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1989

LSIs for analog high-definition television (MUSE system) (various Japanese manufacturers)

~ Integrated Circuit ~

Japan's proprietary MUSE (Multiple Sub-Nyquist Sampling Encoding) transmission method was developed in the1980s, led by NHK, in order to realize high-vision broadcasting in one transponder transmission band of one broadcasting satellite. This is a system to compress the baseband of Hi-Vision from 20 MHz to 8.1 MHz using digital video processing and to transmit them with FM modulation.

This MUSE analog high-vision broadcasting began experimental broadcasting with broadcasting satellite in 1989, switched to trial broadcasting in 1991 and practical test broadcasting in 1994. Massive digital image processing was the main function of MUSE decoders in high-definition receivers, and considerable miniaturization and power consumption reduction of MUSE decoders were needed for their practical use and dissemination. MUSE LSIs were developed for this purpose. The prototype MUSE decoder composed of discrete parts consisted of approximately 3800 TTLs and ECLs, and it consumed about 1 kW of power. First generation MUSE LSIs were developed by NHK and several domestic home electronics /semiconductor makers (Toshiba, NEC, Matsushita Electric Industrial Co. (now Panasonic), Sony and Sharp) in approximately 2 years since 1987, to match the timing of experimental broadcasting in 1989. MUSE LSIs were 25 kinds in total, including high speed ADC/DAC, various digital video processing, image memory, audio processing, control data detection, and control timing generation. All digital processing LSIs adopted CMOS technology with 5V power supply, and the operating frequencies were 16MHz for ADC, 32MHz/48MHz for digital video processing, and 44MHz for DAC. The design rule was 1.2 ~ 1.5μm, the highest-level technology at the time of the start of the development, including its reliability.

Figure 1 shows the MUSE LSI system configuration. In the MUSE system, the stationary portion of the screen was subjected to subsampling that carried out circulation in four fields, and the moving portion of the screen were dealt with lower resolution and the field unit transmission was performed similarly to that of conventional television. The main functions of the video processing unit of the MUSE decoder are as follows.

(1) Pixels sub-sampled over four fields are interpolated by an image memory (still image processing).
(2) Subsampled pixels are interpolated by a two-dimensional filter in the field (moving image processing).
(3) Detect moving parts of the image and mix the processing outputs of still and moving images according to the detected signals. (Motion detection, mixing of still images / moving images)

Furthermore, with addition of the functions of demodulating time-compressed color signals, synchronization / clock recovery, waveform equalization, and audio demodulation, the MUSE decoder is a digital signal processing system of about 3 to 400 k gates and 20Mbits memory.

Thanks to the development of this LSI, the MUSE decoder drastically decreased to about 1/20 in size and about 1/30 of the power consumption compared with the prototype, and compact MUSE decoders and high-vision receivers equipped with MUSE decoder were developed by domestic home appliance manufacturers. However, although it contributed greatly to downsizing and lower price of the 1st generation decoder, problems remained such as large number of chips and high cost from productivity point of view, and the manufacturability of board assembly. Second generation LSIs which overcame these problems and aimed at further high integration were developed by Sony +3 companies, Toshiba + 1 company, Matsushita Electric Industrial Co. (now Panasonic) + 9 companies, etc. from 1992 to 1994, respectively. After 1995, a joint team of Fujitsu, TI Japan and Sony, and another team of Matsushita Electric Industrial Co. (present Panasonic) and JVC (present JVC-Kenwood Holdings) developed one-chip LSIs, respectively.

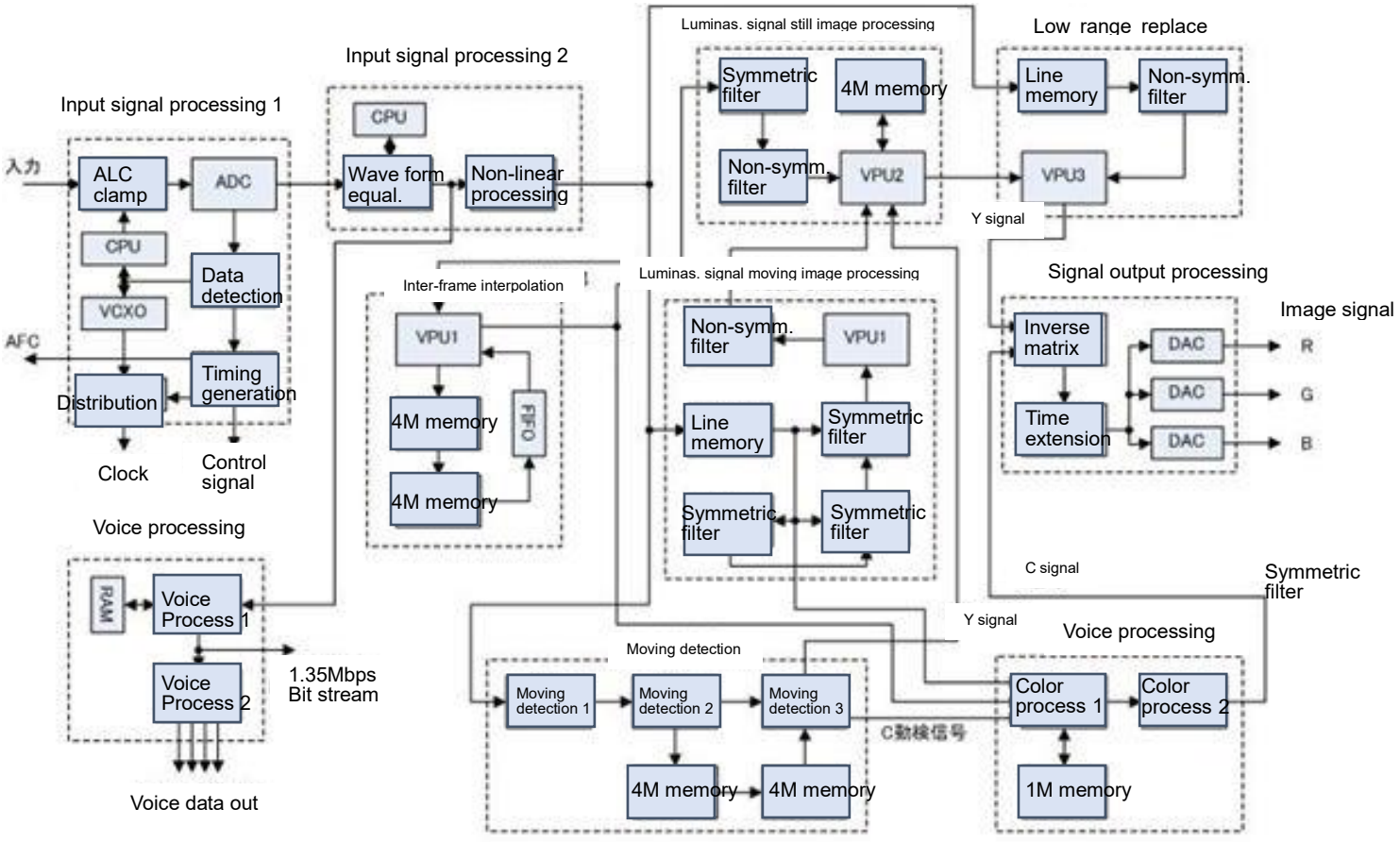

Fig.1: MUSE LSI system

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