N *National Semiconductor*

DS7820A/DS8820A Dual Line Receiver

General Description

The DS7820A and the DS8820A are improved performance digital line receivers with two completely independent units fabricated on a single silicon chip. Intended for use with digital systems connected by twisted pair lines, they have a differential input designed to reject large common mode signals while responding to small differential signals. The output is directly compatible with TTL or LS integrated circuits.
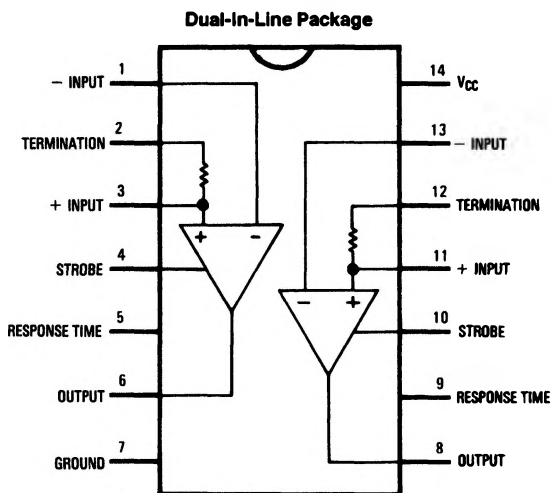
The response time can be controlled with an external capacitor to reject input noise spikes. The output state is a logic "1" for both inputs open. Termination resistors for the twisted pair line are also included in the circuit. Both the DS7820A and the DS8820A are specified, worst case, over

their full operating temperature range ($-55°C$ to $+125°C$ and $0°C$ to $70°C$ respectively), over the entire input voltage range, for $\pm10\%$ supply voltage variations.

Features

- Operation from a single $+5V$ logic supply
- Input voltage range of $\pm15V$
- Strobe low forces output to "1" state
- High input resistance
- Fanout of ten with TTL integrated circuits
- Outputs can be wire OR'ed
- Series 54/74 compatible

Connection Diagram

Dual-In-Line Package

Pin	Signal
1	− INPUT
2	TERMINATION
3	+ INPUT
4	STROBE
5	RESPONSE TIME
6	OUTPUT
7	GROUND
14	V_{CC}
13	− INPUT
12	TERMINATION
11	+ INPUT
10	STROBE
9	RESPONSE TIME
8	OUTPUT

Note: Pin 7 connected to bottom of cavity package.

Top View

TL/F/5797–2

Order Number DS7820AJ or DS8820AN
See NS Package Number J14A or N14A

For Complete Military 883 Specificatons, See RETS Data Sheet.
Order Number DS7820AJ/883 or DS7820AW/883
See NS Package Number J14A or W14B

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	8.0V
Common-Mode Voltage	±20V
Differential Input Voltage	±20V
Strobe Voltage	8.0V
Output Sink Current	50 mA
Storage Temperature Range	−65°C to 150°C
Maximum Power Dissipation* at 25°C	
Cavity Package	1308 mW
Molded Package	1207 mW
Lead Temperature (Soldering, 4 sec.)	260°C

*Derate cavity package 8.7 mW/°C above 25°C; derate molded package 9.7 mW/°C above 25°C.

Operating Conditions

	Min	Max	Units
Supply Voltage (V_{CC})			
DS7820A	4.5	5.5	V
DS8820A	4.75	5.25	V
Temperature (T_A)			
DS7820A	−55	+125	°C
DS8820A	0	+70	°C

Electrical Characteristics (Notes 2, 3, and 4)

Symbol	Parameter	Conditions			Min	Typ	Max	Units
V_{TH}	Differential Threshold Voltage	$I_{OUT} = -400\ \mu A$, $V_{OUT} \geq 2.5V$	$-3V \leq V_{CM} \leq +3V$			0.06	0.5	V
			$-15V \leq V_{CM} \leq +15V$			0.06	1.0	V
		$I_{OUT} = +16\ mA$, $V_{OUT} \leq 0.4V$	$-3V \leq V_{CM} \leq +3V$			−0.08	−0.5	V
			$-15V \leq V_{CM} \leq +15V$			−0.08	−1.0	V
R_I^-	Inverting Input Resistance	$-15V \leq V_{CM} \leq +15V$			3.6	5		kΩ
R_I^+	Non-Inverting Input Resistance	$-15V \leq V_{CM} \leq +15V$			1.8	2.5		kΩ
R_T	Line Termination Resistance	$T_A = 25°C$			120	170	250	Ω
I_I^-	Inverting Input Current	$V_{CM} = 15V$				3.0	4.2	mA
		$V_{CM} = 0V$				0	−0.5	mA
		$V_{CM} = -15V$				−3.0	−4.2	mA
I_I^+	Non-Inverting Input Current	$V_{CM} = 15V$				5.0	7.0	mA
		$V_{CM} = 0V$				−1.0	−1.6	mA
		$V_{CM} = -15V$				−7.0	−9.8	mA
I_{CC}	Power Supply Current One Side Only	$I_{OUT} = $ Logical "0"	$V_{DIFF} = -1V$	$V_{CM} = 15V$		3.9	6.0	mA
				$V_{CM} = -15V$		9.2	14.0	mA
			$V_{DIFF} = -0.5V$, $V_{CM} = 0V$			6.5	10.2	mA
V_{OH}	Logical "1" Output Voltage	$I_{OUT} = -400\ \mu A$, $V_{DIFF} = 1V$			2.5	4.0	5.5	V
V_{OL}	Logical "0" Output Voltage	$I_{OUT} = +16\ mA$, $V_{DIFF} = -1V$			0	0.22	0.4	V
V_{SH}	Logical "1" Strobe Input Voltage	$I_{OUT} = +16\ mA$, $V_{OUT} \leq 0.4V$, $V_{DIFF} = -3V$			2.1			V
V_{SL}	Logical "0" Strobe Input Voltage	$I_{OUT} = -400\ \mu A$, $V_{OUT} \geq 2.5V$, $V_{DIFF} = -3V$					0.9	V
I_{SH}	Logical "1" Strobe Input Current	$V_{STROBE} = 5.5V$, $V_{DIFF} = 3V$				0.01	5.0	μA
I_{SL}	Logical "0" Strobe Input Current	$V_{STROBE} = 0.4V$, $V_{DIFF} = -3V$				−1.0	−1.4	mA
I_{SC}	Output Short Circuit Current	$V_O = 0V$, $V_{CC} = 5.5V$, $V_{STROBE} = 0V$			−2.8	−4.5	−6.7	mA

Note 1: "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 2: These specifications apply for $4.5V \leq V_{CC} \leq 5.5V$, $-15V \leq V_{CM} \leq 15V$ and $-55°C \leq T_A \leq +125°C$ for the DS7820A or $4.75V \leq V_{CC} \leq 5.25V$, $0°C \leq T_A \leq +70°C$ for the DS8820A unless otherwise specified. Typical values given are for $V_{CC} = 5.0V$, $T_A = 25°C$ and $V_{CM} = 0V$ unless stated differently.

Note 3: 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.

Note 4: Only one output at a time should be shorted.

Switching Characteristics $T_A = 25°C$, $V_{CC} = 5V$, unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{pd0}	Propagation Delay, Differential Input to "0" Output			30	45	ns
t_{pd1}	Propagation Delay, Differential Input to "1" Output	$R_L = 400\ \Omega$, $C_L = 15$ pF, see *Figure 1*		27	40	ns
t_{pd0}	Propagation Delay, Strobe Input to "0" Output			16	25	ns
t_{pd1}	Propagation Delay, Strobe Input to "1" Output			18	30	ns

AC Test Circuit and Waveforms

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A = Differential Input to "0" Output
B = Differential Input to "1" Output
C = Strobe Input to "0" Output
D = Strobe Input to "1" Output
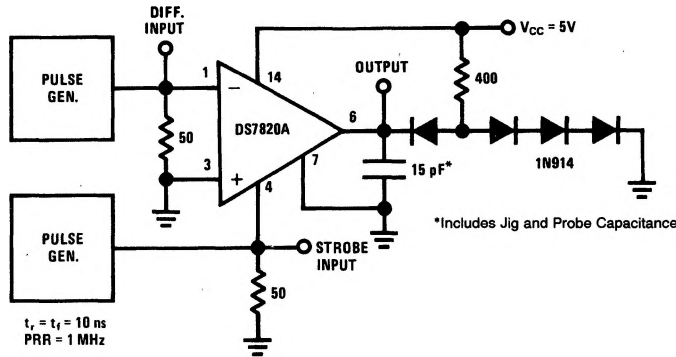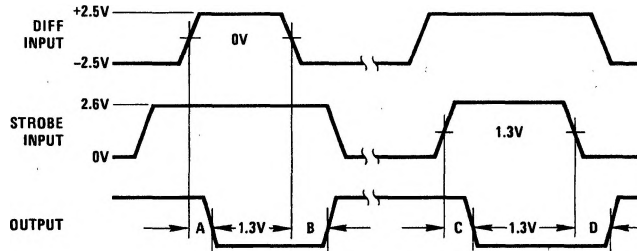
FIGURE 1

Typical Performance Characteristics (Note 3)

Supply Voltage Sensitivity
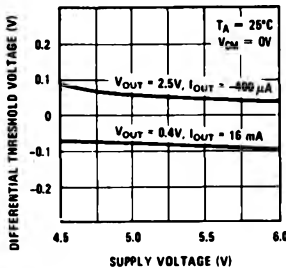
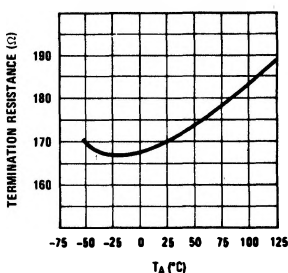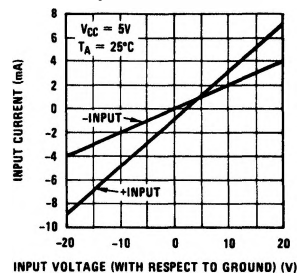### Common-Mode Voltage Sensitivity
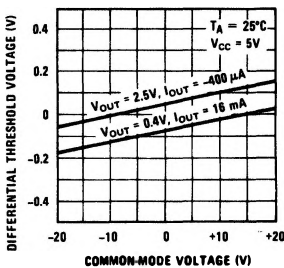
Temperature Sensitivity
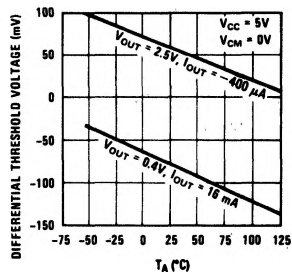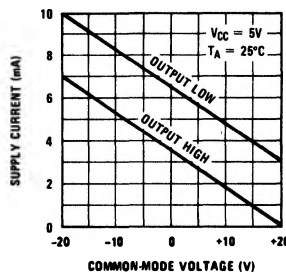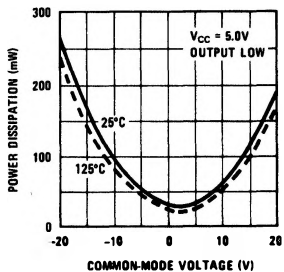
Transfer Function
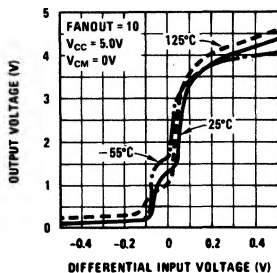
Termination Resistance

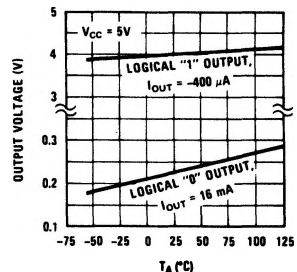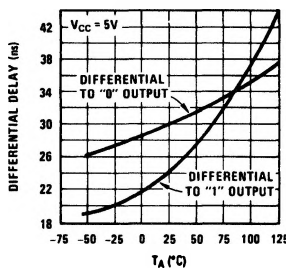### Input Characteristics

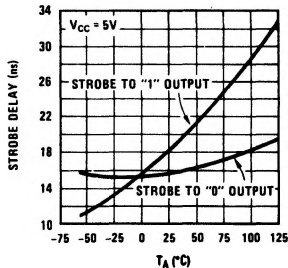### Power Supply Current

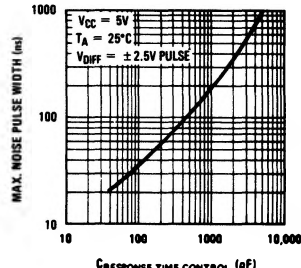### Internal Power Dissipation

Output Voltage Levels
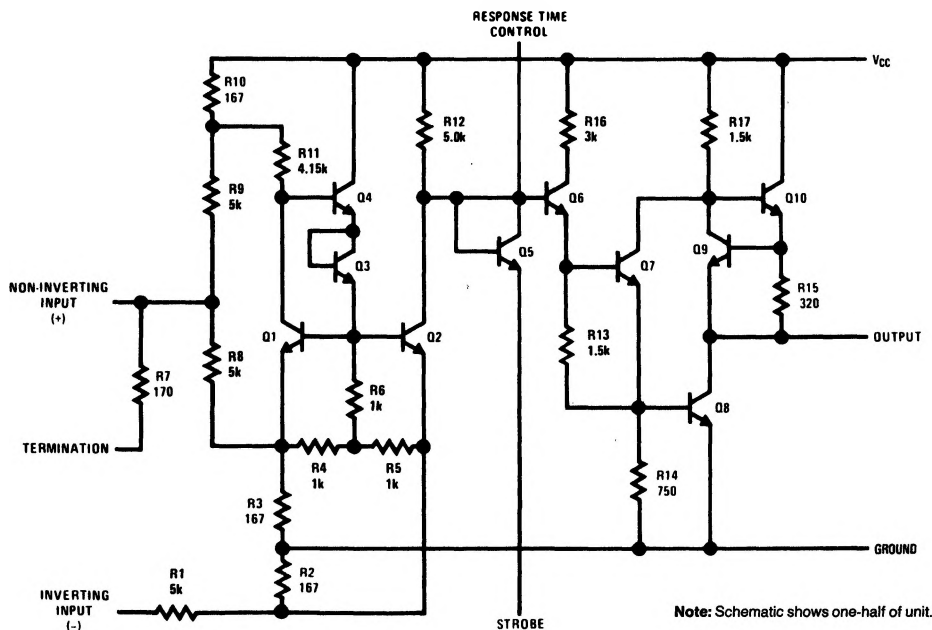
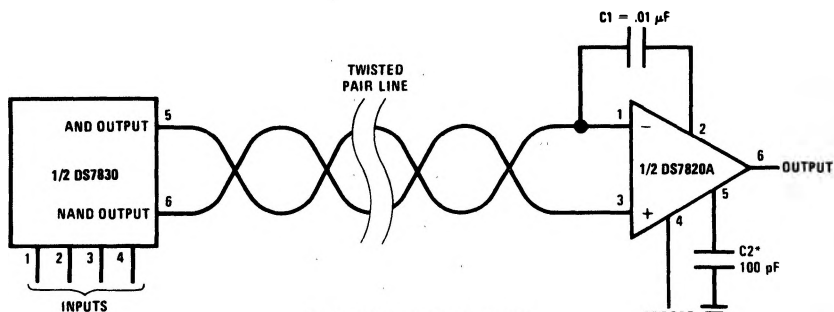### Differential Input Delays

Strobe Delays

Noise Rejection

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Schematic Diagram

RESPONSE TIME
CONTROL

V$_{CC}$

R10
167

R11
4.15k

R12
5.0k

R16
3k

R17
1.5k

R9
5k

Q4

Q3

Q6

Q10

NON-INVERTING
INPUT
(+)

Q5

Q7

Q9

R15
320

R7
170

Q1

Q2

OUTPUT

R8
5k

R6
1k

R13
1.5k

TERMINATION

R4
1k

R5
1k

Q8

R3
167

R14
750

GROUND

R1
5k

R2
167

INVERTING
INPUT
(−)

STROBE

Note: Schematic shows one-half of unit.

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Typical Applications

Differential Line Driver and Receiver

C1 = .01 µF

AND OUTPUT   5

1/2 DS7830

NAND OUTPUT   6

TWISTED
PAIR LINE

1/2 DS7820A

6   OUTPUT

1   2   3   4

INPUTS

STROBE

C2*
100 pF

*Optional to control response time.

TL/F/5797–3

Single Ended (EIA-RS232C) Receiver with Hysteresis

1N914

TWISTED PAIR LINE

1/2 DS7820A

INPUT   1

6   OUTPUT

C2*
100 pF

STROBE

TL/F/5797–4

4V

V$_{OUT}$

0.2V

0   0.8V   V$_{IN}$ 2.5V

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(Output = "1" for Open Input)