

# 100370

*100370 Low Power Universal Demultiplexer/Decoder*



Literature Number: SNOS126

# 100370 Low Power Universal Demultiplexer/Decoder

## General Description

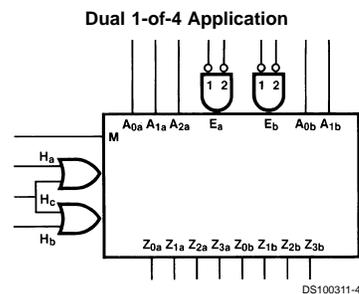
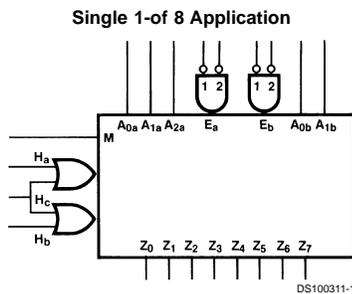
The 100370 universal demultiplexer/decoder functions as either a dual 1-of-4 decoder or as a single 1-of-8 decoder, depending on the signal applied to the Mode Control (M) input. In the dual mode, each half has a pair of active-LOW Enable ( $\bar{E}$ ) inputs. Pin assignments for the  $\bar{E}$  inputs are such that in the 1-of-8 mode they can easily be tied together in pairs to provide two active-LOW enables ( $\bar{E}_{1a}$  to  $\bar{E}_{1b}$ ,  $\bar{E}_{2a}$  to  $\bar{E}_{2b}$ ). Signals applied to auxiliary inputs  $H_a$ ,  $H_b$  and  $H_c$  determine whether the outputs are active HIGH or active LOW. In the dual 1-of-4 mode the Address inputs are  $A_{0a}$ ,  $A_{1a}$  and  $A_{0b}$ ,

$A_{1b}$  with  $A_{2a}$  unused (i.e., left open, tied to  $V_{EE}$  or with LOW signal applied). In the 1-of-8 mode, the Address inputs are  $A_{0a}$ ,  $A_{1a}$ ,  $A_{2a}$  with  $A_{0b}$  and  $A_{1b}$  LOW or open. All inputs have 50 k $\Omega$  pull-down resistors.

## Features

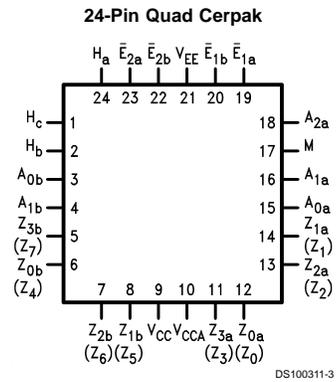
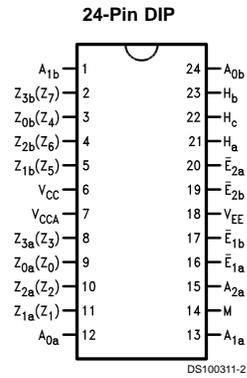
- 35% power reduction of the 100170
- 2000V ESD protection
- Pin/function compatible with 100170
- Voltage compensated operating range = -4.2V to -5.7V

## Logic Symbols

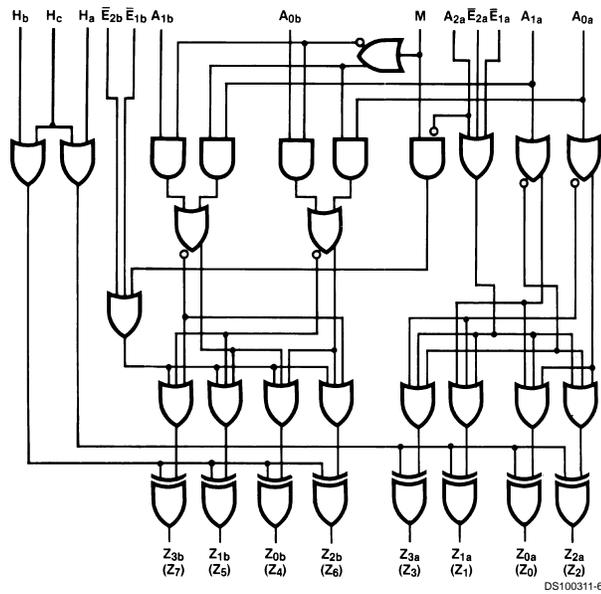


| Pin Names                       | Description  |
|---------------------------------|--|
| $A_{na}$ , $A_{nb}$             | Address Inputs   |
| $\bar{E}_{na}$ , $\bar{E}_{nb}$ | Enable Inputs  |
| M                               | Mode Control Input   |
| $H_a$                           | $Z_0$ - $Z_3$ ( $\bar{Z}_{0a}$ - $\bar{Z}_{3a}$ )<br>Polarity Select Input |
| $H_b$                           | $Z_4$ - $Z_7$ ( $\bar{Z}_{0b}$ - $\bar{Z}_{3b}$ )<br>Polarity Select Input |
| $H_c$                           | Common Polarity<br>Select Input  |
| $Z_0$ - $Z_7$                   | Single 1-of-8<br>Data Outputs  |
| $Z_{na}$ , $Z_{nb}$             | Dual 1-of-4<br>Data Outputs  |

## Connection Diagrams



## Logic Diagram



**Note 1:** (Z<sub>n</sub>) for 1-of-4 applications.

## Truth Tables

### Dual 1-of-4 Mode ( $M = A_{2a} = H_c = \text{LOW}$ )

| Inputs         |                |          |          | Active HIGH Outputs<br>( $H_a$ and $H_b$ Inputs HIGH) |          |          |          | Active LOW Outputs<br>( $H_a$ and $H_b$ Inputs LOW) |          |          |          |
|----------------|----------------|----------|----------|---|----------|----------|----------|---|----------|----------|----------|
| $\bar{E}_{1a}$ | $\bar{E}_{2a}$ | $A_{1a}$ | $A_{0a}$ | $Z_{0a}$  | $Z_{1a}$ | $Z_{2a}$ | $Z_{3a}$ | $Z_{0a}$  | $Z_{1a}$ | $Z_{2a}$ | $Z_{3a}$ |
| $\bar{E}_{1b}$ | $\bar{E}_{2b}$ | $A_{1b}$ | $A_{0b}$ | $Z_{0b}$  | $Z_{1b}$ | $Z_{2b}$ | $Z_{3b}$ | $Z_{0b}$  | $Z_{1b}$ | $Z_{2b}$ | $Z_{3b}$ |
| H              | X              | X        | X        | L   | L        | L        | L        | H   | H        | H        | H        |
| X              | H              | X        | X        | L   | L        | L        | L        | H   | H        | H        | H        |
| L              | L              | L        | L        | H   | L        | L        | L        | L   | H        | H        | H        |
| L              | L              | L        | H        | L   | H        | L        | L        | H   | L        | H        | H        |
| L              | L              | H        | L        | L   | L        | H        | L        | H   | H        | L        | H        |
| L              | L              | H        | H        | L   | L        | L        | H        | H   | H        | H        | L        |

### Single 1-of-8 Mode ( $M = \text{HIGH}; A_{0b} = A_{1b} = H_a = H_b = \text{LOW}$ )

| Inputs      |             |          |          |          | Active HIGH Outputs (Note 2)<br>( $H_c$ Input HIGH) |       |       |       |       |       |       |       |
|-------------|-------------|----------|----------|----------|---|-------|-------|-------|-------|-------|-------|-------|
| $\bar{E}_1$ | $\bar{E}_2$ | $A_{2a}$ | $A_{1a}$ | $A_{0a}$ | $Z_0$   | $Z_1$ | $Z_2$ | $Z_3$ | $Z_4$ | $Z_5$ | $Z_6$ | $Z_7$ |
| H           | X           | X        | X        | X        | L   | L     | L     | L     | L     | L     | L     | L     |
| X           | H           | X        | X        | X        | L   | L     | L     | L     | L     | L     | L     | L     |
| L           | L           | L        | L        | L        | H   | L     | L     | L     | L     | L     | L     | L     |
| L           | L           | L        | L        | H        | L   | H     | L     | L     | L     | L     | L     | L     |
| L           | L           | L        | H        | L        | L   | L     | H     | L     | L     | L     | L     | L     |
| L           | L           | L        | H        | H        | L   | L     | L     | H     | L     | L     | L     | L     |
| L           | L           | H        | L        | L        | L   | L     | L     | L     | H     | L     | L     | L     |
| L           | L           | H        | H        | L        | L   | L     | L     | L     | L     | H     | L     | L     |
| L           | L           | H        | H        | H        | L   | L     | L     | L     | L     | L     | L     | H     |

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Don't Care  
 $\bar{E}_1 = \bar{E}_{1a}$  and  $\bar{E}_{1b}$  wired;  $\bar{E}_2 = \bar{E}_{2a}$  and  $\bar{E}_{2b}$  wired

Note 2: for  $H_c = \text{LOW}$ , output states are complemented

### Absolute Maximum Ratings (Note 3)

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

Above which the useful life may be impaired.

|  |                   |
|--|-------------------|
| Storage Temperature ( $T_{STG}$ )      | -65°C to +150°C   |
| Maximum Junction Temperature ( $T_J$ ) |                   |
| Ceramic                                | +175°C            |
| $V_{EE}$ Pin Potential to Ground Pin   | -7.0V to +0.5V    |
| Input Voltage (DC)                     | $V_{EE}$ to +0.5V |
| Output Current (DC Output HIGH)        | -50 mA            |

ESD (Note 4)

≥2000V

### Recommended Operating Conditions

|                             |                 |
|-----------------------------|-----------------|
| Case Temperature ( $T_C$ )  |                 |
| Military                    | -55°C to +125°C |
| Supply Voltage ( $V_{EE}$ ) | -5.7V to -4.2V  |

**Note 3:** Absolute maximum ratings are those values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

**Note 4:** ESD testing conforms to MIL-STD-883, Method 3015.

### Military Version DC Electrical Characteristics

$V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = V_{CCA} = GND$ ,  $T_C = -55°C$  to  $+125°C$

| Symbol    | Parameter            | Min   | Max   | Units | $T_C$           | Conditions                                   | Notes                     |                 |
|-----------|----------------------|-------|-------|-------|-----------------|--|---------------------------|-----------------|
| $V_{OH}$  | Output HIGH Voltage  | -1025 | -870  | mV    | 0°C to +125°C   | $V_{IN} = V_{IH}$ (Max)<br>or $V_{IL}$ (Min) | Loading with 50Ω to -2.0V | (Notes 5, 6, 7) |
|           |                      | -1085 | -870  | mV    | -55°C           |  |                           |                 |
| $V_{OL}$  | Output LOW Voltage   | -1830 | -1620 | mV    | 0°C to +125°C   |  |                           |                 |
|           |                      | -1830 | -1555 | mV    | -55°C           |  |                           |                 |
| $V_{OHC}$ | Output HIGH Voltage  | -1035 |       | mV    | 0°C to +125°C   | $V_{IN} = V_{IH}$ (Min)<br>or $V_{IL}$ (Max) | Loading with 50Ω to -2.0V | (Notes 5, 6, 7) |
|           |                      | -1085 |       | mV    | -55°C           |  |                           |                 |
| $V_{OLC}$ | Output LOW Voltage   |       | -1610 | mV    | 0°C to +125°C   |  |                           |                 |
|           |                      |       | -1555 | mV    | -55°C           |  |                           |                 |
| $V_{IH}$  | Input HIGH Voltage   | -1165 | -870  | mV    | -55°C to +125°C | Guaranteed HIGH Signal for All Inputs        | (Notes 5, 6, 7, 8)        |                 |
| $V_{IL}$  | Input LOW Voltage    | -1830 | -1475 | mV    | -55°C to +125°C | Guaranteed LOW Signal for All Inputs         | (Notes 5, 6, 7, 8)        |                 |
| $I_{IL}$  | Input LOW Current    | 0.50  |       | μA    | -55°C to +125°C | $V_{EE} = -4.2V$<br>$V_{IN} = V_{IL}$ (Min)  | (Notes 5, 6, 7)           |                 |
| $I_{IH}$  | Input HIGH Current   |       | 240   | μA    | 25°C to +125°C  | $V_{EE} = -5.7V$<br>$V_{IN} = V_{IH}$ (Max)  | (Notes 5, 6, 7)           |                 |
|           |                      |       | 340   | μA    | -55°C           |  |                           |                 |
| $I_{EE}$  | Power Supply Current | -105  | -36   | mA    | -55°C to +125°C | Inputs Open                                  | (Notes 5, 6, 7)           |                 |

**Note 5:** F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals -55°C, then testing immediately without allowing for the junction temperature to stabilize due to heat dissipation after power-up. This provides "cold start" specs which can be considered a worst case condition at cold temperatures.

**Note 6:** Screen tested 100% on each device at -55°C, +25°C, and +125°C, Subgroups 1, 2, 3, 7, and 8.

**Note 7:** Sample tested (Method 5005, Table I) on each manufactured lot at -55°C, +25°C, and +125°C, Subgroups A1, 2, 3, 7, and 8.

**Note 8:** Guaranteed by applying specific input condition and testing  $V_{OH}/V_{OL}$ .

## AC Electrical Characteristics

$V_{EE} = -4.2V$  to  $-5.7V$ ,  $V_{CC} = V_{CCA} = GND$

| Symbol    | Parameter                              | $T_C = -55^\circ C$ |      | $T_C = +25^\circ C$ |      | $T_C = +125^\circ C$ |      | Units | Conditions   | Notes             |
|-----------|--|---------------------|------|---------------------|------|----------------------|------|-------|--------------|-------------------|
|           |  | Min                 | Max  | Min                 | Max  | Min                  | Max  |       |              |                   |
| $t_{PLH}$ | Propagation Delay                      | 0.3                 | 2.40 | 0.4                 | 2.20 | 0.40                 | 2.70 | ns    | Figures 1, 2 | (Notes 9, 10, 11) |
| $t_{PHL}$ | $\bar{E}_{na}, \bar{E}_{nb}$ to Output |                     |      |                     |      |                      |      |       |              |                   |
| $t_{PLH}$ | Propagation Delay                      | 0.30                | 2.60 | 0.40                | 2.40 | 0.40                 | 2.90 | ns    |              |                   |
| $t_{PHL}$ | $A_{na}, A_{nb}$ to Output             |                     |      |                     |      |                      |      |       |              |                   |
| $t_{PLH}$ | Propagation Delay                      | 0.30                | 2.60 | 0.40                | 2.40 | 0.40                 | 2.40 | ns    |              |                   |
| $t_{PHL}$ | $H_a, H_b, H_c$ to Output              |                     |      |                     |      |                      |      |       |              |                   |
| $t_{PLH}$ | Propagation Delay                      | 0.40                | 3.10 | 0.60                | 2.80 | 0.70                 | 3.70 | ns    |              |                   |
| $t_{PHL}$ | M to Output                            |                     |      |                     |      |                      |      |       |              |                   |
| $t_{TLH}$ | Transition Time                        | 0.30                | 1.60 | 0.30                | 1.60 | 0.30                 | 1.60 | ns    |              | (Note 12)         |
| $t_{THL}$ | 20% to 80%, 80% to 20%                 |                     |      |                     |      |                      |      |       |              |                   |

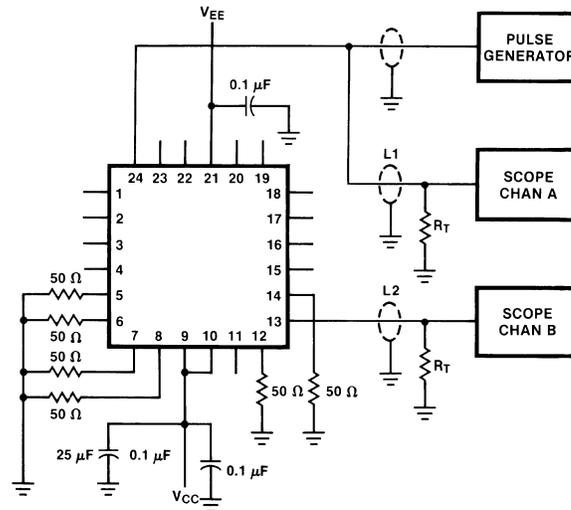
**Note 9:** F100K 300 Series cold temperature testing is performed by temperature soaking (to guarantee junction temperature equals  $-55^\circ C$ ), then testing immediately without allowing for the junction temperature to stabilize due to heat dissipation after power-up. This provides "cold start" specs which can be considered a worst case condition at cold temperatures.

**Note 10:** Screen tested 100% on each device at  $+25^\circ C$ , temperature only, Subgroup A9.

**Note 11:** Sample tested (Method 5005, Table I) on each Mfg. lot at  $+25^\circ C$ , Subgroup A9, and at  $+125^\circ C$ , and  $-55^\circ C$  Temp., Subgroups A10 and A11.

**Note 12:** Not tested at  $+25^\circ C$ ,  $+125^\circ C$  and  $-55^\circ C$  Temperature (design characterization data).

## Test Circuit



DS100311-7

### Notes:

$V_{CC}, V_{CCA} = +2V, V_{EE} = -2.5V$

L1 and L2 = equal length 50 $\Omega$  impedance lines

$R_T = 50\Omega$  terminator internal to scope

Decoupling 0.1  $\mu F$  from GND to  $V_{CC}$  and  $V_{EE}$

All unused outputs are loaded with 50 $\Omega$  to GND

$C_L$  = Fixture and stray capacitance  $\leq 3$  pF

Pin numbers shown are for flatpak; for DIP see logic symbol

FIGURE 1. AC Test Circuit

## Switching Waveforms

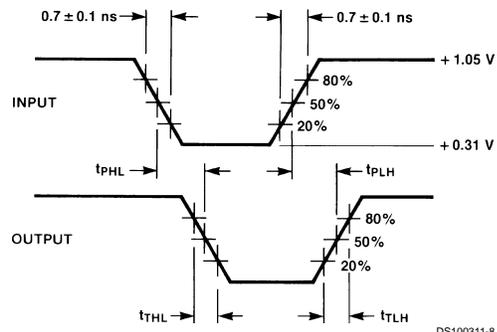
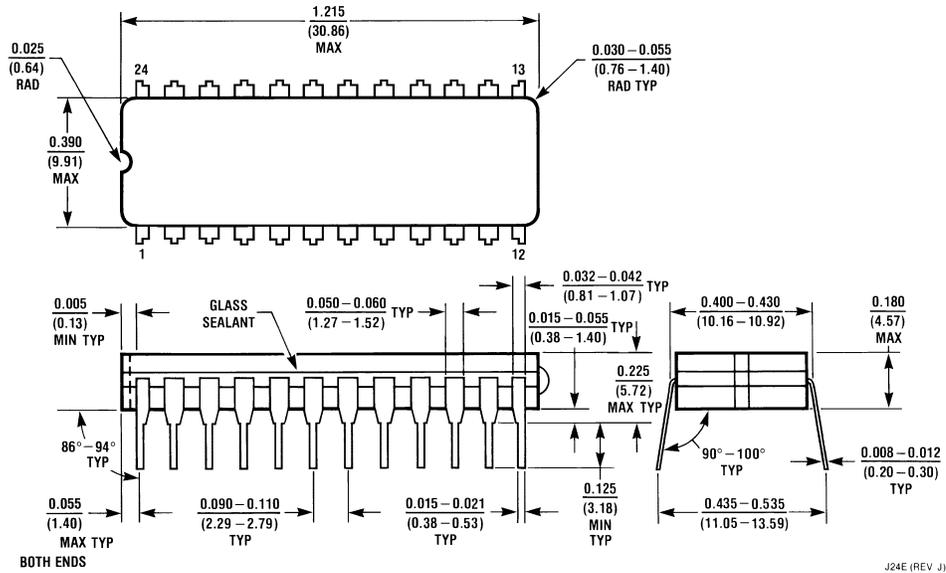
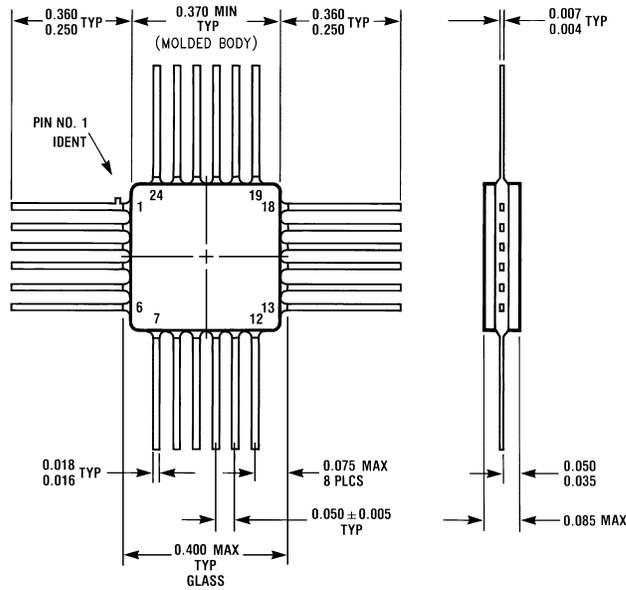


FIGURE 2. Propagation Delay and Transition Times

**Physical Dimensions** inches (millimeters) unless otherwise noted



**24-Lead Ceramic Dual-In-Line Package (D)**  
NS Package Number J24E



**24-Lead Ceramic Flatpak (F)**  
NS Package Number W24B

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