World's first 100-mV operation for CMOS integrated circuits

TOKYO, Japan, February 4, 2002 - Hitachi, Ltd. (NYSE:HIT) and the Microsystems Technology Laboratories of the Massachusetts Institute of Technology (MIT) have jointly developed a new circuit concept for digital signal processors, that will help to realize minimum power processing for system LSIs, such as those used in personal digital assistants. The technology was applied to a Multiply-Accumulate Unit (MAC) used in signal processing LSIs, and operation was confirmed for a 100mV supply voltage, which is considered to be the theoretical limit of low supply voltage in CMOS circuits at room temperature.

Lower power consumption continues to be a vital need in system LSIs, which are the core of mobile multimedia devices such as note PCs, personal digital assistants and cellular phones, in order to extend battery lifetime. Generally the most effective way to achieve this is to decrease the supply voltage, however low voltage operation also degrades LSI performance. Thus, the simultaneous achievement of both high performance and low power has been an important goal.

To tackle these issues, Hitachi and MIT have been independently researching the development of low power circuit technology; Hitachi working on body bias control and MIT on supply voltage control technology, in relation to current LSI operating frequencies. Hitachi and MIT joined forces to cooperate in their research efforts in order to achieve even lower power consumption. The collaboration has resulted in the successful development of technology that approaches the theoretical limit of low power operation.

As a result of initial review, it became clear that optimum control of the supply voltage could be achieved using the body bias (1). That is, if body bias control is simultaneously performed with supply voltage control, minimum power operation can be achieved. Assessment of experimental results indicated that when a forward bias is applied to the body, the direction in which current easily flows, whilst the effectiveness of the control increases, a limit exists after which performance degradation occurs. Based on these finding, the optimal combination of supply voltage and body bias control was investigated to obtain the minimum power consumption in relation to a given clock frequency. A universal control method was developed which generates an adaptive supply voltage and body bias according to a clock frequency processing speed in the circuit.

- more -

The above was applied to a 16-bit MAC composed of 0.14-μm gate length MOS devices, for verification. As a result, when compared to conventional supply voltage control, a 30% reduction in operating power consumption was confirmed. Further, the minimum supply processing was achieved at 175mV in the MAC and 100mV in the MAC ring oscillator. This technology is expected to play an important role in as basic technology for reducing supply voltage in future system LSIs.

This low-power system LSI technology will be presented at the International Solid State Circuits Conference (ISSCC 2002) to be held in San Francisco, U.S.A., from 4th February 2002.

Hitachi, Ltd., headquartered in Tokyo, Japan, is one of the world's leading global electronics companies, with fiscal 2000 (ended March 31, 2001) consolidated sales of 8,417 billion yen ($67.9 billion*) The company manufactures and markets a wide range of products, including computers, semiconductors, consumer products and power and industrial equipment. For more information on Hitachi, Ltd., please visit Hitachi's Web site at http://global.hitachi.com

* At an exchange rate of 124 yen to the dollar.

- 30 -

(1) Forward body bias: the direction of bias that results when the P-type semiconductor region is at a positive voltage relative to the N-type region in the P and N junction, the direction of a current flow with much larger attenuation.

# # #