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STUDIES OF USER FACILITY OFFERED BY ADCs

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Abstract

Based on technical studies documentation of a greatest ADC manufacturer and in some cases on a few experimentation, the author has achieved a syntheses about actuates, essentially technical ADC's performances. Also, the author has exemplified with some actuates ADC integrated circuits from Texas Instruments, Harris Semiconductor and Maxim Corporation, on which their overall products contain the whole facilities category offered by ADC at this moment.

Key words: ADC, product, facility, user, examples

1. INTRODUCING

The passing from analogue to digital systems in the entire activity field leads in a naturally way to the demand increase of ADC circuits. Owing to the variety of application areas, the major differences between technical performances of ADC and some time the contrary market request of producing cheap and high performance circuits, the author has considered important to try to make a brief of the principal technical performances and to point from time to time some directions of ADC's evolution.

2. ACHIEVEMENTS IN ADC'S DOMAIN

Base on the technical studies documentation of a many ADC top manufacturer and in some cases on a few experimentation, the author has drown the following conclusions:

A. Promoted of a competitive spirit by competitive firms makes the most products of these firms to be directly replaced with integrated circuits of other firms. For examples lots of Texas Instruments ADC's integrated circuits can be directly replaced by the ADC's integrated circuits produced by Motorola, Analog Devices, National Semiconductor and others.

B. Production of ADC using the new technologies in semiconductors areas. Thus the TTL technologies has practically replaced by many various CMOS technologies; e.g.: classical CMOS technologies: TLC 542, TLC 545, TLC 548, TLC1550, HI 5767; e.g. Advanced Lin CMOS: TLC 0820; Advanced Lin EPIC1Z process: TLC320AD57C

C. Utilisation of many theoretical systems into circuit architecture but also the frequently solutions are: successive approximation routine successive for normal and rapidly ADC circuits e.g.: HI 3086 , TLV 0838 , sigma delta technologies for the audio

and ultrasonic domain e.g.: HI 7188, TLC 320, parallel technique for high speed ADC e.g.: HI 1276

D. Continually raise of conversion accuracy has marked through considerable increase of the number bits conversion and producing a various type on this point; e.g.: 4 bit (HI 3304), 6 bit (HI 3086), 8 bit (HI 1276), 10 bit (HI 5767, TLC 542, TLC 1541), 12bits (MAX 191, MAX 198, THS 1206, HI 5813, TLC 2543), 14 bit (THS 1408), 16 bit (MAX 195, HI 7188), 18 bit (TLC 320, MAX 132, TLC320AD57C), 24 bits (HI 7190)

E. Making the ADC as a single chip what include all the blocks: the complete data acquisition system, function as analogue multiplexer, sample and hold, control logic, control register, the clock, references voltages regulator. Nowadays, from some reasons, however there are a few ADCs, which cover the whole functions, need for a large spectrum of applications of this circuit.

F Production of many specialised ADC, which made easy the connection of them into the system. For examples:

- Converters for digital display; e.g.: ICL 7129 (4 ½ LCD single chip ADC)
- Converters for television; e.g.: TLC 5733
- Converters for transducer signal measurement; e.g.: MAX 132 (pressure, flow, temperature, voltage, current, resistance, weight)
- Converters for working together with DSPs ; e.g.: TLV 1544, MAX 146 can be controlled with TMS 320
- Converters for numerical measurement; e.g.: ICL 7149 (3 ¾ Digit autoranging multimeter)
- Converters for video applications; e.g.: HI 2302
- Converters for audio application; e.g.: HI 2555, TLC320AD57C
- Converters for cellular base stations e.g.: HSP50216

G. Wide range of temperature and two or three range of variety production normal ($0 – 70^0$ C) or industrial ($-40 – 85^0$ C) temperatures; e.g.: HI 7190; normal ($0 – 70^0$ C) , industrial ($-40 – 85^0$ C) or military ($-55 – 125^0$ C) temperatures: e.g.:MAX 132, MAX 191, MAX 195, MAX 113, TLC 542, HI 774, TLC 548, TLV 1550, THS 1206

H. Utilisation of the advanced and performed packages (SOIC, TSOP, TQFP etc.) and more for some circuit is used two or three package type: e.g.: TLC 542 (20 pin DIP or SPQCC Packages); TLC 2543, TLC 1550 (28 pin DIP or SPQCC Packages); MAX 195 (16 pin DIP or SQ Packages); MAX 191 (24 pin DIP or wide SQ Packages); MAX 146 (20 pin DIP or SSOP Packages); HI 7190 (20 pin DIP or SOIC Packages); ICL 7149 (40 pin DIP or MQFP Packages) .

I. It has passed from the circuits supplied with two or three values voltages simultaneous to supplied a single supply voltage, more often a small value of 3 Vv or very much, 5V but also to a single or dual voltage or wide supply range, in scope of reducing the dissipation power to the package and utilisation the some supply voltage with the other circuits from system; e.g. 5V supply: TLC 542, TLC 545, TLC 0820, TLC 5540, MAX 198, HI 1276, HI 3086; e.g. 3V supply: TLV 0831, TLV 5510, HSP 50216 ; e.g. 3.3V supply: TLV1543, HI 5813, TLV 1549 ; wide supply range 2,7 to 3,6V supply: TLV 0838, MAX 146, TLV 0831 ; e.g. wide supply range 2,7 to 5,5V supply: TLV 1544, MAX 147, TLV 1572 ; e.g. single or dual voltage: HI 2302, 5V/ 3.3V dual

J. Rejection supply frequency; e.g.: MAX 132 (50/60 Hz rejection), HI 7190, HI 7188 (120 dB rejection of 50//60 Hz line noise)

K. Preoccupation of dissipate power reducing in CI, ideal for high performance application including battery operation and portable instrumentation. This power reducing is accomplished by two ways: a. reducing the consumption in normal functioning, and b. introducing the power mode down in situation when the circuit in in standby. E.g.: TLC 548 (max 15 mW at 75 kSPS), TLC 5540 (max. 85 mW at 75 MHz clock), HI 3304 (max. 35 mW at 25 MHz clock)

L. Power-done mode; e.g.: TLC 2543, TLV 1544,TLC320AD57C (programmable power down mode), MAX 196 (two power down modes), TLV 1572 (auto-power down at 10uA), MAX 146 (1uA power down mode)

M. Making the ADC with serial control with serial control building in a package with small number pins (e.g.: TLC 542, TLC 545 TLV 0934 8 pin DIP); MAX 132 serial I/O interface, MAX 146 4 wire serial interface, HI 7190 serial data I/O interface, TLV 0838), and also ADC with parallel microprocessor interface (e.g.: TLC 0820). Both of variants can be controlled with most popular microprocessor (e.g.: TLV 1544, TLV 1570, MAX 146 can be controlled with TMS 320; HI 7190 – synchronous transfer formats with Motorola and Intel 8051 series protocol). Also, there are variants which can have both of control type (e.g.: HI 7188, MAX 191 serial and 8 bit parallel microprocessor interface) or can work with more microprocessors category (e.g.: HI 774 8, 12 or 16 bus interface; THS 1206- micro-controller or DSP interface; TLC 1550 – fast parallel processing for DSP or microprocessor interface)

N. Either external or internal clock can be used; e.g.: TLC1550, MAX 191, and MAX 198

O. Preoccupation in increasing of the circuits speed, and therefore in esantionated rate, achieving at the same time a sufficient number of bits conversion to have a good accuracy conversion: e.g.: TLC 5540 (8 bits at 40 MSPS), HI 2302 (8 bits at 50 MSPS), THS 1050 (10 bits at 50 MSPS), HI 5767 (10 bits at 60 MSPS), THS 8083 (8 bits at 80 MSPS), HI 3086 (8 bits at 140 MSPS), MAX 100 (8 bits at 250 MSPS), HI 1276 (8 bits at 500 MSPS)

P. Any external or internal reference; e.g.: MAX 196 (internal reference = 4.096 V), THS 1206 (two references sources: V_{REFP} = 3,5 V, V_{REFM} = 1,5 V)

Q. Integration in a single chip a many ADC blocks; e.g.: TLC 5733 (3 blocks ADC), MAX 1002 (dual 6 bit ADC)

R. Either internal or external acquisition control; e.g.: MAX 196

S. One or more built in self test mode; e.g.: TLC 2543 (3 built in self test mode), TLC 542, TLC 545

T. Automatic clamp function: e.g.: TLC 5733 (automatic clamp pulse generator for 3 switches), HI 2302 (clamp ON/OFF function)

U. Programmable conversion rata; e.g.: TLV 1544

V. Programmable sample and hold function; e.g.: TLC 548

W. Using a multiple facilities for inputs for customise in applications technique:

- channel autoscan : e.g.: TLV 1570 (autoscan for 8 inputs), THS 1206 (autoscan mode for 2, 3 or 4 inputs)

- .unipolar or bipolar input operation in diverse variants; e.g.: MAX 195 (0 to V_{REF} or V_{REF} to $+V_{REF}$ input), TLV 0831 (input range 0 to Vcc with Vcc reference), HI

3304 (unipolar inputs or bipolar inputs range with optional second supply), HI 774 (standard inputs or bipolar inputs range)

- .passing from converters with 1 or 2 inputs to ADC with 8 or more multiplexed inputs: e.g.: MAX 146 (8 analogue input channel or 4 differential channel), TLC 542 (12 analogue input channel), TLC 2543 (11 analogue input channel), TLC 545 (20 analogue input channel), HI 7188 (8 channel fully software configurable)
- simultaneous sampling or 4 single-ended signals or 2 differential signals or combination of both; e.g.: THS 1206
- automatic channel switching with zero latency; e.g.: HI 7188
- channel single-ended or differential inputs ; e.g.: TLV 0831 (simple channel or multiplexed twin channels with single ended or differential input option), MAX 146 (8 Channel single-ended or 4 differential inputs)
- software selectable input range; e.g.: MAX 196 (input selectable 0 to 10 V), HI7190 (20 mV to +/- 2,5 V full scale input ranges)
- internal PGIA with gains; e.g.: HI 7190 (gains of 1 to 128), HI 7188 (gains of 1 to 8)
- input TTL/CMOS compatible HI 2302, HI 5767
- ECL, PECL or TTL digital input level; e.g.: HI 3086
- channel conversion order and number of active channels; e.g. HI 7188

X. Using a multiple facilities for outputs for customise in applications technique:

-unipolar or bipolar output operation; e.g.: TLV 2543
-end of conversion output; e.g.: TLC 5243, TLV 1544, TLC 542
-programmable MSB or LSB first ; e.g.: TLC 2543
-programmable output data length ; e.g.: HI 5813 : (12, 8 or 4 bit), TLC 2543
-programmable output; e.g.: MAX 132 (programmed output for MUX and PGA)
-three-state serial data output; e.g.: MAX 195, HI 774, HI 2302
-CMOS compatible output; e.g.: HI5767
-CMOS compatible digital output of 3V and 5V; e.g.: THS 1050
-output data format multiplexer ; e.g.: TLC 5733A
-software configurable Overflow bit ; e.g.: HI 3304

Y. Using a multiple facilities for inputs and outputs

-inputs and outputs are compatible with TTL and/or CMOS standards; e.g.: TLV 0838, TLV 0831

In figure 1 we can see the functional bloc diagram of THS1206 integrated circuit which has a lot of ADC' s user facility.

3. CONCLUSIONS

Knowledge of the user facilities offered by ADC products is for a maximum importance in design activity and manufacturing of equipment with a high technical performance and economic competitive.

Nowadays, owing to the changing from analogue technique to digital one in the entire fields and also to the technological progresses of ADCs production we can tell that the number of ADCs and the diversity of them have raised rapidly.

Furthermore, it can be certainly predicted that this tendency will remain in nearly future, too.

Thus, I hope this paper to be very useful to the entire specialists who works in the ADCs field.

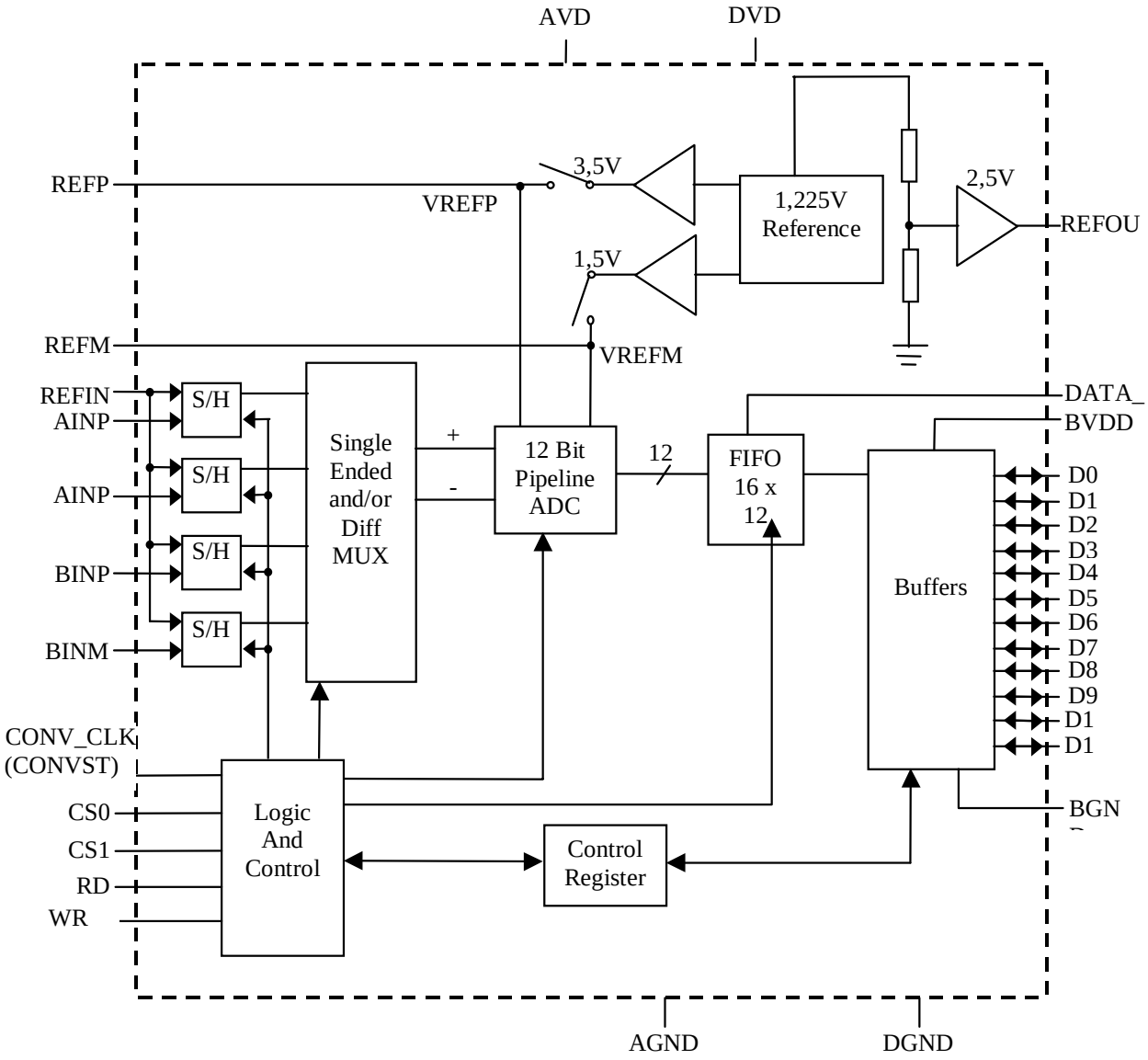

Fig.1 Functional bloc diagram of ADC THS1206

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