



# HCF4054B

## 4 SEGMENT LIQUID CRYSTAL DISPLAY DRIVER WITH STROBED LATCH FUNCTION

- QUIESCENT CURRENT SPECIF. UP TO 20V
- OPERATION OF LIQUID CRYSTALS WITH CMOS CIRCUITS PROVIDES ULTRA LOW POWER DISPLAYS
- EQUIVALENT AC OUTPUT DRIVE FOR LIQUID CRYSTAL DISPLAYS - NO EXTERNAL CAPACITOR REQUIRED
- VOLTAGE DOUBLING ACROSS DISPLAY [( $V_{DD} - V_{EE}$ ) = 18V] RESULTS IN EFFECTIVE 36V (p-p) DRIVE ACROSS SELECTED DISPLAY SEGMENTS
- LOW OR HIGH OUTPUT LEVEL DC DRIVE FOR OTHER TYPES OF DISPLAYS
- ONE CHIP LOGIC LEVEL CONVERSION FOR DIFFERENT INPUT AND OUTPUT LEVEL SWINGS
- FULL DECODING OF ALL INPUT COMBINATIONS : "0 - 9, L, H, P, A" AND BLANK POSITIONS
- INPUT LEAKAGE CURRENT  
 $I_l = 100\text{nA}$  (MAX) AT  $V_{DD} = 18\text{V}$   $T_A = 25^\circ\text{C}$
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B "STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"



### ORDER CODES

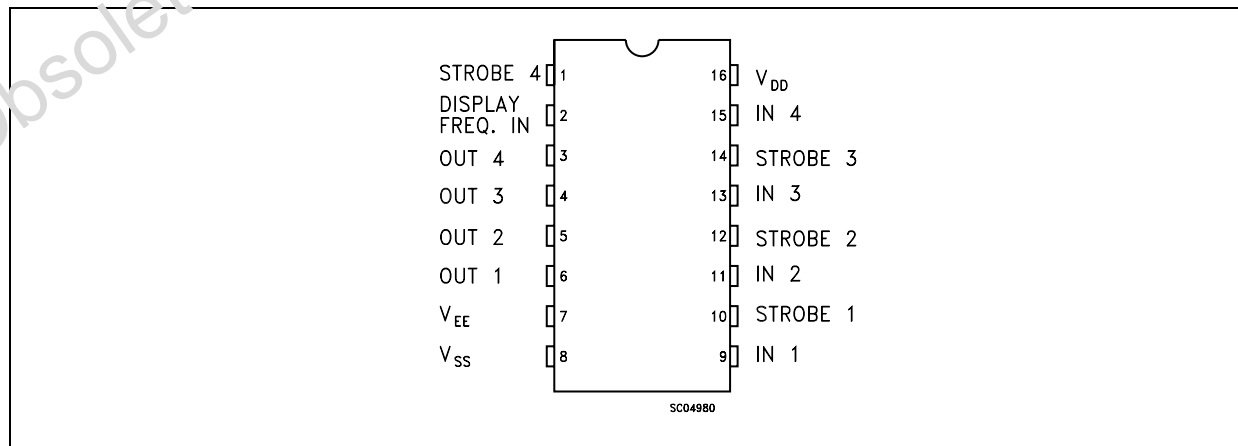
PACKAGE	TUBE	T & R
DIP	HCF4054BEY	
SOP	HCF4054BM1	HCF4054M013TR

HCF4054B provides level shifting similar to HCF4055B and HCF4056B, independently strobed latches, and common DF control on 4 signal lines. This device is intended to provide drive signal compatibility with HCF4055B and HCF4056B 7-segment decoder types for the decimal point, colon, polarity, and similar display lines. A level-shifted high amplitude DF output can be obtained from any HCF4054B output line by connecting the corresponding input and strobe lines to a low and high levels. HCF4054B may also be utilized for logic level "up conversion" or "down conversion" respectively. For example, input signal swings ( $V_{DD}$  to  $V_{SS}$ ) from +5V to 0V

### DESCRIPTION

HCF4054B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages.

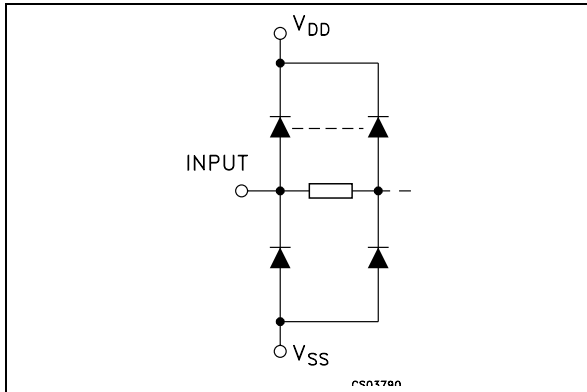
### PIN CONNECTION



## HCF4054B

can be converted to output signal swings ( $V_{DD}$  to  $V_{EE}$ ) of +5V to -5V. The level shifted function permits the use of different input and output signal swings. The input swings from a low level of  $V_{SS}$  to a high level of  $V_{DD}$ , while the outputs swings from a low level of  $V_{EE}$  to the same high level of  $V_{DD}$ . Thus, the input and output swings can be

### INPUT EQUIVALENT CIRCUIT



selected independently of each other over a 3 to 18V range.  $V_{SS}$  may be connected to  $V_{EE}$  when no level-shift function is required. Data is transferred from input to output by placing a high voltage level at the strobe input. A low voltage level at the strobe input latches the data input and the corresponding output segments remain selected (or non selected) while the strobe is low.

### PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
6, 5, 4, 3	OUT1 to OUT4	Outputs
9, 11, 13, 15	IN1 to IN4	Inputs
10, 12, 14, 1	STROBE1 STROBE4	Strobe Input
2	DISPLAY FREQ. IN	Display Frequency Input
7	$V_{EE}$	Negative Supply Voltage
8	$V_{SS}$	Negative Supply Voltage
16	$V_{DD}$	Positive Supply Voltage

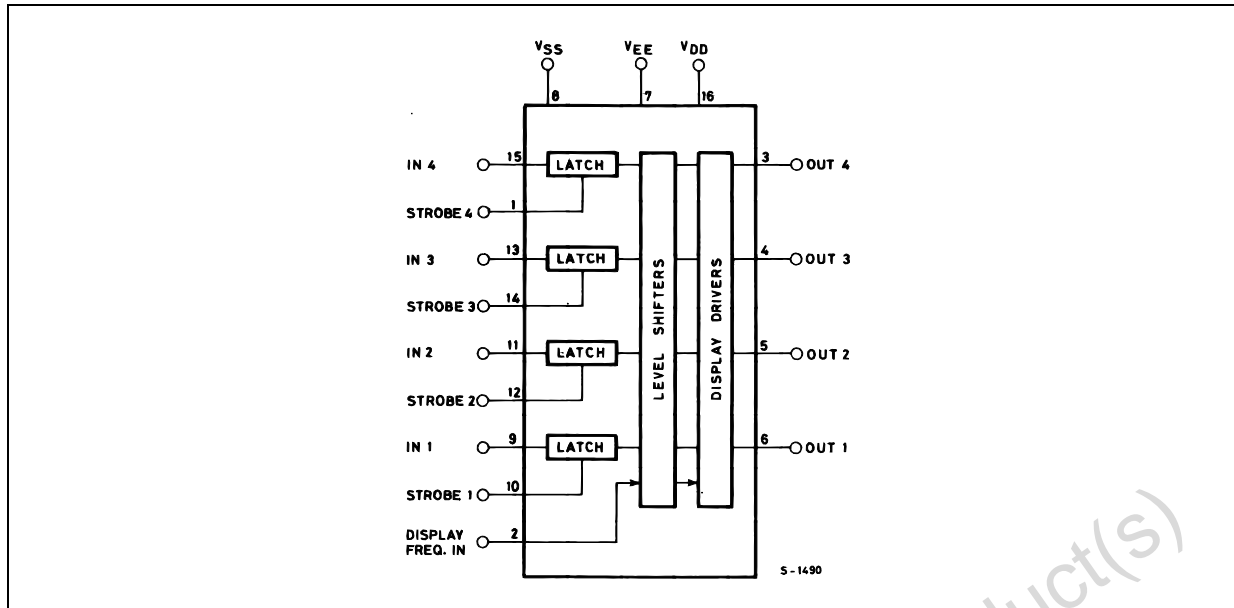
### TRUTH TABLE

DF	IN	STROBE	OUT
L	L	H	L
H	L	H	H
L	H	H	H
H	H	H	L
X	X	L	*

X = Don't Care.

(\*) Depends upon the input mode previously applied when ST=1.

## LOGIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage	-0.5 to +22	V
$V_I$	DC Input Voltage	-0.5 to $V_{DD} + 0.5$	V
$I_I$	DC Input Current	$\pm 10$	mA
$P_D$	Power Dissipation per Package	200	mW
	Power Dissipation per Output Transistor	100	mW
$T_{op}$	Operating Temperature	-55 to +125	$^{\circ}\text{C}$
$T_{stg}$	Storage Temperature	-65 to +150	$^{\circ}\text{C}$

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

All voltage values are referred to  $V_{SS}$  pin voltage.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage	3 to 20	V
$V_I$	Input Voltage	0 to $V_{DD}$	V
$T_{op}$	Operating Temperature	-55 to 125	$^{\circ}\text{C}$

DC SPECIFICATIONS

Symbol	Parameter	Test Condition					Value						Unit	
		V <sub>EE</sub> (V)	V <sub>I</sub> (V)	V <sub>O</sub> (V)	V <sub>SS</sub> (V)	V <sub>DD</sub> (V)	T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
							Min.	Typ.	Max.	Min.	Max.	Min.		Max.
I <sub>L</sub>	Quiescent Current	-5	0/5		0	5		0.04	5		150		150	μA
		0	0/10		0	10		0.04	10		300		300	
		0	0/15		0	15		0.04	20		600		600	
		0	0/20		0	20		0.08	100		3000		3000	
V <sub>OH</sub>	High Level Output Voltage	0	0/5		0	5	4.95			4.95		4.95	V	
		0	0/10		0	10	9.95			9.95		9.95		
		0	0/15		0	15	14.95			14.95		14.95		
V <sub>OL</sub>	Low Level Output Voltage	0	5/0		0	5		0.05			0.05		0.05	V
		0	10/0		0	10		0.05			0.05		0.05	
		0	15/0		0	15		0.05			0.05		0.05	
V <sub>IH</sub>	High Level Input Voltage	-5		0.5/4.5	0	5	3.5			3.5		3.5	V	
		0		1/9	0	10	7			7		7		
		0		1.5/18.5	0	15	11			11		11		
V <sub>IL</sub>	Low Level Input Voltage	5		0.5/4.5	0	5			1.5		1.5		1.5	V
		0		9/1	0	10			3		3		3	
		0		1.5/18.5	0	15			4		4		4	
I <sub>OH</sub>	Output Drive Current	-5	0/5	4.5	0	5	-0.38	-0.9		-0.28		-0.28	mA	
		0	0/10	9.5	0	10	-0.38	-0.9		-0.28		-0.28		
		0	0/15	13.5	0	15	-1.27	-3		-0.95		-0.95		
I <sub>OL</sub>	Output Sink Current	-5	0/5	0.4	0	5	1.1	2.6		0.82		0.82	mA	
		0	0/10	0.5	0	10	1.1	2.6		0.82		0.82		
		0	0/15	1.5	0	15	2.9	6.8		2.17		2.17		
I <sub>I</sub>	Input Leakage Current (any input)	0	0/18		0	18		±10 <sup>-5</sup>	±0.1		±1		±1	μA
C <sub>I</sub>	Input Capacitance (any input)							5	7.5					pF

The Noise Margin for both "1" and "0" level is: 1V min. with V<sub>DD</sub>=5V, 2V min. with V<sub>DD</sub>=10V, 2.5V min. with V<sub>DD</sub>=15V

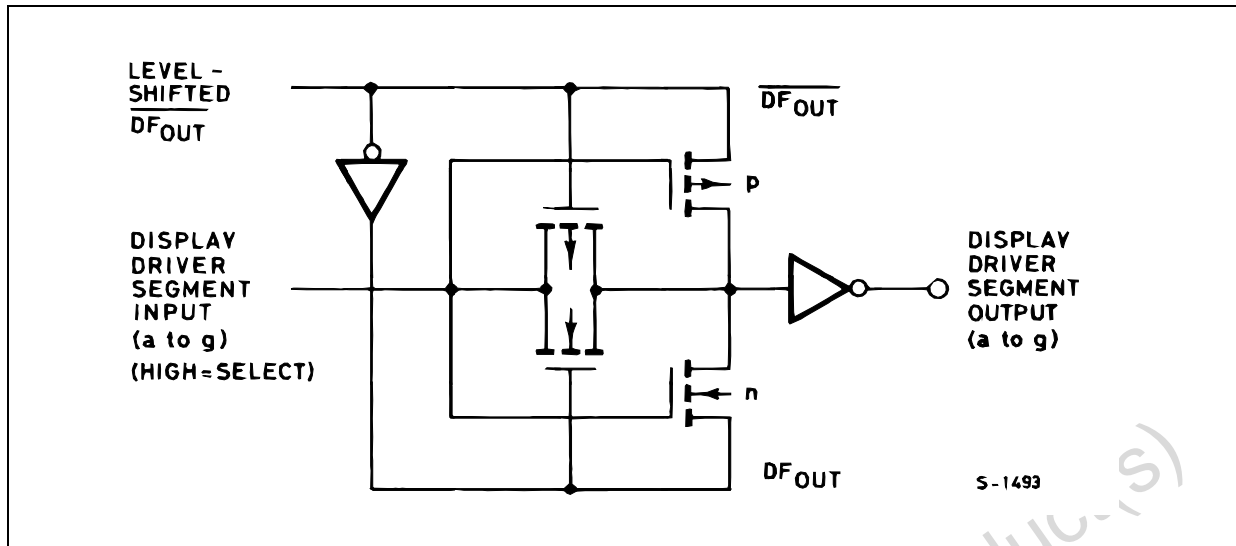
DYNAMIC ELECTRICAL CHARACTERISTICS (T<sub>amb</sub> = 25°C, C<sub>L</sub> = 50pF, R<sub>L</sub> = 200KΩ, t<sub>r</sub> = t<sub>f</sub> = 20 ns)

Symbol	Parameter	Test Condition				Value (*)			Unit
		V <sub>EE</sub> (V)	V <sub>SS</sub> (V)	V <sub>DD</sub> (V)		Min.	Typ.	Max.	
t <sub>PHL</sub> t <sub>PLH</sub>	Propagation Delay Time (any Input to any Output)	-5	0	5			400	800	ns
		0	0	10			340	680	
		0	0	15			250	500	
t <sub>THL</sub> t <sub>TLH</sub>	Transition Time (any Output)	-5	0	5			100	200	ns
		0	0	10			100	200	
		0	0	15			75	150	
t <sub>setup</sub>	Data Setup Time	-5	0	5			220	110	ns
		0	0	10			100	50	
		0	0	15			70	35	
t <sub>w</sub>	Strobe Pulse Width	-5	0	5			220	110	ns
		0	0	10			100	50	
		0	0	15			70	35	

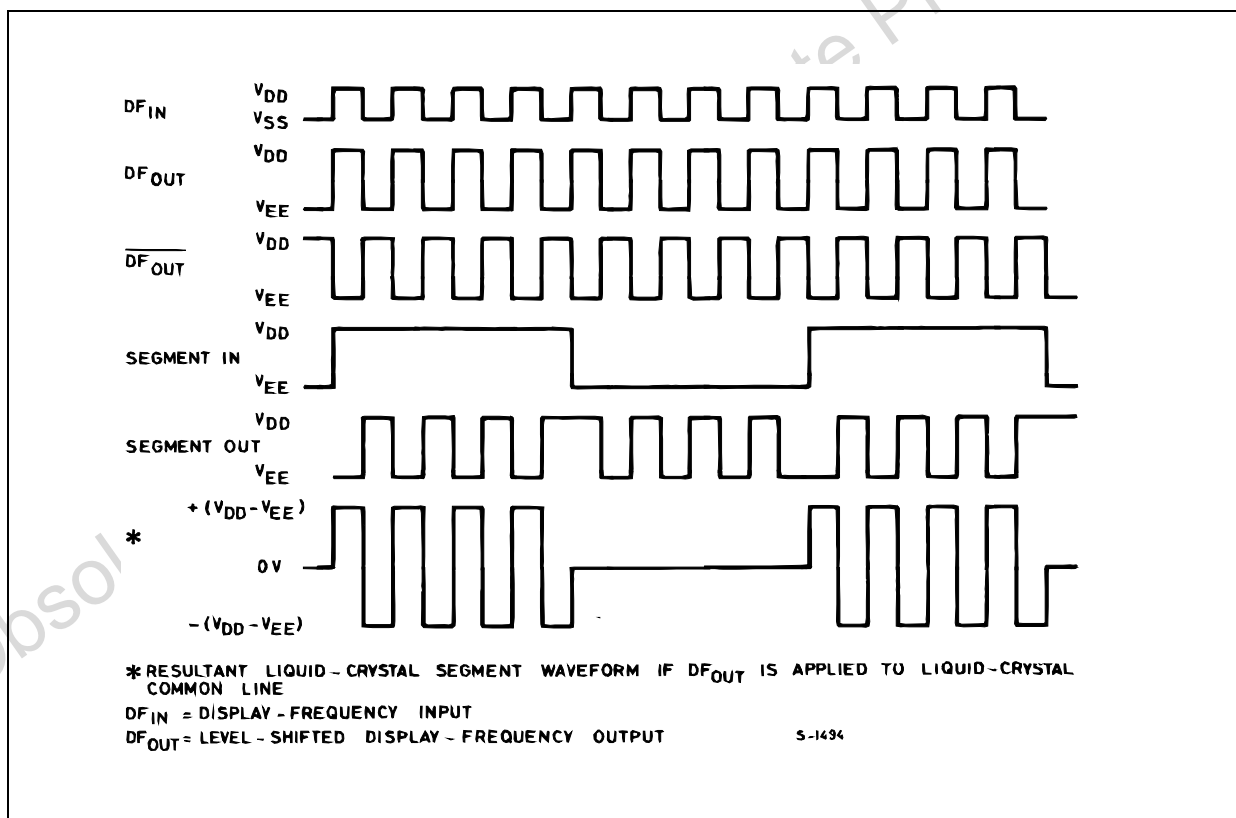
(\*) Typical temperature coefficient for all V<sub>DD</sub> value is 0.3 %/°C.

TYPICAL APPLICATIONS

Display Driver Circuit.

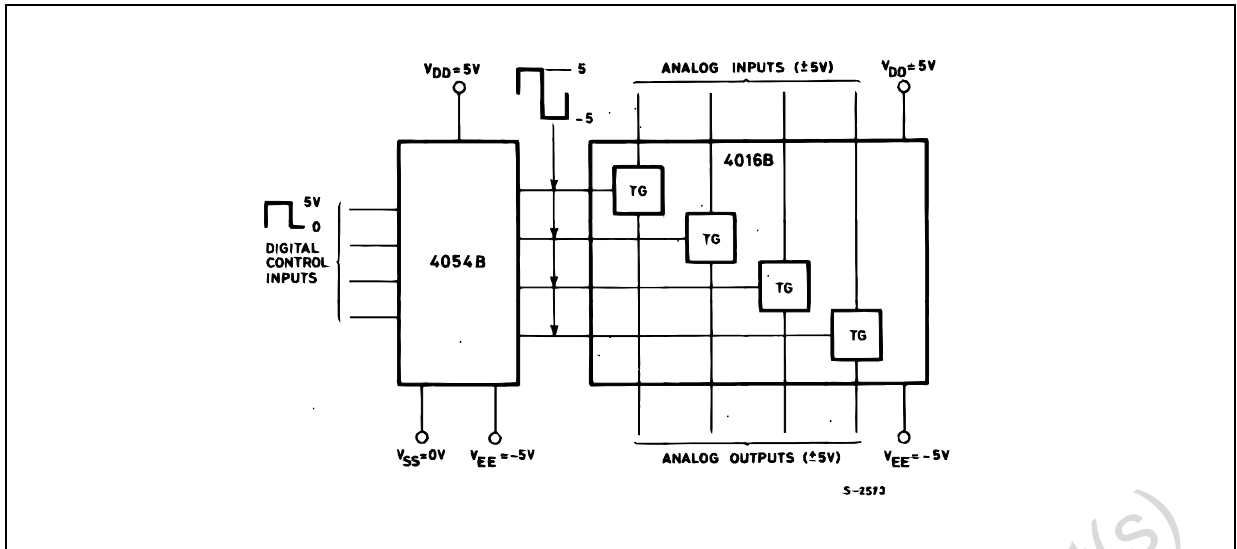


Display Driver Waveform..

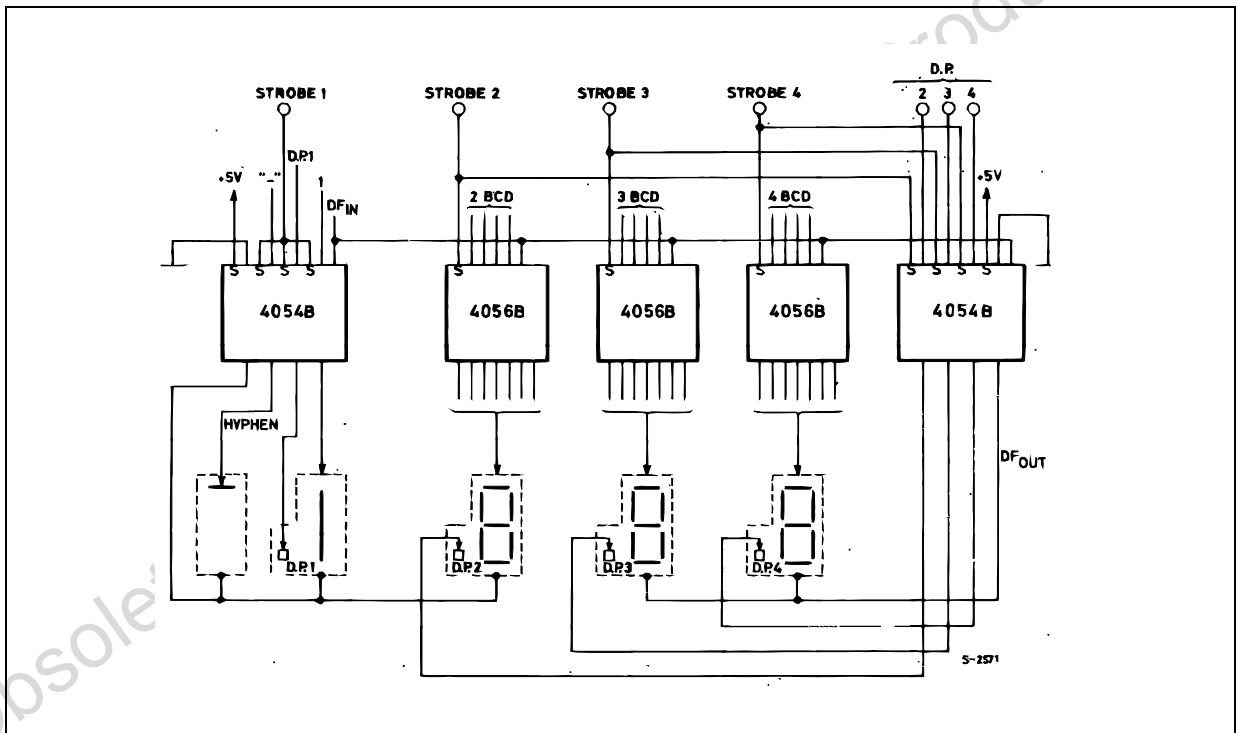


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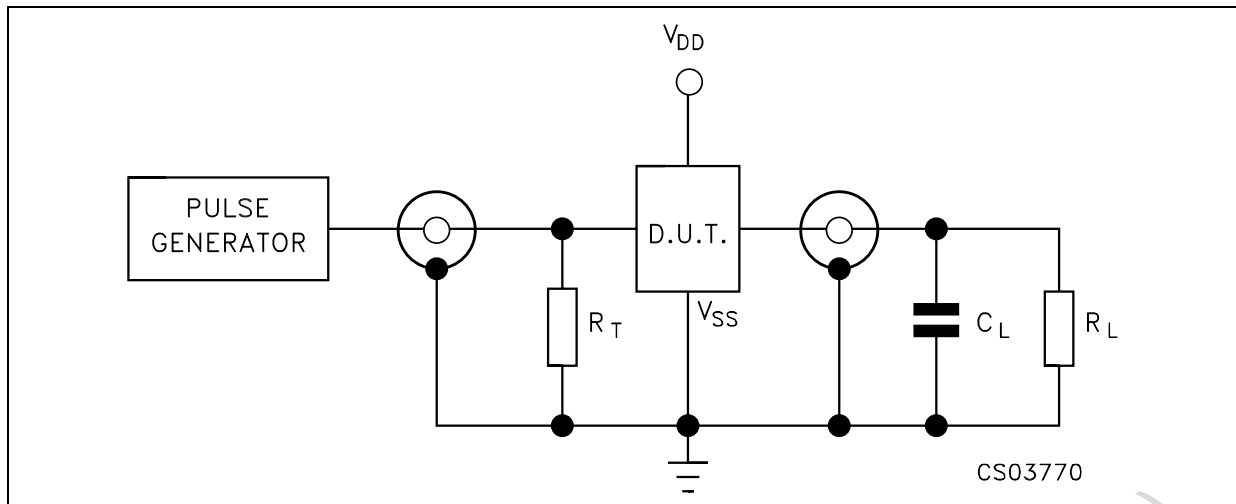
Digital (0 to +5V) to Bidirectional Analog Control (+5V to -5V) Level Shifter.



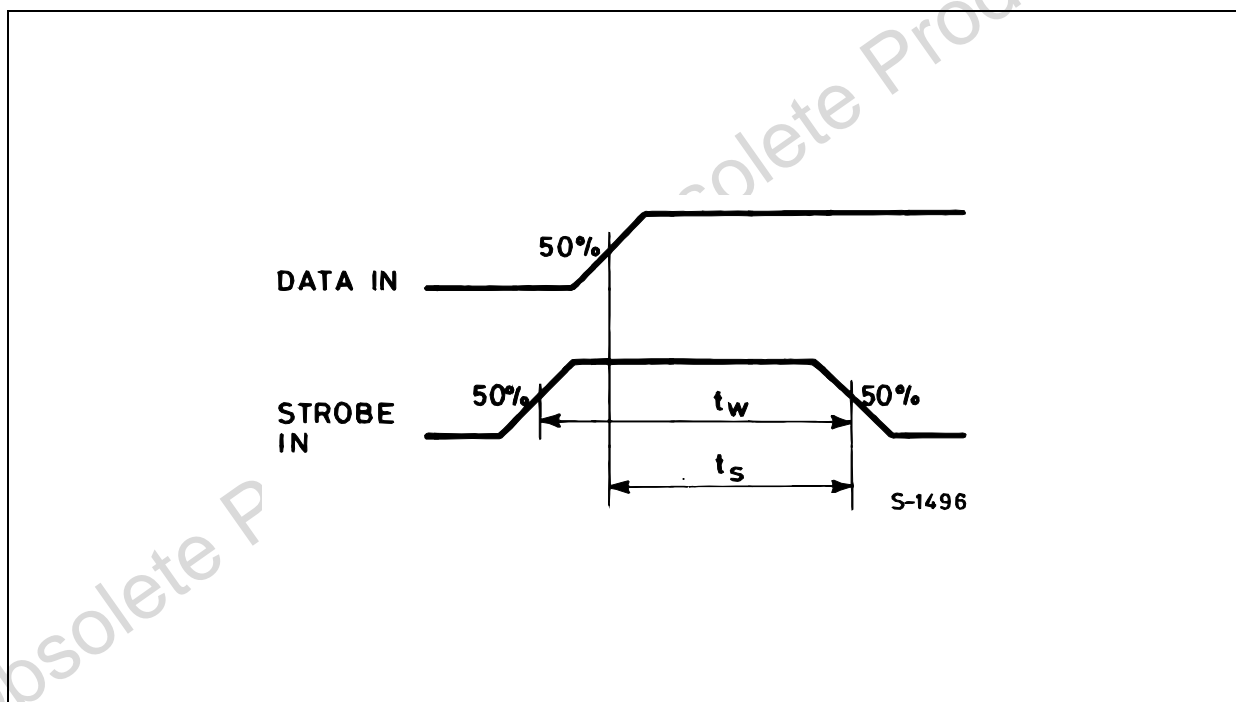
Typical 3½ Digit Crystal Display : (V<sub>DD</sub> = +5V, V<sub>SS</sub> = 0V, V<sub>EE</sub> = -10V, DF<sub>N</sub> = 30Hz Square)



## TEST CIRCUIT

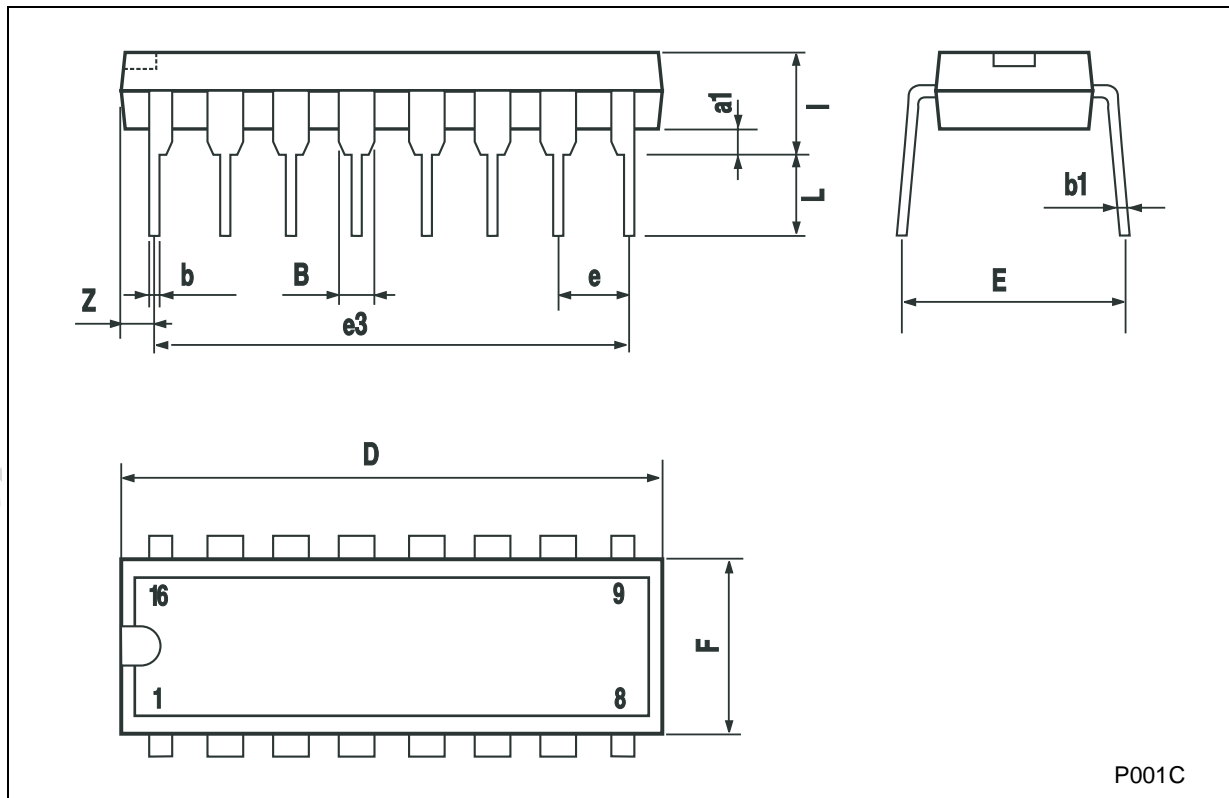


$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = 200\text{k}\Omega$   
 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

**WAVEFORM : DATA SETUP TIME AND STROBE PULSE DURATION (f=1MHz; 50% duty cycle )**


**Plastic DIP-16 (0.25) MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050

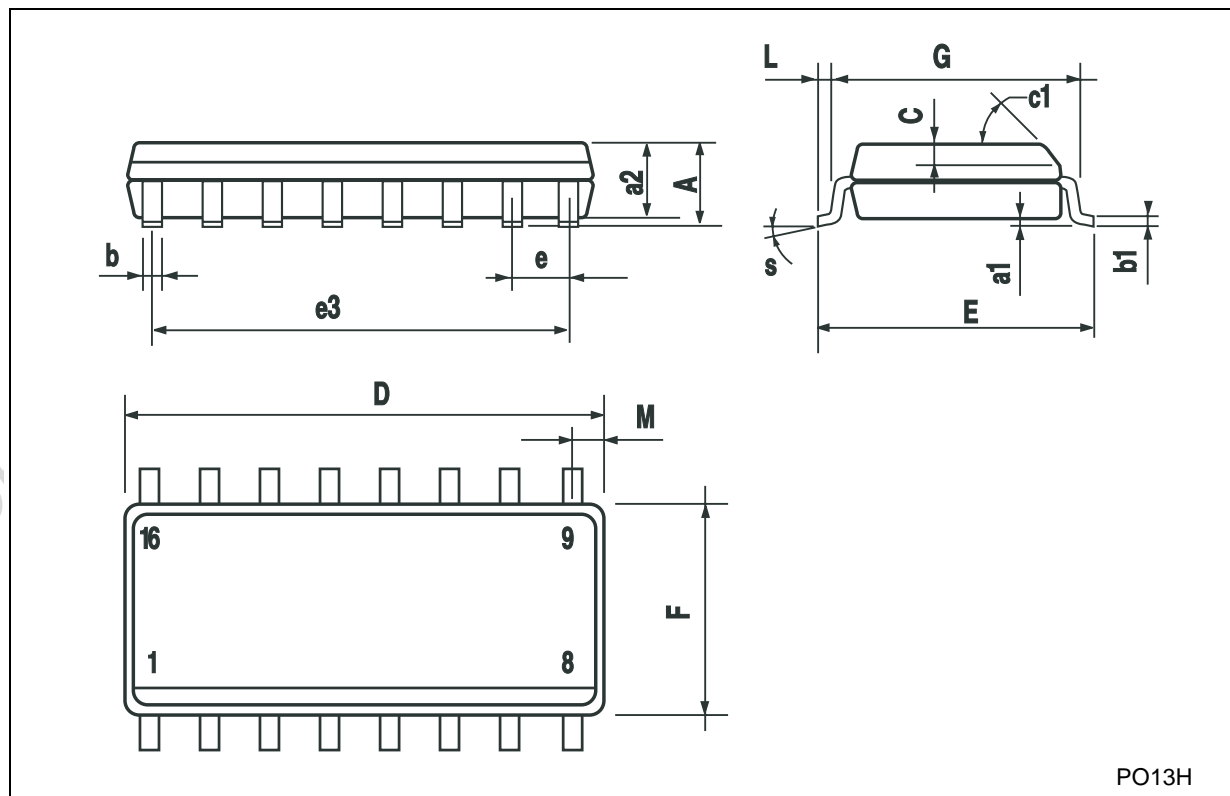


P001C



## SO-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					



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