TEXAS INSTRUMENTS

AN-1334 The LMH0030 in Segmented Frames Applications

ABSTRACT

This application report describes how to use the LMH0030 in segmented frame applications.

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1 Introduction

The LMH0030 and LMH0031 standard and high definition video chipset is an ideal solution for a variety of products in the standard and high definition video systems realm. It allows easy integration in a number of professional video applications such as digital routers, production switchers, format converters or video servers. Figure 1 shows a typical application diagram with the LMH0030 serializer and LMH0031 deserializer.
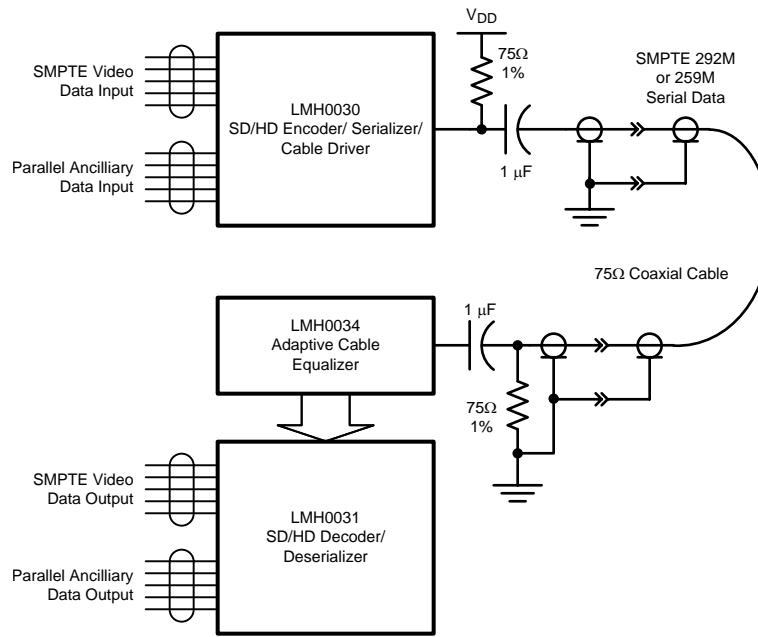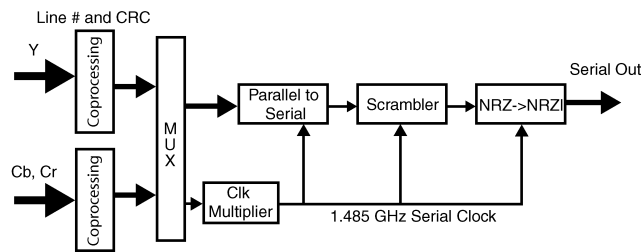

Figure 1. Typical Application Diagram for the LMH0030 and LMH0031

The LMH0030 digital video serializer automatically recognizes standard definition (SD) video and high definition (HD) video formats according to the respective Society of Motion Picture and Television Engineers (SMPTE) standards. The device is compliant to SMPTE 125M/267M for standard definition and SMPTE 260M/274M/295M/296M high definition video as provided to the parallel 10bit or 20-bit interfaces. The LMH0030 auto-detects and processes the video data compliant to SMPTE 259M and SMPTE 344M for SD and SMPTE 292M for HD video and serialization to the output ports.

Table 1 summarizes the supported frame set of the LMH0030 and Figure 2 shows the simplified data path of the LMH0030 SD/HD encoder/serializer.

Table 1. Automated Supported Frames by the LMH0030

Format	Specification	Frame Rate	Lines	Active Lines	Samples	Active Samples
SDTV, 54	SMPTE 344M	60I	525	507/1487	3432	2880
SDTV, 36	SMPTE 267M	60I	525	507/1487	2288	1920
SDTV, 27	SMPTE 125M	60I	525	507/1487	1716	1440
SDTV, 54	ITU-R BT 601.5	50I	625	577	3456	2880
SDTV, 36	ITU-R BT 601.5	50I	625	577	2304	1920
SDTV, 27	ITU-R BT 601.5	50I	625	577	1728	1440
HDTV, 74.25	SMPTE 260M	30I	1125	1035	2200	1920
HDTV, 74.25	SMPTE 274M	30I	1125	1080	2200	1920
HDTV, 74.25	SMPTE 274M	30P	1125	1080	2200	1920
HDTV, 74.25	SMPTE 274M	25I	1125	1080	2640	1920
HDTV, 74.25	SMPTE 274M	25P	1125	1080	2640	1920
HDTV, 74.25	SMPTE 295M	25I	1250	1080	2376	1920
HDTV, 74.25	SMPTE 274M	24P	1125	1080	2750	1920
HDTV, 74.25	SMPTE 296M	60P	750	720	1650	1280

Figure 2. Principal Datapath of the LMH0030 SD/HD Video Encoder/Serializer

The HDTV video processing data path shows the parallel luminance and chroma (Y, Cb, Cr) at the input port, the co-processing (line numbering and CRC) and multiplexing, and the parallel to serial conversion. After data scrambling and NRZ to NRZI conversion, the serial video data is presented at the output port. The LMH0030 has a built in cable driver to ease system design.

2   Segmented Frames

The LMH0030's processing capabilities for interlaced and progressive frames allow easy implementation in a variety of professional video equipment such as video routers and switchers or video processing and editing equipment. SMPTE standardization tries to keep pace with new developments in formatting and transport of digital video. One of the new approaches is segmented frames. Film makers in particular use progressive and segmented formats (24fps) as it promises handling consistency in the production process and makes it more compatible with today's interlaced equipment.

Unlike the normal interlaced television, where interlaced fields represent two successive points in time, with segmented frames, the odd and even lines are from the same snapshot in time - exactly as film is shown today on 625/50 TV systems. This way the signal is more compatible than normal progressive scan for use with broadcast video systems; for example VTRs, cinema projectors, SDTI or HD-SDI converters, mixers/switchers, and so forth, which may also handle interlaced scans. Segmented frames can also be easily viewed without the need to process the pictures to reduce 24-frame flicker. Plus the segments are put back together into a single frame for display and not interleaved one after the other as with interlaced video.

Figure 3 shows that a segmented frame is a progressive frame artificially split into two segments. The split is done line by line and each set of lines (odd or even) makes up the segment.
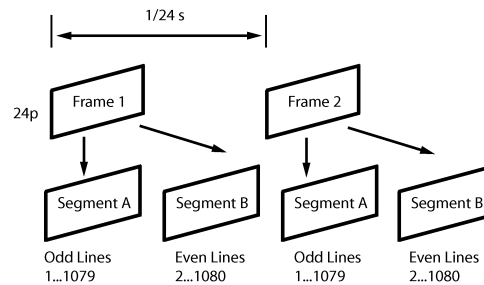
Figure 3. Composition of a Segmented Frame

Segmented frames are not fully standardized by SMPTE yet (as of April 2004), but are currently under discussion by SMPTE and addressed by the recommended practice (RP) RP211-2000.

Table 2. Segmented Frames Under Discussion

System Nomenclature	Samples Per Active Line (S/AL)	Active Line Per Frame	Frame Rate (Hz)	Scanning Format Frequency	Interface Sampling Total Line fs (MHz)	Samples Per Lines Per (S/TL)	Total Lines Per Frame
19201080/30 (sF)	1920	1080	30	Progressive (sF)	74.25	2200	1125
19201080/29.97 (sF)	1920	1080	30/1.001	Progressive (sF)	74.25/1.001	2200	1125
19201080/25 (sF)	1920	1080	25	Progressive (sF)	74.25	2640	1125
19201080/24 (sF)	1920	1080	24	Progressive (sF)	74.25	2750	1125
19201080/23.98 (sF)	1920	1080	24	Progressive (sF)	74.25	2750	1125

By default, the LMH0030 automatically processes frames and generates and inserts CRCs, line numbering and, optionally ANC data in the co-processing section (see Figure 2). In order to configure the LMH0030 as a HDTV serializer to transport segmented frames, the automatic frame detection needs to be disabled. This is done by:

1. Configuring the LMH0030 as an HD serializer by setting into general HD format.

2. Locking the part into format detection to HD only, by writing 0x30 to the FORMAT register address 0x0B.

3. Disabling the automatic insertion functions by setting FORMAT to 0x3F when the incoming data contains CRCs and line numbers.

Note that this action will disable end of active video/start of active video (EAV/SAV) indicators and disable line numbering, CRC insertion and ancillary data insertion. Therefore, pre-processing needs to perform the functions of CRC insertion and line numbering prior to providing the video data to the LMH0030. This is accomplished in a preceding preprocessing logic as with an FPGA device.

Last but not the least, it is strongly recommended to test the correct functionality using a valid segmented frame test generator such as the Synthesis Research HDVA292.

3 References

- Society of Motion Picture and Television Engineers SMPTE: www.smpte.org/
- Synthesis Research: www.synthesysresearch.com/
- Visit www.ti.com/product/lmh0030 for SD and HD Video Products, Reference Designs, Application Reports, White Papers, and System Diagrams

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