

# TC35071P/F

CMOS A/D CONVERTER

TOSHIBA (LOGIC/MEMORY)

## (8-BIT A-D CONVERTER FOR PICTURE SIGNAL PROCESSING)

### 1. GENERAL DESCRIPTION

The TC35071P/F is a high-speed (20MSPS), low power dissipation (45mW) two step-parallel type CMOS 8-bit A-D converter which is suited for picture processing.

### 2. FEATURES

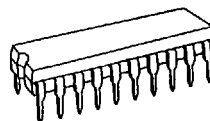
- Resolution : 8 bit
- Linearity :  $\pm 1.0$  LSB MAX.
- Max. conversion rate : 20 MHz MAX.
- Single power supply :  $5.0\text{ V} \pm 10\%$
- Low power dissipation : 45 mW (Typ.)
- Built - in sample & hold circuit

#### 2.1 APPLICATIONS

- Digital TV, digital VTR
- Digital picture processing system
- Various high-speed measuring instruments

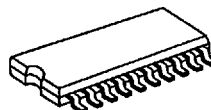
### Advance Information

TC35071P

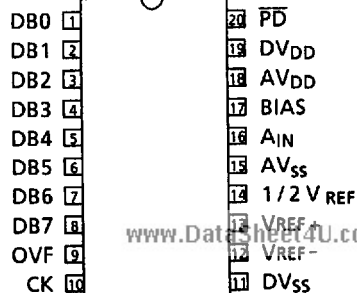


DIP20-P-300A

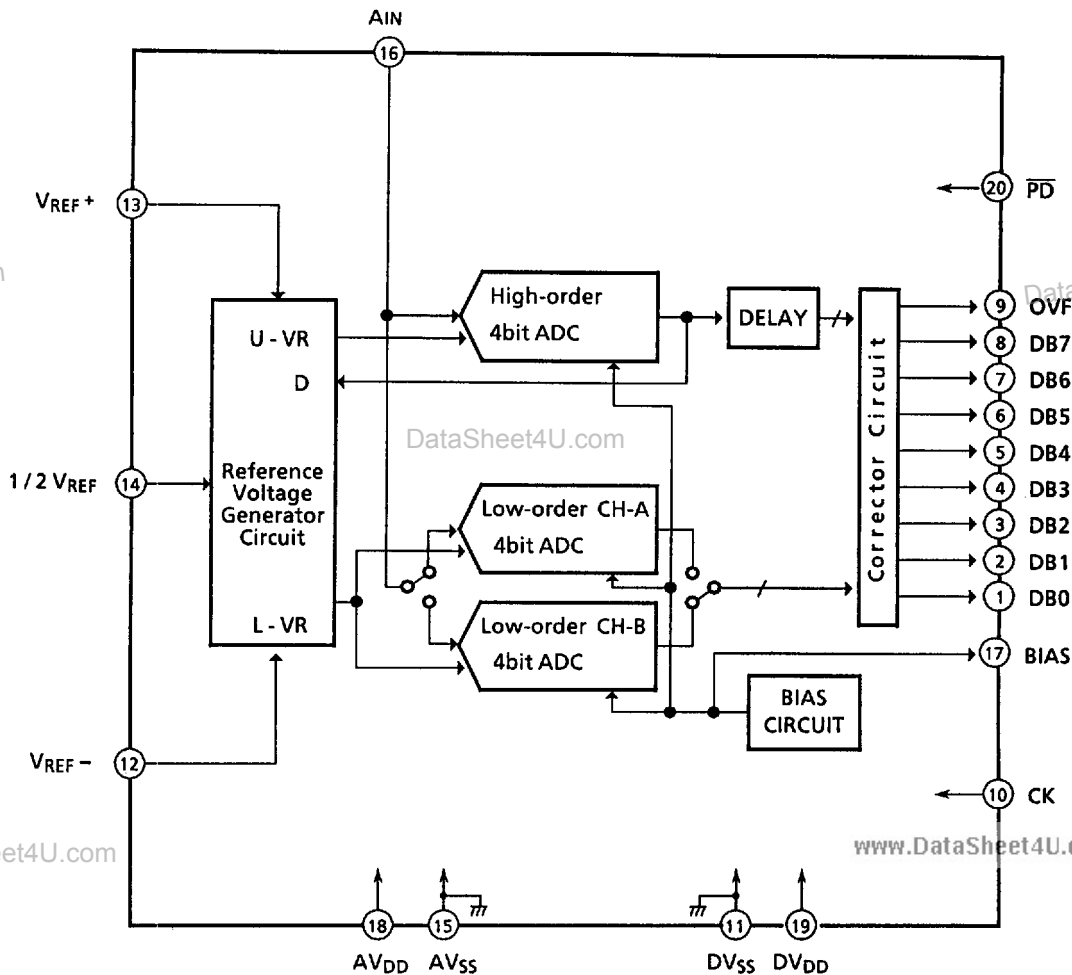
TC35071F



SOP20-P-300



### 3. SYSTEM DESCRIPTION



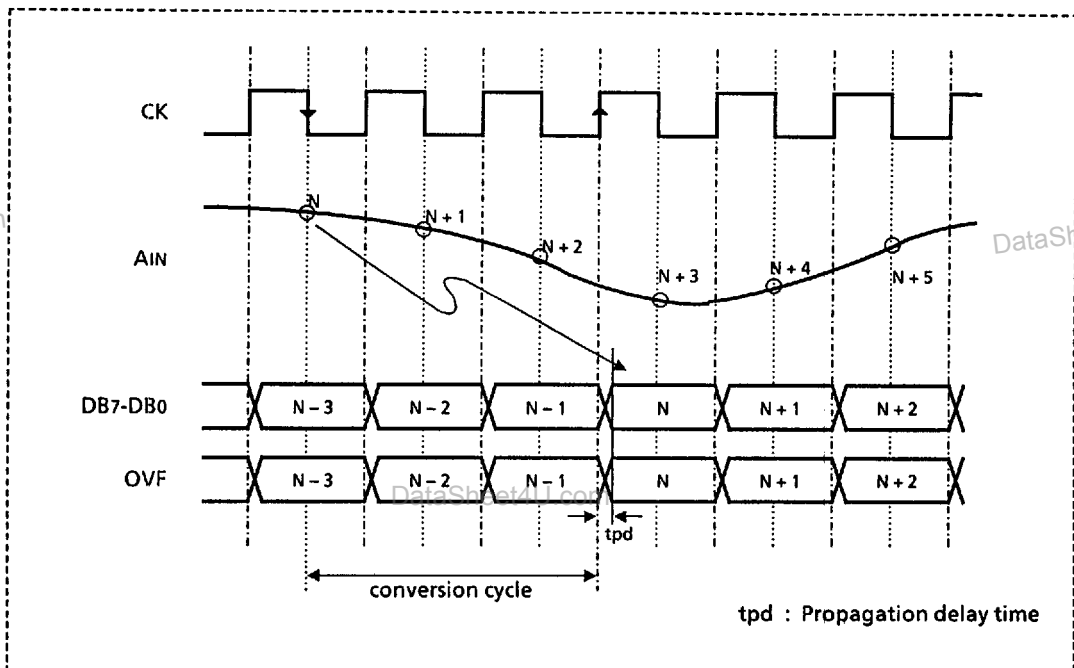
## 4. PIN DESCRIPTION

PIN No.	Symbol	NAME & FUNCTION
1	DB0	[Data Output]
2	DB1	Converted data output terminal
3	DB2	DB0 : LSB
4	DB3	DB7 : MSB
5	DB4	OVF : Overflow
6	DB5	
7	DB6	
8	DB7	
9	OVF	
10	CK	[System Clock] System Clock
11	DV <sub>SS</sub>	[Ground] Ground terminal of the digital unit    Normal : 0.0 V
12	V <sub>REF -</sub>	[Reference Voltage] Reference voltage supply terminal for deciding the zero point of A <sub>IN</sub>
13	V <sub>REF +</sub>	[Reference Voltage] Reference voltage supply terminal for deciding the full scale point of A <sub>IN</sub>
14	1/2 V <sub>REF</sub>	[Reference Voltage] Reference voltage intermediate tap
15	AV <sub>SS</sub>	[Ground] Ground terminal of the comparator    Normal : 0.0 V
16	A <sub>IN</sub>	[Analog Input] Analog input terminal    Input range : V <sub>REF -</sub> ~ V <sub>REF +</sub>
17	BIAS	[BIAS]
18	AV <sub>DD</sub>	[Power Supply] Power supply terminal of the comparator    5.0 V ± 10 %
19	DV <sub>DD</sub>	[Power Supply] Power supply terminal of the digital unit    5.0 V ± 10 %
20	P <sub>D</sub>	[Power Down] Power down terminal

## 5. FUNCTIONAL DESCRIPTION

### 5.1 TIMING CHART

#### (1) A-D Conversion Timing



### 5.2 A-D CONVERSION OPERATION

This A-D converter has adopted the series-parallel type comparison system and its upper and lower comparators are equipped with the sample & hold function, respectively and therefore, no external sample & hold circuit is required.

The series-parallel type normally requires a conversion time two and a half times longer than that of parallel comparison type. However, this A-D converter can get data at the same rate as normal parallel type A-D converter as 2 channels have been given to the low order side comparator and the internal conversion clock has been optimized. (Two and a half A-D conversion times is needed.)

This state is shown in "5.1 (1) A-D Conversion Timing".

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The input signal sampled at the leading edge of CK is obtained as conversion data after 2.5 clock cycles of CK.

## 6. ELECTRICAL CHARACTERISTICS

### 6.1 MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT
Supply Voltage	$V_{DD}$	$V_{SS} - 0.5 \sim V_{SS} + 7$	V
Input Voltage	$V_{IN}$	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Output Voltage	$V_{OUT}$	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Reference Supply Voltage	$V_{REF}$	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Analog Ground Voltage	$A_{GND}$	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Input Current	$I_{IN}$	$\pm 10$	mA
Power Dissipation	$P_D$	625 (DIP), 500 (SOP)	mW
Storage Temperature	$T_{stg}$	-65~150	°C

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### 6.2 RECOMMENDED OPERATING CONDITIONS ( $V_{SS} = 0.0$ V)

ITEM		SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply Voltage		$V_{DD}$		4.5	5.0	5.5	V
Input Voltage		$V_{IN}$		0		$V_{DD}$	V
Reference Voltage	High Level	$V_{REF+}$	$V_{DD} = 5.0$ V, $V_{REF-} = 0.0$ V	2.0		$V_{DD}$	V
	Low Level	$V_{REF-}$	$V_{DD} = 5.0$ V, $V_{REF+} = 5.0$ V	0		3.0	V
$V_{REF+} - V_{REF-}$ Voltage			$V_{DD} = 5.0$ V $\pm 10$ %	2.0		$V_{DD}$	V
Clock Frequency		$f_{ck}$	$V_{DD} = 5.0$ V $\pm 10$ %	1.0		20	MHz
Operating Temperature		$T_{opr}$		0		70	°C

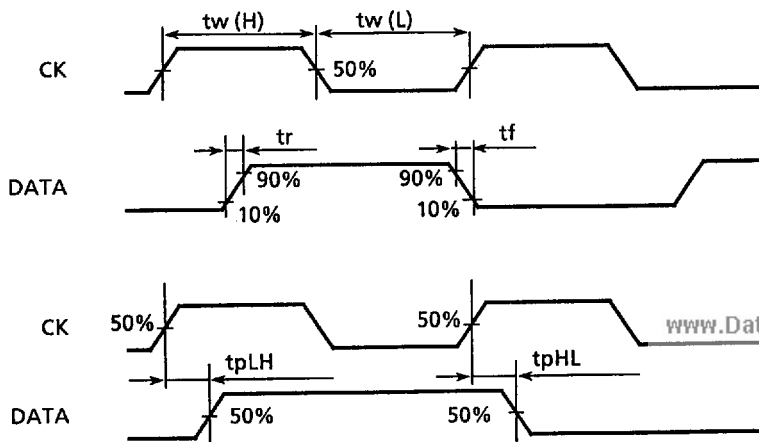
6.3 DC ELECTRICAL CHARACTERISTICS ( $V_{DD} = 5.0\text{ V} \pm 10\%$ ,  $V_{SS} = 0\text{ V}$ )

ITEM		SYM-BOL	CONDITIONS	$T_a = 25\text{ }^\circ\text{C}$			$T_a = 0\sim 70\text{ }^\circ\text{C}$		UNIT
				MIN.	TYP.	MAX.	MIN.	MAX.	
Output Voltage	"H" Level	$V_{OH}$	$ I_{OUT}  < 1\ \mu\text{A}$ $V_{IN} = V_{SS}, V_{DD}$	$V_{DD}$ -0.05	$V_{DD}$	-	$V_{DD}$ -0.05	-	V
	"L" Level	$V_{OL}$	$ I_{OUT}  < 1\ \mu\text{A}$ $V_{IN} = V_{SS}, V_{DD}$	-	0	0.05	-	0.05	
Output Current	"H" Level	$I_{OH}$	$V_{OH} = V_{DD} - 0.4\text{ V}$ $V_{IN} = V_{SS}, V_{DD}$	-0.44	-	-	-0.36	-	mA
	"L" Level	$I_{OL}$	$V_{OL} = 0.4\text{ V}$ $V_{IN} = V_{SS}, V_{DD}$	2.0	-	-	1.6	-	
Input Voltage	"H" Level	$V_{IH}$	$ I_{OUT}  < 1\ \mu\text{A}$ $V_{OUT} = 0.5\text{ V}, V_{DD} - 0.4\text{ V}$	$V_{DD}$ $\times 0.7$	-	-	$V_{DD}$ $\times 0.7$	-	V
	"L" Level	$V_{IL}$	$ I_{OUT}  < 1\ \mu\text{A}$ $V_{OUT} = 0.5\text{ V}, V_{DD} - 0.4\text{ V}$	-	-	$V_{DD}$ $\times 0.3$	-	$V_{DD}$ $\times 0.3$	
Digital Input Current		$I_{IH}$ $I_{IL}$	$V_{IH} = V_{DD}$ or $V_{IL} = 0.0\text{ V}$	-	-	$\pm 0.3$	-	$\pm 1$	$\mu\text{A}$
Dynamic Analog Input Current		$I_{AIND}$	$V_{AIN} = 0.0\text{ V}$ or $V_{DD}$ $f_{ck} = 20\text{ MHz}$	-	$\pm 150$	-	-	-	$\mu\text{A}$
Static Analog Input Current		$I_{AINS}$	$V_{AIN} = 0.0\text{ V}$ or $V_{DD}$ $f_{ck} = \text{"H" or "L"}$	-	-	$\pm 0.3$	-	$\pm 1$	$\mu\text{A}$
Operating Power Dissipation		$I_{DD}$	$f_{ck} = 20\text{ MHz}$	-	9	12	-	-	mW
Stand-by Current		$I_{QD}$	$\overline{PD} = \text{"L"}, CK = \text{"H" or "L"}$	-	-	-	-	-	$\mu\text{A}$
Ref Resistance		$R_{REF}$		-	600	-	-	-	$\Omega$

6.4 AC ELECTRICAL CHARACTERISTICS ( $V_{DD} = 5.0 \text{ V} \pm 10\%$ ,  $V_{SS} = 0.0 \text{ V}$ ,  $T_a = 25^\circ \text{C}$ )

ITEM	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Rise, Fall Time	$t_r, t_f$	$C_L = 20 \text{ pF}$	-	-	20	nS
Propagation Delay Time CK - Data	$t_{pLH}$ $t_{pHL}$	$C_L = 20 \text{ pF}$	-	-	40	nS
Clock Pulse Width	$t_w (H, L)$		25	-	500	nS
Aperture Time	$t_{AP}$		-	10	-	nS
Input Capacity	$C_{IN1}$	Digital Input		5		pF
	$C_{IN2}$	Analog Input		15		pF
Output Capacity	$C_{OUT}$			10		pF

## 6.4.1 AC ELECTRICAL CHARACTERISTICS MEASURED WAVEFORMS



## 6.5 SYSTEM CHARACTERISTICS

( $V_{DD} = 5.0 \text{ V} \pm 10 \%$ ,  $V_{REF+} = 5.00 \text{ V}$ ,  $V_{REF-} = 3.00 \text{ V}$ ,  $T_a = 0 \sim 70 \text{ }^\circ\text{C}$ )

ITEM	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Non - linearity Error	ILE	$f_{ck} = 20 \text{ MHz}$	-	-	$\pm 1.0$	LSB
Differential Non - linearity Error	DLE		-	-	$\pm 0.8$	LSB
Differential Gain Error	DG	NTSC mod ramp	-	2	-	%
Differential Phase Error	DP	$f_{ck} = 14.318 \text{ MSPS}$	-	1	-	deg
SNR.		$f_{IN} = 5 \text{ MHz}$ $f_{ck} = 20 \text{ MHz}$	40	-	-	dB
Analog Input Band		$f_{ck} = 20 \text{ MHz}$ -1dB	-	5	-	MHz
PSRR			-		-	dB