

## DS14C88 Quad CMOS Line Driver

Check for Samples: [DS14C88](#)

### FEATURES

- Meets EIA-232D and CCITT V.28 Standards
- **LOW Power Consumption**
- **Wide Power Supply Range:**  $\pm 5V$  to  $\pm 12V$
- **Available in SOIC Package**

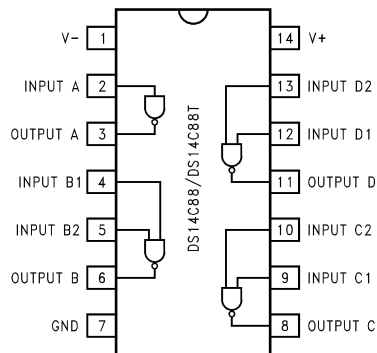
### DESCRIPTION

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  $\mu A$  (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.

### Connection Diagram



**Figure 1. SOIC or PDIP Package- Top View**  
See Package Number NFF0014A or D0014A



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.



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### Absolute Maximum Ratings<sup>(1)(2)(3)(4)</sup>

Supply Voltage	
V <sup>+</sup> Pin	+13V
V <sup>-</sup> Pin	-13V
Driver Input Voltage	(V <sup>+</sup> ) +0.3V to GND -0.3V
Driver Output Voltage	V <sup>+</sup> - V <sub>O</sub>   ≤ 30V  V <sup>-</sup> - V <sub>O</sub>   ≤ 30V
Continuous Power Dissipation @+25°C <sup>(5)</sup>	
NFF0014A Package	1513 mW
D0014A Package	1063 mW
Junction Temperature	+150°C
Lead Temperature (Soldering 4 seconds)	+260°C
Storage Temperature Range	-65°C to +150°C

- (1) "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be ensured. 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.
- (2) If Military/Aerospace specified devices are required, please contact the TI Sales Office/ Distributors for availability and specifications.
- (3) This Product does not meet 2000V ESD rating.
- (4) ESD Rating (HBM, 1.5 kΩ, 100 pF) ≥ 1.0 kV.
- (5) Derate NFF0014A Package 12.1 mW/°C, and D0014A Package 8.5 mW/°C above +25°C.

### Recommended Operating Conditions

	Min	Max	Units
V <sup>+</sup> Supply (GND = 0V)	+4.5	+12.6	V
V <sup>-</sup> Supply (GND = 0V)	-4.5	-12.6	V
Operating Free Air Temp. (T <sub>A</sub> ) DS14C88	0	+75	°C

### Electrical Characteristics

Over Recommended Operating Conditions, unless otherwise specified

Parameter		Test 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 <sup>+</sup>	-10			μA	
V <sub>IL</sub>	Low Level Input Voltage	V <sup>+</sup> ≥ +7V, V <sup>-</sup> ≤ -7V	GND		0.8	V	
		V <sup>+</sup> < +7V, V <sup>-</sup> > -7V	GND		0.6	V	
V <sub>IH</sub>	High Level Input Voltage		2.0		V <sup>+</sup>	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 <sup>+</sup> = 4.5V, V <sup>-</sup> = -4.5V		-4.0	-3.0	V
			V <sup>+</sup> = 9V, V <sup>-</sup> = 9V		-8.0	-6.5	V
			V <sup>+</sup> = 12V, V <sup>-</sup> = -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 <sup>+</sup> = 4.5V, V <sup>-</sup> = -4.5V	3.0	4.0		V
			V <sup>+</sup> = 9V, V <sup>-</sup> = -9V	6.5	8.0		V
			V <sup>+</sup> = 12V, V <sup>-</sup> = -12V	9.0	10.5		V
I <sub>OS+</sub>	High Level Output Short Circuit Current <sup>(1)</sup>	V <sub>IN</sub> = 0.8V, V <sub>O</sub> = GND	V <sup>+</sup> = +12V, V <sup>-</sup> = -12V				mA
I <sub>OS-</sub>	Low Level Output Short Circuit Current <sup>(1)</sup>						
R <sub>OUT</sub>	Output Resistance	V <sup>+</sup> = V <sup>-</sup> = GND = 0V -2V ≤ V <sub>O</sub> ≤ +2V <sup>(2)</sup> (Figure 2)	300				Ω

- (1) I<sub>OS+</sub> and I<sub>OS-</sub> values are for one output at a time. If more than one output is shorted simultaneously, the device dissipation may be exceeded.
- (2) Power supply (V<sup>+</sup>, V<sup>-</sup>) and GND pins are connected to ground for the Output Resistance Test (R<sub>O</sub>).

## Electrical Characteristics (continued)

Over Recommended Operating Conditions, unless otherwise specified

Parameter		Test Conditions	Min	Typ	Max	Units
$I_{CC+}$	Positive Supply Current	$V_{IN} = V_{ILmax}$ $R_L = OPEN$	$V^+ = 4.5V, V^- = -4.5V$		10	$\mu A$
			$V^+ = 9V, V^- = -9V$		30	$\mu A$
			$V^+ = 12V, V^- = -12V$		60	$\mu A$
		$V_{IN} = V_{IHmin}$ $R_L = OPEN$	$V^+ = 4.5V, V^- = -4.5V$		50	$\mu A$
			$V^+ = 9V, V^- = -9V$		300	$\mu A$
			$V^+ = 12V, V^- = -12V$		500	$\mu A$
$I_{CC-}$	Negative Supply Current	$V_{IN} = V_{ILmax}$ $R_L = OPEN$	$V^+ = 4.5V, V^- = -4.5V$		-10	$\mu A$
			$V^+ = 9V, V^- = -9V$		-10	$\mu A$
			$V^+ = 12V, V^- = -12V$		-10	$\mu A$
		$V_{IN} = V_{IHmin}$ $R_L = OPEN$	$V^+ = 4.5V, V^- = -4.5V$		-30	$\mu A$
			$V^+ = 9V, V^- = -9V$		-30	$\mu A$
			$V^+ = 12V, V^- = -12V$		-60	$\mu A$

## Switching Characteristics<sup>(1)(2)</sup>

Over Recommended Operating Conditions, unless otherwise specified (Figure 3, Figure 4)

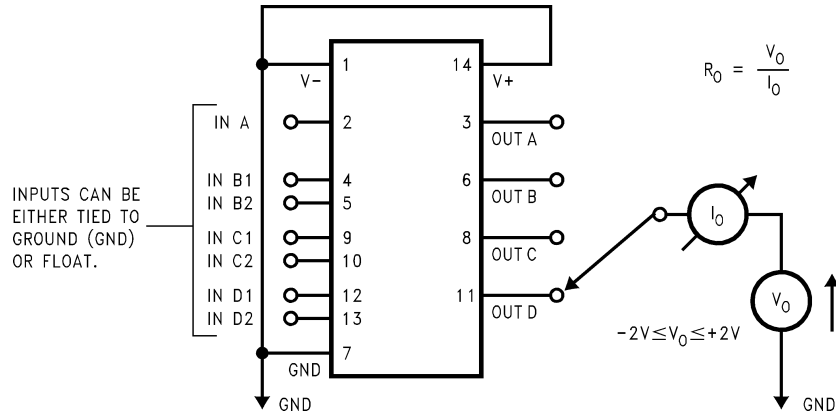
Parameter		Test Conditions	Min	Typ	Max	Units
$t_{PLH}$	Propagation Delay Low to High	$V^+ = +4.5V, V^- = -4.5V$		1.5	6.0	$\mu s$
		$V^+ = +9.0V, V^- = -9.0V$		1.2	5.0	$\mu s$
		$V^+ = +12V, V^- = -12V$		1.2	4.0	$\mu s$
$t_{PHL}$	Propagation Delay High to Low	$V^+ = +4.5V, V^- = -4.5V$		1.5	6.0	$\mu s$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

 (1) 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  $V^+ = 4.5V, V^- = -4.5V$ )

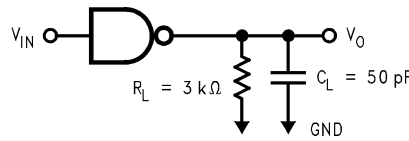
 (2) Input rise and fall times must not exceed 5  $\mu s$ .

(3) The output slew rate, rise time, and fall time are measured from the +3.0V to the -3.0V level on the output waveform.

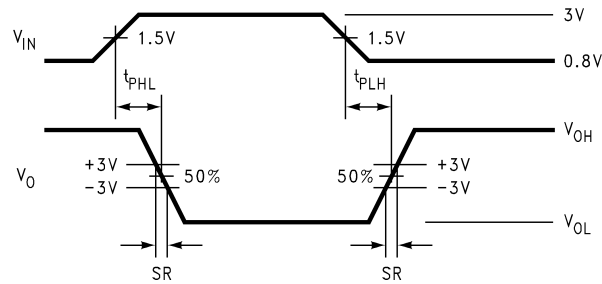
**Parameter Measure Information**



**Figure 2. Output Resistance Test Circuit (Power-Off)**



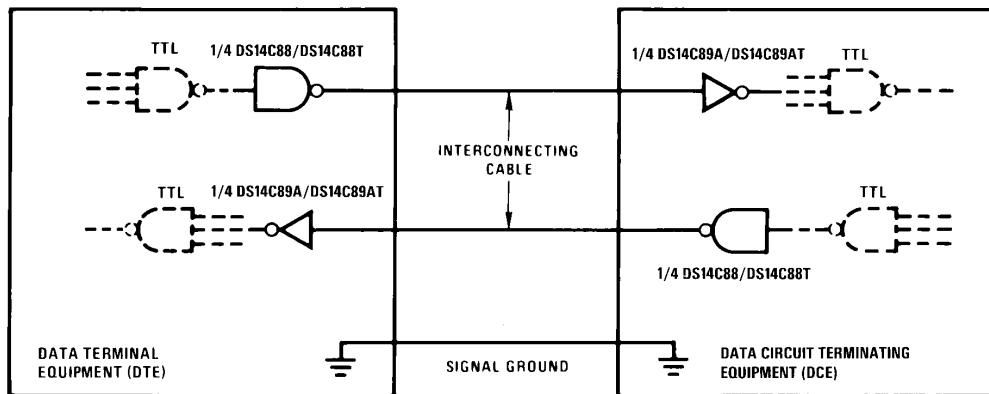
**Figure 3. Driver Load Circuit<sup>(4)</sup>**



**Figure 4. Driver Switching Waveform**

(4)  $C_L$  include jig and probe capacitances.

**TYPICAL APPLICATION INFORMATION**



**Figure 5. EIA-232D Data Transmission**

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**REVISION HISTORY**

<b>Changes from Revision B (April 2013) to Revision C</b>	<b>Page</b>
• Changed layout of National Data Sheet to TI format .....	<a href="#">4</a>

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**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DS14C88M	NRND	SOIC	D	14	55	TBD	Call TI	Call TI	0 to 70	DS14C88M	
DS14C88M/NOPB	ACTIVE	SOIC	D	14	55	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	DS14C88M	<b>Samples</b>
DS14C88MX	NRND	SOIC	D	14	2500	TBD	Call TI	Call TI	0 to 70	DS14C88M	
DS14C88MX/NOPB	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	SN   CU SN	Level-1-260C-UNLIM	0 to 70	DS14C88M	<b>Samples</b>
DS14C88N	NRND	PDIP	NFF	14	25	TBD	Call TI	Call TI	0 to 70	DS14C88N	
DS14C88N/NOPB	ACTIVE	PDIP	NFF	14	25	Green (RoHS & no Sb/Br)	SN   CU SN	Level-1-NA-UNLIM	0 to 70	DS14C88N	<b>Samples</b>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

<sup>(6)</sup> Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DS14C88MX	SOIC	D	14	2500	330.0	16.4	6.5	9.35	2.3	8.0	16.0	Q1
DS14C88MX/NOPB	SOIC	D	14	2500	330.0	16.4	6.5	9.35	2.3	8.0	16.0	Q1

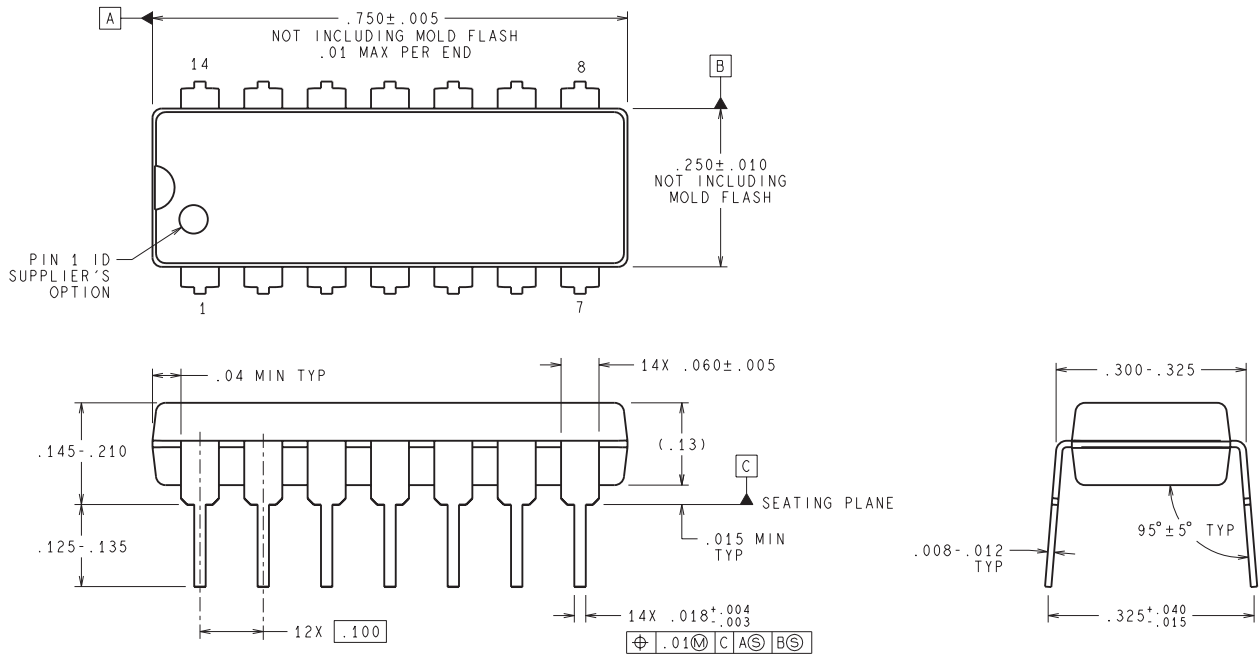


**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS14C88MX	SOIC	D	14	2500	367.0	367.0	35.0
DS14C88MX/NOPB	SOIC	D	14	2500	367.0	367.0	35.0

NFF0014A



**DIMENSIONS ARE IN INCHES**  
 DIMENSIONS IN ( ) FOR REFERENCE ONLY

N14A (Rev G)

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AB.

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