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NTE2028
Integrated Circuit
7–Segment High Voltage Decoder/Driver

Description:

The NTE2028 is an integrated circuit in a 16–Lead DIP type package custom designed to decode four lines of BCD and drive a gas–filled seven–segment display tube.

Each output constitutes a switchable, adjustable current sink which provides constant current to the tube segment, even with high tube anode supply tolerance or fluctuation. These current sinks have a voltage compliance from 3V to at least 80V; typically the output current varies 1% for output voltage changes of 3 to 50V. Each bit line of the decoder switches a current sink on or off as prescribed by the input code. Each current sink is ratioed to the b–output current as required for even illumination of all segments.

Output currents may be varied over the 0.2 to 1.5 mA range for driving various tube types or multiplex operation. The output current is adjusted by connecting an external program resistor (R_p) from V_{CC} to the Program input in accordance with the programming curve. The circuit design provides a one–to–one correlation between program input current and b–segment output current.

The Blanking Input provides unconditional blanking of any output display, while the Ripple Blanking pins allow simple leading or trailing zero blanking.

Features:

- Current Sink Outputs
- Adjustable Output Current: 0.2 to 1.5mA
- High Output Breakdown Voltage: 110V Typ
- Suitable for Multiplex Operation
- Blanking and Ripple Blanking Provisions
- Low Fan–In and Low Power

Absolute Maximum Raings: (Note 1)

Supply Voltage, V_{CC} 7V
Input Voltage (Except BI) 6V
Input Voltage (BI) . . . . . V_{CC}
Segment Output Voltage 80V
Power Dissipation, P_D 600mW
Transient Segment Output Current (Note 2) 50mA
Storage Temperature Range, T_{stg} . . . . . –65° to +150°C
Lead Temperature (During Soldering, 10sec), T_L . . . . . +300°C

Note 1. “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be guaranteed. Except for “Operating Temperature Range” they are not meant to imply that the device should be operated at these limits. The table of “Electrical Chracteristics” provides conditions for actual device operation.

Note 2. In all applications transient segment output current must be limited to 50mA. This may be accomplished in DC applications by connecting a 2.2k resistor from the anode–supply filter capacitor to the display anode, or by current limiting the anode driver in multiplex applications.

Recommended Operating Conditions:

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{CC}		4.75	–	5.25	V
Operating Temperature	T_A		0	–	70	°C

Electrical Characteristics: (Note 3, Note 4)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Logical "1" Input Voltage	V_{IH}	V_{CC} = Min		2.0	–	–	V
Logical "0" Input Voltage	V_{IL}	V_{CC} = Min		–	–	0.8	V
Logical "1" Output Voltage	V_{OH}	V_{CC} = Min, I_{OUT} = –200µA, RBO		2.4	3.7	–	V
Logical "0" Output Voltage	V_{OL}	V_{CC} = Min, I_{OUT} = 8mA, RBO		–	0.13	0.4	V
Logical "1" Input Current	I_{IH}	V_{CC} = Max, Except BI	V_{IN} = 2.4V	–	2	15	µA
			V_{IN} = 5.5V	–	4	400	µA
Logical "0" Input Current	I_{IL}	V_{CC} = Max, V_{IN} = 0.4V	Except BI	–	–300	–600	µA
			BI	–	–1.2	–2.0	mA
Power Supply Current	I_{CC}	V_{CC} = Max, R_P = 2.2k, All Inputs = 0V		–	27	43	mA
Input Diode Clamp Voltage	V_{CD}	V_{CC} = Max, T_A = +25°C, I_{IN} = –12mA		–	–0.9	–1.5	V
Segment Outputs "ON" Current Ratio	I_O	All Outputs = 50V, I_{OUT}b = Ref	Outputs a, f, g	0.84	0.93	1.02	
			Output c	1.12	1.25	1.38	
			Output d	0.90	1.00	1.10	
			Output e	0.99	1.10	1.21	
Output b "ON" Current	$I_{b\ ON}$	V_{CC} = 5V, V_{OUT}b = 50V, All Other Outputs ≥ 5V, T_A = +25°C	R_P = 18.1k	0.15	0.20	0.25	mA
			R_P = 7.03k	0.45	0.50	0.55	mA
			R_P = 3.40k	0.90	1.00	1.10	mA
			R_P = 2.20k	1.35	1.50	1.65	mA
Output Saturation Voltage	V_{SAT}	V_{CC} = Min, R_P = 1k ±5%, I_{OUT}b = 2mA, Note 5		–	0.8	2.5	V
Output Leakage Current	I_{CEX}	V_{OUT} = 75V, BI = 0V, R_P = 2.2k		–	0.003	3.0	µA
Output Breakdown Voltage	V_{BR}	I_{OUT} = 250µA, BI = 0V, R_P = 2.2k		80	110	–	V
Propagation Delays: BCD Input to Segment Output	t_{pd}	V_{CC} = 5V, T_A = +25°C		–	0.4	10	µs
BI to Segment Output				–	0.4	10	µs
RBI to Segment Output				–	0.7	10	µs
RBI to RBO				–	0.4	10	µs

Note 3. Unless otherwise specified, Min/Max limits apply across T_A = 0° to +70°C. All typical values are or T_A = +25°C and V_{CC} = 5V.

Note 4. All currents into device pins ahown as positive, out of device pins as negative, all voltages referenced to GND unless otherwise sepcified. All values shown as Max or Min on absolute value basis.

Note 5. For saturation mode the segment output currents are externally limited and ratioed.

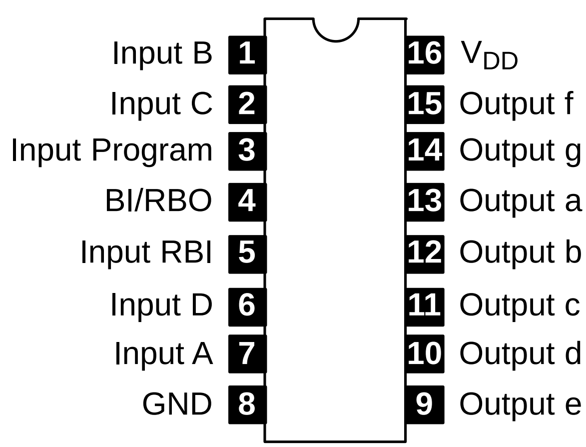
Truth Table:

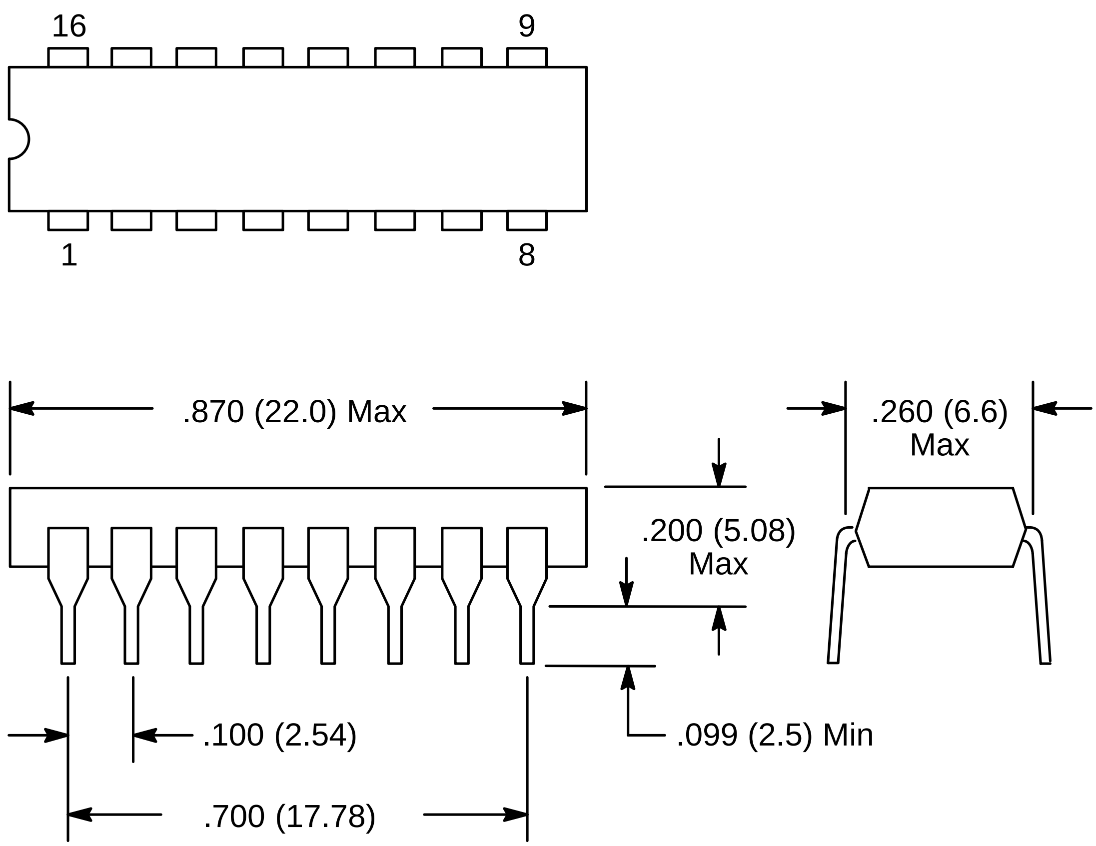
Decimal or Function	RBI†	D	C	B	A	BI/RBO	a	b	c	d	e	f	g	Display
0	1	0	0	0	0	1	0	0	0	0	0	0	1	0
1	X	0	0	0	1	1	1	0	0	1	1	1	1	1
2	X	0	0	1	0	1	0	0	1	0	0	1	0	2
3	X	0	0	1	1	1	0	0	0	0	1	1	0	3
4	X	0	1	0	0	1	1	0	0	1	1	0	0	4
5	X	0	1	0	1	1	0	1	0	0	1	0	0	5
6	X	0	1	1	0	1	0	1	0	0	0	0	0	6
7	X	0	1	1	1	1	0	0	0	1	1	1	1	7
8	X	1	0	0	0	1	0	0	0	0	0	0	0	8
9	X	1	0	0	1	1	0	0	0	0	1	0	0	9
10	X	1	0	1	0	1	0	0	0	1	0	0	0	A
11	X	1	0	1	1	1	1	1	0	0	0	0	0	b
12	X	1	1	0	0	1	0	1	1	0	0	0	1	C
13	X	1	1	0	1	1	1	0	0	0	0	1	0	d
14	X	1	1	1	0	1	0	1	1	0	0	0	0	E
15	X	1	1	1	1	1	0	1	1	1	0	0	0	F
BI *	X	X	X	X	X	0 *	1	1	1	1	1	1	1	
RBI	0	0	0	0	0	0	1	1	1	1	1	1	1	

* BI/RBO used as input only.

† X = Don't care.

Pin Connection Diagram




16
9
1
8
.870 (22.0) Max
.260 (6.6)
Max
.200 (5.08)
Max
.100 (2.54)
.099 (2.5) Min
.700 (17.78)