

## DM7446A, DM5447A/DM7447A BCD to 7-Segment Decoders/Drivers

### General Description

The 46A and 47A feature active-low outputs designed for driving common-anode LEDs or incandescent indicators directly. All of the circuits have full ripple-blanking input/output controls and a lamp test input. Segment identification and resultant displays are shown on a following page. Display patterns for BCD input counts above nine are unique symbols to authenticate input conditions.

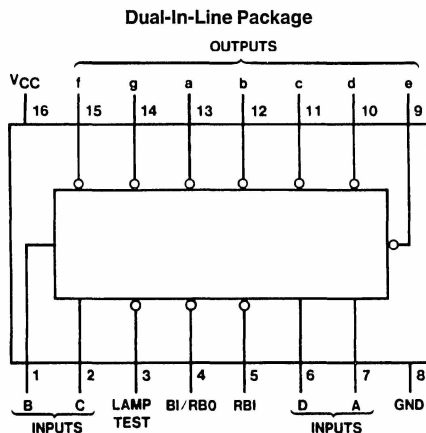
All of the circuits incorporate automatic leading and/or trailing-edge, zero-blanking control (RBI and RBO). Lamp test (LT) of these devices may be performed at any time when the BI/RBO node is at a high logic level. All types contain

an overriding blanking input (BI) which can be used to control the lamp intensity (by pulsing) or to inhibit the outputs.

### Features

- All circuit types feature lamp intensity modulation capability
- Open-collector outputs drive indicators directly
- Lamp-test provision
- Leading/trailing zero suppression

### Connection Diagram



TL/F/6518-1

Order Number DM5447AJ, DM7446AN or DM7447AN  
See NS Package Number J16A or N16E

**Absolute Maximum Ratings** (Note)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|                                      |                 |
|--------------------------------------|-----------------|
| Supply Voltage                       | 7V              |
| Input Voltage                        | 5.5V            |
| Operating Free Air Temperature Range |                 |
| DM54                                 | −55°C to +125°C |
| DM74                                 | 0°C to +70°C    |
| Storage Temperature Range            | −65°C to +150°C |

Note: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Recommended Operating Conditions**

| Symbol          | Parameter                            | DM7446A |     |      | Units |
|-----------------|--------------------------------------|---------|-----|------|-------|
|                 |                                      | Min     | Nom | Max  |       |
| V <sub>CC</sub> | Supply Voltage                       | 4.75    | 5   | 5.25 | V     |
| V <sub>IH</sub> | High Level Input Voltage             | 2       |     |      | V     |
| V <sub>IL</sub> | Low Level Input Voltage              |         |     | 0.8  | V     |
| V <sub>OH</sub> | High Level Output Voltage (a thru g) |         |     | 30   | V     |
| I <sub>OH</sub> | High Level Output Current (BI/RBO)   |         |     | −0.2 | μA    |
| I <sub>OL</sub> | Low Level Output Current (a thru g)  |         |     | 40   | mA    |
| I <sub>OL</sub> | Low Level Output Current (BI/RBO)    |         |     | 8    | mA    |
| T <sub>A</sub>  | Free Air Operating Temperature       | 0       |     | 70   | °C    |

**'46A Electrical Characteristics**

over recommended operating free air temperature range (unless otherwise noted)

| Symbol           | Parameter                            | Conditions                                                                                   | Min    | Typ<br>(Note 1) | Max  | Units |
|------------------|--------------------------------------|----------------------------------------------------------------------------------------------|--------|-----------------|------|-------|
| V <sub>I</sub>   | Input Clamp Voltage                  | V <sub>CC</sub> = Min, I <sub>I</sub> = −12 mA                                               |        |                 | −1.5 | V     |
| V <sub>OH</sub>  | High Level Output Voltage (BI/RBO)   | V <sub>CC</sub> = Min<br>I <sub>OH</sub> = Max                                               | 2.4    | 3.7             |      | V     |
| I <sub>CEX</sub> | High Level Output Current (a thru g) | V <sub>CC</sub> = Max, V <sub>O</sub> = 30V<br>V <sub>IL</sub> = Max, V <sub>IH</sub> = Min  |        |                 | 250  | μA    |
| V <sub>OL</sub>  | Low Level Output Voltage             | V <sub>CC</sub> = Min, I <sub>OL</sub> = Max<br>V <sub>IH</sub> = Min, V <sub>IL</sub> = Max |        | 0.3             | 0.4  | V     |
| I <sub>I</sub>   | Input Current @ Max Input Voltage    | V <sub>CC</sub> = Max, V <sub>I</sub> = 5.5V<br>(Except BI/RBO)                              |        |                 | 1    | mA    |
| I <sub>IH</sub>  | High Level Input Current             | V <sub>CC</sub> = Max, V <sub>I</sub> = 2.4V<br>(Except BI/RBO)                              |        |                 | 40   | μA    |
| I <sub>IL</sub>  | Low Level Input Current              | V <sub>CC</sub> = Max<br>V <sub>I</sub> = 0.4V                                               | BI/RBO |                 | −4   | mA    |
|                  |                                      |                                                                                              | Others |                 | −1.6 |       |
| I <sub>OS</sub>  | Short Circuit Output Current         | V <sub>CC</sub> = Max (BI/RBO)                                                               |        |                 | −4   | mA    |
| I <sub>CC</sub>  | Supply Current                       | V <sub>CC</sub> = Max<br>(Note 2)                                                            |        | 60              | 103  | mA    |

Note 1: All typicals are at V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C.

Note 2: I<sub>CC</sub> is measured with all outputs open and all inputs at 4.5V.

**'46A Switching Characteristics**at  $V_{CC} = 5V$  and  $T_A = 25^\circ C$  (See Section 1 for Test Waveforms and Output Load)

| Symbol    | Parameter                                          | Conditions                                | Min | Max | Units |
|-----------|----------------------------------------------------|-------------------------------------------|-----|-----|-------|
| $t_{PLH}$ | Propagation Delay Time<br>Low to High Level Output | $C_L = 15\text{ pF}$<br>$R_L = 120\Omega$ |     | 100 | ns    |
| $t_{PHL}$ | Propagation Delay Time<br>High to Low Level Output |                                           |     | 100 | ns    |

**Recommended Operating Conditions**

| Symbol   | Parameter                               | DM5447A |     |      | DM7447A |     |      | Units      |
|----------|-----------------------------------------|---------|-----|------|---------|-----|------|------------|
|          |                                         | Min     | Nom | Max  | Min     | Nom | Max  |            |
| $V_{CC}$ | Supply Voltage                          | 4.5     | 5   | 5.5  | 4.75    | 5   | 5.25 | V          |
| $V_{IH}$ | High Level Input Voltage                | 2       |     |      | 2       |     |      | V          |
| $V_{IL}$ | Low Level Input Voltage                 |         |     | 0.8  |         |     | 0.8  | V          |
| $V_{OH}$ | High Level Output<br>Voltage (a thru g) |         |     | 15   |         |     | 15   | V          |
| $I_{OH}$ | High Level Output<br>Current (BI/RBO)   |         |     | -0.2 |         |     | -0.2 | $\mu A$    |
| $I_{OL}$ | Low Level Output<br>Current (a thru g)  |         |     | 40   |         |     | 40   | mA         |
| $I_{OL}$ | Low Level Output<br>Current (BI/RBO)    |         |     | 8    |         |     | 8    | mA         |
| $T_A$    | Free Air Operating Temperature          | -55     |     | 125  | 0       |     | 70   | $^\circ C$ |

**'47A Electrical Characteristics**

over recommended operating free air temperature range (unless otherwise noted)

| Symbol    | Parameter                               | Conditions                                                                               | Min    | Typ<br>(Note 1) | Max  | Units   |
|-----------|-----------------------------------------|------------------------------------------------------------------------------------------|--------|-----------------|------|---------|
| $V_I$     | Input Clamp Voltage                     | $V_{CC} = \text{Min}, I_I = -12\text{ mA}$                                               |        |                 | -1.5 | V       |
| $V_{OH}$  | High Level Output<br>Voltage (BI/RBO)   | $V_{CC} = \text{Min}$<br>$I_{OH} = \text{Max}$                                           | 2.4    | 3.7             |      | V       |
| $I_{CEX}$ | High Level Output<br>Current (a thru g) | $V_{CC} = \text{Max}, V_O = 15V$<br>$V_{IL} = \text{Max}, V_{IH} = \text{Min}$           |        |                 | 250  | $\mu A$ |
| $V_{OL}$  | Low Level Output<br>Voltage             | $V_{CC} = \text{Min}, I_{OL} = \text{Max}$<br>$V_{IH} = \text{Min}, V_{IL} = \text{Max}$ |        | 0.3             | 0.4  | V       |
| $I_I$     | Input Current @ Max<br>Input Voltage    | $V_{CC} = \text{Max}, V_I = 5.5V$                                                        |        |                 | 1    | mA      |
| $I_{IH}$  | High Level Input Current                | $V_{CC} = \text{Max}, V_I = 2.4V$                                                        |        |                 | 40   | $\mu A$ |
| $I_{IL}$  | Low Level Input<br>Current              | $V_{CC} = \text{Max}$<br>$V_I = 0.4V$                                                    | BI/RBO |                 | -4   | mA      |
|           |                                         |                                                                                          | Others |                 | -1.6 |         |
| $I_{OS}$  | Short Circuit<br>Output Current         | $V_{CC} = \text{Max (BI/RBO)}$                                                           |        |                 | -4   | mA      |
| $I_{CC}$  | Supply Current                          | $V_{CC} = \text{Max}$<br>(Note 2)                                                        | DM54   | 60              | 85   | mA      |
|           |                                         |                                                                                          | DM74   | 60              | 103  |         |

**Note 1:** All typicals are at  $V_{CC} = 5V$ ,  $T_A = 25^\circ C$ .**Note 2:**  $I_{CC}$  is measured with all outputs open and all inputs at 4.5V.

**'47A Switching Characteristics**at  $V_{CC} = 5V$  and  $T_A = 25^\circ C$  (See Section 1 for Test Waveforms and Output Load)

| Symbol    | Parameter                                          | Conditions                                | Min | Max | Units |
|-----------|----------------------------------------------------|-------------------------------------------|-----|-----|-------|
| $t_{PLH}$ | Propagation Delay Time<br>Low to High Level Output | $C_L = 15\text{ pF}$<br>$R_L = 120\Omega$ |     | 100 | ns    |
| $t_{PHL}$ | Propagation Delay Time<br>High to Low Level Output |                                           |     | 100 | ns    |

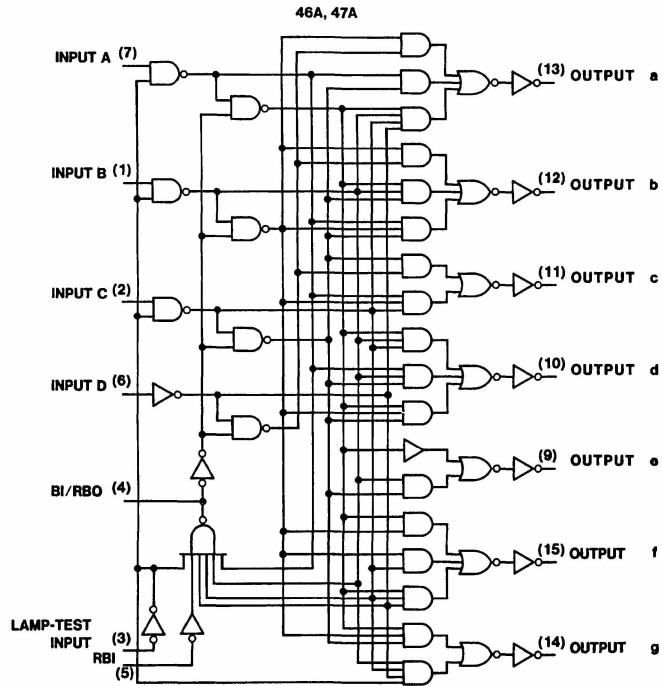
**Function Table**

46A, 47A

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

**Note 1:** BI/RBO is a wire-AND logic serving as blanking input (BI) and/or ripple-blanking output (RBO).**Note 2:** The blanking input (BI) must be open or held at a high logic level when output functions 0 through 15 are desired. The ripple-blanking input (RBI) must be open or high if blanking of a decimal zero is not desired.**Note 3:** When a low logic level is applied directly to the blanking input (BI), all segment outputs are high regardless of the level of any other input.**Note 4:** When ripple-blanking input (RBI) and inputs A, B, C, and D are at a low level with the lamp test input high, all segment outputs go H and the ripple-blanking output (RBO) goes to a low level (response condition).**Note 5:** When the blanking input/ripple-blanking output (BI/RBO) is open or held high and a low is applied to the lamp-test input, all segment outputs are L.  
H = High level, L = Low level, X = Don't Care

# Logic Diagram



TL/F/6518-2