

DS34C87T

CMOS Quad TRI-STATE Differential Line Driver

General Description

The DS34C87T is a quad differential line driver designed for digital data transmission over balanced lines. The DS34C87T meets all the requirements of EIA standard RS-422 while retaining the low power characteristics of CMOS. This enables the construction of serial and terminal interfaces while maintaining minimal power consumption.

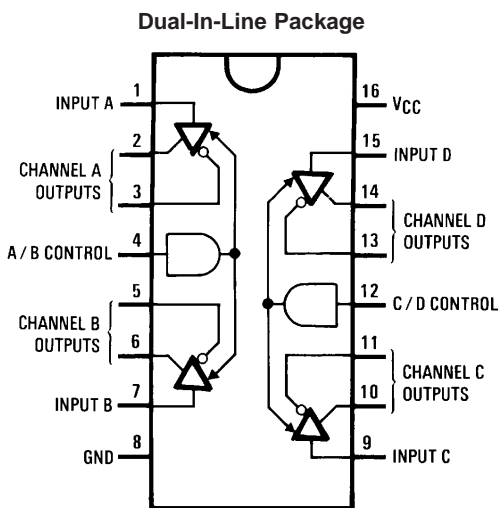
The DS34C87T accepts TTL or CMOS input levels and translates these to RS-422 output levels. This part uses special output circuitry that enables the individual drivers to power down without loading down the bus. This device has separate enable circuitry for each pair of the four drivers. The DS34C87T is pin compatible to the DS3487T.

All inputs are protected against damage due to electrostatic discharge by diodes to V_{CC} and ground.

Features

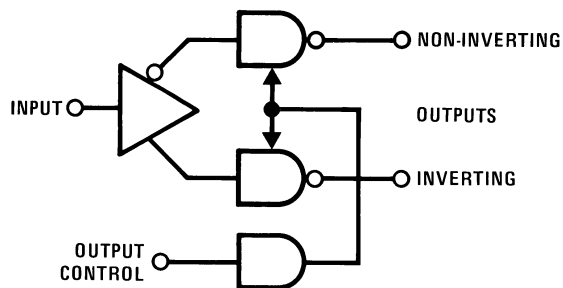
- TTL input compatible
- Typical propagation delays: 6 ns
- Typical output skew: 0.5 ns
- Outputs won't load line when $V_{CC} = 0V$
- Meets the requirements of EIA standard RS-422
- Operation from single 5V supply
- TRI-STATE outputs for connection to system buses
- Low quiescent current
- Available in surface mount

Connection and Logic Diagrams



See Pin Description Table for details
 Top View

Order Number DS34C87TM or DS34C87TN
 See NS Package Number M16A or N16E



00857602

Truth Table

Input	Control Input	Non-Inverting Output	Inverting Output
H	H	H	L
L	H	L	H
X	L	Z	Z

L = Low logic state
 H = High logic state
 X = Irrelevant
 Z = TRI-STATE (high performance)

Absolute Maximum Ratings (Notes 1,

2)

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

Supply Voltage (V_{CC})	-0.5 to 7.0V
DC Voltage (V_{IN})	-1.5 to V_{CC} +1.5V
DC Output Voltage (V_{OUT})	-0.5 to 7V
Clamp Diode Current (I_{IK} , I_{OK})	± 20 mA
DC Output Current, per pin (I_{OUT})	± 150 mA
DC V_{CC} or GND Current (I_{CC})	± 150 mA
Storage Temperature Range (T_{STG})	-65°C to +150°C
Maximum Power Dissipation (P_D) @ 25°C (Note 3)	

Plastic "N" Package

1736 mW

SOIC Package

1226 mW

Lead Temperature (T_L)

(Soldering 4 sec)

260°C

This device does not meet 2000V ESD rating. (Note 12)

Operating Conditions

	Min	Max	Units
Supply Voltage (V_{CC})	4.50	5.50	V
DC Input or Output Voltage (V_{IN} , V_{OUT})	0	V_{CC}	V
Operating Temperature Range (T_A)			
DS34C87T	-40	+85	°C
Input Rise or Fall Times (t_r , t_f)		500	ns

DC Electrical Characteristics (Note 4)

$V_{CC} = 5V \pm 10\%$ (unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{IH}	High Level Input Voltage		2.0			V
V_{IL}	Low Level Input Voltage				0.8	V
V_{OH}	High Level Output Voltage	$V_{IN} = V_{IH}$ or V_{IL} , $I_{OUT} = -20$ mA	2.5	3.4		V
V_{OL}	Low Level Output Voltage	$V_{IN} = V_{IH}$ or V_{IL} , $I_{OUT} = 48$ mA		0.3	0.5	V
V_T	Differential Output Voltage	$R_L = 100 \Omega$ (Note 5)	2.0	3.1		V
$ V_T - \overline{V}_T $	Difference In Differential Output	$R_L = 100 \Omega$ (Note 5)			0.4	V
V_{OS}	Common Mode Output Voltage	$R_L = 100 \Omega$ (Note 5)		2.0	3.0	V
$ V_{OS} - \overline{V}_{OS} $	Difference In Common Mode Output	$R_L = 100 \Omega$ (Note 5)			0.4	V
I_{IN}	Input Current	$V_{IN} = V_{CC}$, GND, V_{IH} , or V_{IL}			± 1.0	μA
I_{CC}	Quiescent Supply Current	$I_{OUT} = 0 \mu A$, $V_{IN} = V_{CC}$ or GND $V_{IN} = 2.4V$ or $0.5V$ (Note 6)		200 0.8	500 2.0	μA mA
I_{OZ}	TRI-STATE™ Output Leakage Current	$V_{OUT} = V_{CC}$ or GND Control = V_{IL}		± 0.5	± 5.0	μA
I_{SC}	Output Short Circuit Current	$V_{IN} = V_{CC}$ or GND (Notes 5, 7)	-30		-150	mA
I_{OFF}	Power Off Output Leakage Current	$V_{CC} = 0V$ (Note 5)		$V_{OUT} = 6V$ $V_{OUT} = -0.25V$	100 -100	μA μA

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 device should be operated at these limits. The table of "Electrical Characteristics" provide conditions for actual device operation.

Note 2: Unless otherwise specified, all voltages are referenced to ground. All currents into device pins are positive; all currents out of device pins are negative.

Note 3: Ratings apply to ambient temperature at 25°C. Above this temperature derate N Package 13.89 mW/°C, and M Package 9.80 mW/°C.

Note 4: Unless otherwise specified, min/max limits apply across the -40°C to 85°C temperature range. All typicals are given for $V_{CC} = 5V$ and $T_A = 25^\circ C$.

Note 5: See EIA Specification RS-422 for exact test conditions.

DC Electrical Characteristics (Note 4) (Continued)

Note 6: Measured per input. All other inputs at V_{CC} or GND.

Note 7: This is the current sourced when a high output is shorted to ground. Only one output at a time should be shorted.

Switching Characteristics (Note 4)

$V_{CC} = 5V \pm 10\%$, $t_r, t_f \leq 6$ ns (Figures 1, 2, 3, 4)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PLH}, t_{PHL}	Propagation Delay Input to Output	S1 Open		6	11	ns
Skew	(Note 8)	S1 Open		0.5	3	ns
t_{TLH}, t_{THL}	Differential Output Rise And Fall Times	S1 Open		6	10	ns
t_{PZH}	Output Enable Time	S1 Closed		12	25	ns
t_{PZL}	Output Enable Time	S1 Closed		13	26	ns
t_{PHZ}	Output Disable Time (Note 9)	S1 Closed		4	8	ns
t_{PLZ}	Output Disable Time (Note 9)	S1 Closed		6	12	ns
C_{PD}	Power Dissipation Capacitance (Note 10)			100		pF
C_{IN}	Input Capacitance			6		pF

Note 8: Skew is defined as the difference in propagation delays between complementary outputs at the 50% point.

Note 9: Output disable time is the delay from the control input being switched to the output transistors turning off. The actual disable times are less than indicated due to the delay added by the RC time constant of the load.

Note 10: C_{PD} determines the no load dynamic power consumption, $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$, and the no load dynamic current consumption, $I_S = C_{PD} V_{CC} f + I_{CC}$.

Comparison Table of Switching Characteristics into “LS-Type” Load (Note 11)

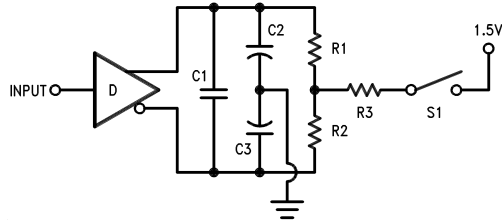
$V_{CC} = 5V$, $T_A = +25^\circ C$, $t_r \leq 6$ ns, $t_f \leq 6$ ns (Figures 4, 5, 6, 7, 8, 9)

Symbol	Parameter	Conditions	DS34C87		DS3487		Units
			Typ	Max	Typ	Max	
t_{PLH}, t_{PHL}	Propagation Delay Input to Output		6	10	10	15	ns
Skew	(Note 8)		1.5	2.0			ns
t_{THL}, t_{TLH}	Differential Output Rise and Fall Times		4	7	10	15	ns
t_{PHZ}	Output Disable Time (Note 9)	$C_L = 50$ pF, $R_L = 200\Omega$, S1 Closed, S2 Closed	8	11	17	25	ns
t_{PLZ}	Output Disable Time (Note 9)	$C_L = 50$ pF, $R_L = 200\Omega$, S1 Closed, S2 Closed	7	10	15	25	ns
t_{PZH}	Output Enable Time	$C_L = 50$ pF, $R_L = \infty$, S1 Open, S2 Closed	11	19	11	25	ns
t_{PZL}	Output Enable Time	$C_L = 50$ pF, $R_L = 200\Omega$, S1 Closed, S2 Open	14	21	15	25	ns

Note 11: This table is provided for comparison purposes only. The values in this table for the DS34C87 reflect the performance of the device but are not tested or guaranteed.

Note 12: ESD Rating: HBM (1.5 kΩ, 100 pF) Inputs $\geq 1500V$ Outputs $\geq 1000V$ EIAJ (0Ω, 200 pF) All Pins $\geq 350V$

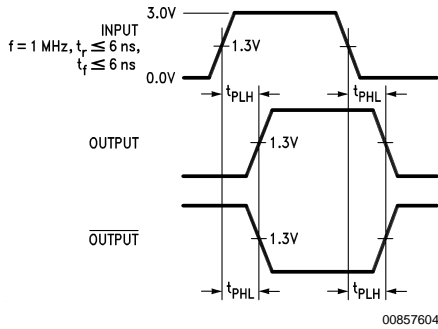
AC Test Circuit and Switching Time Waveforms



00857603

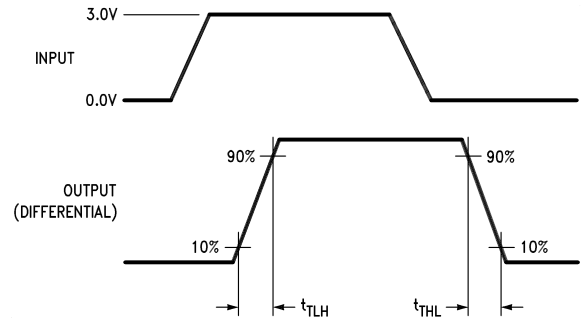
Note: C1 = C2 = C3 = 40 pF (including Probe and Jig Capacitance), R1 = R2 = 50Ω, R3 = 500Ω

FIGURE 1. AC Test Circuit



00857604

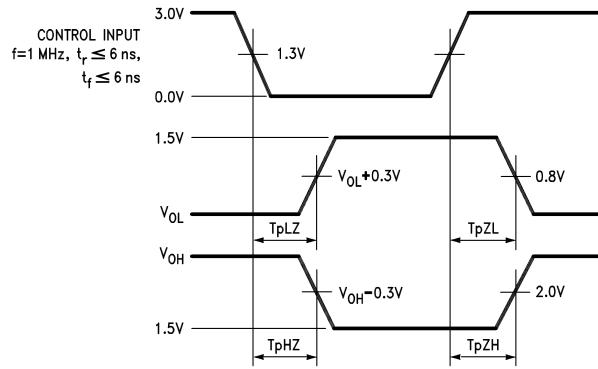
FIGURE 2. Propagation Delays



00857607

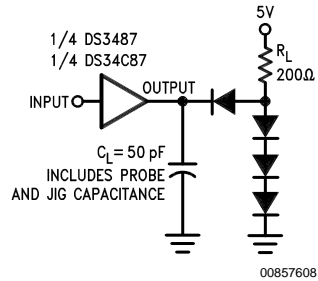
Input pulse; f = 1 MHz, 50%, tr ≤ 6 ns, tf ≤ 6 ns

FIGURE 4. Differential Rise and Fall Times



00857605

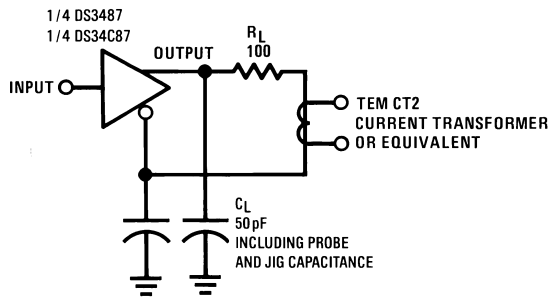
FIGURE 3. Enable and Disable Times



00857608

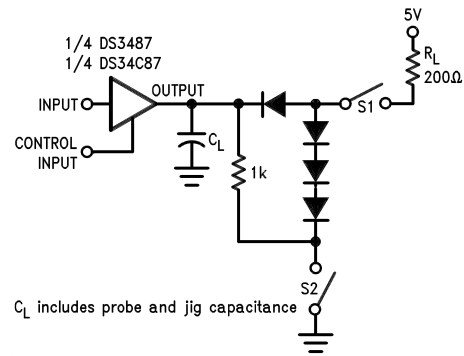
FIGURE 5. Propagation Delays Test Circuit for "LS-Type" Load

AC Test Circuit and Switching Time Waveforms (Continued)



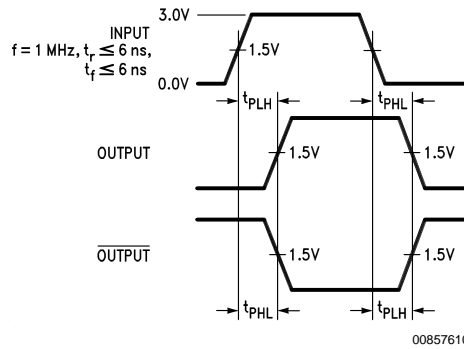
00857606

FIGURE 6. Differential Rise and Fall Times Test Circuit for "LS-Type" Load



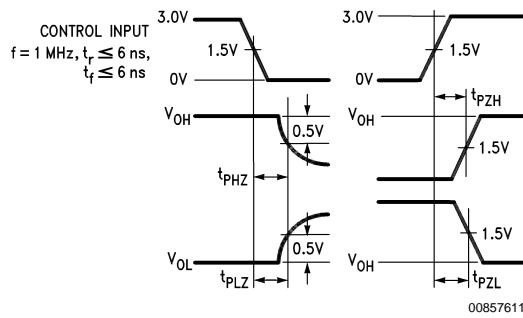
00857609

FIGURE 7. Load Enable and Disable Times Test Circuit for "LS-Type" Load



00857610

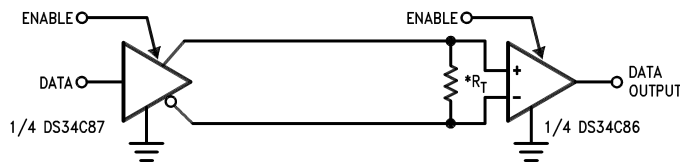
FIGURE 8. Load Propagation Delays for "LS-Type" Load



00857611

FIGURE 9. Load Enable and Disable Times for "LS-Type" Load

Typical Applications



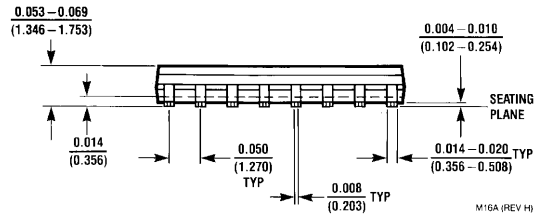
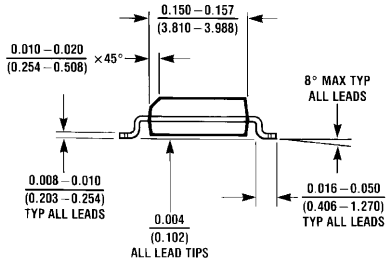
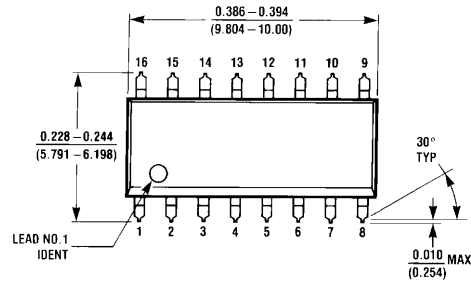
00857612

*RT is optional although highly recommended to reduce reflection.

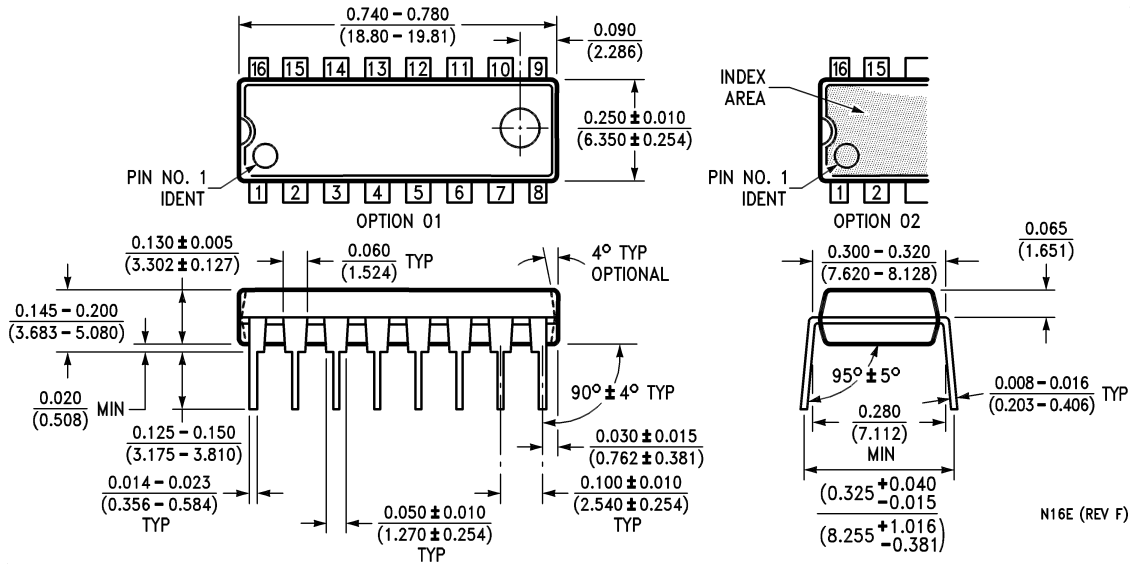
Pin Description Table

Pin Number (DIP or SOP package)	Pin Name	Function
1	INPUT A	Channel A - TTL/CMOS input
2	OUTPUT A - True	True Output for Channel A, RS422 Levels
3	OUTPUT A - Inverting	Inverting Output for Channel A, RS422 Levels
4	A/B CONTROL	Enable Pin for Channels A and B, Active High, TTL/CMOS Levels
5	OUTPUT B - Inverting	Inverting Output for Channel B, RS422 Levels
6	OUTPUT B - True	True Output for Channel B, RS422 Levels
7	INPUT B	Channel B - TTL/CMOS input
8	GND	Ground Pin (0 V)
9	INPUT C	Channel C - TTL/CMOS input
10	OUTPUT C - True	True Output for Channel C, RS422 Levels
11	OUTPUT C - Inverting	Inverting Output for Channel C, RS422 Levels
12	C/D CONTROL	Enable Pin for Channels C and D, Active High, TTL/CMOS Levels
13	OUTPUT D - Inverting	Inverting Output for Channel D, RS422 Levels
14	OUTPUT D - True	True Output for Channel D, RS422 Levels
15	INPUT D	Channel D - TTL/CMOS input
16	V _{CC}	Power Supply Pin, 5.0V typical

Physical Dimensions inches (millimeters) unless otherwise noted



**16-Lead Molded Package
Small Outline (M)
Order Number DS34C87TM
NS Package Number M16A**



**16-Lead Molded Dual-In-Line Package (N)
Order Number DS34C87TN
NS Package Number N16E**

Notes

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance 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 is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



National Semiconductor Corporation
Americas
Email: support@nsc.com

www.national.com

National Semiconductor Europe

Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 69 9508 6208
English Tel: +44 (0) 870 24 0 2171
Français Tel: +33 (0) 1 41 91 8790

National Semiconductor Asia Pacific Customer Response Group

Tel: 65-2544466
Fax: 65-2504466
Email: ap.support@nsc.com

National Semiconductor Japan Ltd.

Tel: 81-3-5639-7560
Fax: 81-3-5639-7507

National Semiconductor was acquired by Texas Instruments.

http://www.ti.com/corp/docs/investor_relations/pr_09_23_2011_national_semiconductor.html

This file is the datasheet for the following electronic components:

DS34C87TM - <http://www.ti.com/product/ds34c87tm?HQS=TI-null-null-dscatalog-df-pf-null-wwe>

DS34C87TMX - <http://www.ti.com/product/ds34c87tmx?HQS=TI-null-null-dscatalog-df-pf-null-wwe>

DS34C87TN - <http://www.ti.com/product/ds34c87tn?HQS=TI-null-null-dscatalog-df-pf-null-wwe>



LittleDiode supplies new, hard to find or obsolete electronic components and semiconductors all over the world.

With over two million different components listed you are sure to find the part you need.

Feel free to visit us today at our online store:

LittleDiode.com

Looking forward to providing you with the best possible service.