AMD HDA Verbs

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1. Audio Descriptor Set and Get

Audio Descriptor Set and Get (pin vendor defined verb 776, F76)

Allows accessing the Short audio descriptor for each format in an indirect way.
Only the Audio Format Code (bits [6:3] of Byte 0) is RW, the other formats are RO.
After the Audio format Code is written using the Set function, the Get function will give the audio descriptor corresponding to the Audio Format Code written.

Byte#	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	0	Audio format code (1 to 14) 0: reserved 1:LPCM 2: AC-3 3: MPEG1 (Layers 1 and 2) 4: MP3 (MPEG1 Layer 3) 5: MPEG2 (Multichannel) 6: AAC 7: DTS 8: ATRAC 9: Reserved 10: Dolby Digital + 11: DTS-HD 12: MAT/MLP (Dolby True HD) 13: Reserved 14: WMA Pro					Max Num of channels – 1		
1 Rates supported. In the LPCM case, these are the rates supported for multi-channel	Reserved	192khz	176.4 kHz	96 kHz	88.2 kHz	48 kHz	44.1 kHz	32 kHz
2	BPS capability for LPCM: • Bit0: 16 bit capable • Bit1: 20 bit capable • Bit 2: 24 bit capable • Bits[7:3] reserved. Format specific for other formats							
3 Rates supported for stereo. Only applicable in the LPCM case.	Reserved	192khz	176.4khz	96khz	88.2 khz	48khz	44.1khz	32khz

2. Speaker Allocation Get

Speaker Allocation Get (pin vendor defined verb F70)

Byte 0 of the response contains the speaker allocation of the DTV according to its Short Audio Descriptor. *All fields are RO.*

Byte #	Bit 7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	0	RLC/RRC Rear left Center and Rear Right center speakers present	FLC/FRC Front left Center and Front Right center speakers present	RC Rear center speaker present	RL/RR Rear left and rear right speakers present	FC Front center speaker present	LFE Low frequency speaker present	FL/FR Front left and Front right speakers present
1	Reserved						DP_CONNECTION (Only for parts supporting DP Audio, for GUI labeling)	HDMI_CONNECTION (Only for parts supporting DP Audio, for GUI labeling)
2	0							
3	0							

3. Multi-Channel Enable Set and Get

Multi-Channel Enable 01 Set and Get (pin vendor defined verb 777, F77)

Multi-Channel Enable 23 Set and Get (pin vendor defined verb 778, F78)

Multi-Channel Enable 45 Set and Get (pin vendor defined verb 779, F79)

Multi-Channel Enable 67 Set and Get (pin vendor defined verb 77A, F7A)

Allows the audio driver to enable sending multi-channel audio through the pin. OUT_ENABLE enables the corresponding channel pair of the HDMI/DP multichannel audio data stream. The channel pair selected are CHANNEL_ID and CHANNEL_ID+1 channels of the controller audio stream.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
CHANNEL_ID				Rsvd		MUTE	OUT_ENABLE
Channels CHANNEL_ID and CHANNEL_ID+1 of the audio stream are sent to the corresponding channel pair of the HDMI/DP.				Rsvd		(Only for Codec Rev 3 and higher) Zeroes the audio in the channel pair	Enables sending the stream channels selected by CHANNEL_ID to the corresponding channel pair of the HDMI/DP.

4. Channel Allocation Set and Get

Channel Allocation Set and Get (pin vendor defined verb 771 and F71)

Defines the value to be sent in the Audio InfoFrame data byte 4. Intended to determine how various speaker location are allocated to transmission channels.
All fields are RW.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
CA7	CA6	CA5	CA4	CA3	CA2	CA1	CA0
Channel Allocation 0: Channel 0 is Front Left, Channel 1 is Front Right, Other channels not used 1: Channel 0 is Front Left, Channel 1 is Front Right, Channel 2 is Low Freq speaker, Other channels not used … 0x1F: Channel 0 is Front Left, Channel 1 is Front Right, Channel 2 is Low Freq speaker, Channel 3 is Front Center, Channel 4 is Rear Left, Channel 5 is Rear Right, Channel 6 is Front Left Center, Channel 7 is Front Right Center. 0x20 to 0xFF: Reserved							

5. Down-Mix Information Set and Get

Down-Mix Information Set and Get (pin vendor defined verb 772 and F72)

Defines the value to be sent in the Audio InfoFrame data byte 5. Intended to communicate to the DTV the total attenuation that the source applied to the audio and if down-mixing is permitted. Also note that the Codec hardware will swap FC, LFE in order to meet the HDMI/DP requirement. This requires no programming on the audio driver side. All fields are RW.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
DM_INH	LSV3	LSV2	LSV1	LSV0	Rsvd	Rsvd	Rsvd
0: Down-mix permitted or no information. 1: Down-mix prohibited.	0: 0dB level shift 1: 1dB Level Shift … 15: 15 dB level Shift						

Multi-channel audio Format	Channel allocation in system memory				Corres-ponding Channel Allocation value to program	Required channel allocation in HDMI/DP packets				Codec channel crossbar programming							
										Multi-Channel Enable 01		Multi-Channel Enable 23		Multi-Channel Enable 45		Multi-Channel Enable 67	
	0,1	2,3	4,5	6,7		0, 1	2, 3	4, 5	6, 7	OUT_ENAB LE	CHANNEL_ ID	OUT_ENAB LE	CHANNEL_ ID	OUT_ENAB LE	CHANNEL_ ID	OUT_ENAB LE	CHANNEL_ ID
2.0	FL,FR	-	-	-	00	FL,FR	-, -	- , -	-, -	1	0	0	x	0	x	0	x
3.0	FL,FR	FC,-	-	-	02	FL,FR	-, FC	- , -	-, -	1	0	1	2	0	x	0	x
4.0	FL,FR	SL,SR	-	-	08	FL,FR	-, -	SL,SR	-, -	1	0	0	x	1	2	0	x
5.1	FL,FR	FC,LFE	SL,SR	-	0B	FL,FR	LFE,FC	SL,SR	-, -	1	0	1	2	1	4	0	x
6.1	FL,FR	FC,LFE	SL,SR	BC,-	0F	FL,FR	LFE,FC	SL,SR	BC,-	1	0	1	2	1	4	1	6
7.1	FL,FR	FC,LFE	BL,BR	SL,SR	13	FL,FR	LFE,FC	SL,SR	BL,BR	1	0	1	2	1	6	1	4

6. Multi-Channel Mode Set and Get

Multi-Channel Mode Set and Get (pin vendor defined verb 789, F89)

Revision ID 3 and newer only.

Allows use of the single-channel-wise Multi-Channel Enable verbs, which provide higher channel routing flexibility for single-sink and DDM Audio multi-sink surround sound.

bit7:1	bit0
Rsvd	MULTICHANNEL_MODE
Rsvd	0: channel pair mode (uses only the channel-pair-wise Multi-channel Enable verbs) 1: single channel mode (uses the single-channel-wise Multi-channel Enable verbs)

7. Multi-Channel Enable Set and Get

Multi-Channel Enable 1 Set and Get (pin vendor verb 785, F85)

Multi-Channel Enable 3 Set and Get (pin vendor verb 786, F86)

Multi-Channel Enable 5 Set and Get (pin vendor verb 787, F87)

Multi-Channel Enable 7 Set and Get (pin vendor verb 788, F88)

Multi-Channel Enable 01 Set and Get (pin vendor verb 777, F77) (applies to ch 0 in single channel mode)

Multi-Channel Enable 23 Set and Get (pin vendor verb 778, F78) (applies to ch 2 in single channel mode)

Multi-Channel Enable 45 Set and Get (pin vendor verb 779, F79) (applies to ch 4 in single channel mode)

Multi-Channel Enable 67 Set and Get (pin vendor verb 77A, F7A) (applies to ch 6 in single channel mode)

When in "Single Channel Mode", the channel-pair-wise Multi-channel Enable verbs (01, 23, 45 and 67) apply only to the even channels (0, 2, 4 and 6) and these verbs apply to the odd channels. Besides that, the format is the same, and the C/LFE swapping is not automatic anymore and has to be explicitly programmed in these controls.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
CHANNEL_ID				Rsvd		MUTE	OUT_ENABLE
Channel of the audio stream sent to the corresponding channel of the HDMI/DP.				Rsvd		Zeroes the audio in the channel	Enables sending the stream channels selected by CHANNEL_ID to the corresponding channel of the HDMI/DP.

8. HBR Compressed Audio Pass-Through (24.576 Mbps)

The HBR Control allows for the transmission of compressed audio using the maximum audio channels in the HDMI/DP link (eight) instead of the regular two channels used for compressed audio. Since compressed audio is always transmitted at 16 data bits per channel and the maximum transmission rate is 192 kHz, the maximum HBR compressed audio transmission bit rate is 24.576 Mbps, a fourfold increase respect to the non-HBR 6.144 Mbps limit for compressed audio transmission. Lossless formats DTS HD Master Audio and Dolby True HD require HBR.

HBR Control Set and Get (pin vendor defined verb 77C and F7C)

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved			HBR Enable Enables sending HBR Compressed Audio. *This is a RW bit.*	*Reserved.*			HBR Capable Indicates that the Pin can send HBR Compressed Audio *This is a RO bit.*

Driver recommendations

- Declaring Support:
  - If the HBR Capable bit is "1" and the Audio Descriptors indicate DTS HD Master Audio or Dolby True HD is supported, declare support for HBR Compressed Audio transmission with 8 channels, 16 Bits, 192 kHz.
- Enabling HBR: Ensure this is the setting before starting the Stream:
  - Audio Controller Stream and Audio Codec Converter are set for 8 channels, 16 BPS, 192 kHz
  - Multi-channel Enable Codec Pin controls enable all channels with increasing channel IDs.
  - HBR Enable bit is set.

9. Audio/Video Delay Verbs (Lipsync)

Lipsync Control Get (pin vendor defined verb F7B)

Byte#	Bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0	Video Latency. *This is a RO field.*							
1	Audio Latency. *This is a RO field.*							
2	0							
3	0							

Video Latency and Audio Latency indicate the Video and Audio processing latency in the sink in
(milliseconds/2 +1). A value of 0 indicates that the latency is not known.
The Application can read this value and compensate for the difference between Video and Audio latency by
delaying or padding the start of the audio or video stream.

10. Audio-Video Association Port ID and Sink Information

Applicable only to Codec Revision ID 3 and onwards. Used to fill the OS Sink Identification fields.

Sink Information Index Set and Get (pin vendor defined verb 780 and F80)

Bit7:0
Sink Information Index

Sink Information Data Get (pin vendor defined verb F81)

Bit 31:0
Sink Information Index = 0: {16'b0, Manufacturer ID[15:0]}
Sink Information Index = 1: {16'b0, Product ID[15:0]}
Sink Information Index = 2: Sink Description Length
Sink Information Index = 3: Port ID [31:0]
Sink Information Index = 4: Port ID [63:32]
Sink Information Index = 5: {24'b0, Sink Description Byte 0 [7:0]}
Sink Information Index = 6: {24'b0, Sink Description Byte 1 [7:0]}
…
Sink Information Index = 22: {24'b0, Sink Description Byte 17 [7:0]}

11. Connection List Entry Get

Connection List Entry Get (Pin vendor-defined verb F02)

Bit 31:8	Bit 7:0
Rsvd	CONNECTION LIST ENTRY
Rsvd	This is a RO field. Node number of the Converter connected to the pin: 2 for pin 0 (Node 3) 4 for pin 1 (Node 5) … "2*Number Of Output Pins" for pin "Number Of Output Pins -1" (Node "2*Number Of Output Pins +1")

12. DDM Audio: Surround sound using one stream and multiple converters-pins

Converter synchronization verb

Starting with Revision ID 3, DDM Audio sends a multi-channel stream to multiple converters. In this case it is recommended that the converters be started in a synchronized fashion using the Converter synchronization verb.

Converter Synchronization Set and Get (Function Group vendor defined verb 770, F70)

Starting with Revision ID 3 Only:
Synchronizes a group of converters

Bit7:0
CONVERTER_SYNCHRONIZATION
Bit 0: Used to synchronize Converter 0
Bit 1: Used to synchronize Converter 1
…

This verb works is a way similar to how stream synchronization is done.
The sequence to start the converters is:
- Set Converter Synchronization "1" for the converters
- Enable the converters one by one
- Release Converter Synchronization ("0") for the converters in a single verb

DDM Audio Association Information Get (Pin vendor defined verb F93)

Starting with Revision ID 3 Only:

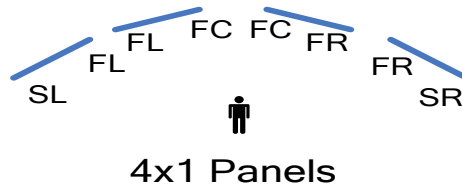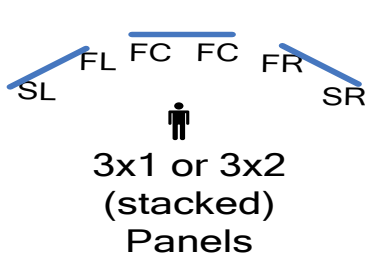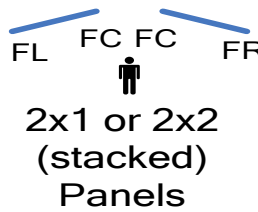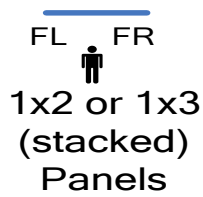Indicates the suggested channel to play in each speaker of the monitor

It is recommended that the video driver issue a forced unsolicited response in one pin (like pin 0) **with payload = 9** after the DDM Audio Association Information values are programmed in all pins to notify the audio driver of the DDM Audio configuration change request.

Bits[31:28]	Bits[27:24]	Bits[23:20]	Bits[19:16]	Bits[15:12]	Bits[11:8]	Bits[7:4]	Bits[3:0]
Chan suggested to play in the monitor's BR Speaker	Chan suggested to play in the monitor's BL Speaker	Chan suggested to play in the monitor's SR Speaker	Chan suggested to play in the monitor's SL Speaker	Chan suggested to play in the monitor's LFE Speaker	Chan suggested to play in the monitor's FC Speaker	Chan suggested to play in the monitor's FR Speaker	Chan suggested to play in the monitor's FL Speaker

0: FL
1: FR
2: FC
3: LFE
4: SL
5: SR
6: BL
7: BR
8: Silence
9-14: reserved
15: No association (register default)

Setting-up DDM Audio

Some Possible Hearfinity Configurations
(Bird's eye view)

FL   FR

**1x2 or 1x3
(stacked)
Panels**

FL   FC FC   FR

**2x1 or 2x2
(stacked)
Panels**

SL   FL   FC FC   FR   SR

**3x1 or 3x2
(stacked)
Panels**

SL   FL FL   FC FC FR   FR   SR

4x1 Panels

Requires MULTICHANNEL_MODE =1.
The following table shows only some possible DDM Audio Configurations in order to illustrate the use of the controls.

LPCM	Stereo Mixer	Channel allocation in system memory				Chann	Required channel allocation in HDMI/DP packets (From DDM Audio Association Information Verb of each pin)				Codec channel crossbar programming			
							Monitor	Monitor	Monitor	Monitor	Monitor 0 (Pin0)	Monitor 1 (Pin 1)	Monitor 2 (Pin 2)	Monitor 3 (Pin 3)

Ver	Cfg	0	1	2	3	4	5		0 (leftmost) (Pin0) 0 FL	Pin0 1 FR	Pin1 0 FL	Pin1 1 FR	Pin2 0 FL	Pin2 1 FR	Pin3 0 FL	Pin3 1 FR	MCE 01 OUT_ENABLE,VALUE	MCE 01 CHANNEL_ID	MCE 1 OUT_ENABLE,VALUE	MCE 1 CHANNEL_ID	MCE 01 OUT_ENABLE,VALUE	MCE 01 CHANNEL_ID	MCE 1 OUT_ENABLE,VALUE	MCE 1 CHANNEL_ID	MCE 01 OUT_ENABLE,VALUE	MCE 01 CHANNEL_ID	MCE 1 OUT_ENABLE,VALUE	MCE 1 CHANNEL_ID	MCE 01 OUT_ENABLE,VALUE	MCE 01 CHANNEL_ID	MCE 1 OUT_ENABLE,VALUE	MCE 1 CHANNEL_ID
2.0	2x1	FL	FR	-	-	-	-	0 0	FL	FL	FR	FR					1,0	0	1,0	0	1,0	1	1,0	1								
2.0	2x1	FL	FR	-	-	-	-	0 0	FL	-	-	FR					1,0	0	1,0	x	1,0	x	1,0	1								
3.0	2x1	FL	FR	FC	-	-	-	0 0	FL	FC	FC	FR					1,0	0	1,0	2	1,0	2	1,0	1								
5.1	3x1	FL	FR	FC	LFE	SL	SR	0 0	SL	FL	FC	FC	FR	SR			1,0	4	1,0	0	1,0	2	1,0	2	1,0	1	1,0	5				
5.1	4x1	FL	FR	FC	LFE	SL	SR	0 0	SL	FL	FL	FC	FC	FR	FR	SR	1,0	4	1,0	0	1,0	0	1,0	2	1,0	2	1,0	1	1,0	1	1,0	5

13. Silent Stream Ramp Rate Control Set and Get

Silent Stream Ramp Rate Control Set and Get (Converter Vendor-Defined verb 770, F70)

Starting with Revision ID 3 Only

Bit 31:8	Bit 7:0
Rsvd	RAMP RATE
Rsvd	Defines the attenuation rate for silent stream (exponential ramp from last value to zero when stream disable, or from zero to active value when stream enable). The actual rate is RAMP RATE / 256. The default is $180/256 \approx 0.7$, which is recommended for LPCM. A value of zero disables ramping. This is recommended for compressed audio