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## DS14C88/DS14C88T QUAD CMOS Line Driver

### General Description

The DS14C88 and DS14C88T, pin-for-pin compatible to the DS1488/MC1488, are line drivers designed to interface data terminal equipment (DTE) with data circuit-terminating equipment (DCE). These devices translate 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  $\mu$ A (DS14C88) versus 25 mA (DS1488).

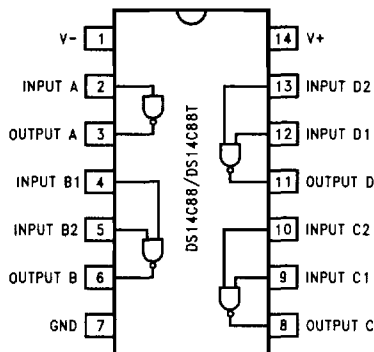
The DS14C88/DS14C88T simplifies designs by eliminating the need for external slew rate control capacitors. Slew rate control in accordance with EIA-232D is provided on-chip, eliminating the output capacitors.

### Features

- Meets EIA-232D and CCITT V.28 standards
- Industrial temperature range  
-40°C to +85°C—DS14C88T
- LOW power consumption
- Wide power supply range  
 $\pm 5V$  to  $\pm 12V$
- Available in SOIC package

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### Connection Diagram



TL/F/11105-1

**Order Number DS14C88N, DS14C88M, DS14C88TJ, DS14C88TN or DS14C88TM**  
**See NS Package Number J14A, 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
J Package	1935 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 <sub>A</sub> )			
DS14C88	0	+75	°C
DS14C88T	-40	+85	°C

**Electrical Characteristics** Over Recommended Operating Conditions, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
I <sub>IL</sub>	Maximum Low Input Current	V <sub>IN</sub> = GND			+10	μA	
I <sub>IH</sub>	Maximum High Input Current	V <sub>IN</sub> = V+	-10			μA	
V <sub>IL</sub>	Low Level Input Voltage	V+ ≥ +7V, V- ≤ -7V	GND		0.8	V	
		V+ < +7V, V- > -7V	GND		0.6	V	
V <sub>IH</sub>	High Level Input Voltage		2.0		V+	V	
V <sub>OL</sub>	Low Level Output Level	V <sub>IN</sub> = V <sub>IH</sub> R <sub>L</sub> = 3 kΩ or 7 kΩ	V+ = 4.5V, V- = -4.5V		-4.0	-3.0	V
			V+ = 9V, V- = 9V		-8.0	-6.5	V
			V+ = 12V, V- = -12V		-10.5	-9.0	V
V <sub>OH</sub>	High Level Output Level	V <sub>IN</sub> = V <sub>IL</sub> R <sub>L</sub> = 3 kΩ or 7 kΩ	V+ = 4.5V, V- = -4.5V		3.0	4.0	V
			V+ = 9V, V- = -9V		6.5	8.0	V
			V+ = 12V, V- = -12V		9.0	10.5	V
I <sub>OS+</sub>	High Level Output Short Circuit Current (Note 3)	V <sub>IN</sub> = 0.8V, V <sub>O</sub> = GND	-45			mA	
I <sub>OS-</sub>	Low Level Output Short Circuit Current (Note 3)	V <sub>IN</sub> = 2.0V, V <sub>O</sub> = GND			+45	mA	
R <sub>OUT</sub>	Output Resistance	V+ = V- = GND = 0V -2V ≤ V <sub>O</sub> ≤ +2V (Note 4) (Figure 1)	300			Ω	
I <sub>CC+</sub>	Positive Supply Current	V <sub>IN</sub> = V <sub>ILmax</sub> R <sub>L</sub> = OPEN	V+ = 4.5V, V- = -4.5V			10	μA
			V+ = 9V, V- = -9V			30	μA
			V+ = 12V, V- = -12V			60	μA
		V <sub>IN</sub> = V <sub>IHmin</sub> R <sub>L</sub> = OPEN	V+ = 4.5V, V- = -4.5V			50	μA
			V+ = 9V, V- = -9V	DS14C88		300	μA
				DS14C88T		400	μA
			V+ = 12V, V- = -12V	DS14C88		500	μA
				DS14C88T		700	μA
I <sub>CC-</sub>	Negative Supply Current	V <sub>IN</sub> = V <sub>ILmax</sub> R <sub>L</sub> = OPEN	V+ = 4.5V,		DS14C88	-10	μA
			V- = -4.5V		DS14C88T	-15	μA
			V+ = 9V,		DS14C88	-10	μA
			V- = -9V		DS14C88T	-15	μA
			V+ = 12V,		DS14C88	-10	μA
			V- = -12V		DS14C88T	-15	μA
		V <sub>IN</sub> = V <sub>IHmin</sub> R <sub>L</sub> = OPEN	V+ = 4.5V,		DS14C88	-30	μA
			V- = -4.5V		DS14C88T	-45	μA
			V+ = 9V,		DS14C88	-30	μA
			V- = -9V		DS14C88T	-45	μA
			V+ = 12V,		DS14C88	-60	μA
			V- = -12V		DS14C88T	-80	μA

## Switching Characteristics

Over Recommended Operating Conditions, unless otherwise specified (Figures 2 and 3) (Notes 5 and 6)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$t_{PLH}$	Propagation Delay Low to High	$V^+ = +4.5V, V^- = -4.5V$		1.5	6.0	$\mu s$
		$V^+ = +9.0V, V^- = -9.0V$		1.2	5.0	$\mu s$
		$V^+ = +12V, V^- = -12V$		1.2	4.0	$\mu s$
$t_{PHL}$	Propagation Delay High to Low	$V^+ = +4.5V, V^- = -4.5V$		1.5	6.0	$\mu s$
		$V^+ = +9.0V, V^- = -9.0V$		1.35	5.0	$\mu s$
		$V^+ = +12V, V^- = -12V$		1.3	4.0	$\mu s$
$t_r$	Rise Time (Note 7)		0.2	1.0		$\mu s$
$t_f$	Fall Time (Note 7)		0.2	1.0		$\mu s$
$t_{sk}$	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)	$R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$ $C_L = 15\text{ pF}$ to $2500\text{ pF}$			30	$V/\mu s$

**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, J Package 12.9 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:  $t_r = t_f \leq 20\text{ ns}$ ,  $V_{IH} = 2V$ ,  $V_{IL} = 0.8V$  (0.6V at  $V^+ = 4.5V$ ,  $V^- = -4.5V$ )

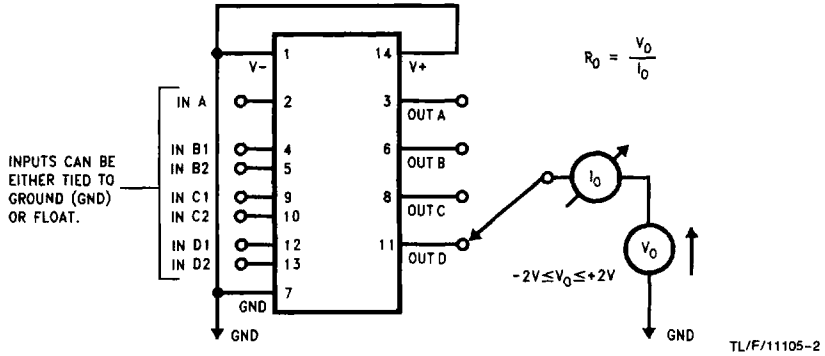
**Note 6:** Input rise and fall times must not exceed 5  $\mu s$ .

**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.

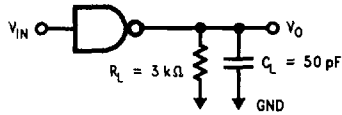
**Note 8:**  $C_L$  include jig and probe capacitances.

**Note 9:** ESD Rating (HBM, 1.5 k $\Omega$ , 100 pF)  $\geq 1.0\text{ kV}$ .

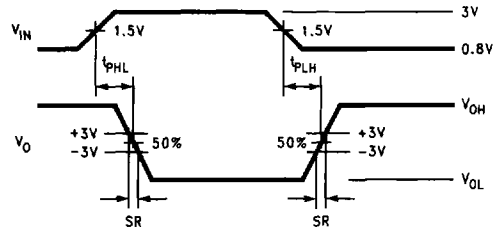
**Parameter Measure Information**



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

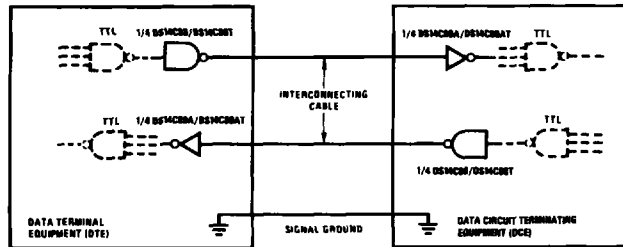


**FIGURE 2. Driver Load Circuit (Note 8)**



**FIGURE 3. Driver Switching Waveform**

**Typical Application Information**



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