

# HARMAN

 **AudioworX**

eXhilarating  
Audio  
Development







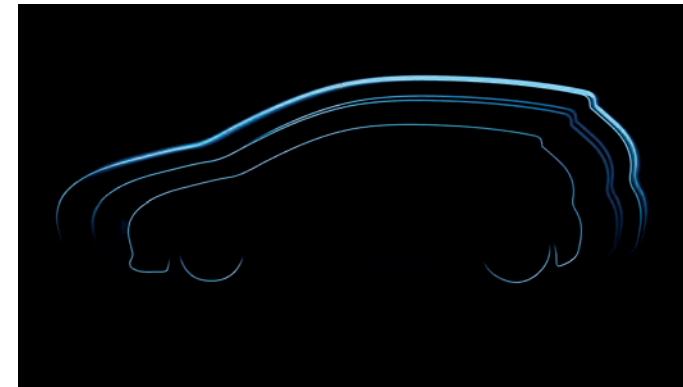
## THE CHALLENGE OF AUDIO PRODUCT DEVELOPMENT IN A COMPLEX ENVIRONMENT

With a growing number and diversity of products that require audio components, our OEM partners are working in an environment of ever shorter product life cycles, increasing cost pressure, and customers demanding ways of setting themselves apart.

OEM partners also want to be in a position to be able to offer the best possible audio and active noise management solutions for a given system architecture with the option to scale to multiple platforms.

# NOW IMAGINE...

...BEING ABLE TO...



...use audio objects and tuning strategies to offer premium sound not only in the mid-size and luxury segment but also for entry level audio systems without the need for a hardware upgrade.



...upsell an audio experience pushed out through over-the-air updates with pay-as-you-go billing.



...select audio objects, including in-house or third-party solutions, without having to worry about software development and the associated integration.

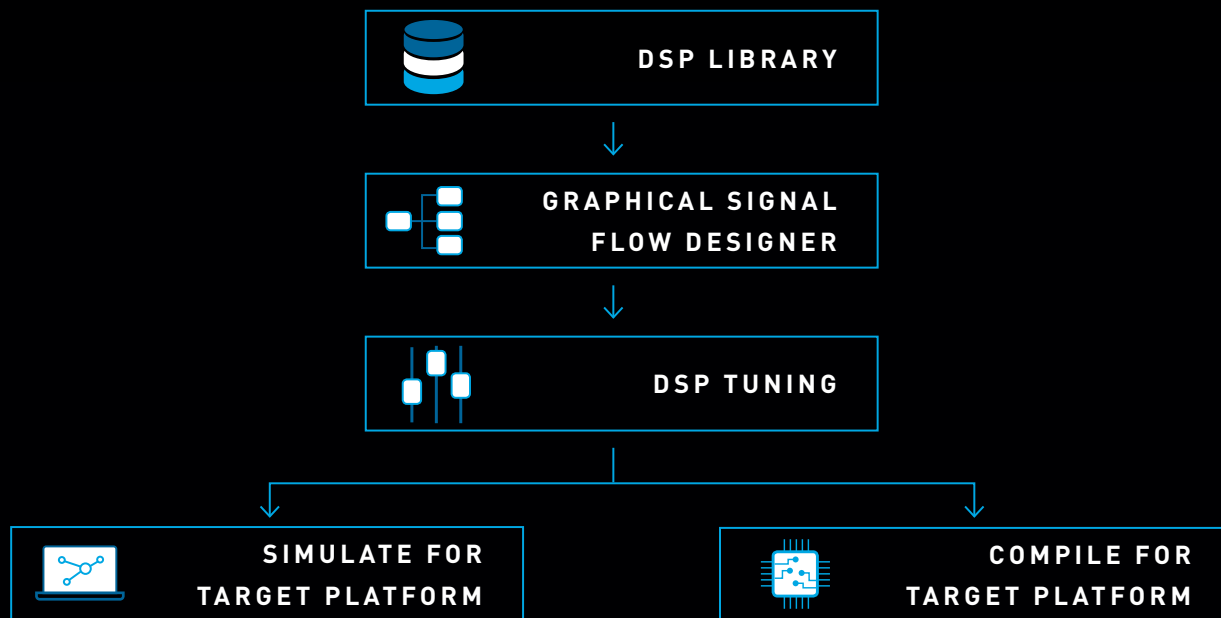


# HARMAN

**AudioworX**

HARMAN's comprehensive tool and functionality suite ensures high quality for all kinds of audio products, and allows fast market entry. The suite offers smart, seamless, and intuitive solutions that make configuring the audio algorithm database and DSP (Digital Signal Processing)

framework easy. It also simplifies the process of tuning and controlling the various algorithms. Moreover, the suite's scalable and modular platform offers an independent solution that can be used even in distributed systems.



## THE 3 KEY PILLARS OF HARMAN AUDIOWORX



### eXTENDABLE AUDIO FRAMEWORK

The standardized DSP framework speeds up the design process and allows for a quick transfer to the target platform. At the same time, it is highly flexible and efficient.



### AUDIO ALGORITHM TOOLBOX

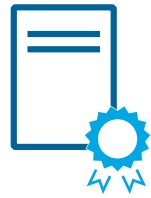
The standardized algorithm toolbox has more than 200 audio objects. It can host both in-house and third-party audio objects, which makes interoperability easier to set up.



### GLOBAL TUNING TOOL

This tool makes it possible to configure the audio algorithm database framework seamlessly and intuitively, as well as to tune the algorithm suite, from the comfort of your laptop, smartphone, and tabs.

# THE BENEFITS FOR OUR CUSTOMERS



## Licensable to external suppliers and developers

With the pay-as-you-go approach, product components, features and user management can be tailored to customer demands based on a very flexible licensing model. This enables a wide range of business models.



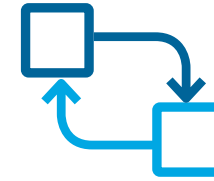
## Integration of sound management solutions

All of HARMAN's HALOsonic® Active Noise Management Solutions are fully supported, as are third-party noise management solutions such as exhaust sound generation, exhaust cancellation, and active vibration. Algorithms and generic key tuning tool functions can be adapted based on building blocks. The system approach ensures that NVH (Noise, Vibration, Harshness) and audio flow smoothly and work together to maximize performance in each domain.



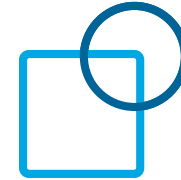
## Interoperable with HARMAN VirtualWORKS

HARMAN AudioworX is perfectly suited to HARMAN's VirtualWORKS simulation suite. Sound tuning can be done virtually based on multiphysics simulation, virtual acoustics, auralization, and the virtual amplifier solution. This makes it possible to carry out sound tuning at a very early stage of the development cycle, even before the physical car and/or amplifier exists.



## Any hardware, anywhere

With the xAF framework, AudioworX can be quickly adapted and optimized to any hardware. In the future it will be flexible enough to move away from legacy hardware like head units or amplifiers. The tool can be run on a PC, smartphone or tablet. It supports multi instances, multi cores, multi processors, and multi devices, all of which run with a single GTT instance.



## Suite of algorithm objects incl. third-party objects

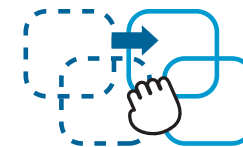
All algorithm objects use standardized interfaces and are managed by a certification process to ensure consistent quality and interoperability.

Third-party algorithms can be easily integrated. The certification process ensures that third-party algorithms comply with pre-defined, customized quality standards.



## Comprehensive solution for audio, speech and noise management

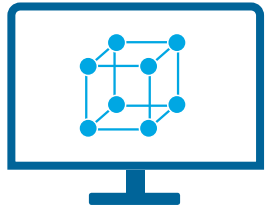
The comprehensive package covers the entire gamut of audio objects (audio, speech, and noise management solution) surrounding the DSP framework, pooled into a state-of-the-art tuning tool suite.



## A system flow that is easy to build

With the Signal Flow Designer, simple, advanced or highly sophisticated signal flows can be easily designed using drag & drop interfaces. Our partners can intuitively configure audio objects on their own.





### **Simulation environment on standardized PC architecture**

HARMAN AudioworX enables rapid prototyping with live profiling for processor MIPS/MEM. New designs are already being tested, demoed, and benchmarked at a very early stage in the project development phase. It is fully compatible with HARMAN's VirtualWORKS simulation suite.



### **An entire audio system can be simulated on a computer**

With HARMAN's VirtualWORKS simulation suite, it is possible to load a virtual room into a real time environment. The room can also be connected with a virtual amplifier as well as with inputs and outputs, in line with sound card configurations. By switching to the tuning mode in the Global Tuning Tool, the full signal flow and audio objects can be tuned in real time on a computer.



### **Your one-stop shop for developers and end users**

AudioworX provides all the elements required for an efficient and smooth development process that is focused on quality. It is designed to meet the needs of system architects, developers, and end users.



### **Access to HARMAN DSP algorithms for your cars**

The Audio Algorithm Toolbox combines the full power of all HARMAN algorithms from the Automotive, Consumer, and Professional divisions.



### **In-depth documentation & training**

AudioworX is delivered as a Reference Software Development Kit (RSDK) which provides a full set of documentation such as specs, technical descriptions, user guides, and tutorials.



# HARMAN AUDIOWORX WORKFLOW





# HARMAN

## xAF

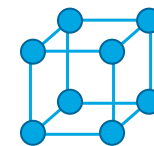
xAF is a single audio framework that can be applied across platforms and projects. It provides a single workflow and structure for the development and use of audio features.



### YOUR BENEFITS

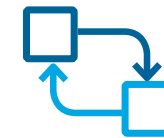
- Re-use and the possibility to focus on efforts makes engineering more efficient
- Hardware solutions can be chosen flexibly, regardless of software code availability
- Integration is fully supported, which ensures interoperability with other technologies
- Demos can be developed and put into practice quickly
- Signal flows can be simulated in real time, incl. profiling for hardware selection during design phase

## EXTENDABLE AUDIO FRAMEWORK KEY FEATURES



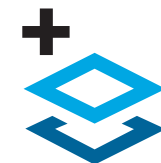
### Offers trace, debugging and instrumentation

The DSP framework offers several tools such as probe points, debug buffers, MIPS/MEM measurement and tracing to help developers debugging the product



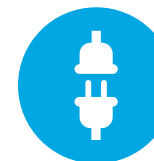
### Any hardware, anywhere

Portable across processors and platforms including multi-core SoCs (System-on-a-Chip)



### High efficiency due to hardware and operating system abstraction layers

Highly optimized CPU load and memory consumption, specific to all supported processors



### Baseline for GTT & AAT

Graphical designer with flexible audio signal flow definition (as part of GTT)  
Features like QLS, Virtual Venues, Clari-Fi™ (as part of AAT)



### Makes integrating third-party algorithms easier

HARMAN provides library management, wrappers, templates, documentation, training material and engineering services



### Enables virtual amplifier

Supports virtual amplifier approach to simulate amplifiers on PC in real time without being connected to the device

# HARMAN AAT



With multiple GRAMMY awards and countless accolades for engineering excellence, HARMAN audio experts and technologies are consistently honored for outstanding performance in the realm of audio systems.



AAT now gives you the opportunity to bring the audio technologies from HARMAN's consumer, professional, and automotive divisions into the car, and enhance the end user's audio experience.



With GTT and xAF, you now have a plug-and-play system to include these algorithms, which is suitable for a broad range of HARMAN or third-party products. Using HARMAN's Software Development Kit, items from the AAT can be installed, customized and run seamlessly on a laptop, in an amplifier, or in a soundbar.

## AUDIO ALGORITHM TOOLBOX KEY FEATURES



### Access to comprehensive HARMAN audio algorithms database

Any kind of standard audio modules like mixers, filters, limiters and patented HARMAN technologies



### Registration, certification process & version control

The certification process ensures that third-party algorithms comply with pre-defined quality standards



### Reference code & standardized interfaces

All algorithms in the AAT library have a standardized architecture and API to be fully compatible with xAF and GTT



### Real time profiling for MIPS/MEM and acoustic performance

All audio objects can be measured in real time to make sure the processor is not overloaded



### Sandbox mechanism for third-party integration

HARMAN offers wrappers to integrate any kind of third-party algorithms



### Comprehensive test setups

HARMAN uses a comprehensive test setup containing unit, integration and system tests to make sure the functionality is always the same compared to the reference



# HARMAN GTT

Today, around 25 million cars around the world are equipped with our branded audio systems. GTT brings together decades of tuning experi-

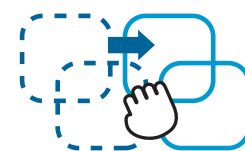
ence for a broad range of car audio systems. This best practice approach to tuning meets diverse global customer needs.



## YOUR BENEFITS

- Your needs can be met thanks to the flexible framework that offers unlimited customization options
- GTT support both real and virtual tuning environments
- Easy-to-use HMI (Human Machine Interface) and data handling make tuning more efficient
- The tuning of both audio technologies and active noise management technologies is covered with a single tool

## GLOBAL TUNING TOOL KEY FEATURES



### Audio algorithm & signal flow designer

Drag & drop creation of signal flows with automated tuning panel creation and access to all audio algorithms



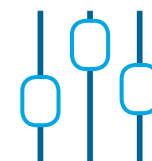
### Database

Intelligent management of all audio objects and supported target devices



### Device handling & communication

A server handles the communication between device and tool



### Tuning module

Enables easy and intuitive adjustment of all tuning parameters



### Measurement module

Runs as a service that can be accessed on the same PC or via network



### Prediction & simulation

Predicts acoustic responses based on a combination of measured or simulated data with assistance from the virtual amplifier



### Design user experience & user interface

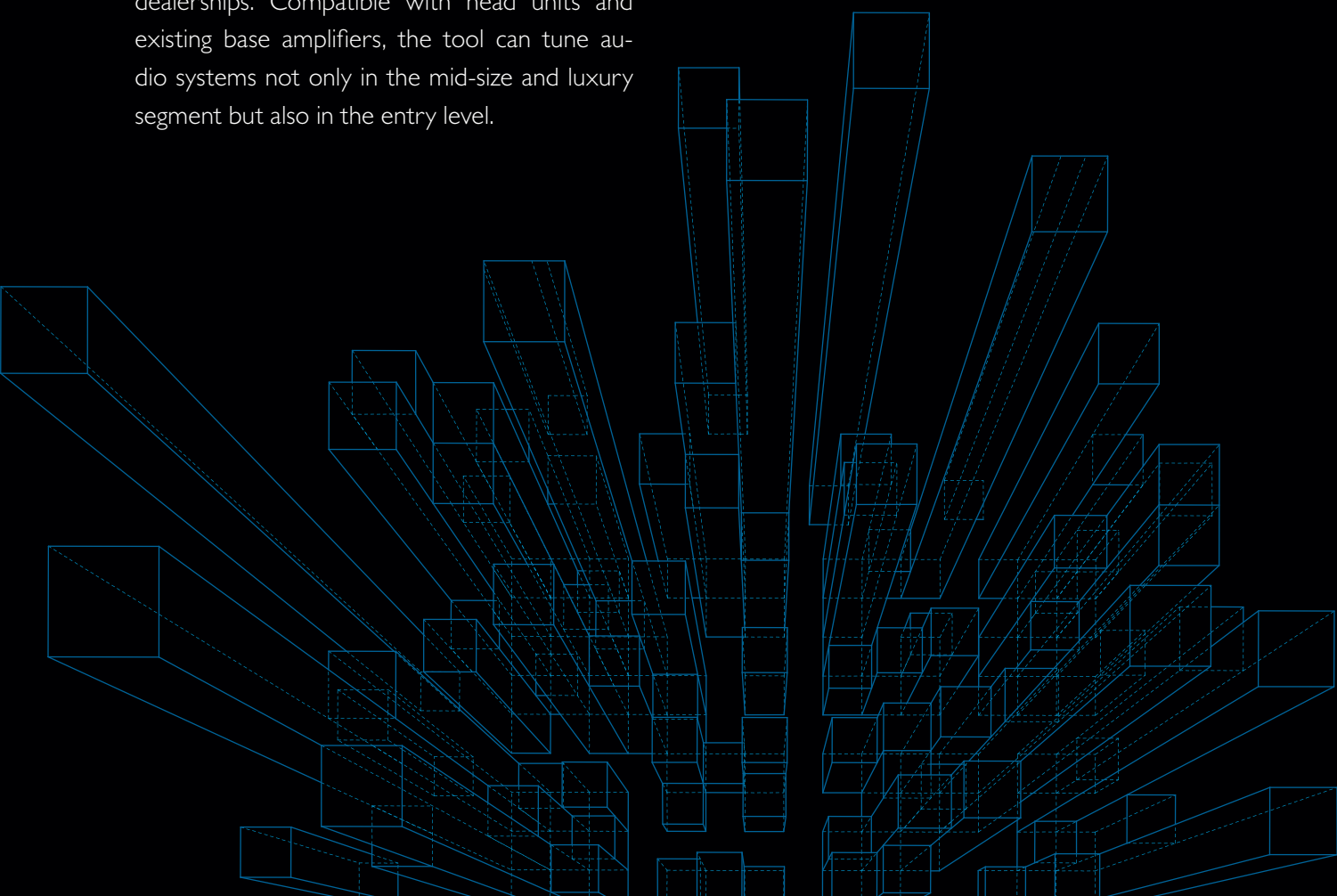
Supports an easy, intuitive and efficient control of all tuning parameters by touch interface on a PC, smartphone or tablet



## SCALABLE AUDIO SOLUTIONS

While 70 percent of consumers say they want premium sound, it is currently available to just 20 percent of the market. HARMAN's response to this challenge is the software-based AudioworX Tuning Tool that can either be installed at the factory or retrofitted at the dealerships. Compatible with head units and existing base amplifiers, the tool can tune audio systems not only in the mid-size and luxury segment but also in the entry level.

AudioworX thus offers a cost-effective means of enhancing acoustic performance and increasing consumer satisfaction. At the same time, it can increase revenue in the small-vehicle segment and emerging markets. The tool is compatible both with HARMAN and third-party hardware.



## GLOSSARY

<b>AAT</b>	Audio Algorithm Toolbox
<b>API</b>	Application Programming Interface
<b>AudioLEVELIZER</b>	AudioLEVELIZER adjusts and balances the loudness of incoming audio signals in real time and does not change the spectrum or dynamics of the music.
<b>Clari-Fi™</b>	Clari-Fi™ helps to cure the quality loss of highly compressed audio files. It analyzes the audio signal in real time and restores most of what was lost in the compression process.
<b>CPU</b>	Central Processing Unit
<b>DSP</b>	Digital Signal Processor
<b>GTT</b>	Global Tuning Tool
<b>GUI</b>	Graphical User Interface
<b>HALOsonic®</b>	HALOsonic® is a suite of technologies that enhances your driving experience by actively managing noise as well as sound inside and outside your vehicle.
<b>HMI</b>	Human Machine Interface
<b>Individual Sound Zones (ISZ)</b>	Individual Sound Zones (ISZ) is an integrated audio entertainment solution that gives every passenger the freedom to choose his or her own audio entertainment while maintaining a harmonious in-cabin experience.
<b>MEM</b>	Memory
<b>MIPS</b>	Million Instructions per Second
<b>NVH</b>	Noise, Vibration, Harshness
<b>OEM</b>	Original Equipment Manufacturer
<b>QuantumLogic® Surround (QLS)</b>	QuantumLogic® Surround creates an astounding 7.1-channel surround sound experience by introducing audio algorithms to extract signal streams and impulse responses from any source.
<b>RFI</b>	Request for Information
<b>RFQ</b>	Request for Quotation
<b>SoC</b>	System-on-a-Chip
<b>Virtual Venues</b>	Virtual Venues changes the acoustic characteristics of your car depending on the chosen location, thereby taking you on a musical tour of the world.
<b>VirtualWORKS</b>	HARMAN VirtualWORKS is based on extraordinary simulation capabilities, both reducing the need for physical samples to an absolute minimum and offering the right solution for every step of the development process.
<b>xAF</b>	Extendable Audio Framework





[www.HARMAN.com/lifestyle-audio](http://www.HARMAN.com/lifestyle-audio)

[WWW.HARMAN.COM](http://WWW.HARMAN.COM)

**HARMAN**

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