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NTE4055B and NTE4056B Integrated Circuit CMOS, BCD to 7-Segment Decoder/Drivers

Description:

The NTE4055B (“Display-Frequency” Output) and NTE4056B (Strobed-Latch Function) are single-digit BCD-to-7-segment decoder/driver circuits in a 16-Lead DIP type package that provides level-shifting functions on the chip. This feature permits the BCD input-signal swings (V_{DD} to V_{SS}) to be the same as or different from the 7-segment output-signal swings (V_{DD} to V_{EE}). For example, the BCD input-signal swings (V_{DD} to V_{SS}) may be as small as 0 to -3V, whereas the output-display drive-signal swing (V_{DD} to V_{EE}) may be as large as from 0 to -15V. If V_{DD} to V_{EE} exceeds 15V, V_{DD} to V_{SS} should be at least 4V (0 to -4V).

The 7-segment outputs are controlled by the DISPLAY-FREQUENCY (DF) input which causes the selected segment outputs to be low, high, or a square-wave output (for liquid-crystal displays). When the DF input is low the output segments will be high when selected by the BCD inputs. When the DF input is high, the output segments will be low when selected by the BCD inputs. When a square-wave is present at the DF input, the selected segments will have a square-wave output that is 180° out of phase with the DF input. Those segments which are not selected will have a square-wave output that is in phase with the input. DF square-wave repetition rates for liquid-crystal displays usually range from 30Hz (well above flicker rate) to 200Hz (well below the upper limit of the liquid-crystal frequency response). The NTE4055B provides a level-shifted high-amplitude DF output which is required for driving the common electrode in liquid-crystal displays. The NTE4056B provides a strobed-latch function at the BCD inputs. Encoding of all input combinations on the NTE4055B and NTE4056B provides displays of 0 to 9 as well as L, P, H, A, -, and a blank position.

Features:

- 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, e.g. $V_{DD} - V_{EE} = 18V$ Results in Effective $36V_{P-P}$ Drive Across Selected Display Segments
- Low or High-Output Level DC Drive for Other Types of Displays
- Full Decoding of All Input Combinations: 0-9, L, H, P, A, -, and Blank Positions
- Strobed-Latch Function (NTE4056B)
- DISPLAY-FREQUENCY (DF) Output for Liquid-Crystal Common-Line Drive Signal (NTE4055B)
- Maximum Input Current of 1 μ A at 18V over Full Package Temperature Range; 100nA at 18V and +25°C
- Noise Margin (Full Package Temperature Range)
 - = 1V at $V_{DD} = 5V$
 - = 2V at $V_{DD} = 10V$
 - = 2.5V at $V_{DD} = 15V$
- 5V, 10V, and 15V Parametric Ratings

Applications:

- General-Purpose Displays
- Calculators and Meters
- Wall and Table Clocks
- Industrial Control Panels
- Portable Lab Instruments
- Panel Meters
- Auto Dashboard Displays
- Appliance Control Panels

Absolute Maximum Ratings:

DC Supply Voltage Range (Voltages referenced to V_{SS} terminal), V_{DD} -0.5 to +20V
 Input Voltage Range, All Inputs -0.5 to $V_{DD}+0.5V$
 DC Input Current, Any One Input $\pm 10mA$
 Power Dissipation ($T_A = -55^\circ$ to $+100^\circ C$), P_D 500mW
 $T_A = +100^\circ$ to $+125^\circ C$ Derate Linearly at 12mW/ $^\circ C$ to 200mW
 Device Dissipation (Per Output Transistor)
 For $T_A =$ Full Package Temperature Range 100mW
 Operating Temperature Range, T_A -55° to $+125^\circ C$
 Storage Temperature Range, T_{stg} -65° to $+150^\circ C$
 Lead Temperature (During Soldering, 1/16" \pm 1/32" from case, 10sec Max), T_L $+265^\circ C$

Recommended Operating Conditions: (Note 1)

Parameter	V_{EE}	V_{SS}	V_{DD}	Min	Typ	Max	Unit
Supply Voltage Range (For $T_A =$ Full package Temperature)	-	-	-	3	-	18	V
Setup Time (NTE4056B ONLY), t_s	-5V	0	5V	220	-	-	ns
	0	0	10V	100	-	-	ns
	0	0	15V	70	-	-	ns
Strobe Pulse Width (NTE4056B ONLY), t_W	-5V	0	5V	220	-	-	ns
	0	0	10V	100	-	-	ns
	0	0	15V	70	-	-	ns

Note 1. For maximum reliability, nominal operating conditions should be selected so that operation is always within the above ranges.

Static Electrical Characteristics:

Characteristic	Conditions			Limits at Indicated Temperature ($^\circ C$)							Units
	V_O (V)	V_{IN} (V)	V_{DD} (V)	$-55^\circ C$	$-40^\circ C$	$+85^\circ C$	$+125^\circ C$	$+25^\circ C$			
								Min.	Typ.	Max.	
Quiescent Device Current I_{DD} Max.	-	0,5	5	5	5	150	150	-	0.04	5	μA
	-	0,10	10	10	10	300	300	-	0.04	10	μA
	-	0,15	15	20	20	600	600	-	0.04	20	μA
	-	0,20	20	100	100	3000	3000	-	0.08	100	μA
Output Voltage Low-Level V_{OL} Max.	-	0,5	5	0.05				-	0	0.05	V
	-	0,10	10	0.05				-	0	0.05	V
	-	0,15	15	0.05				-	0	0.05	V
Output Voltage High-Level V_{OH} Min.	-	0,5	5	4.95				4.95	5	-	V
	-	0,10	10	9.95				9.95	10	-	V
	-	0,15	15	14.95				14.95	15	-	V

Static Electrical Characteristics (Cont'd):

Characteristic	Conditions			Limits at Indicated Temperature (°C)						Units	
	V _O (V)	V _{IN} (V)	V _{DD} (V)	-55°C	-40°C	+85°C	+125°C	+25°C			
								Min.	Typ.		Max.
Input Low Voltage V _{IL} Max.	0,5,4,5	-	5	1.5				-	-	1.5	V
	1,9	-	10	3.0				-	-	3.0	V
	1,5,13,5	-	15	4.0				-	-	4.0	V
Input High Voltage V _{IH} Min.	0,5,4,5	-	5	3.5				3.5	-	-	V
	1,9	-	10	7.0				7.0	-	-	V
	1,5,13,5	-	15	11.0				11.0	-	-	V
Output Low (Sink) Current, I _{OL} Min. (V _{EE} = -5V)	-4.5	-	5	0.98	0.92	0.67	0.55	0.8	1.6	-	mA
	0.5	-	10	0.98	0.92	0.67	0.55	0.8	1.6	-	mA
	1.5	-	15	3.6	3.4	2.4	2.0	2.9	5.8	-	mA
Output High (Source) Current, I _{OH} Min. (V _{EE} = -5V)	4.5	-	5	-0.6	-0.55	-0.35	-0.3	-0.45	-0.9	-	mA
	9.5	-	10	-0.6	-0.55	-0.35	-0.3	-0.45	-0.9	-	mA
	13.5	-	15	-1.9	-1.8	-1.2	-1.1	-1.5	-3.0	-	mA
Input Current, I _{IN} Max.	-	0,18	18	±0.1	±0.1	±1.0	±1.0	-	±10 ⁻⁵	±0.1	µA

Dynamic Electrical Characteristics: (T_A = +25°C, C_L = 50pF, R_L = 200kΩ, t_r and t_f = 20ns unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Propagation Delay Time Any Input to Any Output	t _{PHL} or t _{PLH}	V _{EE} = -5V, V _{DD} = 5V	-	650	1300	ns
		V _{DD} = 10V	-	575	1150	ns
		V _{DD} = 15V	-	375	750	ns
Transition Time Any Output	t _{THL} or t _{TLH}	V _{EE} = -5V, V _{DD} = 5V	-	100	200	ns
		V _{DD} = 10V	-	100	200	ns
		V _{DD} = 15V	-	75	150	ns
Minimum Data Setup Time (NTE4056B ONLY)	t _S	V _{EE} = -5V, V _{DD} = 5V	-	110	220	ns
		V _{DD} = 10V	-	50	100	ns
		V _{DD} = 15V	-	35	70	ns
Minimum Strobe Pulse Width (NTE4056B ONLY)	t _W	V _{EE} = -5V, V _{DD} = 5V	-	110	220	ns
		V _{DD} = 10V	-	50	100	ns
		V _{DD} = 15V	-	35	70	ns
Input Capacitance	C _{IN}	Any Input	-	5.0	7.5	pF

Truth Table:

Input Code				Output State							Display Character
2^3	2^2	2^1	2^0	a	b	c	d	e	f	g	
0	0	0	0	1	1	1	1	1	1	0	0
0	0	0	1	0	1	1	0	0	0	0	1
0	0	1	0	1	1	0	1	1	0	1	2
0	0	1	1	1	1	1	1	0	0	1	3
0	1	0	0	0	1	1	0	0	1	1	4
0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	1	0	1	1	1	1	1	6
0	1	1	1	1	1	1	0	0	0	0	7
1	0	0	0	1	1	1	1	1	1	1	8
1	0	0	1	1	1	1	1	0	1	1	9
1	0	1	0	0	0	0	1	1	1	0	L
1	0	1	1	0	1	1	0	1	1	1	H
1	1	0	0	1	1	0	0	1	1	1	P
1	1	0	1	1	1	1	0	1	1	1	A
1	1	1	0	0	0	0	0	0	0	1	-
1	1	1	1	0	0	0	0	0	0	0	Blank

Pin Connection Diagram



