

# TC4055BP, TC4056BP/BF

C<sup>2</sup>MOS DIGITAL INTEGRATED CIRCUIT  
SILICON MONOLITHIC

TC4055BP LIQUID-CRYSTAL DISPLAY DRIVER

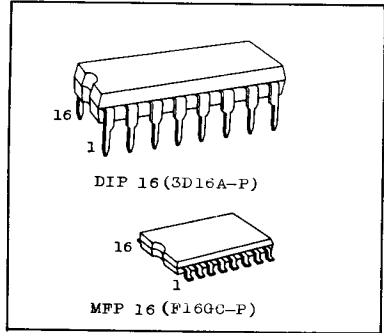
(BCD TO 7-Segment Decoder/Driver with "Display-Frequency" Output)

TC4056BP/TC4056BF LIQUID-CRYSTAL DISPLAY DRIVER

(BCD TO 7-Segment Decoder/Driver with Strobed-Latch Function)

TC4055BP, TC4056BP/BF are LC drivers which drive the field effect type liquid crystal with seven segments by BCD input.

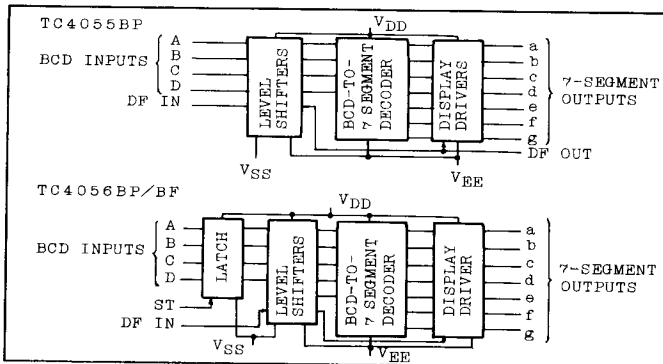
If DF input="L", a selected output among segment outputs of a through g becomes "H" level and if DF input="H", a selected output becomes "L" level. Seven segment liquid crystal element can be directly driven by applying the pulse in-phase with DF input to the common terminal (back plane) of liquid crystal. TC4055BP is equipped with DF output for the common terminal and TC4056BP/BF is equipped with the latch. If  $V_{EE} < V_{SS}$ , the level conversion operation which lowers only "L" side of logical signal can be achieved.



## MAXIMUM RATINGS

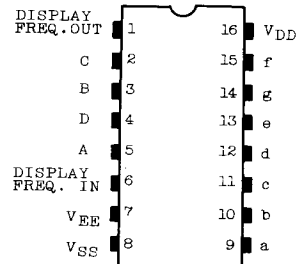
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Supply Voltage	$V_{DD}-V_{SS}$	-0.5 ~ 20	V
	$V_{DD}-V_{EE}$	-0.5 ~ 20	V
Input Voltage	$V_{IN}$	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
Output Voltage	$V_{OUT}$	$V_{EE}-0.5 \sim V_{DD}+0.5$	V
DC Input Current	$I_{IN}$	$\pm 10$	mA
Power Dissipation	PD	300(DIP)/180(MFP)	mW
Operating Temperature Range	$T_A$	-40 ~ 85	°C
Storage Temperature Range	$T_{stg}$	-65 ~ 150	°C
Lead Temp./Time	$T_{sol}$	260°C · 10sec	

## BLOCK DIAGRAM

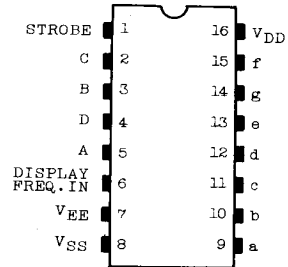


## PIN ASSIGNMENT

TC4055BP



TC4056BP/BF



(TOP VIEW)

TRUTH TABLE

BCD INPUTS				7-SEGMENT OUTPUTS (DF IN="L")							7-SEGMENT OUTPUTS (DF IN="H")							DISPLAY CHARACTER
D	C	B	A	a	b	c	d	e	f	g	a	b	c	d	e	f	g	
L	L	L	L	H	H	H	H	H	H	L	L	L	L	L	L	L	H	0
L	L	L	H	L	H	H	L	L	L	L	H	L	L	H	H	H	H	1
L	L	H	L	H	H	L	H	H	L	H	L	L	H	L	L	H	L	2
L	L	H	H	H	H	H	H	L	L	H	L	L	L	L	H	H	L	3
L	H	L	L	L	H	H	L	L	H	H	H	L	L	H	H	L	L	4
L	H	L	H	H	L	H	H	L	H	H	L	H	L	L	H	L	L	5
L	H	H	L	H	L	H	H	H	H	H	L	H	L	L	L	L	L	6
L	H	H	H	H	H	H	L	L	L	L	L	L	L	H	H	H	H	7
H	L	L	L	H	H	H	H	H	H	H	L	L	L	L	L	L	L	8
H	L	L	H	H	H	H	H	L	H	H	L	L	L	L	H	L	L	9
H	L	H	L	L	L	L	H	H	H	L	H	H	H	L	L	L	H	A
H	L	H	H	L	H	H	L	H	H	H	H	L	L	H	L	L	L	B
H	H	L	L	H	H	L	L	H	H	H	L	L	H	H	L	L	L	C
H	H	L	H	H	H	H	L	H	H	H	L	L	L	H	L	L	L	D
H	H	H	L	L	L	L	L	L	L	H	H	H	H	H	H	H	L	-
H	H	H	H	L	L	L	L	L	L	L	H	H	H	H	H	H	H	BLANK

RECOMMENDED OPERATING CONDITIONS (V<sub>SS</sub>=0V)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
DC Supply Voltage	V <sub>DD</sub> -V <sub>SS</sub>	3	-	18	V
	V <sub>DD</sub> -V <sub>EE</sub>	3	-	18	
Input Voltage	V <sub>IN</sub>	0	-	V <sub>DD</sub>	V

STATIC ELECTRICAL CHARACTERISTICS (V<sub>SS</sub>=V<sub>EE</sub>=0V)

CHARACTERISTIC	SYM-BOL	TEST CONDITION	V <sub>DD</sub> (V)	-40°C		25°C			85°C		UNIT
				MIN.	MAX.	MIN.	TYP.	MAX.	MIN.	MAX.	
High-Level Output Voltage	V <sub>OH</sub>	I <sub>OUT</sub>   < 1μA V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub>	5	4.95	-	4.95	5.00	-	4.95	-	V
			10	9.95	-	9.95	10.00	-	9.95	-	
			15	14.95	-	14.95	15.00	-	14.95	-	
Low-Level Output Voltage	V <sub>OL</sub>	I <sub>OUT</sub>   < 1μA V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub>	5	-	0.05	-	0.00	0.05	-	0.05	V
			10	-	0.05	-	0.00	0.05	-	0.05	
			15	-	0.05	-	0.00	0.05	-	0.05	

# TC4055BP, TC4056BP/BF

## STATIC ELECTRICAL CHARACTERISTICS (V<sub>SS</sub>=V<sub>EE</sub>=0V)

CHARACTERISTIC	SYM-BOL	TEST CONDITION	V <sub>DD</sub> (V)	-40°C		25°C			85°C		UNIT	
				MIN.	MAX.	MIN.	TYP.	MAX.	MIN.	MAX.		
Output High Current	I <sub>OH</sub>	V <sub>OH</sub> =4.6V	5	-0.61	-	-0.51	-1.0	-	-0.42	-	mA	
		V <sub>OH</sub> =2.5V	5	-2.5	-	-2.1	-4.0	-	-1.7	-		
		V <sub>OH</sub> =9.5V	10	-1.5	-	-1.3	-2.2	-	-1.1	-		
		V <sub>OH</sub> =13.5V	15	-4.0	-	-3.4	-9.0	-	-2.8	-		
		V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub>										
Output Low Current	I <sub>OL</sub>	V <sub>OL</sub> =0.4V	5	0.61	-	0.51	1.5	-	0.42	-	mA	
		V <sub>OL</sub> =0.5V	10	1.5	-	1.3	3.8	-	1.1	-		
		V <sub>OL</sub> =1.5V	15	4.0	-	3.4	15.0	-	2.8	-		
		V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub>										
Input High Voltage	V <sub>IH</sub>	V <sub>OUT</sub> =0.5V, 4.5V	5	3.5	-	3.5	2.75	-	3.5	-	V	
		V <sub>OUT</sub> =1.0V, 9.0V	10	7.0	-	7.0	5.5	-	7.0	-		
		V <sub>OUT</sub> =1.5V, 13.5V	15	11.0	-	11.0	8.25	-	11.0	-		
		I <sub>OUT</sub>   < 1μA										
Input Low Voltage	V <sub>IL</sub>	V <sub>OUT</sub> =0.5V, 4.5V	5	-	1.5	-	2.25	1.5	-	1.5	V	
		V <sub>OUT</sub> =1.0V, 9.0V	10	-	3.0	-	4.5	3.0	-	3.0		
		V <sub>OUT</sub> =1.5V, 13.5V	15	-	4.0	-	6.75	4.0	-	4.0		
		I <sub>OUT</sub>   < 1μA										
Input Current	"H" Level	I <sub>IH</sub>	V <sub>IH</sub> =18V	18	-	0.1	-	10 <sup>-5</sup>	0.1	-	1.0	μA
	"L" Level	I <sub>IL</sub>	V <sub>IL</sub> =0V	18	-	-0.1	-	-10 <sup>-5</sup>	-0.1	-	-1.0	
Quiescent Device Current	I <sub>DD</sub>	V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub> *	5	-	5	-	0.005	5	-	150	μA	
			10	-	10	-	0.010	10	-	300		
			15	-	20	-	0.015	20	-	600		

\* All valid input combinations.

## DYNAMIC ELECTRICAL CHARACTERISTICS (T<sub>a</sub>=25°C, V<sub>SS</sub>=0V, C<sub>L</sub>=50pF)

CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
		V <sub>DD</sub> (V)	V <sub>EE</sub> (V)				
Output Transition Time	t <sub>TLH</sub> t <sub>THL</sub>	5	0	-	80	200	ns
		5	-5	-	50	100	
		10	0	-	50	100	
		15	0	-	40	80	

## DYNAMIC ELECTRICAL CHARACTERISTICS (Ta=25°C, VSS=0V, CL=50pF)

CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
		VDD(V)	VEE(V)				
Propagation Delay Time (BCD IN - 7-SEGMENT OUT)	t <sub>pLH</sub>	5	0	-	980	2000	ns
		5	-5	-	380	900	
	t <sub>pHL</sub>	10	0	-	320	750	
		15	0	-	210	500	
Propagation Delay Time (DF IN - 7-SEGMENT OUT)	t <sub>pLH</sub>	5	0	-	620	1800	ns
		5	-5	-	240	900	
	t <sub>pHL</sub>	10	0	-	200	750	
		15	0	-	130	500	
Propagation Delay Time * (DF IN - DF OUT)	t <sub>pLH</sub>	5	0	-	570	1500	ns
		5	-5	-	220	800	
	t <sub>pHL</sub>	10	0	-	180	700	
		15	0	-	110	550	
Propagation Delay Time ** (STROBE - 7-SEGMENT OUT)	t <sub>pLH</sub>	5	0	-	1000	3100	ns
		5	-5	-	400	1300	
	t <sub>pHL</sub>	10	0	-	340	1150	
		15	0	-	210	750	
Min. Pulse Width ** (STROBE)	t <sub>WH</sub>	5	0	-	55	220	ns
		5	-5	-	60	220	
		10	0	-	25	100	
		15	0	-	20	70	
Min. Set-up Time ** (BCD IN - STROBE)	t <sub>SU</sub>	5	0	-	50	220	ns
		5	-5	-	50	220	
		10	0	-	25	100	
		15	0	-	20	70	
Input Capacitance	C <sub>IN</sub>			-	5	7.5	pF

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## WAVEFORM FOR MEASUREMENT OF DYNAMIC CHARACTERISTICS

