May 1998

National Semiconductor

# DS14C88
# QUAD CMOS Line Driver

## General Description

The DS14C88, pin-for-pin compatible to the DS1488/ MC1488, is a quad line drivers designed to interface data terminal equipment (DTE) with data circuit-terminating equipment (DCE). This device translates standard TTL/ CMOS logic levels to levels conforming to EIA-232-D and CCITT V.28 standards.

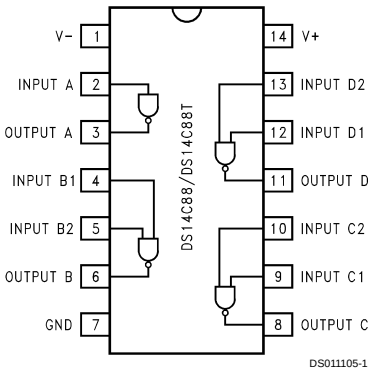
The device is fabricated in low threshold CMOS metal gate technology. The device provides very low power consumption compared to its bipolar equivalents: 500 µA (DS14C88) versus 25 mA (DS1488).

The DS14C88 simplifies designs by eliminating the need for external slew rate control capacitors. Slew rate control in accordance with EIA-232D is provided on-chip, eliminating the output capacitors.

## Features

- Meets EIA-232D and CCITT V.28 standards
- LOW power consumption
- Wide power supply range: ±5V to ±12V
- Available in SOIC package

## Connection Diagram




**Order Number DS14C88N, or DS14C88M**
**See NS Package Number N14A or M14A**

## Absolute Maximum Ratings (Note 1)

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

| | |
|---|---|
| Supply Voltage | |
| $V^+$ Pin | +13V |
| $V^-$ Pin | −13V |
| Driver Input Voltage | ($V^+$) +0.3V to GND −0.3V |
| Driver Output Voltage | $\|(V^+) - V_O\| \leq 30V$ |
| | $\|(V^-) - V_O\| \leq 30V$ |
| Continuous Power Dissipation @+25˚C (Note 2) | |
| N Package | 1513 mW |
| M Package | 1063 mW |
| Junction Temperature | +150˚C |
| Lead Temperature | |
| (Soldering 4 seconds) | +260˚C |
| Storage Temperature Range | −65˚C to +150˚C |

**This Product does not meet 2000V ESD rating.** (Note 9)

## Recommended Operating Conditions

| | Min | Max | Units |
|---|---|---|---|
| $V^+$ Supply (GND = 0V) | +4.5 | +12.6 | V |
| $V^-$ Supply (GND = 0V) | −4.5 | −12.6 | V |
| Operating Free Air Temp. ($T_A$) | | | |
| DS14C88 | 0 | +75 | ˚C |

## Electrical Characteristics

Over Recommended Operating Conditions, unless otherwise specified

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| $I_{IL}$ | Maximum Low Input Current | $V_{IN}$ = GND | | | | +10 | µA |
| $I_{IH}$ | Maximum High Input Current | $V_{IN} = V^+$ | | −10 | | | µA |
| $V_{IL}$ | Low Level Input Voltage | $V^+ \geq +7V$, $V^- \leq -7V$ | | GND | | 0.8 | V |
| | | $V^+ < +7V$, $V^- > -7V$ | | GND | | 0.6 | V |
| $V_{IH}$ | High Level Input Voltage | | | 2.0 | | $V^+$ | V |
| $V_{OL}$ | Low Level Output Level | $V_{IN} = V_{IH}$ | $V^+ = 4.5V$, $V^- = -4.5V$ | | −4.0 | −3.0 | V |
| | | $R_L$ = 3 kΩ | $V^+ = 9V$, $V^- = 9V$ | | −8.0 | −6.5 | V |
| | | or 7 kΩ | $V^+ = 12V$, $V^- = -12V$ | | −10.5 | −9.0 | V |
| $V_{OH}$ | High Level Output Level | $V_{IN} = V_{IL}$ | $V^+ = 4.5V$, $V^- = -4.5V$ | 3.0 | 4.0 | | V |
| | | $R_L$ = 3 kΩ | $V^+ = 9V$, $V^- = -9V$ | 6.5 | 8.0 | | V |
| | | or 7 kΩ | $V^+ = 12V$, $V^- = -12V$ | 9.0 | 10.5 | | V |
| $I_{OS+}$ | High Level Output Short Circuit Current (Note 3) | $V_{IN}$ = 0.8V, $V_O$ = GND | $V^+ = +12V$, $V^- = -12V$ | −45 | | | mA |
| $I_{OS-}$ | Low Level Output Short Circuit Current (Note 3) | $V_{IN}$ = 2.0V, $V_O$ = GND | | | | +45 | mA |
| $R_{OUT}$ | Output Resistance | $V^+ = V^- = GND = 0V$ | | 300 | | | Ω |
| | | $-2V \leq V_O \leq +2V$ (Note 4) (*Figure 1* ) | | | | | |
| $I_{CC+}$ | Positive Supply Current | $V_{IN} = V_{ILmax}$ | $V^+ = 4.5V$, $V^- = -4.5V$ | | | 10 | µA |
| | | $R_L$ = OPEN | $V^+ = 9V$, $V^- = -9V$ | | | 30 | µA |
| | | | $V^+ = 12V$, $V^- = -12V$ | | | 60 | µA |
| | | $V_{IN} = V_{IHmin}$ | $V^+ = 4.5V$, $V^- = -4.5V$ | | | 50 | µA |
| | | $R_L$ = OPEN | $V^+ = 9V$, $V^- = -9V$ | | | 300 | µA |
| | | | $V^+ = 12V$, $V^- = -12V$ | | | 500 | µA |
| $I_{CC-}$ | Negative Supply Current | $V_{IN} = V_{ILmax}$ | $V^+ = 4.5V$, $V^- = -4.5V$ | | | −10 | µA |
| | | $R_L$ = OPEN | $V^+ = 9V$, $V^- = -9V$ | | | −10 | µA |
| | | | $V^+ = 12V$, $V^- = -12V$ | | | −10 | µA |
| | | $V_{IN} = V_{IHmin}$ | $V^+ = 4.5V$, $V^- = -4.5V$ | | | −30 | µA |
| | | $R_L$ = OPEN | $V^+ = 9V$, $V^- = -9V$ | | | −30 | µA |
| | | | $V^+ = 12V$, $V^- = -12V$ | | | −60 | µA |

## Switching Characteristics (Notes 5, 6)

Over Recommended Operating Conditions, unless otheriwse specified (*Figures 2, 3*)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation Delay Low to High | $V^+ = +4.5V$, $V^- = -4.5V$ | | 1.5 | 6.0 | µs |
| | | $V^+ = +9.0V$, $V^- = -9.0V$ | | 1.2 | 5.0 | µs |
| | | $V^+ = +12V$, $V^- = -12V$ | | 1.2 | 4.0 | µs |
| $t_{PHL}$ | Propagation Delay High to Low | $V^+ = +4.5V$, $V^- = -4.5V$ | | 1.5 | 6.0 | µs |
| | | $V^+ = +9.0V$, $V^- = -9.0V$ | | 1.35 | 5.0 | µs |
| | | $V^+ = +12V$, $V^- = -12V$ | | 1.3 | 4.0 | µs |
| $t_r$ | Rise Time (Note 7) | | 0.2 | 1.0 | | µs |
| $t_f$ | Fall Time (Note 7) | | 0.2 | 1.0 | | µs |
| tsk | Typical Propagation Delay Skew | $V^+ = +4.5V$, $V^- = -4.5V$ | | 250 | | ns |
| | | $V^+ = +9.0V$, $V^- = -9.0V$ | | 200 | | ns |
| | | $V^+ = +12V$, $V^- = -12V$ | | 150 | | ns |
| $S_R$ | Output Slew Rate (Note 7) | $R_L$ = 3 kΩ to 7 kΩ, $C_L$ = 15 pF to 2500 pF | | | 30 | V/µs |

**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 tables of "Electrical Characteristics" specify conditions for device operation.

**Note 2:** Derate N Package 12.1 mW/°C, and M Package 8.5 mW/°C above +25°C.

**Note 3:** $I_{OS+}$ and $I_{OS-}$ values are for one output at a time. If more than one output is shorted simultaneously, the device dissipation may be exceeded.

**Note 4:** Power supply ($V^+$, $V^-$) and GND pins are connected to ground for the Output Resistance Test ($R_O$).

**Note 5:** AC input test waveforms for test purposes: $t_r = t_f \leq 20$ ns, $V_{IH} = 2V$, $V_{IL} = 0.8V$ (0.6V at $V^+ = 4.5V$, $V^- = -4.5V$)

**Note 6:** Input rise and rall times must not exceed 5 µs.

**Note 7:** The output slew rate, rise time, and fall time are measured from the +3.0V to the −3.0V level on the output waveform.

**Note 8:** $C_L$ include jig and probe capacitances.

**Note 9:** ESD Rating (HBM, 1.5 kΩ, 100 pF) ≥ 1.0 kV.

## Parameter Measure Information

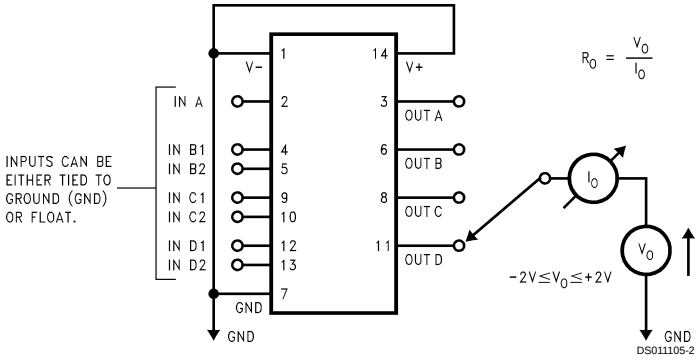



**FIGURE 1. Output Resistance Test Circuit (Power-Off)**

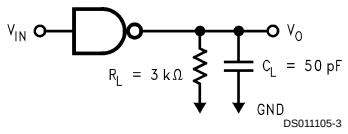



**FIGURE 2. Driver Load Circuit** (Note 8)

## Parameter Measure Information (Continued)

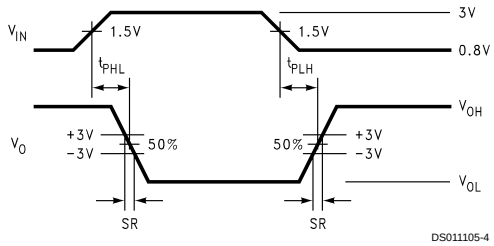



**FIGURE 3. Driver Switching Waveform**

## Typical Application Information

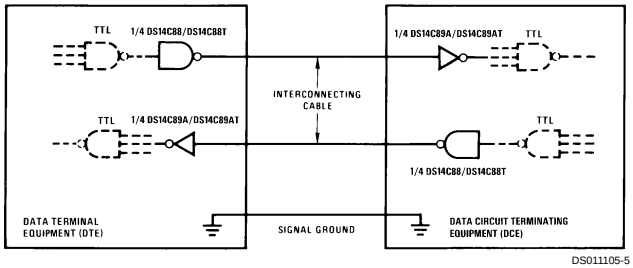
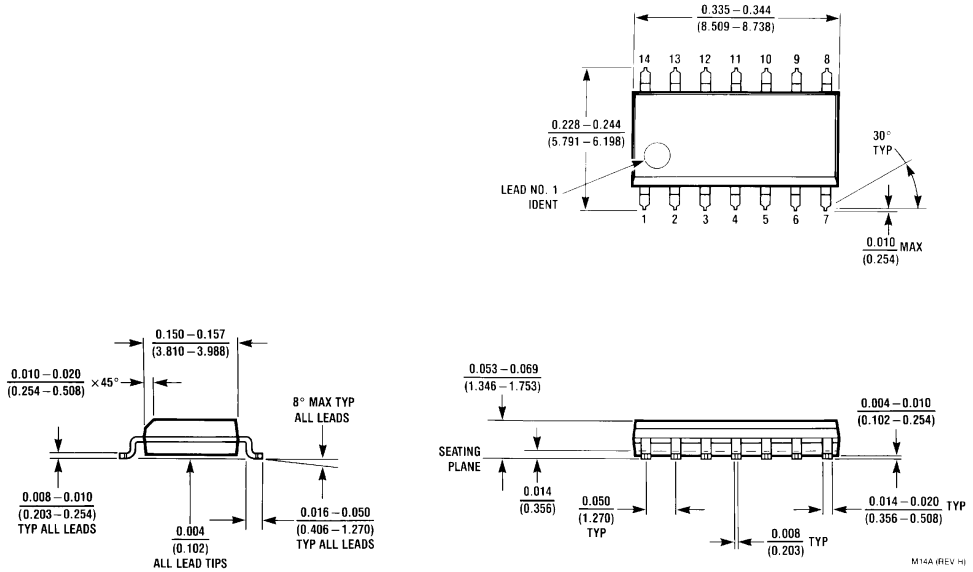
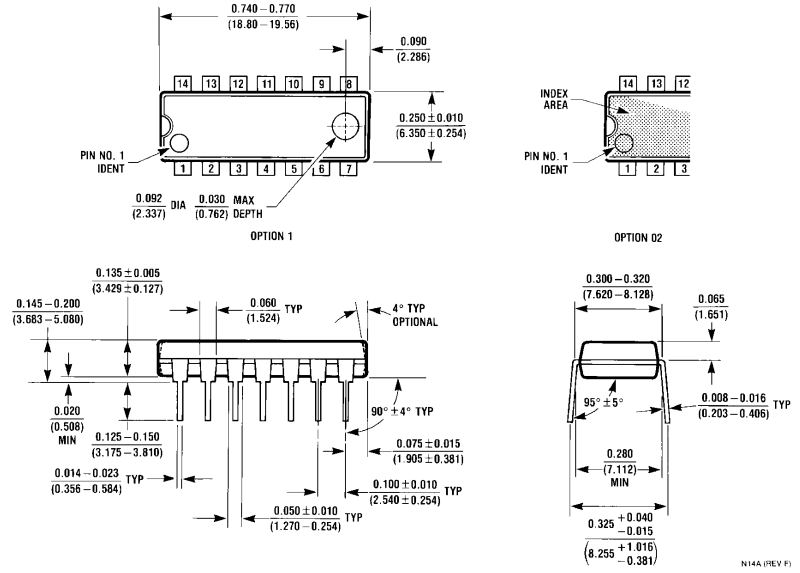



**FIGURE 4. EIA-232D Data Transmission**

## Physical Dimensions inches (millimeters) unless otherwise noted




**Order Number DS14C88M or DS14C88TM**
**NS Package Number M14A**




**Order Number DS14C88N or DS14C88TN**
**NS Package Number N14A**

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