July 1999

N *National Semiconductor*

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

DS005776-1

Dual-In-Line Package

DS005776-2
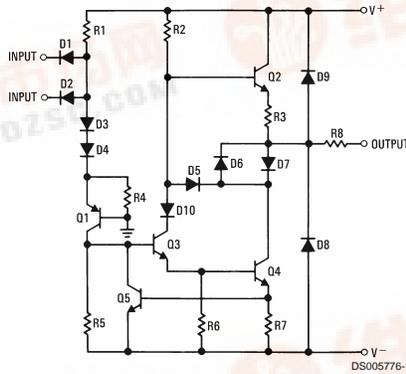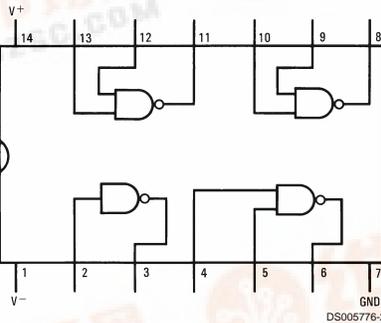
Top View
Order Number DS1488M or DS1488N
See NS Package Number M14A or N14A

Absolute Maximum Ratings (Note 2)

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

Supply Voltage

V⁺	+15V
V⁻	−15V
Input Voltage (V_{IN})	$-15V \leq V_{IN} \leq 7.0V$
Output Voltage	±15V

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

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)

$V_{CC}+ = 9V$, $V_{CC}- = −9V$ unless otherwise specified

Symbol	Parameter	Conditions		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 kΩ,	V⁺ = 9.0V, V⁻ = −9.0V	6.0	7.1		V
		V_{IN} = 0.8V	V⁺ = 13.2V, V⁻ = −13.2V	9.0	10.7		V
V_{OL}	Low Level Output Voltage	R_L = 3.0 kΩ,	V⁺ = 9.0V, V⁻ = −9.0V	−6.0	7.0		V
		V_{IN} = 1.9V	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} = ±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˚C)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{pd1}	Propagation Delay to a Logical "1"	R_L = 3.0 kΩ, C_L = 15 pF, T_A = 25˚C		187	350	ns
t_{pd0}	Propagation Delay to a Logical "0"	R_L = 3.0 kΩ, C_L = 15 pF, T_A = 25˚C		45	175	ns
t_r	Rise Time	R_L = 3.0 kΩ, C_L = 15 pF, T_A = 25˚C		63	100	ns
t_f	Fall Time	R_L = 3.0 kΩ, C_L = 15 pF, T_A = 25˚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.

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

$$C = I_{SC} \ (\Delta T/\Delta V)$$

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

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.

Typical Applications

RS-232C Data Transmission
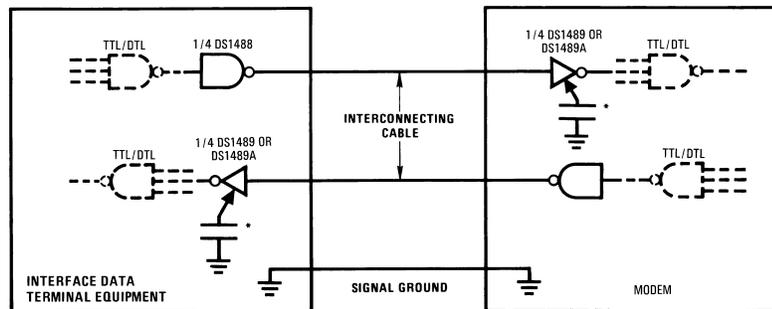
DS005776-3

Note 5: Optional for noise filtering

DTL/TTL-to-MOS Translator
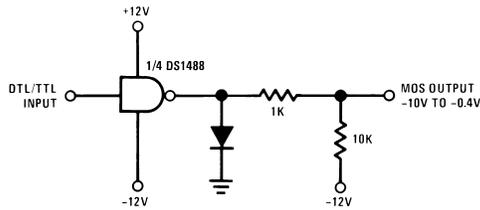

DS005776-4

**DTL/TTL-to-HTL Translator**
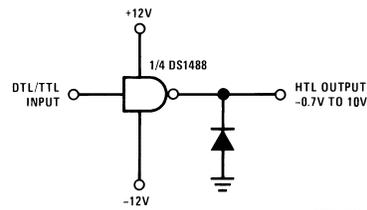
DS005776-5

DTL/TTL-to-RTL Translator
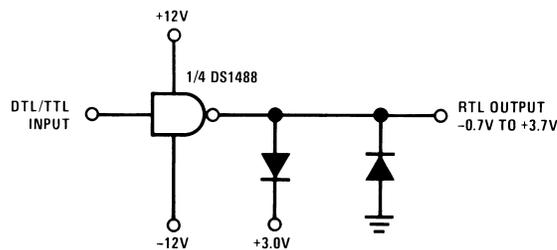
DS005776-6

AC Load Circuit and Switching Time Waveforms

DS005776-7

*C_L includes probe and jig capacitance.
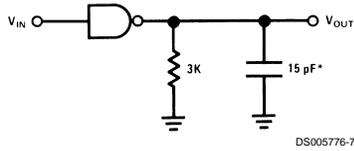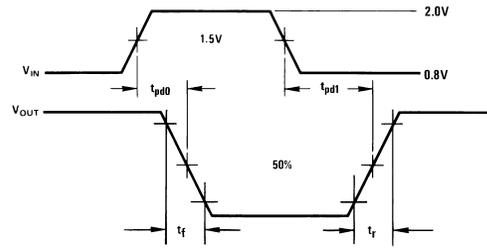
DS005776-8

t_r and t_f are measured between 10%
and 90% of the output waveform.

## Typical Performance Characteristics T_A=+25°C unless otherwise noted
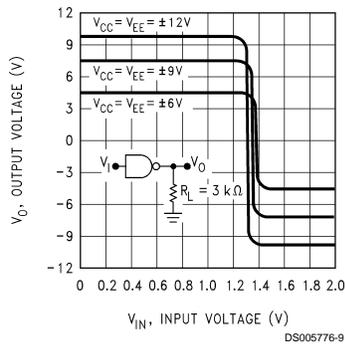
**FIGURE 1. Transfer Characteristics
vs Power Supply Voltage**

DS005776-9
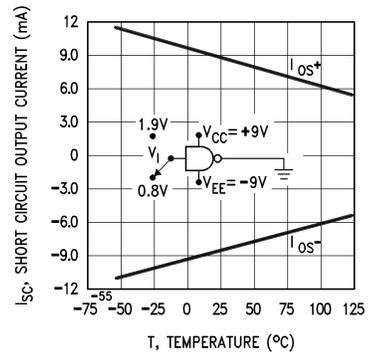
**FIGURE 2. Short-Circuit Output
Current vs Temperature**

DS005776-10
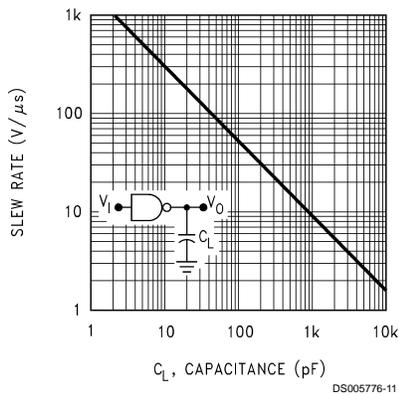
**FIGURE 3. Output Slew Rate vs
Load Capacitance**

DS005776-11
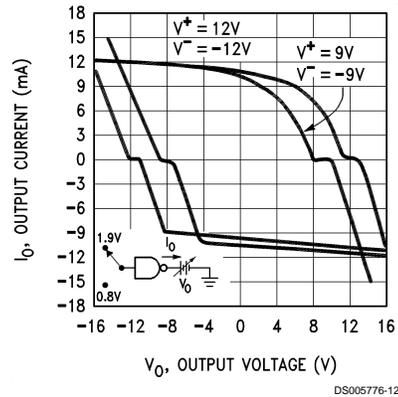
**FIGURE 4. Output Voltage and
Current-Limiting Characteristics**

DS005776-12

Physical Dimensions inches (millimeters) unless otherwise noted

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

1 2 3 4 5 6 7

30°
TYP

0.010 MAX
(0.254)

0.150 − 0.157
(3.810 − 3.988)

0.010 − 0.020
(0.254 − 0.508) × 45°

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)

SEATING
PLANE

0.014
(0.356)

0.050
(1.270)
TYP

0.008
(0.203)
TYP

0.004 − 0.010
(0.102 − 0.254)

0.014 − 0.020
(0.356 − 0.508)
TYP
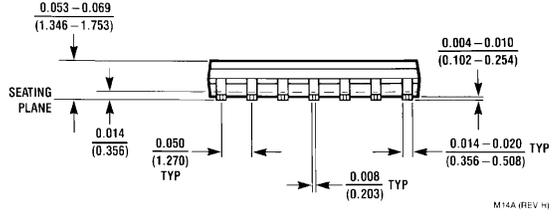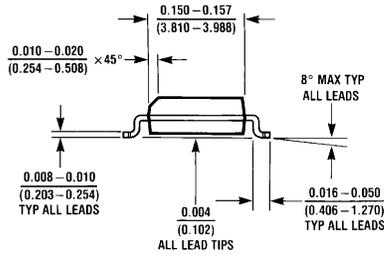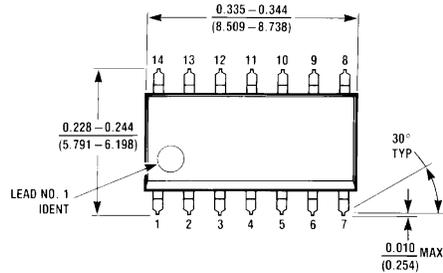
M14A (REV H)

SO Package (M)
Order Number DS1488M
NS Package Number M14A

0.740 − 0.770
(18.80 − 19.56)

0.090
(2.286)

14 13 12 11 10 9 8

PIN NO. 1
IDENT

1 2 3 4 5 6 7

0.250 ± 0.010
(6.350 ± 0.254)

0.092
(2.337) DIA

0.030
(0.762) MAX
DEPTH

OPTION 1

INDEX
AREA

14 13 12

PIN NO. 1
IDENT

1 2 3

OPTION 02

0.135 ± 0.005
(3.429 ± 0.127)

0.145 − 0.200
(3.683 − 5.080)

0.060
(1.524) TYP

4° TYP
OPTIONAL

0.020
(0.508)
MIN

0.125 − 0.150
(3.175 − 3.810)

90° ± 4° TYP

0.075 ± 0.015
(1.905 ± 0.381)

0.014 − 0.023
(0.356 − 0.584) TYP

0.050 ± 0.010
(1.270 − 0.254) TYP

0.100 ± 0.010
(2.540 ± 0.254) TYP

0.300 − 0.320
(7.620 − 8.128)

0.065
(1.651)

95° ± 5°

0.008 − 0.016
(0.203 − 0.406) TYP

0.280
(7.112)
MIN

0.325 +0.040
−0.015

(8.255 +1.016
−0.381)

N14A (REV F)

Molded Dual-In-Line Package (N)
Order Number DS1488N
NS Package Number N14A

DS1488 Quad Line Driver

Notes