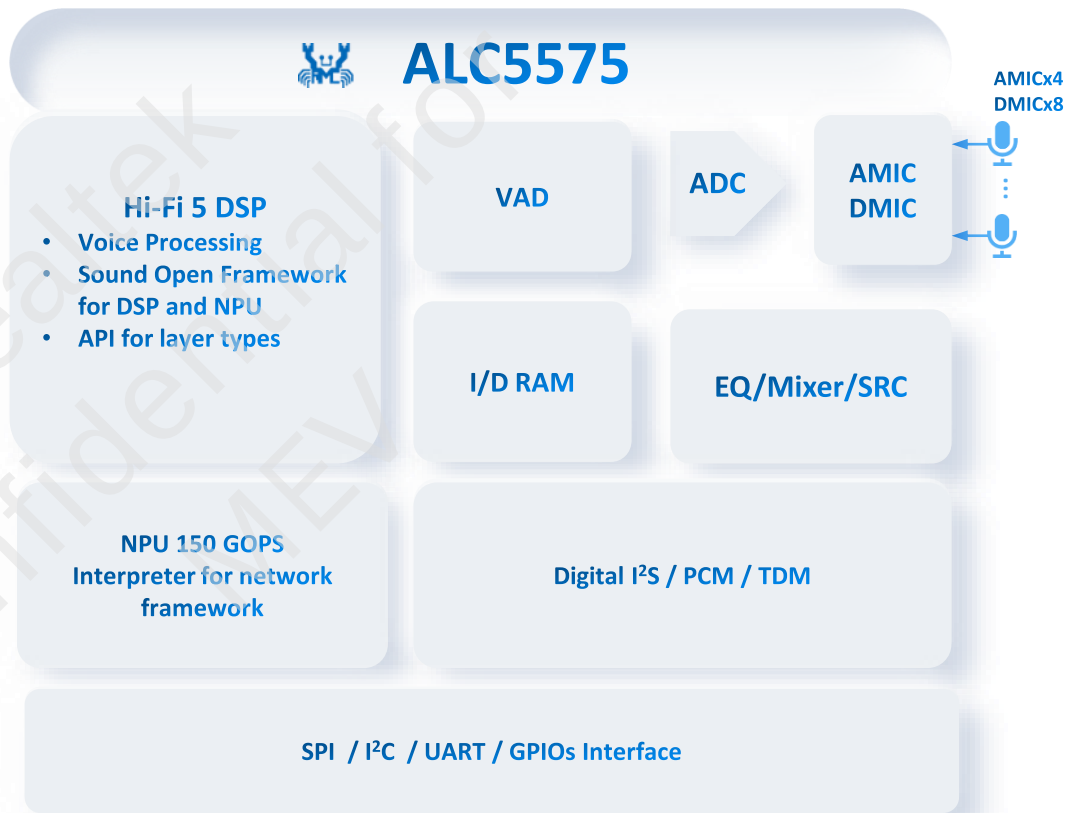
- 4x 93 dBA ADC SNR
- 4x I²S / TDM / PCM
- 2x PDM Output
- SPI/I²C/UART I/Fs

■ Features Highlight

- Realtek AI-NS Algorithm
- Parametric EQ / DRC
- Pitch based VAD & NN KWS
- Interpreter for network framework
- SHA256 and ECDSA

■ Package & Availability

- ES: available (QFN-88, 10mmx10mm, 0.4mm pin pitch)
- CS: Q2'23 (LQFP-100, 14mmx14mm, 0.5mm pin pitch)



Target Market of ALC5575

- **Commercial & Gaming Laptop:**
Audio offload to DSP for low power & Less RD effort on algorithm integration
- **Car Audio:**
Only AI-NS can cancel transient noise & Audio module as turnkey solution (planning)
- **Conferencing Device:**
Bi-directional AI noise suppression & Support long distance use cases (planning)



Market Requirement & Selling Point - NB

- **Audio offload to DSP**

Offload AI audio algorithm to ALC5575 to optimize system power consumption.

- **Less engineering effort**

Customer & RTK spends lots of effort in porting audio algorithm to CPU embedded DSP/ GNA. ALC5575 is a stand-alone DSP, audio flow would be handled by ALC5575 driver, customer can enable AI audio features much easily.

- **Consistence audio performance across platform**

No performance sacrifice or modify algorithm architecture to match CPU embedded DSP/ GNA.



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USB Audio

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USB Audio Experience



USB AUDIO PRODUCTS

- Voice Recording/Pre-processing
- Audio Communication
- Speech Capture/ Recognition
- Audio Content Playback/Post-processing



Realtek USB Audio Codec

Audio Performance



DSD Format Decode

384KHz/32-bits

2Vrms FSOV

DAC SNR 120dB

USB Compliance



USB2.0 Full/High Speed

UAC 1.0

UAC 2.0

USB ADC 3.01 Spec

USB HID Class Standard

Power Consumption



LPM/L1 Protocol

DC/DC Converter

Cap-Saving HP AMP

Suspend/Idle Mode

Firmware Update & Security



Embedded SPI Flash

DFU Mode

ECDSA

CFU Mode

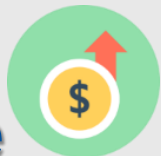
SHA256

FW Auto Recovery

USB Audio Codec Roadmap



Value



ALC4030U

- ✓ Stereo DAC / 3CH ADC
- ✓ 384KHz-32bits Sample Rate
- ✓ HW EQ for Playback/Record
- ✓ I2C/I2S Master Mode
- ✓ Embedded 64KB Flash
- ✓ Class G Headphone AMP

ALC4032

- ✓ DAC SNR 110dB
- ✓ DAC THD+N -90dB
- ✓ **DC/DC Converter**
- ✓ I2C Master Mode
- ✓ **Embedded Dual Bank Flash**
- ✓ **DFU/CFU FW Update**



Expandable

ALC4058

- ✓ **Stereo DAC SNR 120dB**
- ✓ 384KHz-32bits Sample Rate
- ✓ **SHA256/ECDSA FW Security**
- ✓ DSD / DoP Format Decode
- ✓ **2Vrms Cap-saving HP AMP**
- ✓ **Embedded Dual Bank Flash**
- ✓ I2C/I2S Master Mode

ALC4050/H

- ✓ Stereo DAC /up to 5CH ADC
- ✓ 384KHz-32bits Sample Rate
- ✓ DSD / DoP Format Decode
- ✓ **Support LPM/L1 Mode**
- ✓ **I2C/I2S Master/Slave Mode**
- ✓ RTK 2nd Gen. Hybrid ANC



Higher Tier

ALC4080/82

- ✓ **10CH DAC SNR 120dB**
- ✓ **6CH ADC SNR 110dB**
- ✓ 384KHz-32bits Sample Rate
- ✓ **SHA256/ECDSA FW Security**
- ✓ DSD / DoP Format Decode
- ✓ **2Vrms Cap-saving HP AMP**
- ✓ **DFU/CFU FW Update**

ALC5516P

- ✓ **On-chip DSP up to 70MHz**
- ✓ **RTK UniVoice Pre-Process**
- ✓ **MSFT Teams Headset Logo**
- ✓ 384KHz-32bits Sample Rate
- ✓ DSD / DoP Format Decode
- ✓ UART / DMIC / GPIOs



Coming Soon

ALC4052

- ✓ Stereo DAC / 4CH ADC
- ✓ 192KHz-32bits Sample Rate
- ✓ **12-Band HW EQ for Playback**
- ✓ **9-Band HW EQ for Recording**
- ✓ **2 Sets of I2C/I2S Interface**
- ✓ Class G Headphone AMP
- ✓ **Hearing Protection (G616)**
- ✓ **DC/DC Converter**
- ✓ **3x3 LED PWM Matrix**
- ✓ **SHA256/ECDSA FW Security**
- ✓ **Embedded Dual Bank Flash**
- ✓ **DFU/CFU FW Update**
- ✓ **I2S/I2C Master & Slave Mode**
- ✓ 4CH DMIC / S/PDIF-Out
- ✓ UART / GPIOs / PWM
- ✓ QFN48 (6x6) / QFN68 (8x8)
- ✓ **ES: Sep. '22, MP: Q4 '22**



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25

ALC4052 High Configurable Codec

NEW!



6 x 6mm 48pin MQFN (ALC4044)
8 x 8mm 68pin MQFN (ALC4052)

Applications:

- USB Audio Products
- Conferencing Systems
- Audio Content Playback/capture

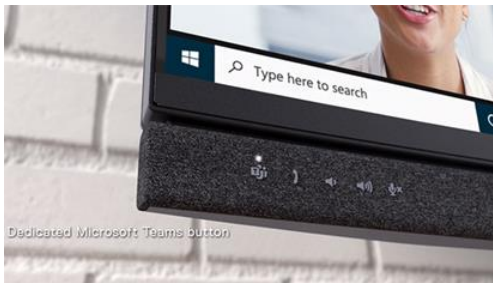
□ High Audio Quality and Performance

- DAC: 110dB SNR / -90dB THD+N, ADC: 95dB SNR
- 12-Band HW EQ for Playback (1xLPF, 1xHPF, 5xBPF, 5xBi-quad)
- 9-Band HW EQ for Recording (1xLPF, 1xHPF, 3xBPF, 4xBi-quad)
- Audio sample rate: 8, 16, 22.05, 24, 32, 44.1, 48, 88.2, 96, 192kHz
- Impedance Sensing (Android Headset Spec.)
- **Hearing Protection (EN50332, G616 Guidelines)**
- Analog and digital channels/path Mixer
- USB DFU / MSFT CFU FW Update Modes
- Auto-recovery w/ Dual-bank Flash Structure Design
- Hardware CRC32 Error-detection
- **ECDSA Digital Signature Algorithm / SHA256 Secure Hash Algorithm**
- Support LPM-L1 Protocol for configurable Low Power and Performance modes
- USB UAC 1.0/2.0 and ADC3.0 USB HID Class Specification Compliant
- Integrated DC-DC Converter for Ultra-low Power Consumption and Single Power Supply 3~5.5V
- **2 x I2S/I2C Master and Slave mode support**
- **9 x PWM LED Output Pins for 3x3 LED Matrix**
- **Three 16-bits for R/G/B LED**
- SPI/I2S/I2C/UART/SPDIF-Out
- ES: Aug. Y2022, MP: Q4 Y2022

USB Audio Solution Selection

Multi-function Dock / Soundcard / Motherboard					
Dongle / Dock / USB Audio Accessories					
Headset / Microphone / Speakerphone					
	ALC5516	ALC4032	ALC4050/H	ALC4044/52	ALC4058/80/82
USB I/F	USB2.0 Full Speed/High Speed				
Audio Class	USB Audio Class 1.0 / 2.0, Audio Device Class 3.01				
Sample Rate	384KHz, 32-bit/ DSD/ DoP	192KHz, 24-bit	384KHz, 32-bit/ DSD/ DoP	192KHz, 32-bit	384KHz, 32-bit/ DSD/ DoP
DAC	2ch DAC, 9-Band HW EQ SNR = 100dB THD+N = -80dB	2ch DAC, 7-Band HW EQ SNR = 110dB THD+N = -90dB	2ch DAC, 9-Band HW EQ SNR = 100dB THD+N = -85dB	2ch DAC, 12-Band HW EQ SNR = 110dB THD+N = -90dB	ALC4080/82: 10ch DAC ALC4058: 2ch DAC 2Vrms HP AMP, SNR = 120dB THD+N = -90dB
ADC	Mic-In / Line-In 6-Band HW EQ w/ AGC AMIC x 5ch DMIC x 4ch	Mic-In / Line-In 6-Band HW EQ w/ AGC AMIC x 2ch DMIC x 2ch	Mic-In / Line-In 6-Band HW EQ w/ AGC ALC4050/H: AMIC x 3ch / 5ch DMIC x 4ch	Mic-In / Line-In 9-Band HW EQ w/ AGC AMIC x 4ch DMIC x 4ch Mic-In / Line-In	ALC4080/82: AMIC x 6ch ALC4058: AMIC x 4ch DMIC x 4ch
Digital I/O Interface	SPI Interface UART GPIOs Jack Detection PWM Tri-color LED Driver	SPI Interface I2C Master Mode GPIOs Jack Detection w/ GHS PWM Tri-color LED Driver	SPI Interface I2C/I2S Master/Slave UART / GPIOs Jack Detection w/ GHS PWM Tri-color LED Driver	SPI Interface I2C/I2S Master/Slave Mode UART / GPIOs Jack Detection w/ GHS 3x3 PWM LED Matrix Driver	SPI Interface I2C/I2S Master GPIOs Jack Detection PWM Tri-color LED Driver
DSP/Security	RTK UniVoice Pre-Processing	N/A	RTK 2 nd Gen. Hybrid ANC	FW Update Authentication	FW Update Authentication
Memory	N/A	256KB Flash w/ Dual Bank	64KB Flash	512KB flash w/Dual Bank	ALC4058/80: 512KB flash w/Dual Bank
Package	MQFN-76 (9x9)	MQFN-48 (5x5)	ALC4050: MQFN-48 (6x6) ALC4050H: MQFN-56 (7x7)	ALC4044: MQFN-48 (6x6) ALC4052: MQFN-68 (8x8)	ALC4058/80: MQFN-48 (6x6) ALC4082: MQFN-68 (8x8)

USB Audio Product and Market Transition



■ Multimedia Equipment with Integrated Audio Features:

■ PC Monitor with Speakers / Web Cam with Microphone

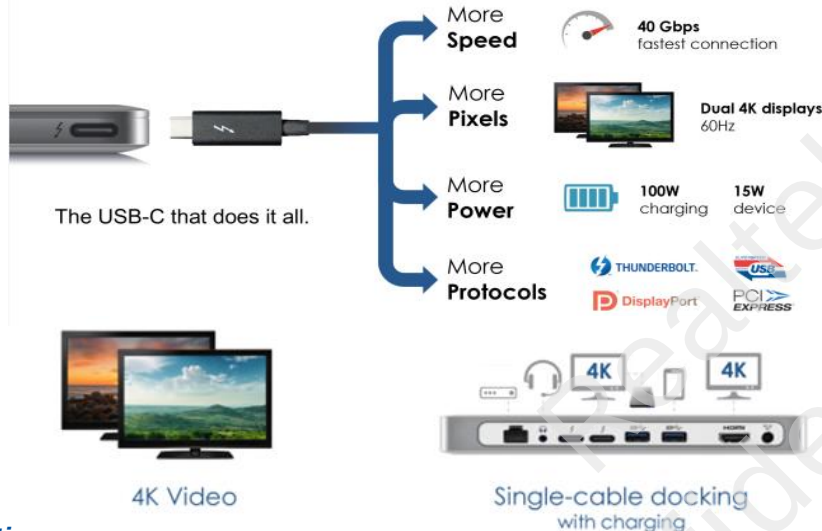
- USB interface for data return path to the PC (button controls, volume sync between monitor and PC...etc.)
- USB audio device for independent control and audio data capturing

■ Communication Equipment:

■ Conferencing Monitor / Speakerphone

- USB interface for plug 'n play audio features with abilities to extend audio functions (microphone processing integrated in DSP, smart AMP...etc.)
- UC and MS logo complaints (Teams, Zoom, Webex...etc.)
- APPs status LED indicator, volume control indicators, multiple button controls sync with PC
- Audio jack with GHS support for switching between group and individual user scenario

The New and Next Docking Station

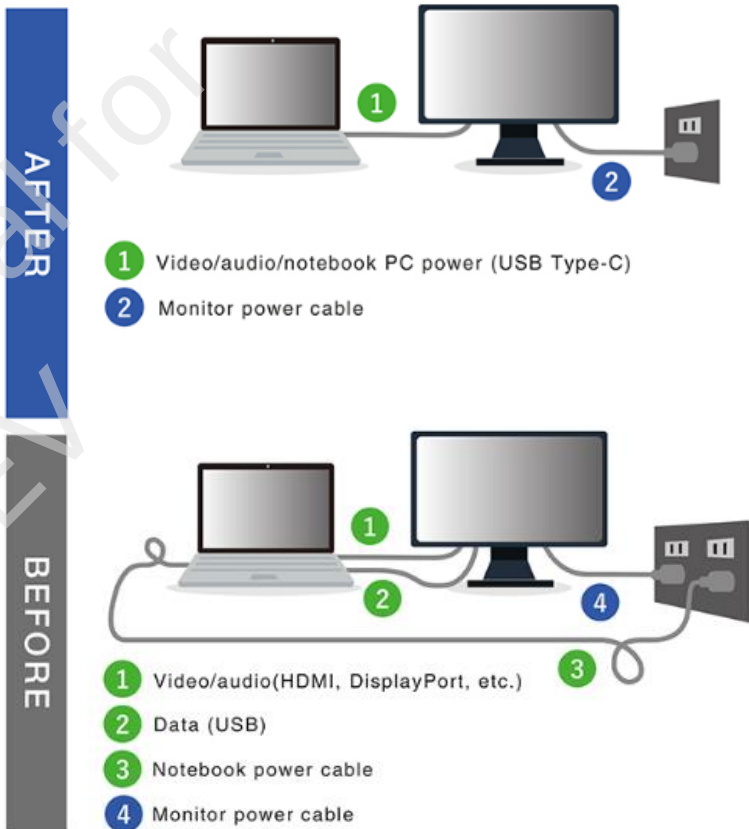


Applications:

- Adaptor (AC) or USB powered device with audio features
- Built-in speakers
- Line-out, headphone or headset audio jack

User Experience:

- Connect a laptop PC or MacBook with only A USB-C or Thunderbolt 3 cable
- USB-C monitor works as a docking station also charge external devices
- Physical button controls (Vol+/-/Mute...etc.) for quick and easy access
- OSD for speaker volume controls / adjustments synchronized between monitor and PC
- Extendable for audio related features to communicate between monitor and PC





Thank You

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