DS1488
Quad Line Driver

General Description
The DS1488 is a quad line driver which converts standard
TTL input logic levels through one stage of inversion to output
levels which meet EIA Standard RS-232D and CCITT
Recommendation V.24.

Features
- Current limited output: ±10 mA typ
- Power-off source impedance: 300Ω min
- Simple slew rate control with external capacitor
- Flexible operating supply range
- Inputs are TTL/LS compatible

Schematic and Connection Diagrams

1/4 Circuit

Dual-In-Line Package

Top View
Order Number DS1488M or DS1488N
See NS Package Number M14A or N14A
## Absolute Maximum Ratings (Note 2)
If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

- **Operating Temperature Range**: 0°C to +75°C
- **Storage Temperature Range**: -65°C to +150°C
- **Maximum Power Dissipation**: (Note 1) at 25°C
  - Molded DIP Package: 1280 mW
  - SO Package: 974 mW

### Supply Voltage
- \( V^+ = +15V \)
- \( V^- = -15V \)

### Input Voltage (\( V_{IN} \))
- \( -15V \leq V_{IN} \leq 7.0V \)

### Output Voltage
- \( \pm 15V \)

### Operating Temperature Range
- 0˚C to +75˚C

### Storage Temperature Range
- −65˚C to +150˚C

### Lead Temperature (Soldering, 4 sec.)
- 260˚C

### Maximum Power Dissipation (Note 1)
- Molded DIP Package: 1280 mW
- SO Package: 974 mW

(Note 1): Derate molded DIP package 10.2 mW/˚C above 25˚C; derate SO package 7.8 mW/˚C above 25˚C.

## Electrical Characteristics (Notes 3, 4)

### Symbol | Parameter | Condition | Min | Typ | Max | Units
--- | --- | --- | --- | --- | --- | ---
\( I_{IL} \) | Logical “0” Input Current | \( V_{IN} = 0V \) | −0.8 | −1.3 | mA |
\( I_{IH} \) | Logical “1” Input Current | \( V_{IN} = +5.0V \) | 0.005 | 10.0 | µA |
\( V_{OH} \) | High Level Output Voltage | \( R_L = 3.0 \, k\Omega \), \( V^+ = 9.0V \), \( V^- = -9.0V \) | 6.0 | 7.1 | V |
\( V_{OL} \) | Low Level Output Voltage | \( R_L = 3.0 \, k\Omega \), \( V^+ = 13.2V \), \( V^- = -13.2V \) | −6.0 | 7.0 | V |
\( V_{IN} = 0.8V \), \( V^+ = 13.2V \), \( V^- = -13.2V \) | −9.0 | −10.6 | V |
\( I_{OS}^+ \) | High Level Output Short-Circuit Current | \( V_{OUT} = 0V \), \( V_{IN} = 0.8V \) | −6.0 | −10.0 | −12.0 | mA |
\( I_{OS}^- \) | Low Level Output Short-Circuit Current | \( V_{OUT} = 0V \), \( V_{IN} = 1.9V \) | 6.0 | 10.0 | 12.0 | mA |
\( R_{OUT} \) | Output Resistance | \( V^+ = V^- = 0V \), \( V_{OUT} = \pm 2V \) | 300 | Ω |
\( I_{CC}^+ \) | Positive Supply Current (Output Open) | \( V_{IN} = 1.9V \), \( V^+ = 9.0V \), \( V^- = -9.0V \) | 11.6 | 20.0 | mA |
\( V^+ = 12V \), \( V^- = -12V \) | 15.7 | 25.0 | mA |
\( V^+ = 15V \), \( V^- = -15V \) | 19.4 | 34.0 | mA |
\( V_{IN} = 0.8V \), \( V^+ = 9.0V \), \( V^- = -9.0V \) | 3.4 | 6.0 | mA |
\( V^+ = 12V \), \( V^- = -12V \) | 4.1 | 7.0 | mA |
\( V^+ = 15V \), \( V^- = -15V \) | 9.1 | 12.0 | mA |
\( I_{CC}^- \) | Negative Supply Current (Output Open) | \( V_{IN} = 1.9V \), \( V^+ = 9.0V \), \( V^- = -9.0V \) | −10.8 | −17.0 | mA |
\( V^+ = 12V \), \( V^- = -12V \) | −14.6 | −23.0 | mA |
\( V^+ = 15V \), \( V^- = -15V \) | −18.3 | −34.0 | mA |
\( V_{IN} = 0.8V \), \( V^+ = 9.0V \), \( V^- = -9.0V \) | −0.001 | −0.100 | mA |
\( V^+ = 12V \), \( V^- = -12V \) | −0.001 | −0.100 | mA |
\( V^+ = 15V \), \( V^- = -15V \) | −0.01 | −2.5 | mA |
\( P_d \) | Power Dissipation | \( V^+ = 9.0V \), \( V^- = -9.0V \) | 252 | 333 | mW |
\( V^+ = 12V \), \( V^- = -12V \) | 444 | 576 | mW |

### Switching Characteristics

\( V_{CC} = 9V \), \( V_{EE} = -9V \), \( T_A = 25^\circ C \)

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
--- | --- | --- | --- | --- | --- | ---
\( t_{pd} \) | Propagation Delay to a Logical “1” | \( R_L = 3.0 \, k\Omega \), \( C_L = 15 \, pF \), \( T_A = 25^\circ C \) | 187 | 350 | ns |
\( t_{pd} \) | Propagation Delay to a Logical “0” | \( R_L = 3.0 \, k\Omega \), \( C_L = 15 \, pF \), \( T_A = 25^\circ C \) | 45 | 175 | ns |
\( t_r \) | Rise Time | \( R_L = 3.0 \, k\Omega \), \( C_L = 15 \, pF \), \( T_A = 25^\circ C \) | 63 | 100 | ns |
\( t_f \) | Fall Time | \( R_L = 3.0 \, k\Omega \), \( C_L = 15 \, pF \), \( T_A = 25^\circ C \) | 33 | 75 | ns |

Note 2: "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 devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

Note 3: Unless otherwise specified min/max limits apply across the 0˚C to +75˚C temperature range for the DS1488.

Note 4: All currents into device pins shown as positive, out of device pins as negative, all voltages referenced to ground unless otherwise noted. All values shown as max or min on absolute value basis.

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Applications

By connecting a capacitor to each driver output the slew rate can be controlled utilizing the output current limiting characteristics of the DS1488. For a set slew rate the appropriate capacitor value may be calculated using the following relationship

\[ C = \frac{I_{SC} \cdot \Delta T}{\Delta V} \]

where \( C \) is the required capacitor, \( I_{SC} \) is the short circuit current value, and \( \Delta V/\Delta T \) is the slew rate.

Typical Applications

RS-232C specifies that the output slew rate must not exceed 30V per microsecond. Using the worst case output short circuit current of 12 mA in the above equation, calculations result in a required capacitor of 400 pF connected to each output.

See Typical Performance Characteristics.
AC Load Circuit and Switching Time Waveforms

*C_L includes probe and jig capacitance.

Typical Performance Characteristics  \( T_A = +25^\circ\text{C} \) unless otherwise noted

**FIGURE 1.** Transfer Characteristics vs Power Supply Voltage

**FIGURE 2.** Short-Circuit Output Current vs Temperature

**FIGURE 3.** Output Slew Rate vs Load Capacitance

**FIGURE 4.** Output Voltage and Current-Limiting Characteristics
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