# DM5446A/DM7446A
# DM5447A/DM7447A
# DM5448/DM7448
## BCD-to-7-segment decoder/drivers

## general description

This versatile series of 7-segment display drivers fulfills a wide variety of requirements for most active high (common cathode) and active low (common anode) Light Emitting Diodes (LED) or lamp displays. Each device fully decodes a 4-bit BCD input into a number from 0 through 9 in the standard 7-segment display format, and BCD numbers above 9 into unique patterns that verify operation. All circuits operate from a single 5.0V supply.

The DM5446A/DM7446A has active-low, open-collector outputs that will drive segments requiring up to 40 mA of current. The outputs are capable of withstanding 30V at a maximum leakage current of 250μA. This configuration is particularly well suited for common anode LED displays or higher voltage lamp displays. The high sink current capability also allows this circuit to be used in the multiplex or nonmultiplex mode of display drive. In addition, the device may be used to drive logic circuits since its normalized fanout is 25.

The DM5447A/DM7447A has the same output characteristics as the DM5446A/DM7446A except that the outputs withstand 15V at a maximum leakage current of 250μA. Since its output configuration is the same as the DM5446A/DM7446A its applications will also be the same, the only restriction is that a lower voltage type display be used because of the reduced output voltage limit of 15V.

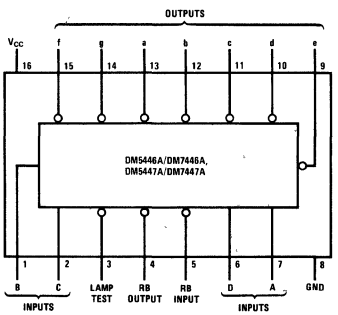
The DM5448/DM7448 has active-high, passive-pull up outputs with a fanout of 4. Typical source current is 2.0 mA at an output voltage of 0.85V. The sink capability is 6.4 mA at a maximum voltage of 0.4V. It is normally used to drive logic circuits, operate high-voltage loads such as electroluminescent displays through buffer transistors or SCR switches, and in low current common cathode Non-Multiplex LED applications.

## features

- Lamp-test input
- Leading/trailing zero suppression (RBI and RBO)
- Blanking input that may be used to modulate lamp intensity or inhibit output
- TTL and DTL compatible
- Input clamping diodes

## connection diagrams

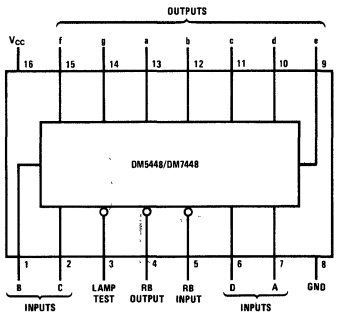
**Dual-In-Line and Flat Package**




TOP VIEW

**Order Number DM5446AJ, DM7446AJ, DM5447AJ, DM7447AJ, DM5448J, or DM7448J**
**See Package 17**

**Dual-In-Line and Flat Package**




TOP VIEW

**Order Number DM5446AN, DM7446AN, DM5447AN, DM7447AN, DM5448N, or DM7448N**
**See Package 23**

**Order Number DM5446AW, DM7446AW, DM5447AW, DM7447AW, DM5448W or DM7448W**
**See Package 28**

## absolute maximum ratings (Note 1)

| | |
|---|---|
| Supply Voltage | 7.0V |
| Input Voltage | 5.5V |
| Storage Temperature Range | −65°C to +150°C |
| Lead Temperature (Soldering, 10 seconds) | 300°C |

## operating conditions

| | MIN | MAX | UNITS |
|---|---|---|---|
| Supply Voltage ($V_{CC}$) | | | |
| DM5446A, DM5447A, DM5448 | 4.5 | 5.5 | V |
| DM7446A, DM7447, DM7448 | 4.75 | 5.25 | V |
| Temperature ($T_A$) | | | |
| DM5446A, DM5447A, DM5448 | −55 | +125 | °C |
| DM7446A, DM7447A, DM7448 | 0 | +70 | °C |
| Output Voltage | | | |
| DM5446A, DM7446A | | 30 | V |
| DM5447A, DM7447A | | 15 | V |
| DM5448, DM7448 | | 5.5 | V |
| Output Sink Current (per segment) | | | |
| DM5446A, DM7446A, | | 40 | mA |
| DM5447A, DM7447A | | 40 | mA |
| DM5448, DM7448 | | 6.4 | mA |

## electrical characteristics (Note 2) The following is applicable to all parts.

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| Logical "1" Input Voltage | | 2.0 | | | V |
| Logical "0" Input Votlage | | | | 0.8 | V |
| Logical "1" Output Voltage BI/RBO Node | $V_{CC}$ = Min, $I_{OUT}$ = −200μA | 2.4 | 3 7 | | V |
| Logical "0" Output Voltage at BI/RBO Node | $V_{CC}$ = Min, $I_{IN}$ = 8.0 mA | | 0.3 | 0.4 | V |
| Logical "1" Input Current at any Input Except BI/RBO Node | $V_{CC}$ = Max, $V_{IN}$ = 2.4V<br>$V_{CC}$ = Max, $V_{IN}$ = 5.5V | | | 40<br>1.0 | μA<br>mA |
| Logical "0" Input Current (Except BI/RBO Node) | $V_{CC}$ = Max, $V_{IN}$ = 0.4V | | | −1.6 | mA |
| Logical "0" Input Current BI/RBO Node | $V_{CC}$ = Max, $V_{IN}$ = 0.4V | | | −4.2 | mA |
| Output Short Circuit Current at BI/RBO Node | $V_{CC}$ = Max | | | −4.0 | mA |
| Input Clamp Voltage | $V_{CC}$ = 5.0V, $T_A$ = 25°C, $I_{IN}$ = −12 mA | | | −1.5 | V |

## output characteristics and supply current

DM5446A/DM7446A, DM5447A/DM7447A (Note 2)

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| Logical "1" Output Voltage Outputs a through g | | | | | |
| DM5446A, DM7446A | $V_{CC}$ = Max, $I_{OUT}$ = 250μA | 30 | | | V |
| DM5447A, DM7447A | | 15 | | | V |
| Logical "0" Output Voltage Outputs a through g | $V_{CC}$ = Min, $I_{OUT}$ = 40 mA | | 0 3 | 0 4 | V |
| Supply Current | | | | | |
| DM5446A, DM5447A | $V_{CC}$ = Max | | 60 | 85 | mA |
| DM7446A, DM7447A | | | 60 | 103 | mA |

## output characteristics and supply current

DM5448/DM7448 (Note 2)

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| Logical "1" Output Voltage Outputs a through g DM5448, DM7448 | $V_{CC}$ = Min, $I_{OUT}$ = −400μA | 2.4 | 3.2 | | V |
| Logical "0" Output Voltage Outputs a through g | $V_{CC}$ = Min, $I_{OUT}$ = 6.4 mA | | 0.25 | 0.4 | V |
| Logical "1" Load Current Available, Outputs a through g | $V_{CC}$ = Min, $V_{OUT}$ = 0.85V | −1.3 | −2.0 | | mA |
| Output Short Circuit Current Outputs a through g (Note 3) | $V_{CC}$ = Max | | −3.0 | −4.0 | mA |
| Supply Current DM5448 | $V_{CC}$ = Max | | 50 | 76 | mA |
| DM7448 | | | 50 | 90 | mA |

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

**Note 2:** Unless otherwise specified min/max limits apply across the −55°C to +125°C temperature range for DM5446A, DM5447A, and DM5448, and across the 0°C to +70°C range for DM7446A, DM7447A, and DM7448. All typicals are given for $V_{CC}$ = 5.0V and $T_A$ = 25°C.

## switching characteristics

DM5446A/DM7446A, DM5447A/DM7447A, DM5448/DM7448 ($V_{CC}$ = 5.0V, $T_A$ = 25°C)

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| Propagation Delay to a Logical "0" from A Input to any Output ($t_{pd0}$) | | | | | |
| DM5446A/DM7446A | $C_L$ = 15 pF, $R_L$ = 120Ω | | | 100 | ns |
| DM5447A/DM7447A | $C_L$ = 15 pF, $R_L$ = 120Ω | | | 100 | ns |
| DM5448 | $C_L$ = 15 pF, $R_L$ = 1kΩ | | | 100 | ns |
| DM7448 | $C_L$ = 15 pF, $R_L$ = 667Ω | | | 100 | ns |
| Propagation Delay to a Logical "0" from RBI to any Output ($t_{pd0}$) | | | | | |
| DM5446A/DM7446A | $C_L$ = 15 pF, $R_L$ = 120Ω | | | 100 | ns |
| DM5447A/DM7447A | $C_L$ = 15 pF, $R_L$ = 120Ω | | | 100 | ns |
| DM5448 | $C_L$ = 15 pF, $R_L$ = 1kΩ | | | 100 | ns |
| DM7448 | $C_L$ = 15 pF, $R_L$ = 667Ω | | | 100 | ns |
| Propagation Delay to a Logical "1" from A Input to any Output ($t_{pd1}$) | | | | | |
| DM5446A/DM7446A | $C_L$ = 15 pF, $R_L$ = 120Ω | | | 100 | ns |
| DM5447A/DM7447A | $C_L$ = 15 pF, $R_L$ = 120Ω | | | 100 | ns |
| DM5448 | $C_L$ = 15 pF, $R_L$ = 1kΩ | | | 100 | ns |
| DM7448 | $C_L$ = 15 pF, $R_L$ = 667Ω | | | 100 | ns |
| Propagation Delay to a Logical "1" from RBI to any Output ($t_{pd1}$) | | | | | |
| DM5446A/DM7446A | $C_L$ = 15 pF, $R_L$ = 120Ω | | | 100 | ns |
| DM5447A/DM7447A | $C_L$ = 15 pF, $R_L$ = 120Ω | | | 100 | ns |
| DM5448 | $C_L$ = 15 pF, $R_L$ = 1kΩ | | | 100 | ns |
| DM7448 | $C_L$ = 15 pF, $R_L$ = 667Ω | | | 100 | ns |

## truth tables

**DM5446A/DM7446A, DM5447A/DM7447A**

| DECIMAL OR FUNCTION | INPUTS LT | RBI | D | C | B | A | BI/RBO | OUTPUTS a | b | c | d | e | f | g | NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | X | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 2 | 1 | X | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | |
| 3 | 1 | X | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | |
| 4 | 1 | X | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | |
| 5 | 1 | X | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | |
| 6 | 1 | X | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | |
| 7 | 1 | X | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | |
| 8 | 1 | X | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 9 | 1 | X | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | |
| 10 | 1 | X | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | |
| 11 | 1 | X | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | |
| 12 | 1 | X | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | |
| 13 | 1 | X | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | |
| 14 | 1 | X | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | |
| 15 | 1 | X | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| BI | X | X | X | X | X | X | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| RBI | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 |
| LT | 0 | X | X | X | X | X | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |

**Note 1:** BI/RBO is wire-AND logic serving as blanking input (BI) and/or ripple-blanking output (RBO). The blanking input (BI) must be open or held at a logical 1 when output functions 0 through 15 are desired, and the ripple-blanking input (RBI) must be open or at a logical 1 if blanking of a decimal 0 is not desired. X = input may be high or low.

**Note 2:** When a logical 0 is applied directly to the blanking input (forced condition) all segment outputs go to a logical 1 regardless of the state of any other input condition

**Note 3:** When the ripple-blanking input (RBI) and inputs A, B, C, and D are at logical 0, with the lamp test input at logical 1, all segment outputs go to a logical 1 and the ripple-blanking output (RBO) goes to a logical 0 (response condition).

**Note 4:** When the blanking input/ripple-blanking output (BI/RBO) is open or held at a logical 1, and a logical 0 is applied to the lamp-test input, all segment outputs go to a logical 0.

**DM5448/DM7448**

| DECIMAL OR FUNCTION | INPUTS LT | RBI | D | C | B | A | BI/RBO | OUTPUTS a | b | c | d | e | f | g | NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | X | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| 2 | 1 | X | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | |
| 3 | 1 | X | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | |
| 4 | 1 | X | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | |
| 5 | 1 | X | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | |
| 6 | 1 | X | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | |
| 7 | 1 | X | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | |
| 8 | 1 | X | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| 9 | 1 | X | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | |
| 10 | 1 | X | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | |
| 11 | 1 | X | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | |
| 12 | 1 | X | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | |
| 13 | 1 | X | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | |
| 14 | 1 | X | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | |
| 15 | 1 | X | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| BI | X | X | X | X | X | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| RBI | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| LT | 0 | X | X | X | X | X | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 |

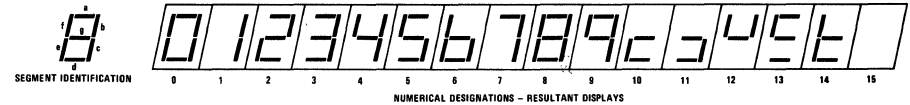
**Note 1:** BI/RBO is wire-AND logic serving as blanking input (BI) and/or ripple-blanking output (RBO). The blanking input (BI) must be open or held at a logical 1 when output functions 0 through 15 are desired, and the ripple-blanking input (RBI) must be open or at a logical 1 if blanking of a decimal 0 is not desired. X = input may be high or low.

**Note 2:** When a logical 0 is applied directly to the blanking input (forced condition) all segment outputs go to a logical 0 regardless of the state of any other input condition.

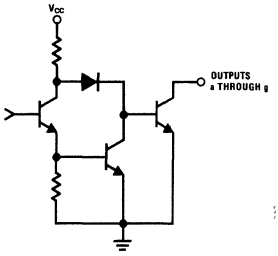
**Note 3:** When the ripple-blanking input (RBI) and inputs A, B, C, and D are at logical 0, with the lamp test at logical 1 all segment outputs go to the logical 0 and the ripple blanking output (RBO) goes to a logical 0 (response condition).

**Note 4:** When the blanking input/ripple-blanking output (RI/RBO) is open or held at a logical 1, and a logical 0 is applied to the lamp-test input, all segment outputs go to a logical 1.

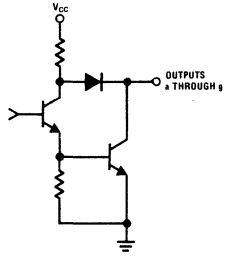
## output display



## output stage schematics

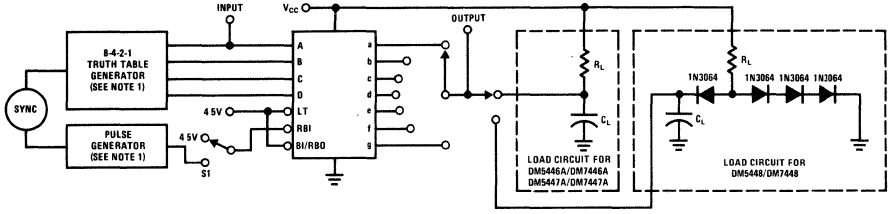



DM5446A/DM7446A
DM5447A/DM7447A

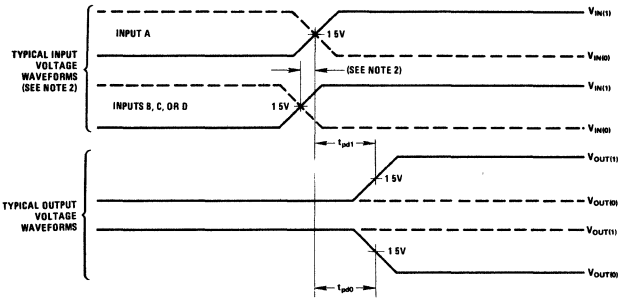



DM5448/DM7448

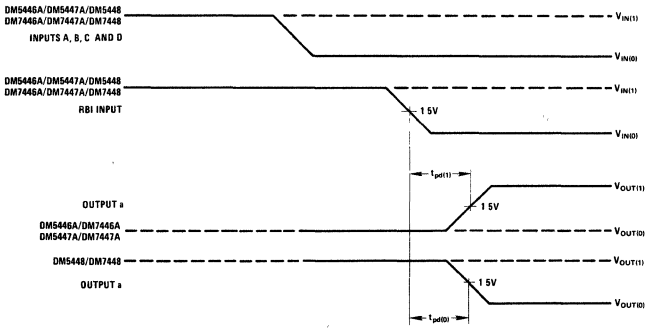
## ac test circuit




## switching time waveforms




A Input to Outputs




RBI Input to Outputs

Note 1 The truth table generator and pulse generator have the following characteristics: $V_{OUT(1)} \geq 2.4V$, $V_{OUT(0)} \leq 0.4V$, $t_r$ and $t_f \leq 10$ ns, and PRR = 1.0 MHz

Note 2 Inputs B, C, and D transitions occur simultaneously with or prior to input A transitions RBI = 4.5V.

Note 3 $C_L$ includes probe and jig capacitance.

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