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May 1998

# DS8921/DS8921A/DS8921AT
# Differential Line Driver and Receiver Pair

## General Description

The DS8921, DS8921A are Differential Line Driver and Receiver pairs designed specifically for applications meeting the ST506, ST412 and ESDI Disk Drive Standards. In addition, these devices meet the requirements of the EIA Standard RS-422.

The DS8921, DS8921A receivers offer an input sensitivity of 200 mV over a ±7V common mode operating range. Hysteresis is incorporated (typically 70 mV) to improve noise margin for slowly changing input waveforms.

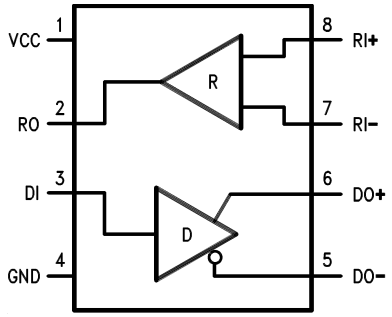
The DS8921, DS8921A drivers are designed to provide unipolar differential drive to twisted pair or parallel wire transmission lines. Complementary outputs are logically ANDed and provide an output skew of 0.5 ns (typ.) with propagation delays of 12 ns.

The DS8921, DS8921A are designed to be compatible with TTL and CMOS.

## Features

- 12 ns typical propagation delay
- Output skew - 0.5 ns typical
- Meet the requirements of EIA Standard RS-422
- Complementary Driver Outputs
- High differential or common-mode input voltage ranges of ±7V
- ±0.2V receiver sensitivity over the input voltage range
- Receiver input hysteresis-70 mV typical
- DS8921AT industrial temperature operation: (–40˚C to +85˚C)

## Connection Diagram

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**Order Number DS8921M, DS8921N, DS8921AM, DS8921AN, DS8921ATM, or DS8921ATN**
**See NS Package Number M08A or N08E**

## Truth Table

| Receiver | | Driver | | |
|---|---|---|---|---|
| Input | $V_{OUT}$ | Input | $V_{OUT}$ | $\overline{V_{OUT}}$ |
| $V_{ID} \geq V_{TH}$ (MAX) | 1 | 1 | 1 | 0 |
| $V_{ID} \leq V_{TH}$ (MIN) | 0 | 0 | 0 | 1 |
| Open | 1 | | | |

## 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 | 7V |
| Driver Input Voltage | −0.5V to +7V |
| Output Voltage | 5.5V |
| Receiver Output Sink Current | 50 mA |
| Receiver Input Voltage | ±10V |
| Differential Input Voltage | ±12V |
| Maximum Package Power Dissipation @ +25˚C | |
| M Package | 730 mW |
| N Package | 1160 mW |
| Derate M Package | 9.3 mW/˚C above +25˚C |
| Derate N Package | 5.8 mW/˚C above +25˚C |
| Storage Temperature Range | −65˚C to +165˚C |
| Lead Temperature (Soldering, 4 sec.) | +260˚C |
| Maximum Junction Temperature | +150˚C |

## Recommended Operating Conditions

| | Min | Max | Units |
|---|---|---|---|
| Supply Voltage | 4.5 | 5.5 | V |
| Temperature ($T_A$) | | | |
| DS8921/DS8921A | 0 | 70 | ˚C |
| DS8921AT | −40 | +85 | ˚C |

## DS8921/DS8921A Electrical Characteristics (Notes 2, 3, 4)

| Symbol | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| **RECEIVER** | | | | | |
| $V_{TH}$ | $-7V \le V_{CM} \le +7V$ | −200 | ±35 | +200 | mV |
| $V_{HYST}$ | $-7V \le V_{CM} \le +7V$ | 15 | 70 | | mV |
| $R_{IN}$ | $V_{IN}$ = −7V, +7V (Other Input = GND) | 4.0 | 6.0 | | kΩ |
| $I_{IN}$ | $V_{IN}$ = 10V | | | 3.25 | mA |
| | $V_{IN}$ = −10V | | | −3.25 | mA |
| $V_{OH}$ | $I_{OH}$ = −400 µA | 2.5 | | | V |
| $V_{OL}$ | $I_{OL}$ = 8 mA | | | 0.5 | V |
| $I_{SC}$ | $V_{CC}$ = MAX, $V_{OUT}$ = 0V | −15 | | −100 | mA |
| **DRIVER** | | | | | |
| $V_{IH}$ | | 2.0 | | | V |
| $V_{IL}$ | | | | 0.8 | V |
| $I_{IL}$ | $V_{CC}$ = MAX, $V_{IN}$ = 0.4V | | −40 | −200 | µA |
| $I_{IH}$ | $V_{CC}$ = MAX, $V_{IN}$ = 2.7V | | | 20 | µA |
| $I_I$ | $V_{CC}$ = MAX, $V_{IN}$ = 7.0V | | | 100 | µA |
| $V_{CL}$ | $V_{CC}$ = MIN, $I_{IN}$ = −18 mA | | | −1.5 | V |
| $V_{OH}$ | $V_{CC}$ = MIN, $I_{OH}$ = −20 mA | 2.5 | | | V |
| $V_{OL}$ | $V_{CC}$ = MIN, $I_{OL}$ = +20 mA | | | 0.5 | V |
| $I_{OFF}$ | $V_{CC}$ = 0V, $V_{OUT}$ = 5.5V | | | 100 | µA |
| $\lvert V_T \rvert - \lvert \overline{VT} \rvert$ | | | | 0.4 | V |
| $V_T$ | | 2.0 | | | V |
| $\lvert V_{OS} - \overline{V_{OS}} \rvert$ | | | | 0.4 | V |
| $I_{SC}$ | $V_{CC}$ = MAX, $V_{OUT}$ = 0V | −30 | | −150 | mA |
| **DRIVER and RECEIVER** | | | | | |
| $I_{CC}$ | $V_{CC}$ = MAX, $V_{OUT}$ = Logic 0 | | | 35 | mA |

## Receiver Switching Characteristics

*Figure 1*(*Figure 2*)

| Symbol | Conditions | Min | Typ | Max | | | Units |
|---|---|---|---|---|---|---|---|
| | | | | 8921 | 8921A | 8921AT | |
| $T_{pLH}$ | $C_L$ = 30 pF (*Figures 1, 2* ) | | 14 | 22.5 | 20 | 20 | ns |
| $T_{pHL}$ | $C_L$ = 30 pF (*Figures 1, 2*) | | 14 | 22.5 | 20 | 20 | ns |
| $\lvert T_{pLH} - T_{pHL} \rvert$ | $C_L$ = 30 pF (*Figures 1, 2* ) | | 0.5 | 5 | 3.5 | 5 | ns |

## Driver Switching Characteristics

**SINGLE ENDED CHARACTERISTICS** (*Figures 3, 4*)

| Symbol | Conditions | Min | Typ | Max | | | Units |
|---|---|---|---|---|---|---|---|
| | | | | 8921 | 8921A | 8921AT | |
| $T_{pLH}$ | $C_L$ = 30 pF (*Figures 3, 4*) | | 10 | 15 | 15 | 15 | ns |
| $T_{pHL}$ | $C_L$ = 30 pF (*Figures 3, 4*) | | 10 | 15 | 15 | 15 | ns |
| $T_{TLH}$ | $C_L$ = 30 pF (*Figures 7, 8*) | | 5 | 8 | 8 | 9.5 | ns |
| $T_{THL}$ | $C_L$ = 30 pF (*Figures 7, 8*) | | 5 | 8 | 8 | 9.5 | ns |
| Skew | CL = 30 pF (*Figures 3, 4*) | | 1 | 5 | 3.5 | 3.5 | ns |

## Driver Switching Characteristics(Note 6)

**DIFFERENTIAL CHARACTERISTICS** (*Figures 3, 5*)

| Symbol | Conditions | Min | Typ | Max | | | Units |
|---|---|---|---|---|---|---|---|
| | | | | 8921 | 8921A | 8921AT | |
| $T_{pLH}$ | $C_L$ = 30 pF (*Figures 3, 5, 6*) | | 10 | 15 | 15 | 15 | ns |
| $T_{pHL}$ | $C_L$ = 30 pF (*Figures 3, 5, 6*) | | 10 | 15 | 15 | 15 | ns |
| $\lvert T_{pLH} - T_{pHL} \rvert$ | $C_L$ = 30 pF (*Figures 3, 5, 6*) | | 0.5 | 6 | 2.75 | 2.75 | ns |

**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" provides conditions for actual device operation.

**Note 2:** All currents into device pins are shown as positive values; all currents out of the device are shown as negative; all voltages are referenced to ground unless otherwise specified. All values shown as max or min are classified on absolute value basis.

**Note 3:** All typical values are $V_{CC}$ = 5V, $T_A$ = 25˚C.

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

**Note 5:** Difference between complementary outputs at the 50% point.

**Note 6:** Differential Delays are defined as calculated results from single ended rise and fall time measurements. This approach in establishing AC performance specifications has been taken due to limitations of available Automatic Test Equipment (ATE).

The calculated ATE results assume a linear transition between measurement points and are a result of the following equations:

$$T_{cr} = \frac{(T_{fb} \times T_{rb}) - (T_{ra} \times T_{fa})}{T_{rb} - T_{ra} - T_{fa} + T_{fb}}$$

Where: $T_{cr}$ = Crossing Point

$T_{ra}$, $T_{rb}$, $T_{fa}$ and $T_{fb}$ are time measurements with respect to the input. See *Figure 6* .

## AC Test Circuits and Switching Diagrams

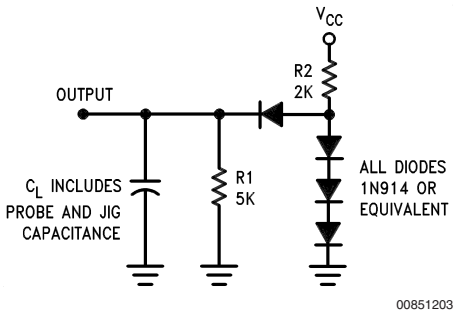



**FIGURE 1.**

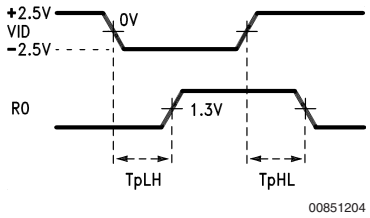



**FIGURE 2.**

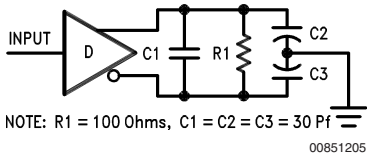



**FIGURE 3.**

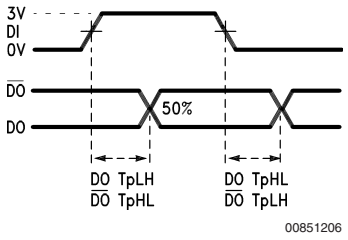



**FIGURE 4.**

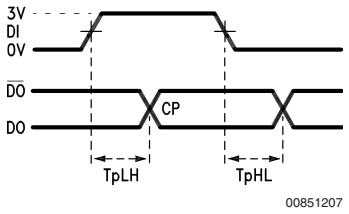



**FIGURE 5.**

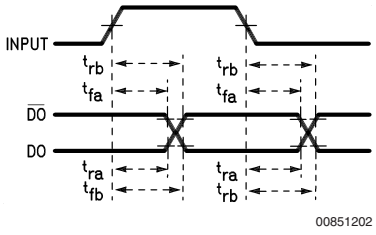



**FIGURE 6.**

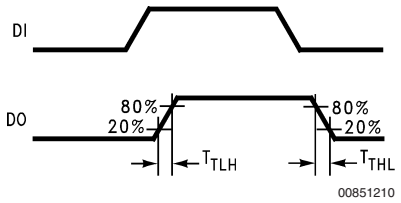



**FIGURE 7.**

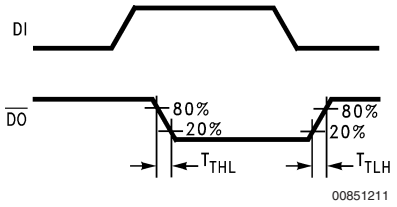
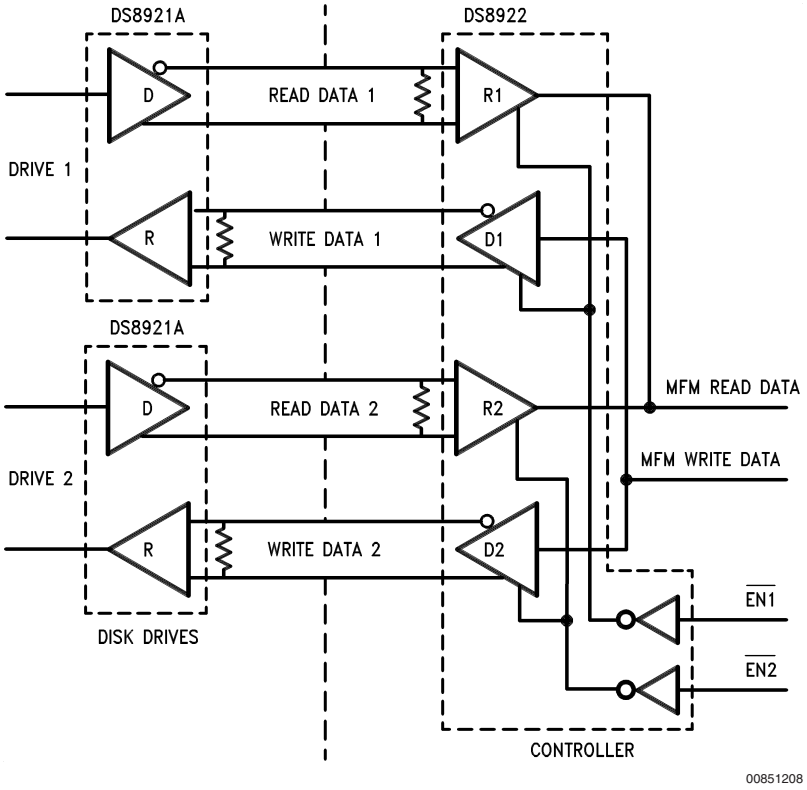


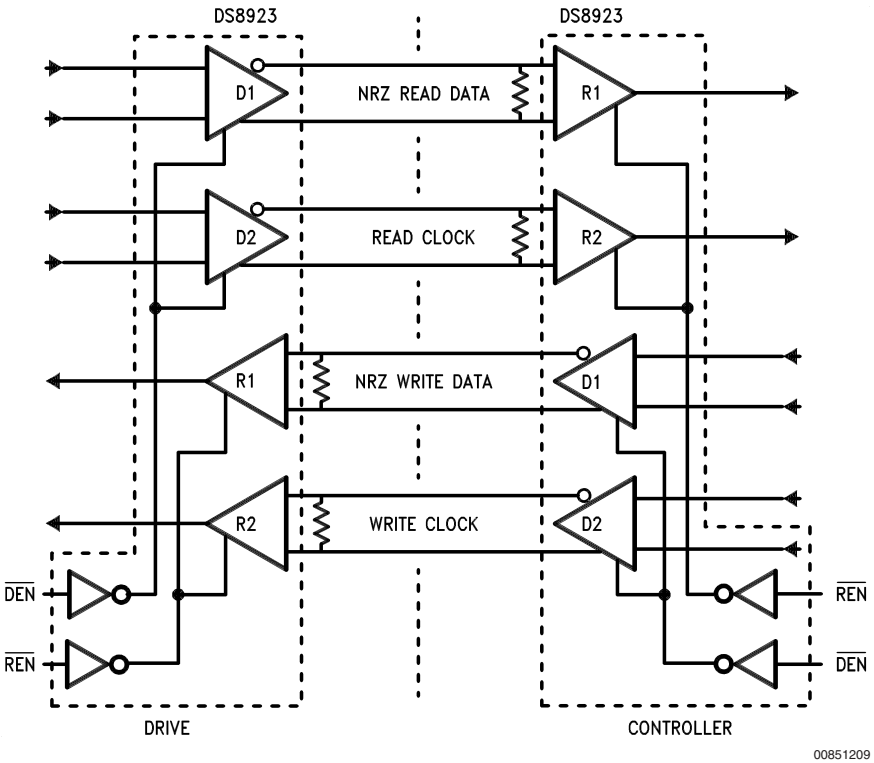

**FIGURE 8.**

## Typical Applications

**ST506 and ST412 Application**

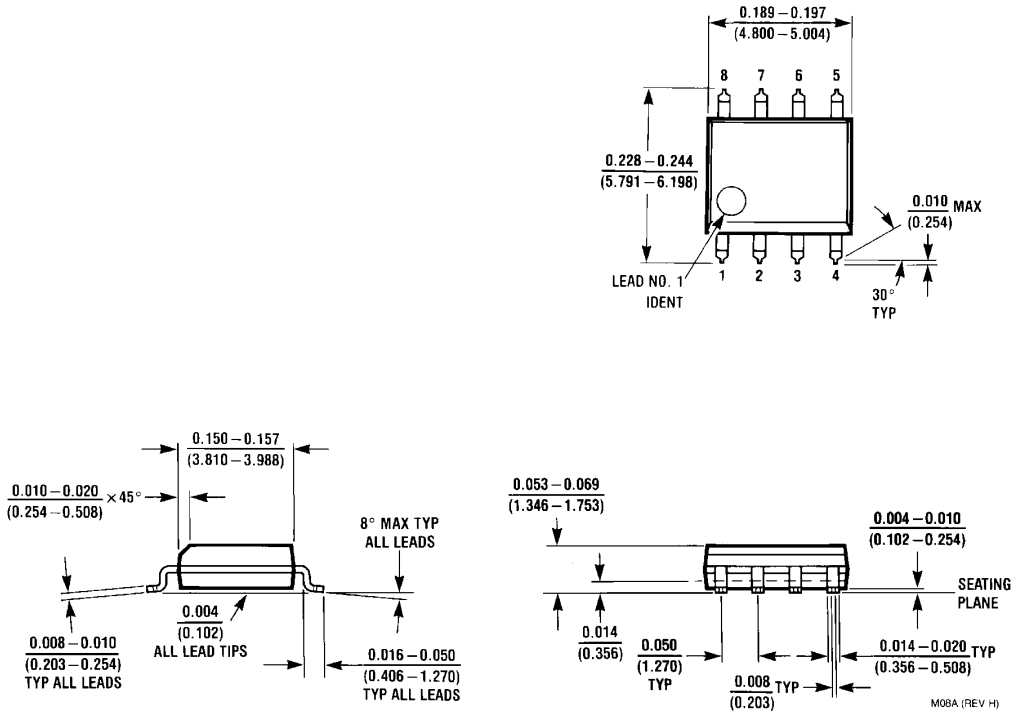



**ESDI Application**

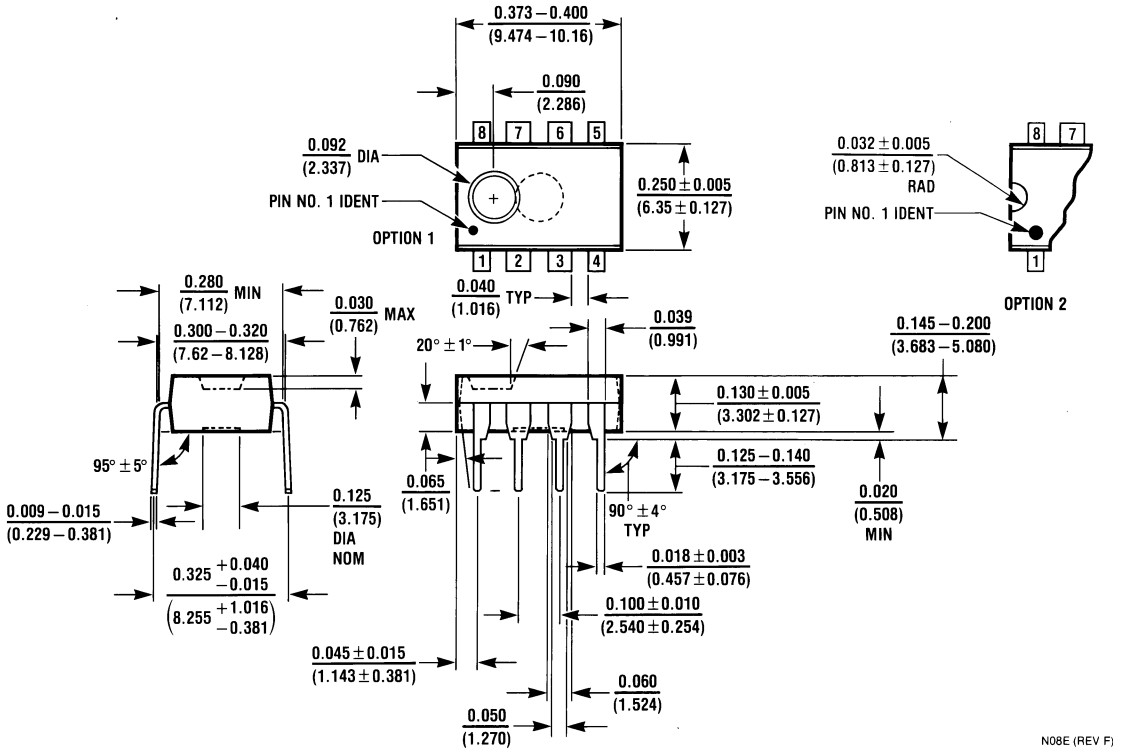


## Physical Dimensions inches (millimeters)

unless otherwise noted




**SO Package (M)**
**Order Number DS8921M, DS8921AM or DS8921ATM**
**NS Package Number M08A**




**Molded Dual-In-Line Package (N)**
**Order Number DS8921N, DS8921AN or DS8921ATN**
**NS Package Number N08E**

## Notes



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