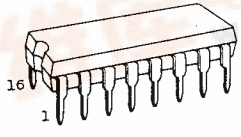
C²MOS DIGITAL INTEGRATED CIRCUIT
SILICON MONOLITHIC

TC5002BP, TC5022BP

TC5002BP, TC5022BP BCD TO 7-SEGMENT DECODER/DRIVER

TC5002BP and TC5022BP are decoders to convert BCD code input to the driving signal for 7-segment display element and equipped with NPN transistors as the output buffers enabling direct driving of common cathode type LED.
When BI input is set at "H" level, all the segment outputs are turned "OFF" (not illumination) regardless of other inputs.
RBI input is to turn the output "OFF" and RBO input is to generate "H" level output only for "0" code input and these are used for leading zero suppress when connected in cascade.

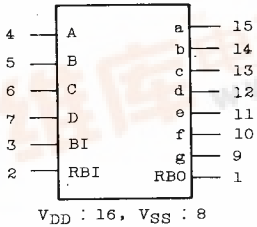


DIP 16 (3D16A-P)

ABSOLUTE MAXIMUM RATINGS

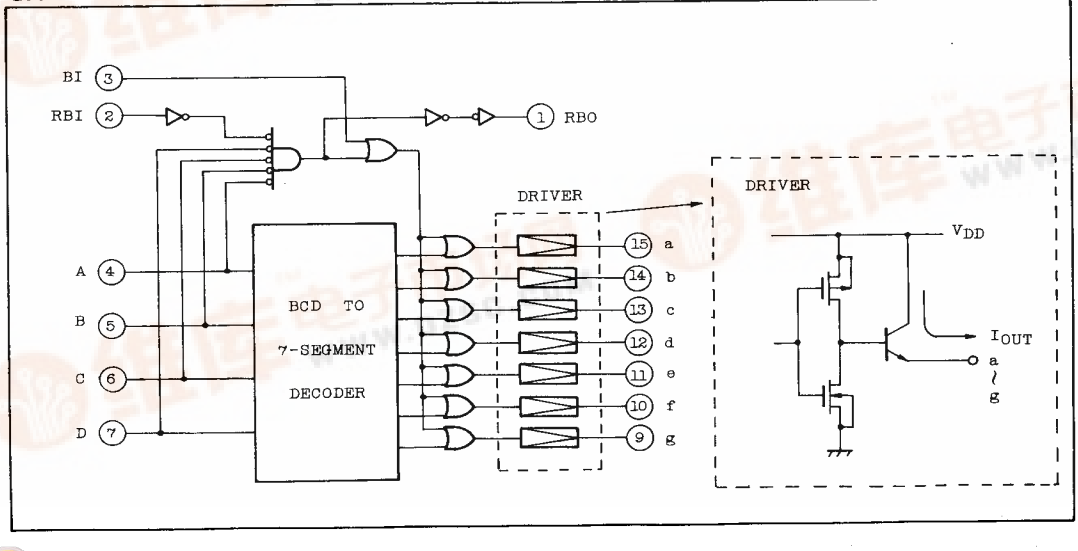
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Supply Voltage	V_{DD}	V_{SS}-0.5 ~ V_{SS}+20	V
Input Voltage	V_{IN}	V_{SS}-0.5 ~ V_{DD}+0.5	V
Output Voltage	V_{OUT}	V_{SS}-0.5 ~ V_{DD}+0.5	V
DC Input Current	I_{IN}	±10	mA
Power Dissipation	P_D	300	mW
Storage Temperature Range	T_{stg}	-65 ~ 150	°C
Lead Temp./Time	T_{sol}	260°C · 10sec	

PIN ASSIGNMENT



V_{DD} : 16, V_{SS} : 8

LOGIC DIAGRAM



TRUTH TABLE

(TC5002BP)

INPUT						OUTPUT								
BI	RBI	A	B	C	D	a	b	c	d	e	f	g	RBO	NOTE
H	*	*	*	*	*	L	L	L	L	L	L	L	☆	
L	H	L	L	L	L	L	L	L	L	L	L	L	H	
L	L	L	L	L	L	H	H	H	H	H	H	L	L	
L	*	H	L	L	L	L	H	H	L	L	L	L	L	
L	*	L	H	L	L	H	H	L	H	H	L	H	L	
L	*	H	H	L	L	H	H	H	H	L	L	H	L	
L	*	L	L	H	L	L	H	H	L	L	H	H	L	
L	*	H	L	H	L	H	L	H	H	L	H	H	L	
L	*	L	H	H	L	L	L	H	H	H	H	H	L	1
L	*	H	H	H	L	H	H	H	L	L	L	L	L	2
L	*	L	L	L	H	H	H	H	H	H	H	H	L	
L	*	H	L	L	H	H	H	H	L	L	H	H	L	3
L	*	L	H	L	H	H	H	H	H	H	H	L	L	
L	*	H	H	L	H	L	H	H	L	L	L	L	L	
L	*	L	L	H	H	H	H	L	H	H	L	H	L	
L	*	H	L	H	H	H	H	H	H	L	L	H	L	
L	*	L	H	H	H	L	H	H	L	L	H	H	L	
L	*	H	H	H	H	H	L	H	H	L	H	H	L	

NOTE 1 : TC5022BP, ——→ a = "H"

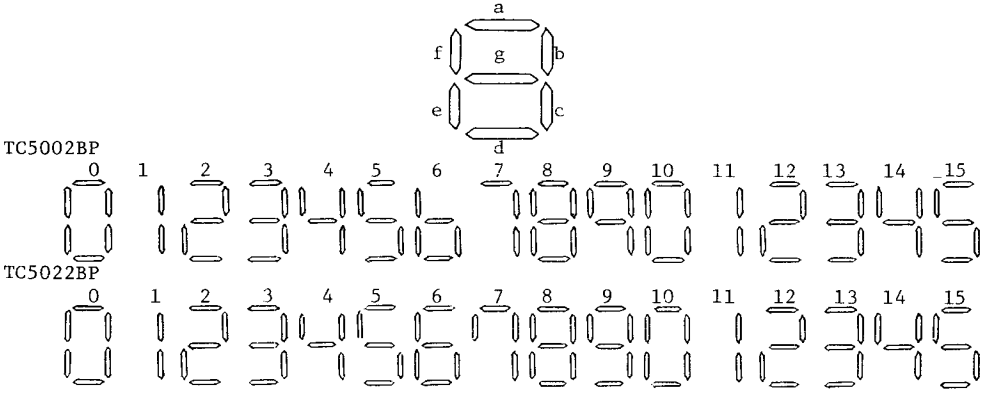
2 : TC5022BP, ——→ f = "H"

3 : TC5022BP, ——→ d = "H"

☆ : Undetermined

* : Don't Care

DISPLAY INDICATE MODE



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

CHARACTERISTIC	SYMBOL		MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{DD}		3	-	18	V
Input Voltage	V_{IN}		0	-	V_{DD}	V
Operating Temp.	Topr		-40	-	85	°C

ELECTRICAL CHARACTERISTICS (V_{SS}=0V)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	V_{DD} (V)	-40°C MIN.	-40°C MAX.	25°C MIN.	25°C TYP.	25°C MAX.	85°C MIN.	85°C MAX.	UNIT
High Level Output Voltage (RBO)	V_{OH}	$\|I_{OUT}\| < 1\mu A$ $V_{IN}=V_{SS}$, V_{DD}	5 10 15	4.95 9.95 14.95	- - -	4.95 9.95 14.95	5.00 10.00 15.00	- - -	4.95 9.95 14.95	- - -	V
Low Level Output Voltage (RBO)	V_{OL}	$\|I_{OUT}\| < 1\mu A$ $V_{IN}=V_{SS}$, V_{DD}	5 10 15	- - -	0.05 0.05 0.05	- - -	0.00 0.00 0.00	0.05 0.05 0.05	- - -	0.05 0.05 0.05	
High Level Output Voltage (a - g)	V_{OH}	$\|I_{OUT}\| < 1\mu A$ $V_{IN}=V_{SS}$, V_{DD}	5 10 15	4.0 9.0 14.0	- - -	4.0 9.0 14.0	4.5 9.5 14.5	- - -	4.0 9.0 14.0	- - -	V
High Level Output Current (RBO)	I_{OH}	V_{OH}=4.6V V_{OH}=9.5V V_{OH}=13.5V $V_{IN}=V_{SS}$, V_{DD}	5 10 15	-0.2 -0.5 -1.4	- - -	-0.16 -0.4 -1.2		- - -	-0.12 -0.3 -1.0	- - -	mA
Low Level Output Current (RBO)	I_{OL}	V_{OL}=0.4V V_{OL}=0.5V V_{OL}=1.5V $V_{IN}=V_{SS}$, V_{DD}	5 10 15	0.52 1.3 3.6	- - -	0.44 1.1 3.0		- - -	0.36 0.9 2.4	- - -	
High Level Output Current (a - g)	I_{OH}	V_{OH}=3.5V V_{OH}=8.5V V_{OH}=13.5V $V_{IN}=V_{SS}$, V_{DD}	5 10 15	-20 -25 -30	- - -	-20 -25 -30		- - -	-15 -20 -25	- - -	mA
High Level Input Voltage	V_{IH} **	V_{OUT}=0.5V,4.0V V_{OUT}=1.0V,9.0V V_{OUT}=1.5V,13.5V $\|I_{OUT}\| < 1\mu A$	5 10 15	3.5 7.0 11.0	- - -	3.5 7.0 11.0	2.75 5.5 8.25	- - -	3.5 7.0 11.0	- - -	V
Low Level Input Voltage	V_{IL} **	V_{OUT}=0.5V,4.0V V_{OUT}=1.0V,9.0V V_{OUT}=1.5V,13.5V $\|I_{OUT}\| < 1\mu A$	5 10 15	- - -	1.5 3.0 4.0	- - -	2.25 4.5 6.75	1.5 3.0 4.0	- - -	1.5 3.0 4.0	
Disable Current (a - g)	I_{DL}	V_{OL}=0V	18	-	-3.0	-	-10^{-4}	-3.0	-	-30	µA
Input Current "H" Level	I_{IH}	V_{IH}=18V	18	-	0.3	-	10^{-5}	0.3	-	1.0	µA
Input Current "L" Level	I_{IL}	V_{IL}=0V	18	-	-0.3	-	-10^{-5}	-0.3	-	-1.0	µA
Quiescent Current Consumption	I_{DD}	$V_{IN}=V_{SS}$,V_{DD} *	5 10 15	- - -	20 40 80	- - -	0.005 0.010 0.015	20 40 80	- - -	150 300 600	µA

* All valid input combinations. Outputs open.

** Required pull down register R_L = 20 kΩ (a ~ g outputs).

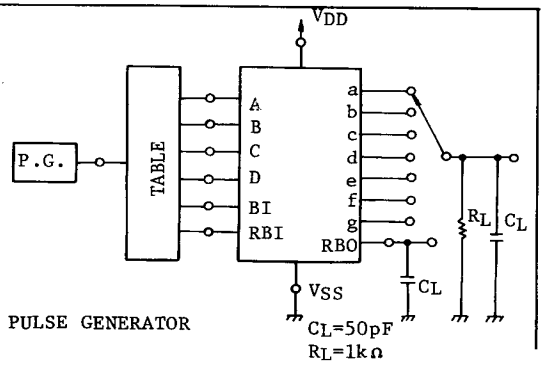
SWITCHING CHARACTERISTICS (Ta=25°C, V_{SS}=0V, C_L=50 pF)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	V_{DD}(V)	MIN.	TYP.	MAX.	UNIT
Output Rise Time (SEGMENT OUT)	t_{TLH}	R_L=1 kΩ	5	-	100	200	ns
			10	-	50	100	
			15	-	40	80	
Output Rise Time (RBO)	t_{TLH}		5	-	130	400	
			10	-	65	200	
			15	-	50	160	
Output Fall Time (RBO)	t_{THL}		5	-	100	200	
			10	-	50	100	
			15	-	40	80	
(LOW-HIGH) Propagation Delay Time (A,B,C,D-SEGMENT OUT)	t_{pLH}	R_L=1 kΩ	5	-	500	1000	ns
			10	-	150	400	
			15	-	120	300	
(HIGH-LOW) Propagation Delay Time (A,B,C,D-SEGMENT OUT)	t_{pHL}	R_L=1 kΩ	5	-	1000	2000	
			10	-	450	1000	
			15	-	320	700	
(LOW-HIGH) Propagation Delay Time (A,B,C,D - RBO)	t_{pLH}		5	-	1000	2000	ns
			10	-	370	1000	
			15	-	250	750	
(HIGH-LOW) Propagation Delay Time (A,B,C,D - RBO)	t_{pHL}		5	-	500	1000	
			10	-	200	500	
			15	-	140	300	
(LOW-HIGH) Propagation Delay Time (RBI - RBO)	t_{pLH}		5	-	800	1600	ns
			10	-	270	700	
			15	-	190	500	
(HIGH-LOW) Propagation Delay Time (RBI - RBO)	t_{pHL}		5	-	180	700	
			10	-	70	350	
			15	-	50	250	
Propagation Delay Time (BI - SEGMENT OUT)	t_{pLH} t_{pHL}	R_L=1 kΩ	5	-	500	1500	ns
			10	-	200	600	
			15	-	150	500	
Input Capacity	C_{IN}			-	5	7.5	pF

SWITCHING TIME TEST CIRCUIT

TABLE (t_{pLH}, t_{pHL} Test Codition)

TEST	P.G.	"H"	"L"	OUTPUT	Wave-form
A,B,C,D - SEGMENT OUT	A	-	Other Inputs	a	1
A,B,C,D - RBO	A	RBI	Other Inputs	RBO	2
RBI - RBO	RBI	-	Other Inputs	RBO	3
BI - SEGMENT OUT	BI	A,B	Other Inputs	a	4



P.G.: PULSE GENERATOR

C_L=50pF
R_L=1kΩ

SWITCHING TIME TEST WAVEFORMS