The 4th Generation SD to Full-HD Up-converter with Embedded Memory and HDMI Output

**MDIN-221/241H**

- **MDIN-221/241H** is a highly integrated single chip implementation of deinterlacing, format conversion and video enhancement. It converts SD video to higher resolution format, up to full-HD.

- **MDIN-221/241H** receives any format of input video and performs deinterlacing and format conversion to produce any desired format of progressive and interlaced scan video with excellent signal quality preservation.

- **MDIN-221/241H** provides high quality edge preserving deinterlacing with the 4th generation motion adaptive 3-D deinterlacing algorithm and performs proper processing for fast motion and film video sources.

- **MDIN-221/241H’s** high quality deinterlacing, format converting and video enhancement capability are suitable for digital display applications such as set-top-box, digital video recorder(DVR), DVD player, TV Box and portable converter system.
**Main Features**

- Two digital video input ports for 10-bit precision interlaced or progressive scan video
- Four I²S and one S/PDIF audio input ports (MDIN-241H Only)
- MDIN-221: Analog RGB/Component and Digital video output MDIN-241H: Analog RGB/Component and HDMI output (ver. 1.2)
- Motion adaptive 3-D deinterlacing with pixel-by-pixel level motion adaptive interpolation
- Advanced multi-directional edge preserving deinterlacing
- Deinterlacing with fast motion, slow motion and still image detection and processing
- Deinterlacing with film mode, bad-edit and subtitle detection and processing
- 3-D noise reduction filter with cross-color suppression
- Independent horizontal and vertical scaling with anti-aliasing interpolation filter
- Horizontal peaking filter and color enhancement processing for crispier picture quality
- Programmable brightness, contrast, hue, saturation control with adaptive contrast enhancement
- 1 layer OSD with 16 colors and 4 sprites (bitmap and character mode)
- Cost and size effective embedded frame memory
- Serial I²C bus interface
- 144-pin FBGA packages (12mm x 12mm)

**Specifications**

### Video Input

- Digital video input with 10-bit precision
- Input resolution: Interlaced 720x480i or 720x576i
- Progressive up to 1280x1024p
- Video format: RGB/YCbCr 4:4:4 or YCbCr 4:2:2
- Y/C type: Multiplexed (BT.656) or separated (BT.601)
- Sync type: Separated or embedded (BT.656/BT.1120)
- Digital input: 12/24-bit (4:4:4) or 8/10/16/20-bit (4:2:2)

### Video Output

- Digital (MDIN-221 Only) and analog video output
- HDMI (ver. 1.2) output (MDIN-241H Only)
- Output resolution: Interlaced up to 1920x1080i
- Progressive up to 1920x1080p
- Digital output video format (MDIN-221 Only): 12/24-bit (4:4:4) or 8/10/16/20-bit (4:2:2)
- RGB/YCbCr 4:4:4 or YCbCr 4:2:2
- Y/C type: Multiplexed (BT.656) or separated (BT.601)
- Sync type: Separated or embedded (BT.656/BT.1120)
- Analog video output with triple 10-bit DACs (Separated sync or Sync on G/Y)

### Deinterlacing

- Motion adaptive 3-D deinterlacing on a per-pixel basis
- Advanced multi-directional edge preserving
- Fast motion, slow motion and still image detection
- Motion boundary preserving
- High frequency area detection and adaptation
- Film mode support for 3:2 and 2:2 pull-down
- Bad-edit/subtitle detection and adaptation

### Noise Reduction and Cross Color Suppression

- High quality 3-D noise reduction with motion detection
- Cross-color suppression for 2-D comb-filtered input

### Format Conversion

- Independent horizontal and vertical scaling with anti-aliasing interpolation filter
- Format conversion from one format to another format with an arbitrary scaling ratio
- Scaling ratio: x1/15 ~ unlimited
- Programmable size & position zoom in/out

### Display Functions

- Brightness, contrast, hue, saturation control
- Programmable display size and position

### Frame Rate Conversion

- Frame rate conversion from 3-250Hz to 3-250Hz
- Conversion ratio: x1/31 ~ x31
- Utilizes embedded memory as frame buffer

### Signal Enhancement

- High order programmable horizontal peaking filter
- Filter for color component enhancement
- LTI and CTI for edge enhancement
- Programmable gain control & coring
- Adaptive contrast enhancement

### OSD

- Bitmap and character mode OSD
- One layer with 4 sprites
- 16-color with 32-level alpha blending
- Up to 32x63 font size, and 1-bpp or 4-bpp font color
- 32-row x 16-col or 16-row x 32-col character map
- Bitmap copy and run-length decoding

### HDMI/DVI Transmitter (MDIN-241H Only)

- Industrial standard compliant HDMI 1.2, DVI 1.0, EIA/CEA-861D and HDCP 1.1
- IC Master interface for DDC connection
- Integrated HDCP cipher engine and Pre-programmed HDCP keys
- Hot plug detection for monitor/TV interface
- Four I²S audio inputs: 2-ch 192kHz or 8-ch 96kHz
- Industrial audio standard support:
  - IEC60958 for PCM
  - IEC61937 compressed audio (Dolby Digital, DTS and etc.)
- Adjustable audio delay for AV synchronization (up to 680ms at 48kHz)
- Built-in Consumer Electronics Control (CEC) support

### Frame Buffer Memory

- Embedded frame buffer memory

### Communication Interface

- 2-wire serial interface-I²C

### Miscellaneous

- Auto detection of input video/sync
- Support composite sync and non-standard sync signal
- Lock-to-input sync mode or free-run mode
- Programmable output sync signal generation
- Built-in test pattern generation logic

### Electrical and Mechanical Characteristics

- 1.2, 1.8V & 3.3V supply voltage
- 3.3V I/O signal interface
- Low power consumption: Max 0.5W (for HDMI output)
- Max 0.7W (for analog output)
- 144-pin FBGA package (12mm x 12mm/0.8mm pitch)