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## NTE7446 Integrated Circuit TTL – BCD-to–Seven–Segment Decoder/Driver with Open Collector Outputs

### **Description:**

The NTE7446 is a BCD-to–Seven–Segment Decoder/Driver in a 16–Lead plastic DIP type package that features active–low outputs designed for driving common–anode VLEDs or incandescent indicators directly. This device has full ripple–blanking input/output controls and a lamp test input. Display patterns for BCD input count above 9 are unique symbols to authenticate input conditions.

The NTE7446 incorporates automatic leading and/or trailing–edge zero–blanking control ( $\overline{\text{RBI}}$  and  $\overline{\text{RBO}}$ ). Lamp test ( $\overline{\text{LT}}$ ) may be performed at any time when the  $\overline{\text{BI}}/\overline{\text{RBO}}$  node is set at a high level. This device also contains an overriding blanking input ( $\overline{\text{BI}}$ ) which can be used to control the lamp intensity by pulsing or to inhibit the outputs. Inputs and outputs are entirely compatible for use with TTL logic outputs.

### **Features:**

- Open–Collector Outputs Drive Indicators Directly
- Lamp Test Provision
- Leading/Trailing Zero Suppression

### **Absolute Maximum Ratings:** (Note 1)

|                                                 |                 |
|-------------------------------------------------|-----------------|
| Supply Voltage, $V_{CC}$                        | 7V              |
| Input Voltage                                   | 5.5V            |
| Current Forced Into Any Output in the Off–State | 1mA             |
| Operating Temperature Range, $T_A$              | 0°C to +70°C    |
| Storage Temperature Range, $T_{stg}$            | –65°C to +150°C |

Note 1. Unless otherwise specified, all voltages are referenced to GND.

### **Recommended Operating Conditions:**

| Parameter                                                                  | Symbol       | Min  | Typ | Max  | Unit          |
|----------------------------------------------------------------------------|--------------|------|-----|------|---------------|
| Supply Voltage                                                             | $V_{CC}$     | 4.75 | 5.0 | 5.25 | V             |
| Off–State Output Voltage (a through g)                                     | $V_{O(off)}$ | –    | –   | 30   | V             |
| On–State Output Current (a through g)                                      | $I_{O(on)}$  | –    | –   | 40   | mA            |
| High–Level Output Current ( $\overline{\text{BI}}/\overline{\text{RBO}}$ ) | $I_{OH}$     | –    | –   | –200 | $\mu\text{A}$ |
| Low–Level Output Current ( $\overline{\text{BI}}/\overline{\text{RBO}}$ )  | $I_{OL}$     | –    | –   | 8    | mA            |
| Operating Temperature Range                                                | $T_A$        | 0    | –   | +70  | °C            |

**Electrical Characteristics:** (Note 2, Note 3)

| Parameter                                          | Symbol              | Test Conditions                                                                                    | Min  | Typ  | Max  | Unit          |
|----------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------|------|------|------|---------------|
| High-Level Input Voltage                           | $V_{IH}$            |                                                                                                    | 2    | –    | –    | V             |
| Low-Level Input Voltage                            | $V_{IL}$            |                                                                                                    | –    | –    | 0.8  | V             |
| Input Clamp Voltage                                | $V_{IK}$            | $V_{CC} = \text{MIN}, I_I = -18\text{mA}$                                                          | –    | –    | –1.5 | V             |
| High Level Output Voltage<br>BI/RBO                | $V_{OH}$            | $V_{CC} = \text{MIN}, V_{IH} = 2\text{V}, V_{IL} = \text{MAX}, I_{OH} = -50\mu\text{A}$            | 2.4  | 4.2  | –    | V             |
| Low Level Output Voltage<br>BI/RBO                 | $V_{OL}$            | $V_{CC} = \text{MIN}, V_{IH} = 2\text{V}, V_{IL} = \text{MAX}$<br>$I_{OL} = 1.6\text{mA}$          | –    | 0.25 | 0.4  | V             |
|                                                    |                     | $I_{OL} = 3.2\text{mA}$                                                                            | –    | 0.35 | 0.5  | V             |
| Off-State Output Current<br>a through g            | $I_{O(\text{off})}$ | $V_{CC} = \text{MAX}, V_{IH} = 2\text{V}, V_{IL} = \text{MAX}, V_{O(\text{off})} = 15\text{V}$     | –    |      | 250  | $\mu\text{A}$ |
| On-State Output Voltage<br>a through g             | $V_{O(\text{on})}$  | $V_{CC} = \text{MIN}, V_{IH} = 2\text{V}, V_{IL} = \text{MAX}$<br>$I_{O(\text{on})} = 12\text{mA}$ | –    | 0.25 | 0.4  | V             |
|                                                    |                     | $I_{O(\text{on})} = 24\text{mA}$                                                                   | –    | 0.35 | 0.5  | V             |
| Input Current                                      | $I_I$               | $V_{CC} = \text{MAX}, V_I = 7\text{V}$                                                             | –    | –    | 0.1  | mA            |
| High Level Input Current                           | $I_{IH}$            | $V_{CC} = \text{MAX}, V_I = 2.7\text{V}$                                                           | –    | –    | 20   | $\mu\text{A}$ |
| Low Level Input Current<br>Any Input except BI/RBO | $I_{IL}$            | $V_{CC} = \text{MAX}, V_I = 0.4\text{V}$                                                           | –    | –    | –0.4 | mA            |
| BI/RBO                                             |                     |                                                                                                    | –    | –    | –1.2 | mA            |
| Short-Circuit Output Current<br>BI/RBO             | $I_{OS}$            | $V_{CC} = \text{MAX}$                                                                              | –0.3 | –    | –2   | mA            |
| Supply Current                                     | $I_{CC}$            | $V_{CC} = \text{MAX}, \text{Note 4}$                                                               | –    | 7    | 13   | mA            |

Note 2. .For conditions shown as MIN or MAX, use the appropriate value specified under “Recommended Operation Conditions”.

Note 3. All typical values are at  $V_{CC} = 5\text{V}$ ,  $T_A = +25^\circ\text{C}$ .

Note 4.  $I_{CC}$  is measured with all outputs open and all inputs at 4.5V.

**Switching Characteristics:** ( $V_{CC} = 5\text{V}$ ,  $T_A = +25^\circ\text{C}$  unless otherwise specified)

| Parameter                                        | Symbol           | Test Conditions                      | Min | Typ | Max | Unit |
|--------------------------------------------------|------------------|--------------------------------------|-----|-----|-----|------|
| Turn-Off Time from A Input                       | $t_{\text{off}}$ | $R_L = 665\Omega, C_L = 15\text{pF}$ | –   | –   | 100 | ns   |
| Turn-On Time from A Input                        | $t_{\text{on}}$  |                                      | –   | –   | 100 | ns   |
| Turn-Off Time from $\overline{\text{RBI}}$ Input | $t_{\text{off}}$ |                                      | –   | –   | 100 | ns   |
| Turn-On Time from $\overline{\text{RBI}}$ Input  | $t_{\text{on}}$  |                                      | –   | –   | 100 | ns   |

**Function Table:**

| Decimal<br>or<br>Function | Inputs |     |   |   |   |   | BI/RBO<br>(NOTE) | Outputs |     |     |     |     |     |     | Notes |
|---------------------------|--------|-----|---|---|---|---|------------------|---------|-----|-----|-----|-----|-----|-----|-------|
|                           | LT     | RBI | D | C | B | A |                  | a       | b   | c   | d   | e   | f   | g   |       |
| 0                         | H      | H   | L | L | L | L | H                | ON      | ON  | ON  | ON  | ON  | ON  | OFF | 1     |
| 1                         | H      | X   | L | L | L | H | H                | OFF     | ON  | ON  | OFF | OFF | OFF | OFF |       |
| 2                         | H      | X   | L | L | H | L | H                | ON      | ON  | OFF | ON  | ON  | OFF | ON  |       |
| 3                         | H      | X   | L | L | H | H | H                | ON      | ON  | ON  | ON  | OFF | OFF | ON  |       |
| 4                         | H      | X   | L | H | L | L | H                | OFF     | ON  | ON  | OFF | OFF | ON  | ON  |       |
| 5                         | H      | X   | L | H | L | H | H                | ON      | OFF | ON  | ON  | OFF | ON  | ON  |       |
| 6                         | H      | X   | L | H | H | L | H                | OFF     | OFF | ON  | ON  | ON  | ON  | ON  |       |
| 7                         | H      | X   | L | H | H | H | H                | ON      | ON  | ON  | OFF | OFF | OFF | OFF |       |
| 8                         | H      | X   | H | L | L | L | H                | ON      | ON  | ON  | ON  | ON  | ON  | ON  |       |
| 9                         | H      | X   | H | L | L | H | H                | ON      | ON  | ON  | OFF | OFF | ON  | ON  |       |
| 10                        | H      | X   | H | L | H | L | H                | OFF     | OFF | OFF | ON  | ON  | OFF | ON  |       |
| 11                        | H      | X   | H | L | H | H | H                | OFF     | OFF | ON  | ON  | OFF | OFF | ON  |       |
| 12                        | H      | X   | H | H | L | L | H                | OFF     | ON  | OFF | OFF | OFF | ON  | ON  |       |
| 13                        | H      | X   | H | H | L | H | H                | ON      | OFF | OFF | ON  | OFF | ON  | ON  |       |
| 14                        | H      | X   | H | H | H | L | H                | OFF     | OFF | OFF | ON  | ON  | ON  | ON  |       |
| 15                        | H      | X   | H | H | H | H | H                | OFF     | OFF | OFF | OFF | OFF | OFF | OFF |       |
| BI                        | X      | X   | X | X | X | X | L                | OFF     | OFF | OFF | OFF | OFF | OFF | OFF | 2     |
| RBI                       | H      | L   | L | L | L | L | L                | OFF     | OFF | OFF | OFF | OFF | OFF | OFF | 3     |
| LT                        | L      | X   | X | X | X | X | H                | ON      | ON  | ON  | ON  | ON  | ON  | ON  | 4     |

H = HIGH Level

L = LOW Level

X = Irrelevant

**NOTE:**  $\overline{\text{BI}}/\overline{\text{RBO}}$  is wire-AND logic serving as blanking input ( $\overline{\text{BI}}$ ) and/or ripple-blanking output ( $\overline{\text{RBO}}$ ).

Note 1. The blanking input ( $\overline{\text{BI}}$ ) must be open or held at a high logic level when output functions 0 through 15 are desired. The ripple-blanking input ( $\overline{\text{RBI}}$ ) must be open or high if blanking of a decimal zero is not desired.

Note 2. When a low logic level is applied directly to the blanking input ( $\overline{\text{BI}}$ ), all segment outputs are off regardless of the level of any other input.

Note 3. When ripple-blanking input ( $\overline{\text{RBI}}$ ) and inputs A, B, C, and D are at a low level with the lamp test input high, all segment outputs go off and the ripple-blanking output ( $\overline{\text{RBO}}$ ) goes to a low level (response condition).

Note 4. When the blanking input/ripple blanking output ( $\overline{\text{BI}}/\overline{\text{RBO}}$ ) is open or held high and a low is applied to the lamp-test input, all segment outputs are on.

### Pin Connection Diagram

