

## “Zero Latency” High Definition Video Encoding

The **MAKO-HD™** for the **hai1000™** series multi-stream encoder systems defines a new era of video communications where latency is imperceptible and full motion image quality is pristine. Ideally suited for the demands of telepresence, medical, and interactive broadcast applications, the MAKO-HD supports up to 1080p high definition with 70 milliseconds of end to end latency. This is the lowest latency ever achieved by an H.264 codec system providing truly interactive sessions between remote sites.



Designed using revolutionary encoding technology the MAKO-HD delivers ultimate high definition video quality, super wideband audio, and even computer graphics content over common networks. Some latency is introduced in any video encoding process, but the key is to strive to limit the latency in order to provide seamless communication. Systems that contain excessive delay (traditional conferencing systems and satellite based systems observed in remote news broadcast for example) lead to extremely poor communications and dramatic fatigue. As a result such systems can only be used for very short durations. With MAKO-HD configured **hai1000** systems, “zero latency” high definition communications is now readily available for telepresence conferencing, medical training and consultation, and interactive broadcast solutions. “Zero latency” can be considered within systems that operate assuring hand eye coordination (below 90ms) or operating within a blink of an eye (100 ms). The MAKO-HD performs at least 5 to 10 times faster than traditional conferencing codecs and “low latency” broadcast encoders.

The MAKO-HD achieves its revolutionary latency performance through the implementation of Progressive Encoding technology. Unlike other video encoders that need to await a number of frames in order to commence the encoding process, HaiVision’s Progressive Encoding engine starts encoding well before the first frame has even been completely delivered.

Incorporating industry standard compression, encapsulation, and signaling protocols such as H.264 (MPEG-4 AVC or MPEG-4 part 10) video, AAC audio, Transport Stream, and SIP, the MAKO-HD not only enables the highest caliber of video communications, but also, where needed, provides simple integration with low cost set top box decode appliances, soft players, QuickTime™ and QuickTime Streaming Server™ (QTSS) environments, storage systems, and, through INVITATION, traditional video conferencing systems. Designing communication infrastructure around HaiVision’s MAKO-HD enables clients to leverage the true power and ubiquity of IP video.

### MAKO-HD – up to 1080p High Definition with Media Sharing

The MAKO-HD is the highest performance HD codec available supporting up to 1080p and achieving end to end latency of 70 milliseconds. Each MAKO-HD has a digital (HD-SDI/SD-SDI) and an analog (RGBHV/YPbPr) input port. The output design is similar with the addition of DVI support. The MAKO-HD can encode up to 1080p video and up to 1280x768 on RGB. Uniquely and with the Dual Stream option, the MAKO-HD can share its compression power between both input ports simultaneously – each at adjusted frame rates. So, for example, one may wish to encode the video at 720p 50 frames per second and simultaneously encode an RGB source at 1024x768 10 frames per second with perfect synchronization between the video and computer graphics. Or perhaps encode the HD-SDI at 720p 30 and the YPbPr at 720p 30. Effectively this gives integrators extreme flexibility in addressing their client’s exact needs and maximizing resources.

### TELEPRESENCE SUITES

where you need to present, discuss and debate ideas clearly and completely without having to cut corners because the technology gets in the way.

### MEDICAL SYSTEMS

bringing procedures to critical audiences where reliability, quality and precision is a must.

### INTERACTIVE BROADCAST

connecting facilities, affiliates, and event locations to enable flexible video distribution and interactive real-time commentary without the costs and inherent delay of satellite.





## hai1000 features

- hai1060 – up to 5 MAKO-HD blades
- hai1020 – for a single MAKO-HD blade
- INVITATION Videoconference Interoperability
- Logical multicast / multiple unicast
- Telecom grade reliability
- Robust and extensible frame & blade design
- Web, CLI, and SNMP interfaces
- 1080p, 1080i, 720p, 480p, 480i

## HD blade (MAKO-HD) features

- Full frame rate video
- 256 kbps to 10 Mbps video bitrate
- Add'l RGBHV input up to 1280x768 60Hz
- I/O #1 - HD SDI, SDI, embedded digital audio
- I/O #2 – RGBHV or YPbPr or DVI (output only)

- Separate 4 channel analog audio
- Unique Dual Stream – 2 Channel Encoding (Video & RGB)
- Encoder/decoder design
- Latency of 70 milliseconds

## Specifications - hai1000 series MAKO-HD codec blades (encode with decode)

### VIDEO ENCODING / DECODING

#### H.264 AVC (MPEG-4 part 10)

##### HD-SDI/SDI Resolution:

720x480/576i	25, 30 frames per sec.
1280x720p	25, 30, 50, 60 frames per sec.
1920x1080i	50, 60 fields per sec.
1920x1080p	25, 30 frames per sec.

##### YPbPr Resolution:

720x480/576p	25, 30, 50, 60 frames per sec.
720x480/576i	50, 60 fields per sec.
1280x720p	25, 30, 50, 60 frames per sec.
1920x1080i	50, 60 fields per sec.

##### RGBHV Resolution:

VGA 640x480	Up to 85 Hz
SVGA 800x600	Up to 85 Hz
XGA 1024x768	Up to 85 Hz
WXGA 1280x768	Up to 60 Hz

##### Bit Rates

HD from 256 kbps to 10 Mbps  
SD from 256 kbps to 10 Mbps

##### Traffic Shaping

Constant (CBR)  
Variable (VBR)

##### Latency (end to end)

As low as 70ms

##### Compression Standard

H.264 AVC (MPEG-4 part 10)

ISO/IEC 14496-10

Baseline Profile

Level 4.1 and lower Intermediate Levels

I, IP framing

Variable Group of Picture (GOP) size

### AUDIO ENCODING / DECODING

#### MPEG-4 AAC

**Audio Channels**  
Up to 4 per video channel

**Compression Standard**  
MPEG-4 AAC-LC  
ISO/IEC 14496-3

**Bit Rates**  
From 32 to 256 kbps per audio pair

**Frequency Response**  
From 20 Hz to 22 kHz

**A-V Synchronization**  
Under 20 milliseconds

### ADVANCED FEATURES

**Text / Logo Insertion**

**Closed Captioning Support**

**Video Noise Filtering and Noise Reduction**

**Start-up Effects (fade/zoom)**

**Deblocking Filter**

**Video noise filtering - MCTF (motion-compensated temporal filter)**

**Dual Stream encoding optional**  
(HD-SDI with YPbPr or RGBHV)

### AUDIO/VIDEO INTERFACES

#### MAKO-HD Inputs/outputs

**SDI / HD-SDI (Input/Output)**  
SMPT-E-259M-C 75Ω BNC  
SMPT-E-296M 75Ω BNC  
SMPT-E-274M 75Ω BNC  
Embedded Audio Supported

**YPbPr (Input/Output)**  
CEA\_770.2-C  
CEA\_770.3-C  
DB15 to 3xBNC breakout req'd on input  
DVI-I to 3xBNC breakout req'd on output

#### RGBHV (Input/Output)

VGA  
SVGA  
XGA  
WXGA  
No breakout req'd on input  
DVI-I to VGA DB-15 breakout req'd. on output

#### Audio (Input/Output)

4 analog audio channels  
Balanced XLR connectors  
Unbalanced RCA connectors  
DB15 breakout req'd, specify when ordering  
Embedded Audio Supported on SDI



www.haivision.com

4445 Garand  
Montréal, QC, H4R 2H9  
Canada  
Tel: (514) 334-5445  
Fax: (514) 334-0088  
sales@haivision.com

13975 Polo Trail Drive  
Lake Forest, IL, 60045  
USA  
Tel: (847) 362-6800  
Fax: (847) 362-6866

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