

## 8-Bit, 18 MSPS, Video A/D Converter with 3.3V Power Supply Operation

August 1997

### Features

- Resolution ..... 8-Bit  $\pm 1/2$  LSB (DL)
- Maximum Sampling Frequency ..... 18 MSPS
- Low Power Consumption at 18 MSPS (Typ)  
(Reference Current Excluded) ..... 18mW
- Synchronizing Clamp Function
- Clamp ON/OFF Function
- Reference Voltage Self-Bias Circuit
- Input CMOS Compatible
- Three-State TTL Compatible Output
- Power Supply ..... 3.3V Single
- Low Input Capacitance ..... 8pF
- Reference Impedance ..... 330 $\Omega$  (Typ)
- Direct Replacement for Sony CXD2300

### Applications

- Portable Equipment
- Hand-Held Instruments

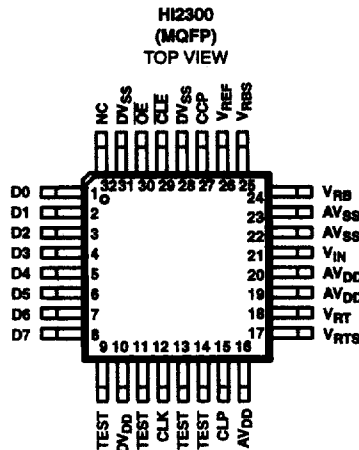
### Description

The HI2300 is an 8-bit, CMOS A/D converter for video with synchronizing clamp function and can operate on 3.3V power supply. The adoption of 2 step-parallel method achieves ultra-low power consumption and a maximum conversion speed of 18 MSPS.

### Ordering Information

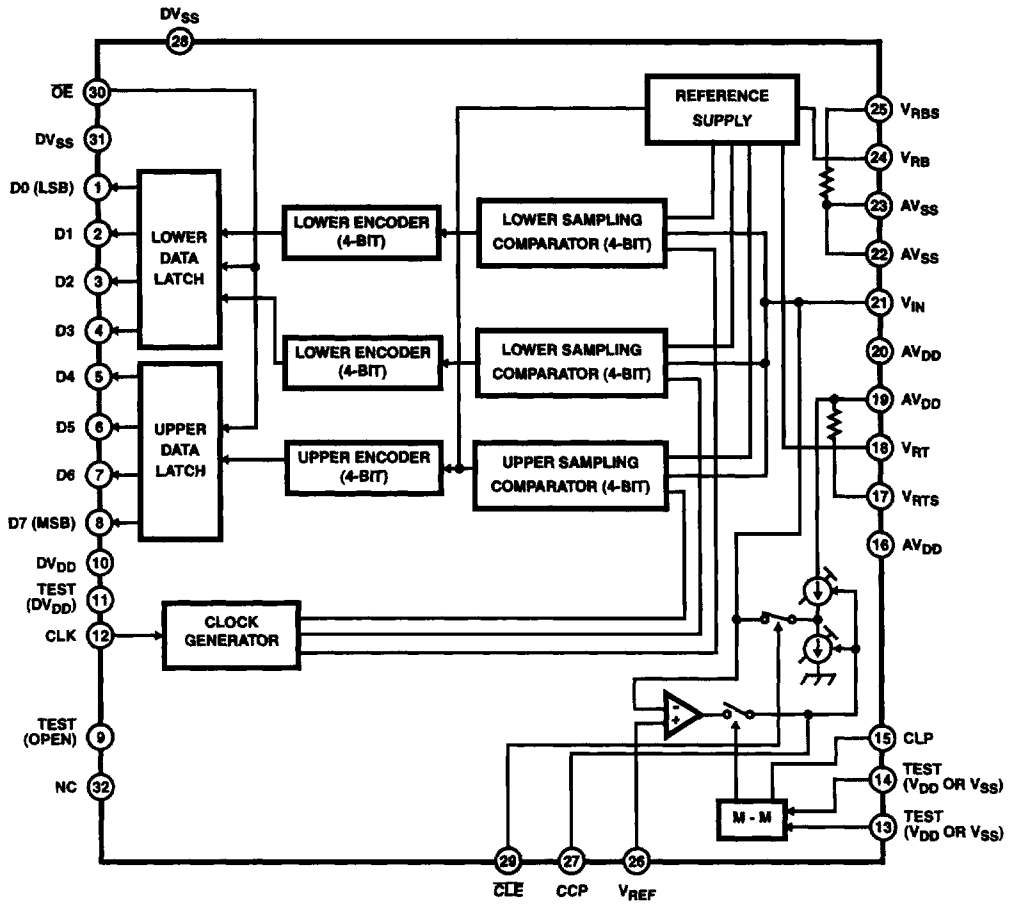
PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
HI2300JCQ	-40 to 85	32 Ld MQFP	Q32.7x7-S

### Pinout

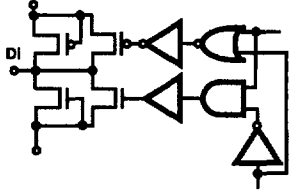
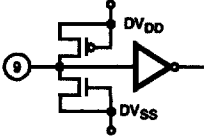
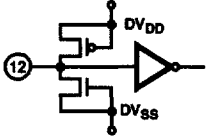
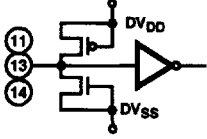
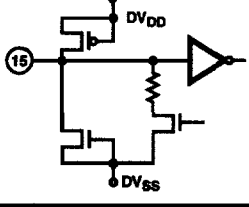
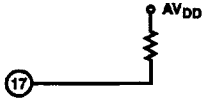
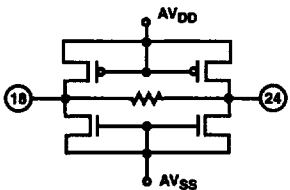


4  
A/D CONVERTERS  
HIGH SPEED

Functional Block Diagram



**Pin Descriptions**

PIN NUMBER	SYMBOL	EQUIVALENT CIRCUIT	DESCRIPTION
1 to 8	D0 to D7		D0 (LSB) to D7 (MSB) Output.
9	TEST		Leave open during normal usage.
10	DV <sub>DD</sub>		Digital +3.3V.
12	CLK		Clock Input.
11, 13, 14	TEST		Fix Pin 11 to V <sub>DD</sub> . Pins 13 and 14 to V <sub>DD</sub> or V <sub>SS</sub> during normal usage.
15	CLP		Inputs Clamp Pulse to Pin 15 (CLP). Clamps the signal voltage during Low interval.
16, 19, 20	AV <sub>DD</sub>		Analog +3.3V
17	V <sub>RTS</sub>		Generates approximately +1.8V when shorted with V <sub>RT</sub> .
18	V <sub>RT</sub>		Reference Voltage (Top).
24	V <sub>RB</sub>		Reference Voltage (Bottom).

# HI2300

## Pin Descriptions (Continued)

PIN NUMBER	SYMBOL	EQUIVALENT CIRCUIT	DESCRIPTION
21	$V_{IN}$		Analog Input.
25	$V_{BRS}$		Generates approximately +0.4V when shorted with $V_{RB}$ .
26	$V_{REF}$		Clamp Reference Voltage Input. Clamps so that the reference voltage and the input signal during clamp interval are equal.
27	CCP		Integrates the clamp control voltage. The relationship between the changes in CCP voltage and in $V_{IN}$ voltage is positive phase.
28, 31	$DV_{SS}$		Digital Ground.
29	$\overline{CLE}$		The clamp function is enabled when $\overline{CLE} = \text{Low}$ . The clamp function is set to off and the converter functions as a normal A/D converter when $\overline{CLE} = \text{High}$ . The clamp pulse can be measured by connecting $\overline{CLE}$ to $DV_{DD}$ through a several-hundred-ohm resistor.
30	$\overline{OE}$		Data is output when $\overline{OE} = \text{Low}$ . Pins D0 to D7 are at high impedance when $\overline{OE} = \text{High}$ .
32	NC		No Connect pin.

# HI2300

## Absolute Maximum Ratings $T_A = 25^\circ\text{C}$

Supply Voltage ( $V_{DD}$ )	7V
Reference Voltage ( $V_{RT}, V_{RB}$ )	$V_{DD} + 0.5\text{V}$ to $V_{SS} - 0.5\text{V}$
Input Voltage, Analog ( $V_{IN}$ )	$V_{DD} + 0.5\text{V}$ to $V_{SS} - 0.5\text{V}$
Input Voltage, Digital ( $V_{IH}, V_{IL}$ )	$V_{DD} + 0.5\text{V}$ to $V_{SS} - 0.5\text{V}$
Output Voltage, Digital ( $V_{OH}, V_{OL}$ )	$V_{DD} + 0.5\text{V}$ to $V_{SS} - 0.5\text{V}$

## Thermal Information

Thermal Resistance (Typical, Note 1)	$\theta_{JA}$ ( $^\circ\text{C}/\text{W}$ )
MQFP Package	122
Maximum Junction Temperature (Plastic Package)	$150^\circ\text{C}$
Maximum Storage Temperature Range	$-65^\circ\text{C}$ to $150^\circ\text{C}$
Maximum Lead Temperature (Soldering 10s)	$300^\circ\text{C}$
(MQFP - Lead Tips Only)	

## Recommended Operating Conditions

Temperature Range ( $t_{OPR}$ )	$-40^\circ\text{C}$ to $85^\circ\text{C}$
Supply Voltage ( $1DV_{SS} - AV_{SS}$ )	0 to 100mV
Power Supply ( $DV_{DD}, DV_{SS}(AV_{DD}, AV_{SS})$ )	3.14V to 4.0V
Reference Input Voltage ( $V_{RB}$ )	0.4V
( $V_{RT}$ )	1.8V

Analog Input (ADIN)	$V_{RT}$ to $V_{RB}$
Clock Pulse width ( $t_{PW1}$ )	27ns (Min)
( $t_{PW0}$ )	27ns (Min)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

### NOTE:

- $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.

## Electrical Specifications When using a single power supply; $f_C = 18$ MSPS, $V_{DD} = 3.3\text{V}$ , $V_{RB} = 0\text{V}$ , $V_{RT} = 1.5\text{V}$ , $T_A = 25^\circ\text{C}$

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Maximum Conversion Rate	$f_C$ Max	$V_{IN} = 0$ to $1.5\text{V}$	18	32	-	MSPS
Minimum Conversion Rate	$f_C$ Min	$f_{IN} = 1\text{kHz Ramp}$	-	32	0.5	MSPS
Supply Current	$I_{DD}$	$f_C = 18$ MSPS, NTSC Ramp Wave Input	-	5.5	10	mA
Reference Pin Current	$I_{REF}$		3.3	4.6	6.6	mA
Analog Input Band Width	BW	$V_{IN} = 1.4\text{V}_{p-p}$ , 17.9MHz	-	-9	-	dB
Analog Input Capacitance	$C_{IN}$	$V_{IN} = 0.75\text{V} + 0.07 V_{RMS}$	-	8	-	pF
Reference Resistance ( $V_{RT}$ to $V_{RB}$ )	$R_{REF}$		230	330	440	$\Omega$
Self Bias I	$V_{RB1}$	Shorts $V_{RB}$ and $V_{RBS}$	0.33	0.36	0.39	V
	$V_{RT1} - V_{RB1}$	Shorts $V_{RT}$ and $V_{RTS}$	1.30	1.39	1.48	V
Offset Voltage	$E_{OT}$		-45	-25	-5	mV
	$E_{OB}$		40	60	80	mV
Digital Input Voltage	$V_{IH}$		2.5	-	-	V
	$V_{IL}$		-	-	0.5	V
Digital Input Current	$I_{IH}$	$V_{DD} = \text{Max}$			5	$\mu\text{A}$
	$I_{IL}$	$V_{IL} = 0\text{V}$			-	$\mu\text{A}$
Digital Output Current	$I_{OH}$	$\overline{OE} = V_{SS}$			-	mA
	$I_{OL}$	$V_{DD} = \text{Min}$			-	mA
Digital Output Current	$I_{OZH}$	$\overline{OE} = V_{DD}$			16	$\mu\text{A}$
	$I_{OZL}$	$V_{DD} = \text{Max}$			16	$\mu\text{A}$
Output Data Delay	$t_{DL}$	With TTL 1 Gate and 10pF Load	8	18	30	ns
Three-State Output Enable Time	$t_{PZH}$	$R_L = 1\text{k}\Omega$ , $C_L = 20\text{pF}$ , $\overline{OE} = 3\text{V} \rightarrow 0\text{V}$				
	$t_{PZL}$					
Three-State Output Disable Time	$t_{PHZ}$	$R_L = 1\text{k}\Omega$ , $C_L = 20\text{pF}$ , $\overline{OE} = 0\text{V} \rightarrow 3\text{V}$				
	$t_{PLZ}$					
Integral Nonlinearity Error	$E_L$	$f_C = 18$ MSPS $V_{IN} = 0$ to $1.5\text{V}$	-	+0.5	$\pm 1.3$	LSB
Differential Nonlinearity Error	$E_D$	$f_C = 18$ MSPS $V_{IN} = 0$ to $1.5\text{V}$	-	$\pm 0.3$	$\pm 0.5$	LSB
Aperture Jitter	$t_{AJ}$		-	30	-	ps
Sampling Delay	$t_{SD}$		-	4	-	ns
Clamp Offset Voltage	$E_{OC}$	$V_{IN} = \text{DC}$				
		$PWS = 3\mu\text{s}$	$V_{REF} = 0.5\text{V}$	-20	0	+20
Clamp Pulse Delay	$t_{CPD}$	$V_{REF} = 1.5\text{V}$	-30	-10	+10	mV
			-	25	-	ns

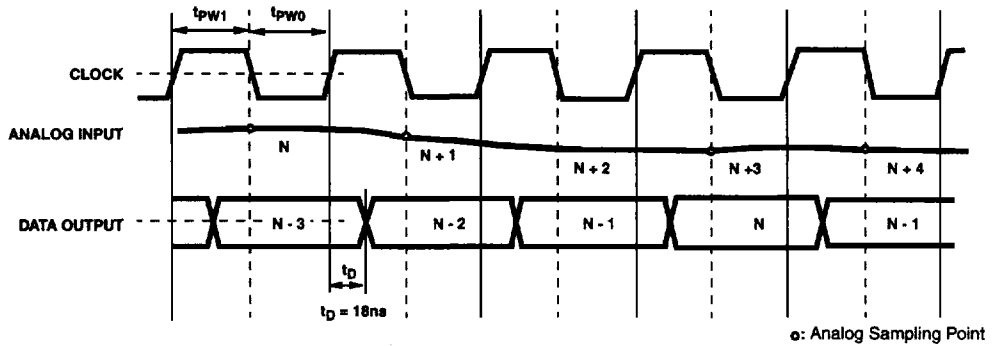
4  
A/D CONVERTERS  
HIGH SPEED

**Digital Output**

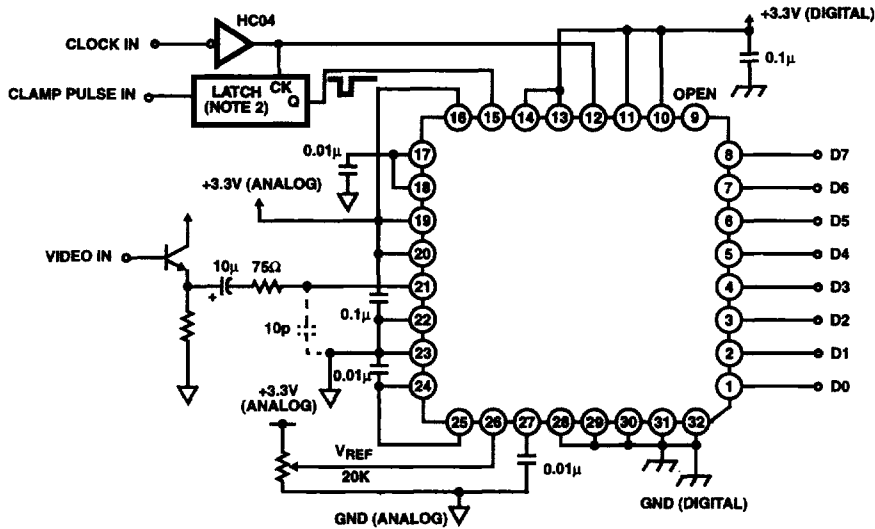
The following table shows the relationship between analog input voltage and digital output code.

INPUT SIGNAL VOLTAGE	STEP	DIGITAL OUTPUT CODE							
		MSB							LSG
V <sub>RT</sub>	0	1	1	1	1	1	1	1	1
•	•					•			
•	•					•			
•	•					•			
•	127	1	0	0	0	0	0	0	0
•	128	0	1	1	1	1	1	1	1
•	•					•			
•	•					•			
•	•					•			
V <sub>RB</sub>	255	0	0	0	0	0	0	0	0

**Timing Chart**



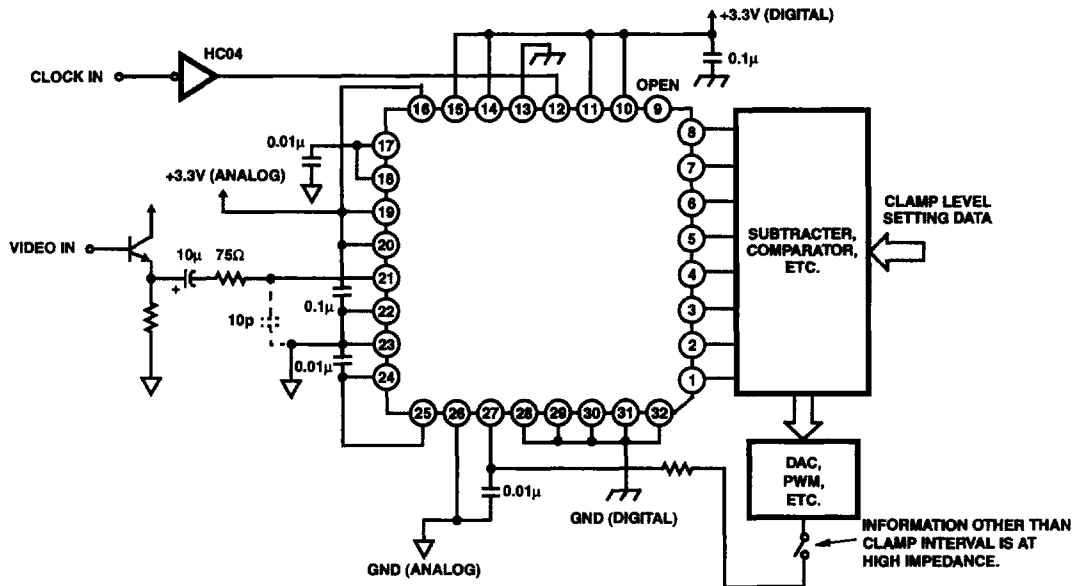
Typical Application Circuits



NOTE:

1. The clamp pulse is latched by the sampling clock of ADC, but that is not necessary for basic clamp operation. However, slight small beat may be generated as Vertical sag according to the relationship between the sampling frequency and the clamp pulse frequency. At such time, the latch circuit is effective in this case.

FIGURE 1. WHEN CLAMP IS USED (SELF BIAS)



NOTES:

2. The relationship between the changes in CCP voltage (Pin 27) and in  $V_{IN}$  voltage is positive phase.
3.  $\Delta V_{IN} / \Delta V_{CCP} = 3.0$  ( $f_s = 20$  MSPS).

FIGURE 2. DIGITAL CLAMP (SELF BIAS)

Typical Application Circuits (Continued)

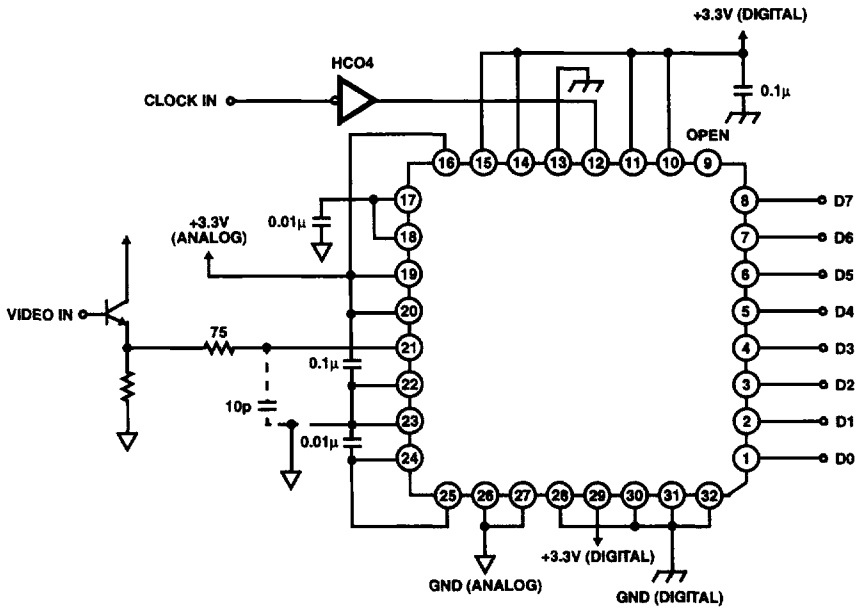


FIGURE 3. WHEN CLAMP IS NOT USED (SELF BIAS)