N a t i o n a l   S e m i c o n d u c t o r

February 1996

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 µA (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: ±5V to ±12V
- Available in SOIC package

Connection Diagram

DS011105-1
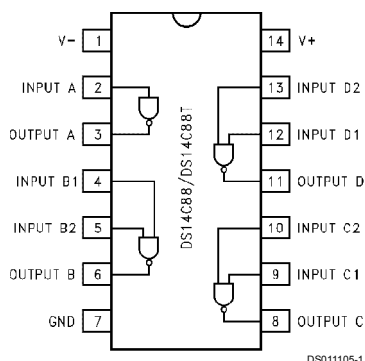
**Order Number DS14C88N, DS14C88M, DS14C88TJ, DS14C88TN or DS14C88TM
See NS Package Number J14A, N14A or M14A**

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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_A)			
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_{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 $-2V \leq V_O \leq +2V$ (Note 4) (*Figure 1*)			300			Ω
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,	DS14C88			300	μA
			V^- = −9V	DS14C88T			400	μA
			V^+ = 12V,	DS14C88			500	μA
			V^- = −12V	DS14C88T			700	μA

Electrical Characteristics (Continued)

Over Recommended Operating Conditions, unless otherwise specified

Symbol	Parameter	Conditions			Min	Typ	Max	Units
I_{CC-}	Negative Supply Current	$V_{IN} = V_{ILmax}$ R_L = OPEN	V^+ = 4.5V, V^- = −4.5V	DS14C88			−10	µA
				DS14C88T			−15	µA
			V^+ = 9V, V^- = −9V	DS14C88			−10	µA
				DS14C88T			−15	µA
			V^+ = 12V, V^- = −12V	DS14C88			−10	µA
				DS14C88T			−15	µA
		$V_{IN} = V_{IHmin}$ R_L = OPEN	V^+ = 4.5V, V^- = −4.5V	DS14C88			−30	µA
				DS14C88T			−45	µA
			V^+ = 9V, V^- = −9V	DS14C88			−30	µA
				DS14C88T			−45	µA
			V^+ = 12V, V^- = −12V	DS14C88			−60	µA
				DS14C88T			−80	µA

Switching Characteristics (Note 5) (Note 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, 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 ≤ 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.
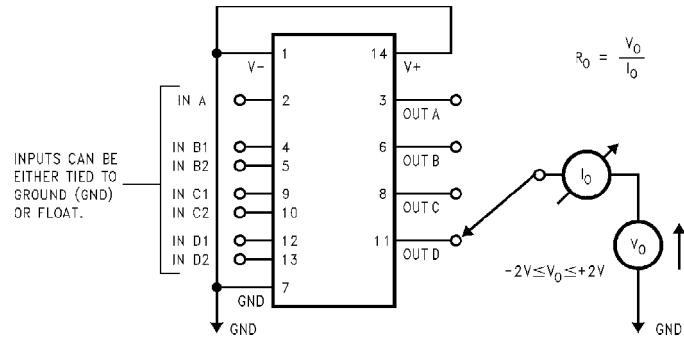
Parameter Measure Information

$$R_O = \frac{V_O}{I_O}$$

INPUTS CAN BE EITHER TIED TO GROUND (GND) OR FLOAT.

$-2V \leq V_O \leq +2V$

DS011105-2

FIGURE 1. Output Resistance Test Circuit (Power-Off)
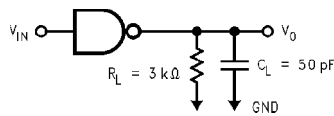
$R_L = 3\,k\Omega$ $C_L = 50\,pF$

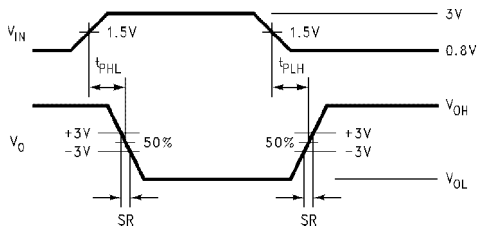DS011105-3

FIGURE 2. Driver Load Circuit (Note 8)

DS011105-4

FIGURE 3. Driver Switching Waveform

Typical Application Information

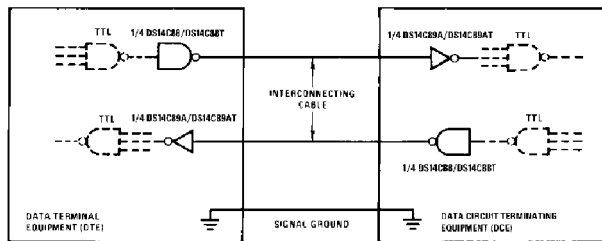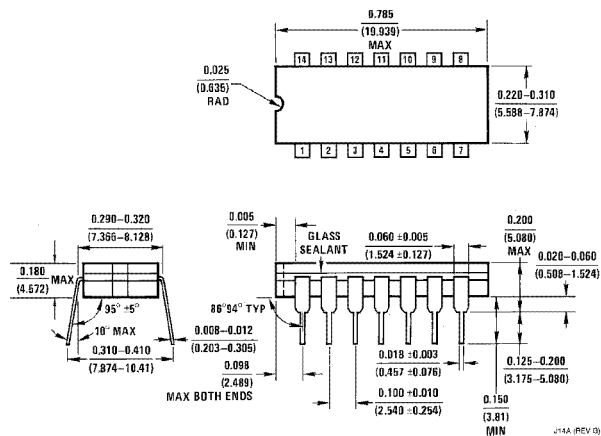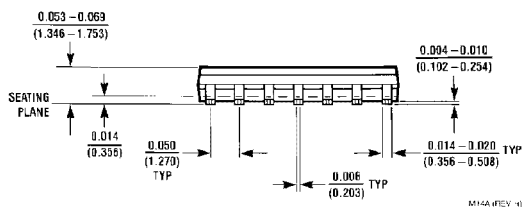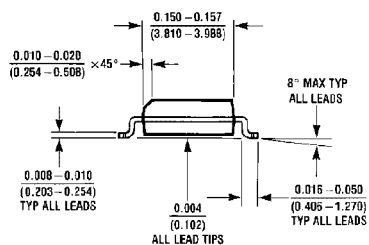DS011105-5

FIGURE 4. EIA-232D Data Transmission

Book
Extract
End

Physical Dimensions inches (millimeters)

0.785
(19.939)
MAX

14 13 12 11 10 9 8

0.025
(0.635)
RAD

0.220−0.310
(5.588−7.874)

1 2 3 4 5 6 7

0.290−0.320
(7.366−8.128)

0.180 MAX
(4.572)

0.005
(0.127)
MIN

GLASS
SEALANT

0.060 ±0.005
(1.524 ±0.127)

0.200
(5.080)
MAX

0.020−0.060
(0.508−1.524)

95° ±5°

86°94° TYP

10° MAX

0.310−0.410
(7.874−10.41)

0.008−0.012
(0.203−0.305)

0.098
(2.489)
MAX BOTH ENDS

0.018 ±0.003
(0.457 ±0.076)

0.100 ±0.010
(2.540 ±0.254)

0.125−0.200
(3.175−5.080)

0.150
(3.81)
MIN

J14A (REV G)

**Order Number DS14C88TJ
NS Package Number J14A**

0.335−0.344
(8.509 − 8.738)

14 13 12 11 10 9 8

0.228−0.244
(5.791 − 6.198)

LEAD NO. 1
IDENT

30°
TYP

1 2 3 4 5 6 7

0.010 MAX
(0.254)

0.010−0.020
(0.254−0.508) ×45°

0.150 − 0.157
(3.810 − 3.988)

8° MAX TYP
ALL LEADS

0.008−0.010
(0.203−0.254)
TYP ALL LEADS

0.004
(0.102)
ALL LEAD TIPS

0.016−0.050
(0.406−1.270)
TYP ALL LEADS

0.053−0.069
(1.346 − 1.753)

0.004−0.010
(0.102−0.254)

SEATING
PLANE

0.014
(0.355)

0.050
(1.270)
TYP

0.006
(0.203) TYP

0.014 − 0.020 TYP
(0.356 − 0.508)

M14A (REV H)
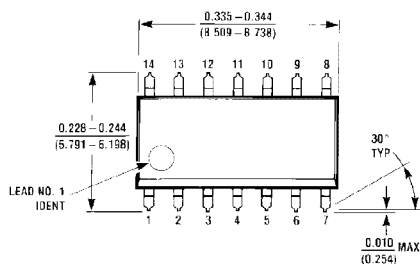
**Order Number DS14C88M or DS14C88TM
NS Package Number M14A**

Physical Dimensions inches (millimeters) (Continued)

OPTION 1

OPTION 02
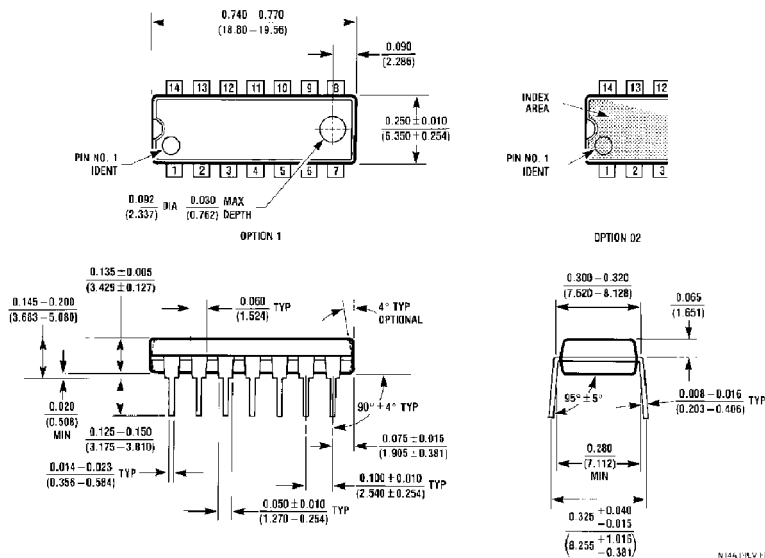
Order Number DS14C88N or DS14C88TN
NS Package Number N14A

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with instructions for use provided in the labeling, can
be reasonably expected to result in a significant injury
to the user.

2. A critical component in any component of a life support
device or system whose failure to perform can be rea-
sonably expected to cause the failure of the life support
device or system, or to affect its safety or effectiveness.