

## **E9X Audio Background**

### **Introduction**

This document is intended to explain the different audio systems in BMW E90 sedans, E91 wagons, E92 coupes, and E93 convertibles. These audio systems are major departures from the systems in E36 and E46 3-series vehicles, and the potential for performance is much greater, if one is aware of the system specifics.

This document is not intended to advocate any one upgrade path versus another – it is descriptive, not prescriptive. It does not address iDrive features.

#### *Notes:*

- *This early version 1.1 is very US-centric and is only thru MY2011.*
- *This early version 1.1 does not attempt to cover M3 systems in depth. A future draft will address these in more detail.*
- *Please pm suggestions to vp electricity on E90post.com.*

### **Terminology**

BMW uses two different vocabularies to refer to their various audio systems – service terminology, and sales/marketing terminology.

From the service side, there is Stereo, Hi-Fi, and Top Hi-Fi.

From the sales and marketing side, there is Base Audio, Hi-Fi Audio, and Premium or Logic 7 (starting in 2011, this changes to Premium “harman/kardon”, and Logic 7 becomes only a setting in the harman/kardon system menu).

*Note: The “Individual” system is available in M3 vehicles, and is available as a special-order option in non-M E9x vehicles. From a service point of view, its architecture is identical to the Top Hi-Fi, but different part number speakers and amplifiers are used. It is VERY rare in US non-M E9x.*

Base = Stereo

Hi-Fi = Hi-Fi

Top HiFi = Premium, Logic 7 or harman/kardon, Individual

This document uses the service designators for simplicity.

## U.S. Availability in non-M3 E9X vehicles:

Model Year	Stereo	Hi-Fi	Top Hi-Fi
2006	NA	Y	Y
2007	NA	Y	Y
2008	NA	Y	Y
2009	NA	Y	Y
2010	Y	NA	Y
2011	Y	NA	Y

## BMW Head Units

There are three levels of head unit: Business CD, Professional CD, and iDrive. The Business CD has not been available in the US market as of this date.

Either the Professional CD Player or the iDrive system may be present in any audio system. That is to say, which head unit is present does not affect which audio system is present. A Professional CD Player may be present in a Top Hi-Fi, Logic 7 system, or in a Base Audio, Stereo system.

The head unit must be “coded” to operate properly with a given audio system. This will be described in more detail in the System Architecture section.

## MOST

MOST is a vehicle-specific protocol, which is different from other digital fiber-optic standards such as Toslink. Other devices, such as Sirius tuners, Bluetooth M-ULF modules, and iPod interfaces, also exist on this MOST network.

The head unit uses MOST to connect to other devices such as Sirius tuners (when external to the head unit), iPod interfaces, and Bluetooth handsfree modules. In addition, MOST is used only in Top Hi-Fi systems as an audio connection between the head unit and the amplifier.

## **System Architecture**

### *Stereo*

A US-model Stereo system can be easily identified by looking at the top of the door panel, inboard of the side mirrors. If there are no tweeter grilles present there, the vehicle has Stereo audio.

The Stereo system consists of:

- A head unit coded to Stereo mode, providing speaker-level analog signals
- Front door 4" cone speakers using the standard BMW 3-bolt frame
- Rear 4" cone speakers (rear deck, doors, or sides, depending on body)
- Underseat 6" cone speakers with 8" frames, inverted-mounted in 8" enclosures

These speakers are powered by a 4-channel amplifier IC inside the head unit. The iDrive head unit has slightly more power than the Professional CD player, but both are limited in performance and can be thought of as having similar output as an aftermarket CD player.

To compensate for the lack of tweeters and of larger 8" subwoofers, the head unit front speaker signal is heavily boosted in the bass and treble. This equalization curve is fixed at all volume settings.

The front 4" door speakers and the underseat 6" speakers are both connected to the front channels of the head unit output in parallel. The 4" rear speakers are connected to the rear output channels of the head unit, and that signal is crossover-filtered within the head unit with a roughly 150 Hz high-pass filter.

## *Hi-Fi*

A Hi-Fi system can be identified by the presence of tweeter grilles at the top of the front door, inboard of the sail panels, but without a center channel speaker in the dashboard, and by simple bass and treble tone controls in the head unit.

A Hi-Fi system consists of:

- A head unit coded to Hi-Fi mode, sending front and rear balanced-differential preamp-level signals to the Hi-Fi amplifier
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- A six-channel amplifier with equalization and crossover filters onboard
  - o 2 front channels, equalized and high-pass filtered at ~ 120 Hz
  - o 2 rear channels, equalized and high-pass filtered at ~ 120 Hz
  - o 2 subwoofer channels equalized and low-pass filtered at ~100 Hz
- Front 1" tweeters in mounting trim pieces, with series capacitors
- Front 4" midranges in the door (connected in parallel with the tweeters)
- Rear 1" tweeters and 4" midranges connected in parallel
- Underseat 8" flat woofers in enclosures.

The head unit sends analog front and rear analog signals to the Hi-Fi amplifier. These signals are balanced-differential, and have a 5V maximum. They are not processed, equalized, or crossover-filtered, other than a slight auto-loudness feature which is not objectionable and should not be corrected. The subwoofer channel outputs are derived within the amplifier from these signals.

The Hi-Fi amplifier is black in color, and is in the trunk or cargo area on the driver's side. In sedans and coupes, the amplifier is under a plastic cover which snaps off. In wagons, it is behind the driver's side rear cargo storage cover, and under a plastic bolted-on cover.

The Hi-Fi Audio system has been called the easiest to upgrade, because the balanced signal can be used by several good-quality aftermarket amplifiers, because the signal from the head unit is not processed, and because the tweeter trim is already present in the vehicle.

The E90/1 has the tweeters in on-axis mounts with some depth behind them. The E92/3 have the tweeters slightly less on axis, and with no additional depth.

## *Top Hi-Fi - Logic 7 or harmon/kardon*

The Top Hi-Fi system consists of:

- A head unit coded to Top Hi-Fi mode
  - o Sending optical digital audio signals over a MOST fiber-optic cable
  - o Displaying a 7-band user equalizer in its UI
  - o Allowing Logic 7 processing to be turned on and off
- A silver Top Hi-Fi amp (same location as Hi-Fi) with MOST fiber-optic input, 9 channels of processed, equalized, filtered, time-delayed output
  - o 2 front channels
  - o 2 rear channels
  - o 2 rear effects channels
  - o 2 subwoofer channels
  - o 1 center channel
- A pair of front 4" and tweeters, connected in parallel
- A pair of rear 4" and tweeters, connected in parallel
- A pair of rear 4" effects speakers
- A pair of underseat 8" woofers
- A single dash-mounted 4" center midrange speaker

The purpose of Logic 7 processing is to create a sense of ambience, and to let both front-seat passengers have a similar stereo experience. Its effectiveness in this implementation is not a topic for this document. The technology is from the Lexicon division of Harman International, and more on the technology can be read here: <http://www.lexicon.com/logic7/index.asp>

Logic 7 systems use metal-diaphragm drivers. At this time the writer is not aware of the composition of 2011 harman/kardon drivers.

*Note: When a head unit is coded to Top Hi-Fi mode, its analog outputs are inactive.*

## **Body-style differences**

### *4" door speakers*

In E90/1 sedans and wagons, there is about 2"/50mm of usable depth behind the speaker area of the door panel.

In the E92/3 coupe/convertible, there is significantly less depth.

### *Tweeters*

In E90/1 sedans and wagons, there is about 2"/50mm of usable depth behind the speaker area of the door panel.

In the E92/3 coupe/convertible, there is significantly less depth.

### *Underseat woofers*

All E9x have roughly identical underseat woofer provisions.