

TC5093AP 8 BIT ANALOG TO DIGITAL CONVERTER

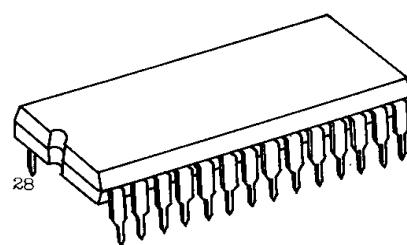
GENERAL DESCRIPTION

The TC5093AP is a monolithic CMOS 8 bit successive approximation A/D converter with 8 channel multiplex inputs. After an analog input channel is selected with channel select input (CH0 ~ 2) and channel latch input (CHL), when STC is set high EOC goes low at the leading edge of STC and the conversion starts. After the conversion is completed, EOC returns high and the new data replace the previous data at DB0 ~ DB7.

The TC5093AP has features of high speed, high accuracy and very low power consumption which make the device well suited to a broad application field such as process and machine control and automotive equipment.

FEATURES

- High accuracy $\pm \frac{1}{2}$ LSB TYP
- High speed conversion 100 μ sec TYP @ f_{cp} = 640 kHz
- Single power supply 5V \pm 10%
- Low power consumption 9mW MAX @ T_a = 25°C
- 8 channel analog multiplex input
- Easy interface to all microprocessors
- Zero or full scale adjustment free
- Latched 3-state output



DIP28 (6D28A-P)

PIN ASSIGNMENT

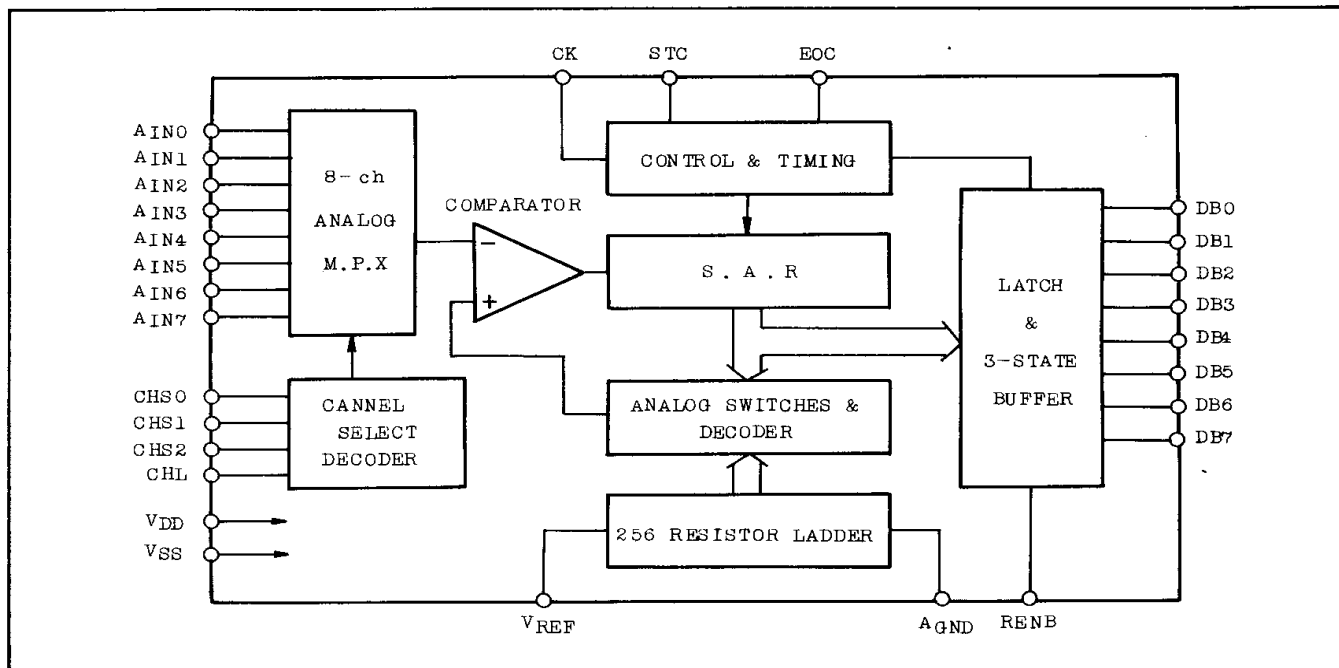
AIN3	1	28	AIN2
AIN4	2	27	AIN1
AIN5	3	26	AIN0
AIN6	4	25	CHS0
AIN7	5	24	CHS1
STC	6	23	CHS2
EOC	7	22	CHL
DB3	8	21	DB7
RENB	9	20	DB6
CLOCK	10	19	DB5
VDD	11	18	DB4
VREF	12	17	DB0
VSS	13	16	AGND
DB1	14	15	DB2

(TOP VIEW)

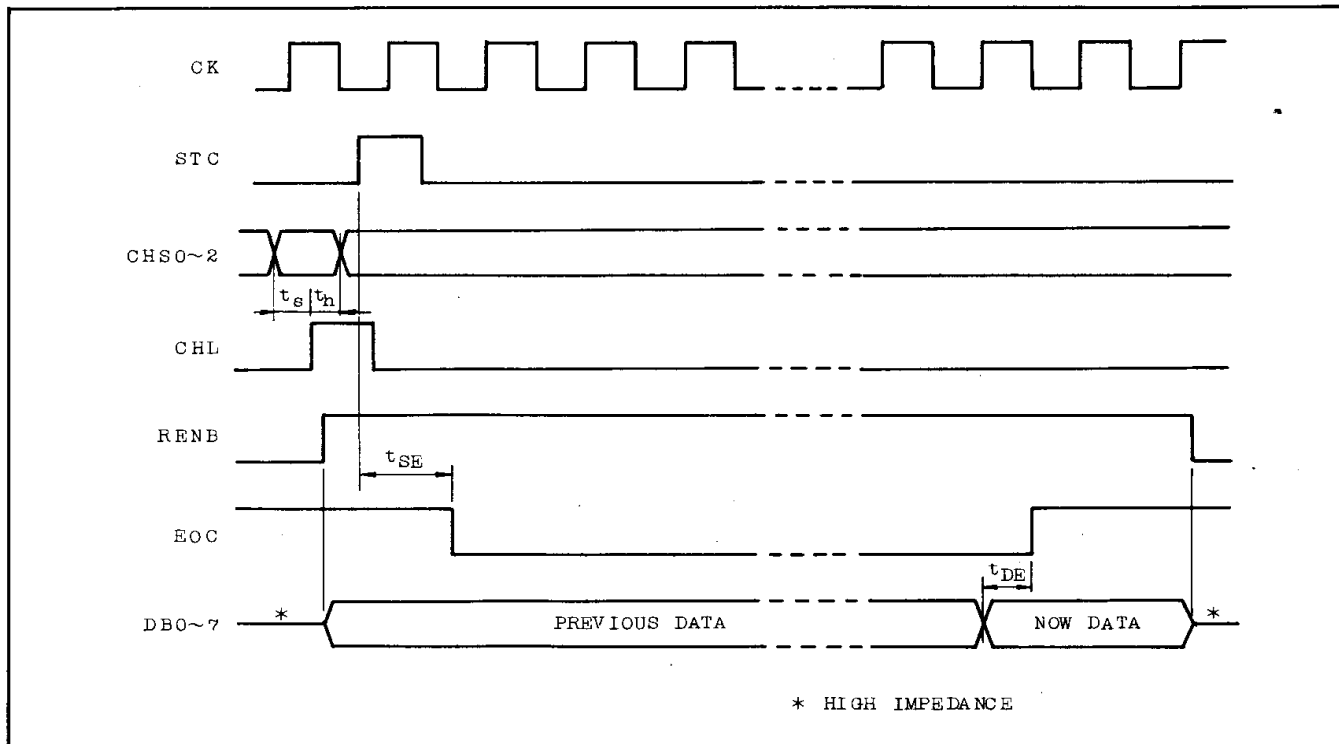
ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage Range	VDD	VSS-0.5 ~ VSS + 7	V
DC Input Voltage	VIN	VSS-0.5 ~ VDD + 0.5	V
DC Output Voltage	VOUT	VSS-0.5 ~ VDD + 0.5	V
Reference Voltage	VREF	VSS-0.5 ~ VDD + 0.5	V
Analog Ground Voltage	AGND	VSS-0.5 ~ VDD + 0.5	V
DC Input Current	IIN	± 10	mA
Power Dissipation	P _D	300	mW
Storage Temperature	T _{STG}	-65 ~ 150	°C
Lead Temperature 10 sec.	T _L	300	°C

BLOCK DIAGRAM



TIMING CHART



PIN & FUNCTION

PIN NO.	SYMBOL	PIN NAME & FUNCTION	PIN NO.	SYMBOL	PIN NAME & FUNCTION
1	A _{IN3}	[ANALOG INPUT] The analog input voltage applied to the selected channel is converted. Full range of input signal is to be from A _{GND} to V _{REF} .	15	DB2	3-STATE PARALLEL DATA OUTPUT
2	A _{IN4}		16	A _{GND}	[ANALOG GROUND] A _{GND} defines the zero level of A _{IN} .
3	A _{IN5}		17	DB0	3-STATE PARALLEL DATA OUTPUT DB0 : LSB DB7 : MSB
4	A _{IN6}		18	DB4	
5	A _{IN7}		19	DB5	
6	STC	[START CONVERSION] Conversion starts at the falling edge of STC.	20	DB6	
7	EOC	[END OF CONVERSION] EOC becomes low level at the rising edge of STC. And when the conversion is completed EOC returns to high level.	21	DB7	
8	DB3	3-STATE PARALLEL DATA OUTPUT	22	CHL	[CHANNEL LATCH INPUT] The channel select signals CHS0 ~2 are latched at the rising edge of CHL.
9	RENB	[READ ENABLE] Output enable signal "H" = DB0 ~7 enable "L" = DB0 ~7 high impedance	23	CHS2	[CHANNEL SELECT INPUT] One of A _{IN0} ~A _{IN7} is selected according to the status of CH0 ~CH2.
10	CLOCK	[CLOCK INPUT] Basic system clock	24	CHS2	
11	V _{DD}	[SYSTEM POWER SUPPLY] V _{DD} =5V ±10%	25	CHS0	
12	V _{REF}	[REFERENCE VOLTAGE] V _{REF} defines the full scale of A _{IN} .	25	CHS0	
13	V _{SS}	[SYSTEM GROUND] V _{SS} =0V	26	A _{IN0}	[ANALOG INPUT]
14	DB1	3-STATE PARALLEL DATA OUTPUT	27	A _{IN1}	
			28	A _{IN2}	

CHS2	CHS1	CHS0	ON CHANNEL
L	L	L	A _{IN0}
L	L	H	A _{IN1}
L	H	L	A _{IN2}
L	H	H	A _{IN3}
H	L	L	A _{IN4}
H	L	H	A _{IN5}
H	H	L	A _{IN6}
H	H	H	A _{IN7}

RECOMMENDED OPERATING CONDITIONS ($V_{SS}=0V$)

PARAMETER	SYMBOL	CONDITION	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	V_{REF}	$V_{DD}=5V$, $AGND=0V$	3.5	V_{DD}	V_{DD}	V
Analog Ground Voltage	$AGND$	$V_{DD}=5V$, $V_{REF}=5V$	0.0	0.0	3.0	V
Voltage Between V_{REF} and $AGND$		$V_{DD}=5V \pm 10\%$	2.0	V_{DD}	V_{DD}	V
Clock Frequency	f_{cp}	$V_{DD}=5V \pm 10\%$ Duty Cycle=50%	10	640	1280	kHz
Operating Temperature	T_{opr}		-40	-	+85	$^{\circ}C$

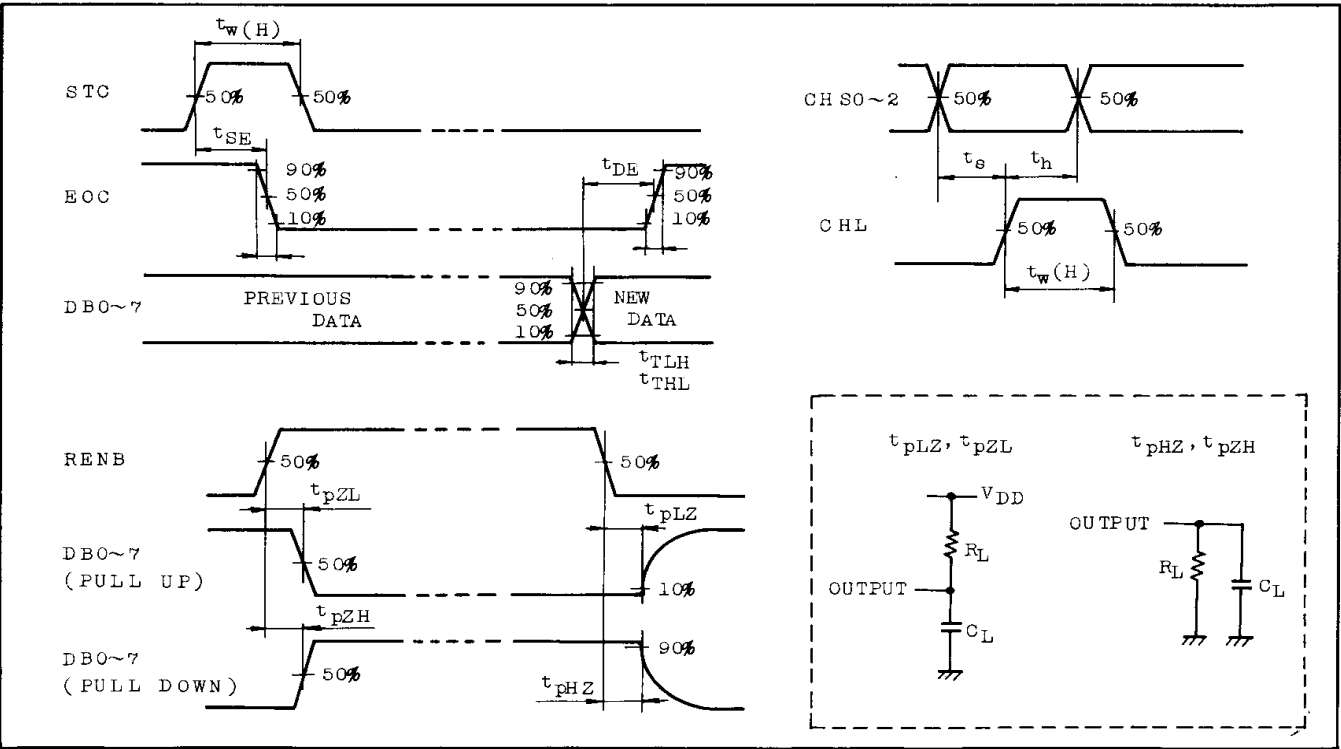
DC ELECTRICAL CHARACTERISTICS ($V_{SS}=0V$)

PARAMETER	SYMBOL	TEST CONDITION	V_{DD}	-40 $^{\circ}C$		25 $^{\circ}C$			85 $^{\circ}C$		UNIT
				MIN.	MAX.	MIN.	TYP.	MAX.	MIN.	MAX.	
High Level Output Voltage	V_{OH}	$ I_{OUT} < 1\mu A$ $V_{IN}=V_{SS}, V_{DD}$	5.0	4.95	-	4.95	5.00	-	4.95	-	V
Low Level Output Voltage	V_{OL}	$ I_{OUT} < 1\mu A$ $V_{IN}=V_{SS}, V_{DD}$	5.0	-	0.05	-	0.00	0.05	-	0.05	V
High Level Output Current	I_{OH}	$V_{OH}=4.6V$ $V_{IN}=V_{SS}, V_{DD}$	5.0	-1.2	-	-	-	-	-0.7	-	mA
Low Level Output Current	I_{OL}	$V_{OL}=0.4V$ $V_{IN}=V_{SS}, V_{DD}$	5.0	2.4	-	2.0	-	-	1.6	-	mA
High Level Input Voltage	V_{IH}	$ I_{OUT} < 1\mu A$ $V_{OUT}=0.5V, 4.5V$	5.0	3.5	-	3.5	-	-	3.5	-	V
Low Level Input Voltage	V_{IL}	$ I_{OUT} < 1\mu A$ $V_{OUT}=0.5V, 4.5V$	5.0	-	1.5	-	-	1.5	-	1.5	V
3-State Output Disable Current	I_{DH} I_{DL}	$V_{OH}=5.5V$ or $V_{OL}=0.0V$	5.5	-	± 0.5	-	-	± 0.5	-	± 1	μA
Digital Input Current	I_{IH} I_{IL}	$V_{IH}=5.5V$ or $V_{IL}=0.0V$	5.5	-	± 0.3	-	-	± 0.3	-	± 1	μA
On Channel Input Current	I_{ON}	$V_{IH}=5.5V$ or $V_{IL}=0.0V$ $f_{cp} = \text{kHz}$	5.5	-	± 2	-	-	± 2	-	± 5	μA
OFF Channel Input Current	I_{OFF}	$V_{IH}=5.5V$ or $V_{IL}=0.0V$	5.5	-	± 0.2	-	-	± 0.2	-	± 1	μA
Operating Current	I_{DD}	$f_{cp}=1 \text{ MHz}$	5.0	-	2.0	-	-	1.8	-	2.0	mA
Reference Resistance	R_{REF}		-	4.0	1.7	4.3	7.5	17	4.3	19	k Ω

SWITCHING CHARACTERISTICS (V_{DD}=5.0V, T_a=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Transition Time	t _{TLH} t _{THL}	C _L =50pF	-	50	100	nS
Propagation Delay Time (STC - EOC)	t _{SE}	C _L =50pF	10	1/2 CLOCK + 200	1/2 CLOCK + 600	
Data-EOC Time	t _{DE}	C _L =50pF	1 CLOCK - 300	1 CLOCK - 70	1 CLOCK	
3-State Output Enable Time	t _{pZH} t _{pZL}	C _L =50pF R _L =1k	-	85	200	
3-State Output Disable Time	t _{pHZ} t _{pLZ}		-	85 65	200 200	
Minimum Pulse Width (STC. CHL)	t _w (H)	C _L =50pF	-	40	100	
Minimum Set-up Time (CHS0 ~2)	t _s	C _L =50pF	-	2	50	
Minimum Hold Time (CHS0 ~2)	t _h	C _L =50pF	-	0	50	pF
Input Capacitance	C _{IN1}	Digital Input	-	5	-	
Input Capacitance	C _{IN2}	Analog In(ON)	-	-	-	
Input Capacitance	C _{IN3}	Analog In(OFF)	-	-	-	
Output Capacitance	C _{OUT}	3-State Out	-	10	-	

SWITCHING CHARACTERISTICS TEST WAVEFORM



SYSTEM CHARACTERISTICS (T_a=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Zero Point Error	E _{ZR}	V _{DD} =5.0V V _{REF} =5.000V t _{CP} =1 MHz	-	$\pm \frac{1}{4}$	±1	LSB
Full Scale Error	E _{FS}		-	$\pm \frac{1}{2}$	±1	
Nonlinearity Error	E _{LI}		-	$\pm \frac{1}{2}$	±1	
Conversion Time	T _C	f _{CP} =640 kHz	-	100		μs
		f _{CP} =1280 kHz	-	50		