

TC35095P 8 BIT 8-CH SERIAL I/O ANALOG TO DIGITAL CONVERTER

GENERAL DESCRIPTION

The TC35095P is a monolithic CMOS 8 bit successive approximation A/D converter with serial I/O and 8 channel multiplex inputs.

Conversion start when \overline{CS} is set low and start bit ("L" level) and channel select bit (three bits) are given to serial input DI.

In case that \overline{SE} is high, as soon as the conversion starts a start bit ("L" level) appears at serial output DO and 8 bit conversion data (MSB first) and a stop bit ("H" level) follow continuously.

In case that \overline{SE} is low, after the conversion is completed a start bit, 8 bit conversion data (LSB first) and a stop bit appear at DO.

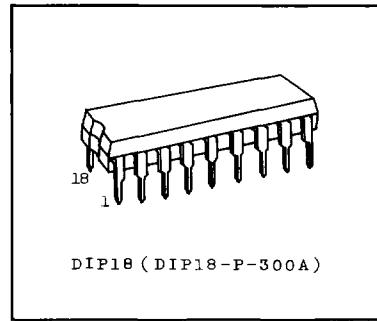
The TC35095P has features of high speed, high accuracy and microprocessor compatible I/O which make the device well suited to a broad application field such as process and machine control and automotive equipment.

FEATURES

- High accuracy $\pm \frac{3}{4}$ LSB MAX
- High speed conversion 35 μ sec MAX @ $f_{cp}=400$ kHz
- Single Power supply 5V $\pm 10\%$
- Low Power consumption 5mW MAX @ $T_a=25^\circ C$
- Serial I/O
- 8 channel analog multiplex input
- Easy interface to all microprocessors
- 3-state output
- Zero or full scale adjustment free

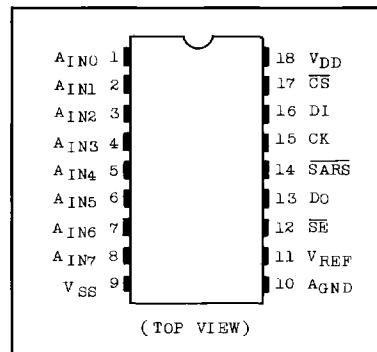
MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage Range	V_{DD}	$V_{SS}-0.5 \sim V_{SS}+7$	V
DC Input Voltage	V_{IN}	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
DC Output Voltage	V_{OUT}	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
Reference 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
DC Input Current	I_{IN}	± 10	mA
Power Dissipation	P_D	300	mW
Storage Temperature	T_{stg}	-65 ~ 150	°C
Lead Temperature 10sec.	T_L	300	°C

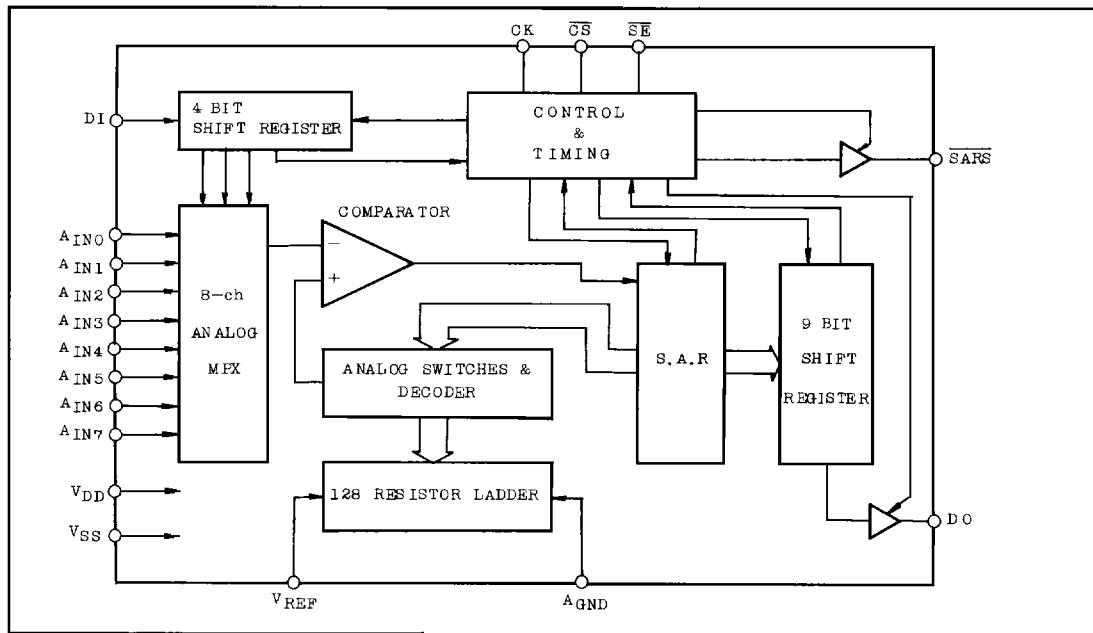


DIP18 (DIP18-P-300A)

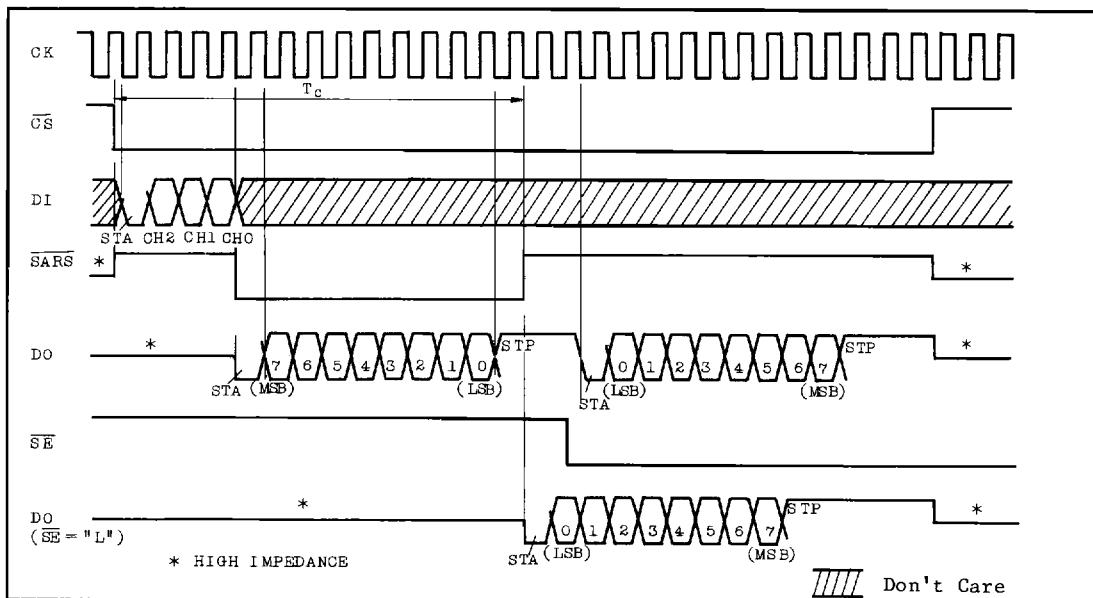
PIN ASSIGNMENT



BLOCK DIAGRAM



TIMING CHART



PIN & FUNCTION

PIN NO.	SYMBOL	PIN NAME & FUNCTION	PIN NO.	SYMBOL	PIN NAME & FUNCTION
1	A _{IN0}	[ANALOG INPUT] One of A _{IN0} ~ A _{IN7} is selected according to the serial channel select bit applied on DI input. Full range of input signal is to be from A _{GND} to V _{REF} .	10	A _{GND}	[ANALOG GROUND] A _{GND} defines the zero level of A _{IN} .
2	A _{IN1}		11	V _{REF}	[REFERENCE VOLTAGE] V _{REF} defines the full scale of A _{IN} .
3	A _{IN2}		12	S _E	[SELECT INPUT] S _E determines the order of output data. S _E ="L" LSB first S _E ="H" MSB first
4	A _{IN3}		13	D _O	[DATA OUTPUT] Output data is sent out in series.
5	A _{IN4}		14	S _{ARS}	[SAR STATUS] When a start bit ("L" level) is detected at DI input, S _{ARS} is set "L" level and conversion starts. When conversion is completed S _{ARS} returns to "H" level.
6	A _{IN5}		15	C _K	[CLOCK INPUT] Basic system clock. Duty cycle is to be 50%.
7	A _{IN6}		16	D _I	[DATA INPUT] For starting the conversion a start bit ("L" level) and channel select bit (from CH2 to CHO in order) are to be applied.
8	A _{IN7}		17	C _S	[CHIP SELECT] At the falling edge of C _S , the device is set stand-by for conversion. When C _S is "H" the device is reset and all outputs become high impedance.
9	V _{SS}	[DIGITAL GROUND]	18	V _{DD}	[Power Supply] 5V ± 10%

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

CHARACTERISTIC	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}	$V_{DD}=5V, AGND=0V$	2.0	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}	$V_{DD}=5V \pm 10\%$	-	-	400	kHz
Clock Pulse Width	$t_{W(H)}$ $t_{W(L)}$	$V_{DD}=5V \pm 10\%$	1.00	1.25	-	μs
Operating Temperature	T_{OPR}		-40	-	+85	$^{\circ}C$

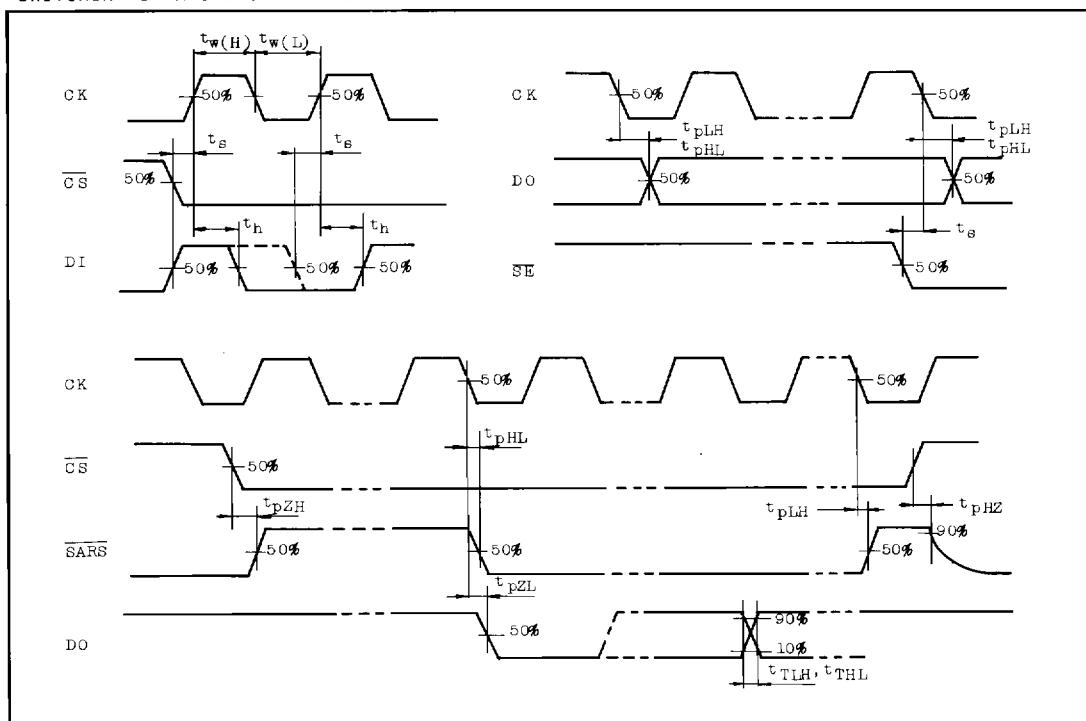
DC ELECTRICAL CHARACTERISTICS ($V_{DD}=5V \pm 10\%, V_{SS}=0V$)

CHARACTERISTIC	SYMBOL	TEST CONDITION	25°C			-40 ~ 85°C		UNIT
			MIN.	TYP.	MAX.	MIN.	MAX.	
High Level Output Voltage	V_{OH}	$ I_{OUT} < 1\mu A$ $V_{IN}=V_{SS}, V_{DD}$	$V_{DD}-0.05$	V_{DD}	-	$V_{DD}-0.05$	-	V
Low Level Output Voltage	V_{OL}	$ I_{OUT} < 1\mu A$ $V_{IN}=V_{SS}, V_{DD}$	-	0.00	0.05	-	0.05	V
High Level Output Current	I_{OH}	$V_{OH}=V_{DD}-0.4V$ $V_{IN}=V_{SS}, V_{DD}$	-0.44	-	-	-0.36	-	mA
Low Level Output Current	I_{OL}	$V_{OL}=0.4V$ $V_{IN}=V_{SS}, V_{DD}$	2.0	-	-	1.6	-	mA
High Level Input Voltage	V_{IH}	$ I_{OUT} < 1\mu A$ $V_{OUT}=0.5V, V_{DD}=0.5V$	0.7 $\times V_{DD}$	-	-	0.7 $\times V_{DD}$	-	V
Low Level Input Voltage	V_{IL}	$ I_{OUT} < 1\mu A$ $V_{OUT}=0.5V, V_{DD}=0.5V$	-	-	0.3 $\times V_{DD}$	-	0.3 $\times V_{DD}$	V
3-State Output Disable Current	I_{DH} I_{DL}	$V_{OH}=V_{DD}$ or $V_{OL}=0.0V$	-	± 0.5	-	-	± 1	μA
Digital Input Current	I_{IH} I_{IL}	$V_{IH}=V_{DD}$ or $V_{IL}=0.0V$	-	± 0.3	-	-	± 1	μA
ON Channel Input Current	I_{ON}	$V_{IH}=V_{REF}$ or $V_{IL}=0.0V$ $f_{CP}=400kHz$	-	-	± 5	-	± 7	μA
OFF Channel Input Current	I_{OFF}	$V_{IH}=V_{DD}$ or $V_{IL}=0.0V$	-	-	± 0.2	-	± 1	μA
Operating Current	I_{DD}	$f_{CP}=400kHz$	-	-	1.1	-	1.4	mA
Reference Resistance	R_{REF}		1.4	2.6	3.8	1.2	4.2	$k\Omega$
Quiescent Supply Current	I_{DDS}	$CK=V_{DD}, V_{SS}$ $\bar{CS}=V_{DD}$	-	-	1	-	100	μA

SWITCHING CHARACTERISTICS ($V_{DD}=5V\pm10\%$, $V_{SS}=0V$, $T_a=25^\circ C$)

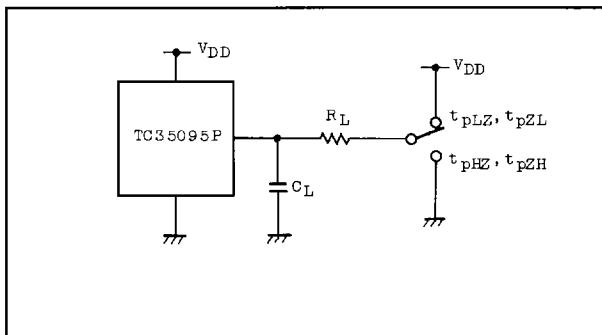
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Transition Time	t_{TLH} t_{THL}	$C_L=50pF$	-	30	100	ns
Propagation Delay Time (CK-Data)	t_{pLH} t_{pHL}	$C_L=50pF$	-	80	250	
Propagation Delay Time (CK-SARS)	t_{pLH} t_{pHL}	$C_L=50pF$	-	80	250	
3-State Output Enable Time (CS-SARS, SARS-Data)	t_{pZH} t_{pZL}	$C_L=50pF$	-	30	200	
3-State Output Disable Time (CS-SARS, Data)	t_{pHZ} t_{pLZ}	$R_L=1k$	-	60	200	
Minimum Pulse Width (CS)	$t_w(H)$	$C_L=50pF$	-	30	100	
Minimum Set-up Time (CS, SE, DI)	t_s	$C_L=50pF$	-	-10	150	
Minimum Hold Time (DI)	t_h	$C_L=50pF$	-	10	50	
Input Capacitance	C_{IN1}	Digital Input	-	5	-	pF
Input Capacitance	C_{IN2}	Analog In(ON)	-	5	-	
Input Capacitance	C_{IN3}	Analog In(OFF)	-	5	-	
Output Capacitance	C_{OUT}	3-State Out	-	10	-	

SWITCHING CHARACTERISTICS TEST WAVEFORM



TC35095P

3-STATE OUTPUT TEST CIRCUIT



SYSTEM CHARACTERISTICS (Ta = -40 ~ 85°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Zero Point Error	E _{ZR}	V _{DD} =5.0V V _{REF} =5.000V f _{cp} =400kHz Duty=50%	-	±1/4	±1/2	LSB
Full Scale Error	E _{FS}		-	±1/4	±1/2	
Nonlinearity Error	E _{LI}		-	±1/4	-	
Total Error	E _T		-	±1/4	±3/4	
Conversion Time	T _C	f _{cp} =400kHz	-	35	36.5	μs

APPLICATION CIRCUIT (EXAMPLE)

$$T_c = \frac{14}{f_{cp}} \pm \alpha \quad 0 < \alpha < \frac{1}{2f_{cp}}$$

