



## IM1 - HDMI 1.4a

*This course covers the HDMI multimedia interface*

### Objectives

- The course describes the architecture of a HDMI source-cable-sink system.
- An introduction to Video and Audio standards is done prior to clarifying how this standards are transported through HDMI.
- The analog interface is studied in detail, particularly the TMDS specification.
- The course clarifies information coding / decoding schemes.
- Content protection mechanisms are explained.
- Ethernet connectivity and audio return channel are also covered.
- This course has been delivered to several companies developing mobile phone chipsets.

A more detailed course description is available on request at [training@ac6-training.com](mailto:training@ac6-training.com)

### Prerequisites

- Experience of a digital bus is recommended.

### Environnement du cours

- Cours théorique
  - Support de cours au format PDF (en anglais) et une version imprimée lors des sessions en présentiel
  - Cours dispensé via le système de visioconférence Teams (si à distance)
  - Le formateur répond aux questions des stagiaires en direct pendant la formation et fournit une assistance technique et pédagogique
- Au début de chaque demi-journée une période est réservée à une interaction avec les stagiaires pour s'assurer que le cours répond à leurs attentes et l'adapter si nécessaire

### Audience visée

- Tout ingénieur ou technicien en systèmes embarqués possédant les prérequis ci-dessus.

## Plan du cours

### First day

#### INTRODUCTION TO HDMI

- Digital link between audio / video source and display or video-projector
- Pinout, source and sink requirements
- Status exchange through VESA DDC channel
- Optional HDMI Ethernet and Audio Return Channel (HEAC)
- Content protection technology
- Compatibility with Digital Visual Interface [DVI], adapter
- Mechanical specification, connectors Type A, B, C, D and E
- Dual link capability
- Maximum possible bit rates

## PHYSICAL LAYER

- TMDS character time definition
- Single-ended differential signal, definition of the swing
- Sink clock recovery
- Line termination and equalization
- Source pre-emphasis
- Source and sink TMDS characteristics, eye diagrams
- I2C and CEC signal requirements
- Interface testing (compliance checklist)
- Lecroy QualiPHY HDMI test solution
- HEAC physical layer, MLT-3 signaling
- Simultaneous transmitting ARC and MLT-3 100BASE-TX signals
- Differential mode and common mode transmission characteristics

## SIGNALING AND ENCODING

- Clock channel, pixel rate
- Encoder mux
- Leading and trailing guard bands and preamble
- TERC4 data coding scheme
- Video data coding
- Purpose of auxiliary data
- Error correction
- Packet formats

## VIDEO STREAMS

- Video standard basics, SDTV, EDTV, HDTV
- 3D video format structure
- 3D transmission video formats
- Video data coding 24, 30, 36 or 48 bits
- Video control signals HSYNC, VSYNC
- Video data decoding
- Video format timing specification
- Color depth requirements
- Gamut-related metadata

## Second day

## AUDIO STREAMS

- Audio basics, L-PCM coding, IEC standards
- Audio sample clock capture and regeneration, N and CTS parameters
- Using a CEC feedback channel to adjust the clock in the Source device
- Audio, video synchronization
- Audio data packetization
- DST usage
- HEAC audio return channel

## CONTROL AND CONFIGURATION

- I2C basics
- The Display Data Channel [DDC] usage during configuration
- VESA enhanced display data channel standard
- Physical address discovery algorithm

- AVI info frame
- Audio info frame
- E-EDID data structure
- CEA extension
- HDMI vendor-specific data block
- DVI / HDMI device discrimination
- Consumer Electronic Control
- CEC command description, remote control, AV-link protocol
- HEAC capability discovery and control
- CDC arbitration
- Channel states and transitions
- Activation of an HDMI channel
- HEC control for adjacent devices
- Message description
- Networking using 100BASE-TX
- Connection to internet via home network
- Switching, loop detection and removal

## **CONTENT PROTECTION**

- HDCP specification (DRM)
- Authentication of devices
- Computation of shared key
- Multimedia contents encryption
- HDCP over HDMI
- ACP packets