National Semiconductor

January 1996

DS3896/DS3897
BTL Trapezoidal™ Transceivers

General Description

These advanced transceivers are specifically designed to overcome problems associated with driving a densely populated backplane, and thus provide significant improvement in both speed and data integrity. Their low output capacitance, low output signal swing and noise immunity features make them ideal for driving low impedance buses with minimum power consumption.

The DS3896 is an octal high speed schottky bus transceiver with common control signals, whereas the DS3897 is a quad device with independent driver input and receiver output pins. The DS3897 has a separate driver disable for each driver and is, therefore, suitable for arbitration lines. The separate driver disable pins (En) feature internal pull ups and may be left open if not required. On the other hand, the DS3896 provides high package density for data/address lines.

The open collector drivers generate precise trapezoidal waveforms, which are relatively independent of capacitive loading conditions on the outputs. This significantly reduces noise coupling to adjacent lines. In addition, the receivers use a low pass filter in conjunction with a high speed comparator, to further enhance the noise immunity and provide equal rejection to both negative and positive going noise pulses on the bus.

To minimize bus loading, these devices also feature a schottky diode in series with the open collector output that isolates the driver output capacitance in the disabled state. The output low voltage is typically “1V” and the output high level is intended to be 2V. This is achieved by terminating the bus with a pull up resistor to 2V at both ends. The device can drive an equivalent DC load of 18.5Ω (or greater) in the above configuration.

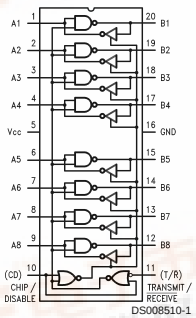
These signalling requirements, including a 1 volt signal swing, low output capacitance and precise receiver thresholds are referred to as Bus Transceiver Logic (BTL).

Features

- 8 bit DS3896 transceiver provides high package density
- 4 bit DS3897 transceiver provides separate driver input and receiver output pins
- BTL compatible
- Less than 5 pF output capacitance for minimal bus loading
- 1 Volt bus signal swing reduces power consumption
- Trapezoidal driver waveforms (t_r, $t_f \cong 6$ ns typical) reduce noise coupling to adjacent lines
- Temperature insensitive receiver thresholds track the bus logic high level to maximize noise immunity in both high and low states
- Guaranteed A.C. specifications on noise immunity and propagation delay over the specified temperature and supply voltage range
- Open collector driver output allows wire-or connection
- Advanced low power schottky technology
- Glitch free power up/down protection on driver and receiver outputs
- TTL compatible driver and control inputs and receiver outputs

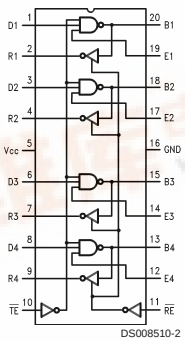
Logic Diagrams

DS3896N, M



DS008510-1

DS3897N, M



DS008510-2

Order Numbers DS3896M, DS3896N, DS3897M or DS3897N
See NS Package Number M20B or N20A

Trapezoidal™ is a trademark of National Semiconductor Corporation.

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	6V
Control Input Voltage	5.5V
Driver Input and Receiver Output	5.5V
Receiver Input and Driver Output	2.5V
Power Dissipation at 70˚C N Package	1480 mW
M Package	TBD mW
Storage Temperature Range	−65˚C to +150˚C
Lead Temperature (Soldering, 4 sec.)	260˚C

Recommended Operating Conditions

	Min	Max	Units
Supply Voltage, V_{CC}	4.75	5.25	V
Bus Termination Voltage	1.90	2.10	V
Operating Free Air Temperature	0	70	˚C

Electrical Characteristics: (Notes 2, 3)

(**0˚C ≤ T_A ≤ 70˚C, 4.75V ≤ V_{CC} ≤ 5.25V** unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Driver and Control Inputs: (An, Dn, En, CD, T/$\overline{R}$, $\overline{RE}$, $\overline{TE}$)						
V_{IH}	Logical “1” Input Voltage		2.0			V
V_{IL}	Logical “0” Input Voltage				0.8	V
I_I	Logical “1” Input Current	An = Dn = En = V_{CC}			1	mA
I_{IH}	Logical “1” Input Current	An = Dn = En = 2.4V			40	µA
I_{IHC}	Logical “1” Input Current	CD = T/$\overline{R}$ = $\overline{RE}$ = $\overline{TE}$ = 2.4V			80	µA
I_{IL}	Logical “0” Input Current	An = Dn = En = 0.4V		−1	−1.6	mA
I_{ILC}	Logical “0” Input Current	CD = T/$\overline{R}$ = $\overline{RE}$ = $\overline{TE}$ = 0.4V		−180	−400	µA
V_{CL}	Input Diode Clamp Voltage	Iclamp = −12 mA		−0.9	−1.5	V
Driver Output/Receiver Input: (Bn)						
V_{OLB}	Low Level Bus Voltage	An = Dn = En = T/$\overline{R}$ = 2V, VL = 2V RL = 18.5Ω, CD = $\overline{TE}$ = 0.8V (*Figure 1*)	0.75	1.0	1.2	V
I_{IHB}	Maximum Bus Current (Power On)	An = Dn = En = 0.8V, V_{CC} = 5.25V Bn = 2V		10	100	µA
I_{ILB}	Maximum Bus Current (Power Off)	An = Dn = En = 0.8V, V_{CC} = 0V Bn = 2V			100	µA
V_{TH}	Receiver Input Threshold	V_{CC} = 5V	1.47	1.55	1.62	V
Receiver Output: (An, Rn)						
V_{OH}	Logical “1” Output Voltage	Bn = 1.2V, I_{OH} = −400 µA CD = T/$\overline{R}$ = $\overline{RE}$ = 0.8V	2.4	3.2		V
V_{OL}	Logical “0” Output Voltage	Bn = 2V, I_{OL} = 16 mA CD = T/$\overline{R}$ = $\overline{RE}$ = 0.8V		0.35	0.5	V
I_{OS}	Output Short Circuit Current	Bn = 1.2V CD = T/$\overline{R}$ = $\overline{RE}$ = 0.8V	−20	−70	−100	mA
I_{CC}	Supply Current (DS3896)	V_{CC} = 5.25V		90	135	mA
I_{CC}	Supply Current (DS3897)	V_{CC} = 5.25V		50	80	mA

Note 1: “Absolute maximum ratings” are those 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 Characteristic” provide conditions for actual device operation.

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

Note 3: All typicals are given for V_{CC} = 5V and T_a = 25˚C.

DS3896 Switching Characteristics

(**0˚C ≤ T_A ≤ 70˚C, 4.75V ≤ V_{CC} ≤ 5.25V** unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Driver:						
t_{DLH}	An to Bn	CD = 0.8V, T/$\overline{R}$ = 2.0V, VL = 2V	5	9	15	ns
t_{DHL}		(*Figure 2*)	5	9	15	ns

DS3896 Switching Characteristics (Continued)

(**0˚C ≤ T_A ≤ 70˚C, 4.75V ≤ V_{CC} ≤ 5.25V** unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Driver:						
t_{DLHC}	CD to Bn	An = T/$\overline{R}$ = 2.0V, VL = 2V	5	10	18	ns
t_{DHLC}		(*Figure 2*)	5	12	20	ns
t_{DLHT}	T/$\overline{R}$ to Bn	VCI = An, VC = 5V, (*Figure 5*)	5	15	25	ns
t_{DHLT}		CD = 0.8V, RC = 390Ω, CL = 30 pF	5	22	35	ns
		RL1 = 18Ω, RL2 = NC, VL = 2V				
t_R	Driver Output Rise Time	CD = 0.8V, T/$\overline{R}$ = 2V, VL = 2V	3	6	10	ns
t_F	Driver Output Fall Time	(*Figure 2*)	3	6	10	ns
Receiver:						
t_{RLH}	Bn to An	CD = 0.8V, T/$\overline{R}$ = 0.8V	5	12	18	ns
t_{RHL}		(*Figure 3*)	5	10	18	ns
t_{RLZC}	CD to An	Bn = 2.0V, T/$\overline{R}$ = 0.8V, CL = 5 pF	5	10	18	ns
		RL1 = 390Ω, RL2 = NC, VL = 5V (*Figure 4*)				
t_{RZLC}		Bn = 2.0V, T/$\overline{R}$ = 0.8V, CL = 30 pF	5	8	15	ns
		RL1 = 390Ω, RL2 = 1.6k, VL = 5V (*Figure 4*)				
t_{RHZC}		Bn = 0.8V, T/$\overline{R}$ = 0.8V, VL = 0V,	2	4	8	ns
		RL1 = 390Ω, RL2 = NC, CL = 5 pF (*Figure 4*)				
t_{RZHC}		Bn = 0.8V, T/$\overline{R}$ = 0.8V, VL = 0V,	3	7	12	ns
		RL1 = NC, RL2 = 1.6k, CL = 30 pF (*Figure 4*)				
t_{RLZT}	T/$\overline{R}$ to An	VCI = Bn, VC = 2V, RC = 18Ω,	5	10	18	ns
		CD = 0.8V, VL = 5V, RL1 = 390Ω,				
		RL2 = NC, CL = 5 pF (*Figure 5*)				
t_{RZLT}		VCI = Bn, VC = 2V, RC = 18Ω,	14	24	40	ns
		CD = 0.8V, VL = 5V, RL1 = 390Ω,				
		RL2 = 1.6k, CL = 30 pF (*Figure 5*)				
t_{RHZT}		VCI = Bn, VC = 0V, RC = 18Ω,	2	4	8	ns
		CD = 0.8V, VL = 0V, RL1 = 390Ω,				
		RL2 = NC, CL = 5 pF (*Figure 5*)				
t_{RZHT}		VCI = Bn, VC = 0V, RC = 18Ω,	2	8	15	ns
		CD = 0.8V, VL = 0V, RL1 = NC				
		RL2 = 1.6k, CL = 30 pF (*Figure 5*)				
t_{NR}	Receiver Noise	(*Figure 6*)	3	6		ns
	Rejection Pulse Width					

Note: NC means open

DS3897 Switching Characteristics

(**0˚C ≤ T_A ≤ 70˚C, 4.75V ≤ V_{CC} ≤ 5.25V** unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Driver:						
t_{DLH}	Dn, En to Bn	$\overline{TE}$ = 0.8V, $\overline{RE}$ = 2.0V, VL = 2V	5	9	15	ns
t_{DHL}		(*Figure 2*)	5	9	15	ns
t_{DLHT}	$\overline{TE}$ to Bn	An = $\overline{RE}$ = 2.0V, VL = 2V, (*Figure 2*)	5	10	18	ns
t_{DHLT}		RC = 390Ω, VCI = An, VC = 5V, CL = 30 pF	5	12	20	ns
		RL1 = 18Ω, RL2 = NC, VL = 2V (*Figure 5*)				
t_R	Driver Output Rise Time	CD = 0.8V, T/$\overline{R}$ = 2V, VL = 2V	3	6	10	ns
tF	Driver Output Fall Time	(*Figure 2*)	3	6	10	ns
Receiver:						
t_{RLH}	Bn to Rn	$\overline{TE}$ = 2.0V, $\overline{RE}$ = 0.8V (*Figure 3*)	5	10	18	ns

DS3897 Switching Characteristics (Continued)

($0^{\circ}C \le T_A \le 70^{\circ}C$, $4.75V \le V_{CC} \le 5.25V$ unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Receiver:						
t_{RHL}			5	12	18	ns
t_{RLZR}	$\overline{RE}$ to Rn	Bn = $\overline{TE}$ = 2V, VL = 5V, CL = 5 pF RL1 = 390Ω, RL2 = NC (*Figure 4*)	5	10	18	ns
t_{RZLR}		Bn = $\overline{TE}$ = 2V, VL = 5V, CL = 30 pF RL1 = 390Ω, RL2 = 1.6k (*Figure 4*)	5	8	15	ns
t_{RHZR}		Bn = 0.8V, $\overline{TE}$ = 2V, VL = 0V, RL1 = 390Ω, RL2 = NC, CL = 5 pF (*Figure 4*)	2	4	8	ns
t_{RZHR}		Bn = 0.8V, $\overline{TE}$ = 2V, VL = 0V, RL1 = NC, RL2 = 1.6k, CL = 30 pF (*Figure 4*)	3	7	12	ns
t_{NR}	Receiver Noise Rejection Pulse Width	(*Figure 6*)	3	6		ns
Driver plus Receiver:						
t_{DRLH}	Dn to Rn	$\overline{TE}$ = $\overline{RE}$ = 0.8V (*Figure 7*)	10	20	30	ns
t_{DRHL}			10	20	30	ns

Note: NC means open

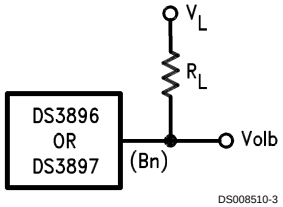
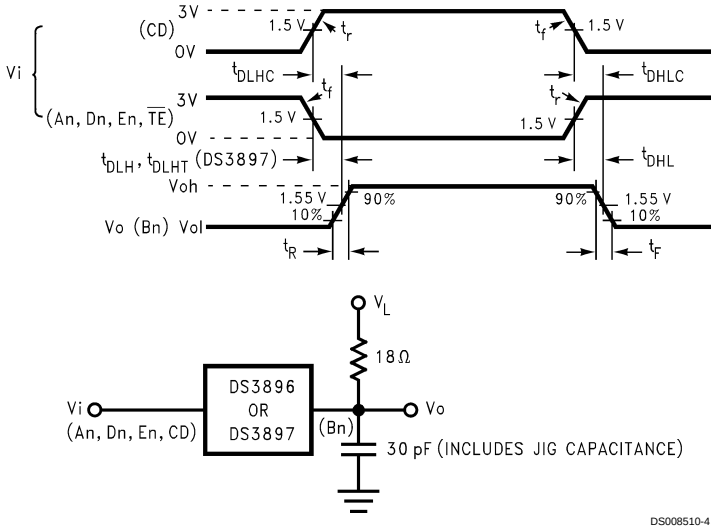


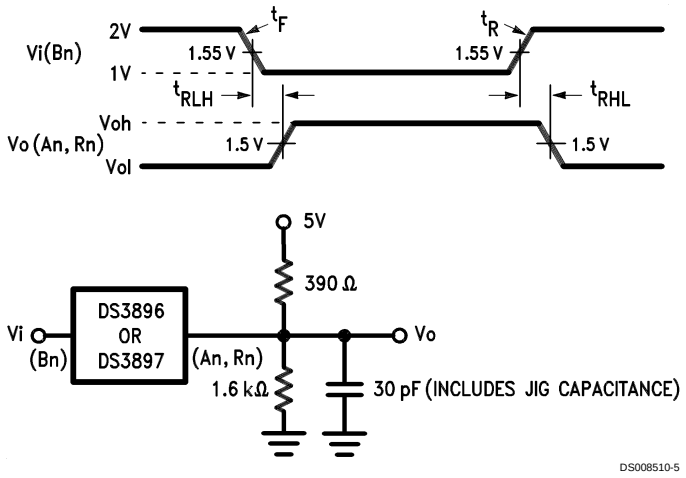
FIGURE 1. Driver Output Low Voltage Test



Note: $t_r = t_f \le 5$ ns from 10% to 90%

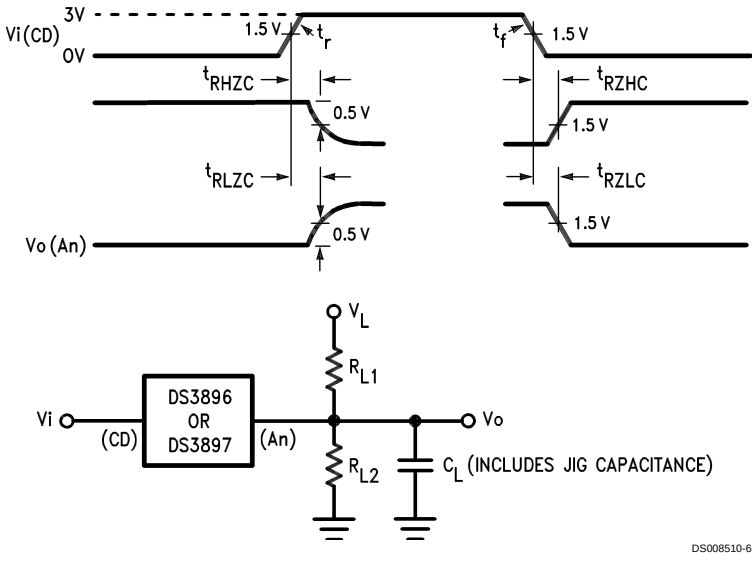
FIGURE 2. Driver Propagation Delays

DS3897 Switching Characteristics (Continued)



Note: $t_R = t_F \leq 10$ ns from 10% to 90%

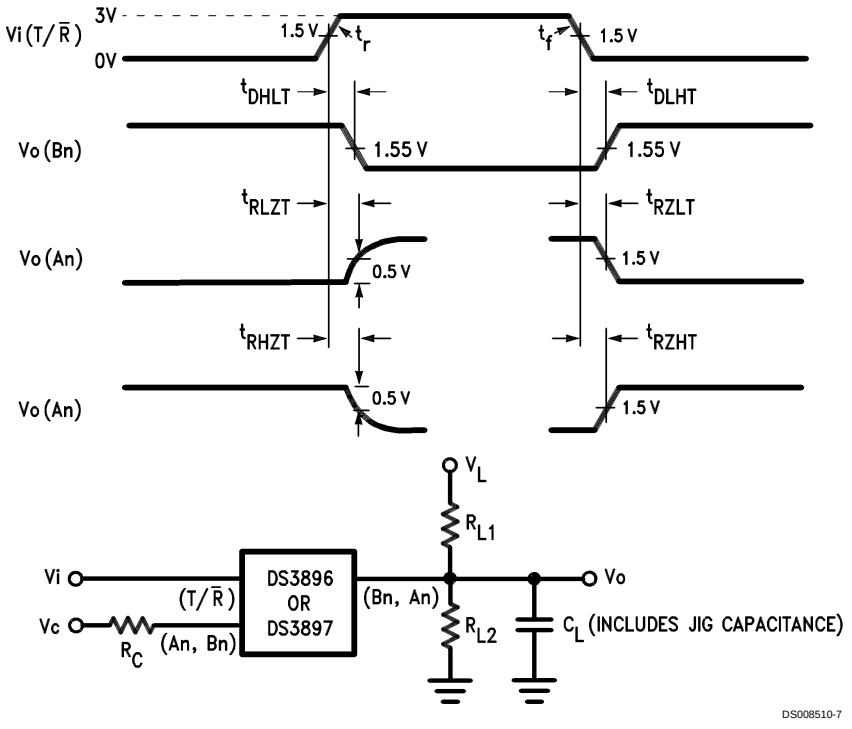
FIGURE 3. Receiver Propagation Delays



Note: $t_r = t_f \leq 5$ ns from 10% to 90%

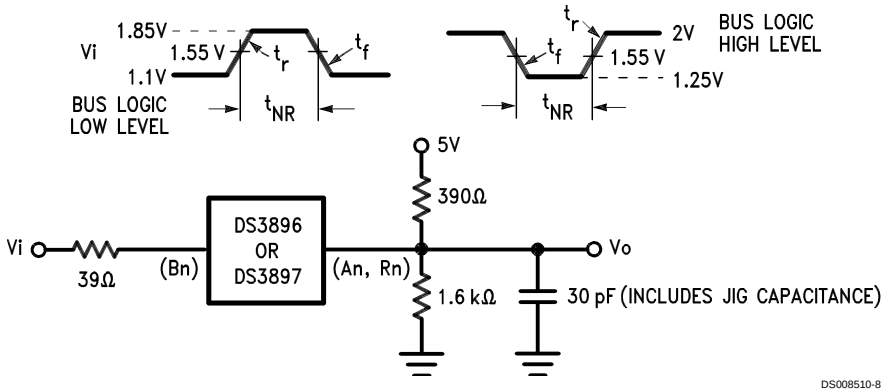
FIGURE 4. Propagation Delay from CD pin to An

DS3897 Switching Characteristics (Continued)



Note: $t_r = t_f \leq 5$ ns from 10% to 90%

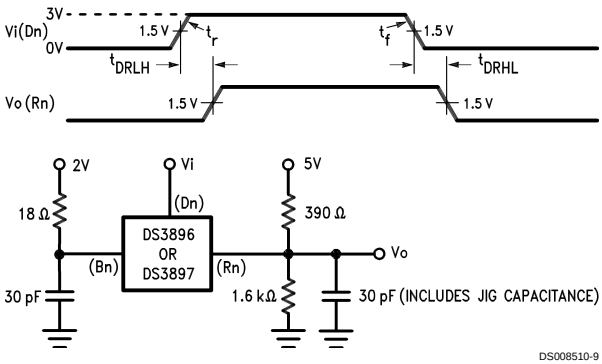
FIGURE 5. Propagation Delay from T/$\overline{R}$ pin to An or Bn



Note: $t_r = t_f = 2$ ns from 10% to 90%

FIGURE 6. Receiver Noise Immunity: "No Response at Output" Input Waveforms

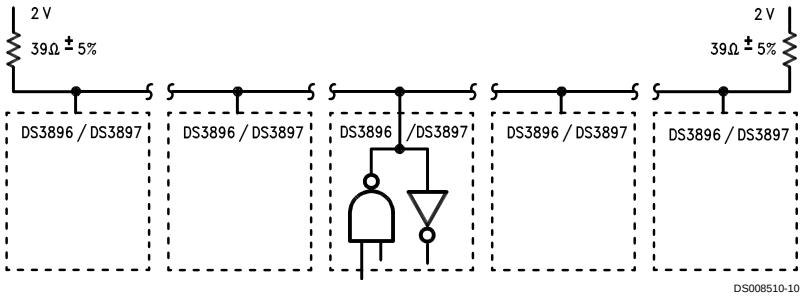
DS3897 Switching Characteristics (Continued)



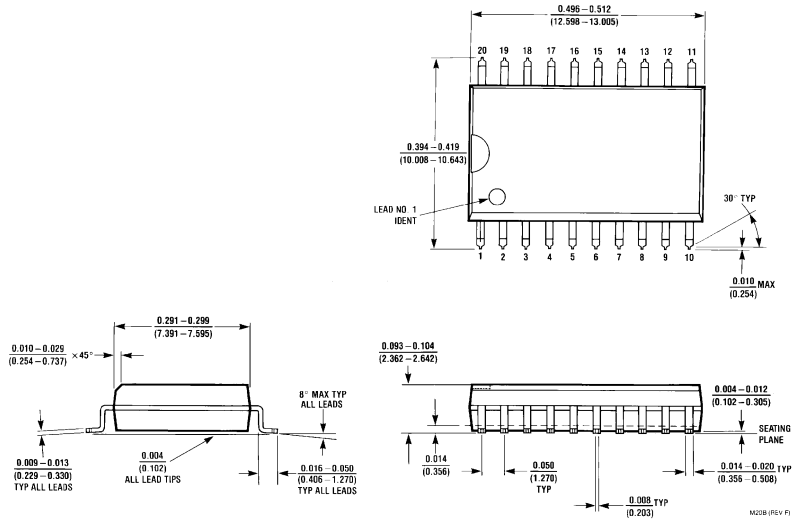
Note: $t_r = t_f \leq 5$ ns from 10% to 90%

FIGURE 7. Driver Plus Receiver Delays

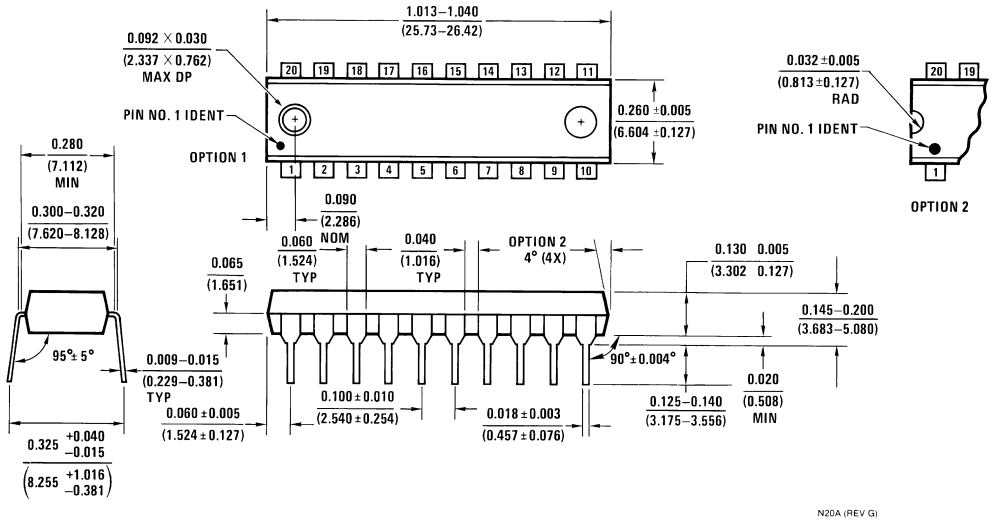
Typical Application



Physical Dimensions inches (millimeters) unless otherwise noted



20-Lead (0.300" Wide) Molded Small Outline Package, JEDEC (M)
Order Number DS3896M or DS2897M
NS Package Number M20B



Molded Dual-In-Line Package (N)
Order Number DS3896N or DS3897N
NS Package Number N20A

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
Tel: 1-800-272-9959
Fax: 1-800-737-7018
Email: support@nsc.com

www.national.com

National Semiconductor Europe
Fax: +49 (0) 1 80-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 1 80-530 85 85
English Tel: +49 (0) 1 80-532 78 32
Français Tel: +49 (0) 1 80-532 93 58
Italiano Tel: +49 (0) 1 80-534 16 80

National Semiconductor Asia Pacific Customer Response Group
Tel: 65-2544466
Fax: 65-2504466
Email: sea.support@nsc.com

National Semiconductor Japan Ltd.
Tel: 81-3-5639-7560
Fax: 81-3-5639-7507