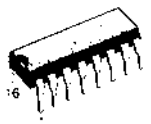
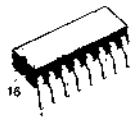
# QUAD 2-INPUT MULTIPLEXER WITH 3-STATE OUTPUTS

## DESCRIPTION

The LSTTL/MSI T54LS258/258A, T74LS258/258A is a Quad 2-Input Multiplexer with 3-state outputs. Four bits of data from two sources can be selected using a Common Data Select input. The four outputs present the selected data in the complement (inverted) form. The outputs may be switched to a high impedance state with a HIGH on the common Outputs Enable ($\overline{E}_0$) Input, allowing the outputs to interface directly with bus oriented systems. It is fabricated with the Scottky barrier diode process for high speed and is completely compatible with all SGS TTL families.



**B1**
Plastic Package



**D1/D2**
Ceramic Package

**M1**
Micro Package

**C1**
Plastic Chip Carrier

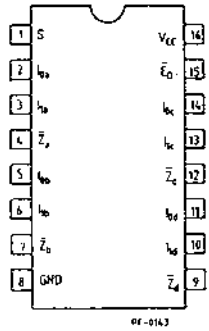
ORDERING NUMBERS:

| | |
|---|---|
| T54LSXXX D2 | T74LSXXX C1 |
| T74LSXXX D1 | T74LSXXX M1 |
| T74LSXXX B1 | |

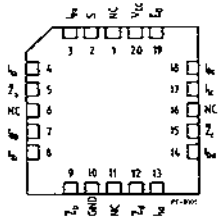
- SCHOTTKY PROCESS FOR HIGH SPEED
- MULTIPLEXER EXPANSION BY TYING OUTPUTS TOGETHER
- INVERTING 3 STATE OUTPUTS
- INPUT CLAMP DIODES LIMIT HIGH SPEED TERMINATION EFFECTS
- FULLY TTL AND CMOS COMPATIBLE
- VERSION "A" PRELIMINARY DATA

## PIN CONNECTION
(top view)

DUAL IN LINE




CHIP CARRIER

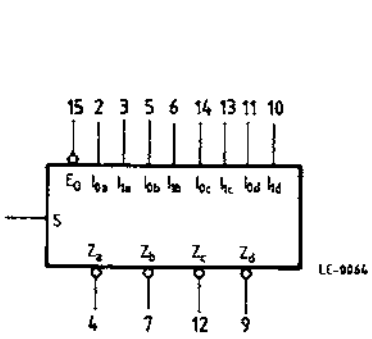


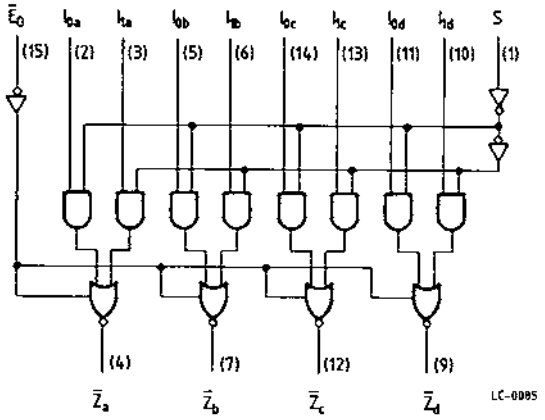
NC = No Internal Connection

## PIN NAMES

| | |
|---|---|
| S | Common Select Input |
| $\overline{E}_0$ | Output Enable (Active LOW) Input |
| $I_{0a}$-$I_{0d}$ | Data Inputs from Source 0 |
| $I_{1a}$-$I_{1d}$ | Data Inputs from Source 1 |
| $Z_a$-$Z_d$ | Multiplexer Output |

## LOGIC SYMBOL AND LOGIC DIAGRAM




## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CC}$ | Supply Voltage | −0.5 to 7 | V |
| $V_I$ | Input Voltage, Applied to Input | −0.5 to 15 | V |
| $V_O$ | Output Voltage, Applied to Output | −0.6 to 5.5 | V |
| $I_I$ | Input Current, Into Inputs | −30 to 5 | mA |
| $I_O$ | Output Current, Into Outputs | 50 | mA |

Stresses in excess of those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions in excess of those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## GUARANTEED OPERATING RANGES

| Part Numbers | Supply Voltage | | | Temperature |
|---|---|---|---|---|
| | Min | Typ | Max | |
| T54LS258/258AD2 | 4.5 V | 5.0 V | 5.5 V | −55°C to +125°C |
| T74LS258/258AXX | 4.75 V | 5.0 V | 5.25 V | 0°C to +70°C |

XX = package type.

## FUNCTIONAL DESCRIPTION

The LS258/258A is a Quad 2-Input Multiplexer with 3-state outputs. It selects four bits of data from two sources under control of a Common Select Input (S). When the Select Input is LOW, the $I_0$ inputs are selected and when Selected is HIGH, the $I_1$ inputs are selected. The data on the selected inputs appear at the outputs in inverted form.

The LS258 Quad 2-Input Multiplexer is the logic implementation of a 4-pole, 2-position switch where the position of the switch is determined by the logic levels supplied to the Select Input. The Logic equations for the outputs are show below:

$$Z_a = \overline{E}_0 \bullet (I_{1a} \bullet S + I_{0a} \bullet \overline{S})$$

$$Z_b = \overline{E}_0 \bullet (I_{1b} \bullet S + I_{0b} \bullet \overline{S})$$

$$Z_c = \overline{E}_0 \bullet (I_{1c} \bullet S + I_{0c} \bullet \overline{S})$$

$$Z_d = \overline{E}_0 \bullet (I_{1d} \bullet S + I_{0d} \bullet \overline{S})$$

When the Output Enable Input ($\overline{E}_0$) is HIGH, the outputs are forced to a high impedance "off" state. If the outputs of the 3-state are tied together, all but one device must be in the high impedance state to avoid high currents that would exceed the maximum ratings. Designers should ensure that Output Enable signals to 3-state devices whose outputs are tied together are designed so there is no overlap.

## TRUTH TABLE

| OUTPUT ENABLE | SELECT INPUT | DATA INPUTS | | OUTPUTS |
|---|---|---|---|---|
| $\overline{E}_0$ | S | $I_0$ | $I_1$ | Z |
| H | X | X | X | (Z) |
| L | H | X | L | H |
| L | H | X | H | L |
| L | L | L | X | H |
| L | L | H | X | L |

H = HIGH Voltage Level
L = LOW Voltage Level
X = Don't Care
(Z) = High impedance (Off)

## DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (T54LS/T74LS258)

| Symbol | Parameter | | Limits | | | Test Conditions (Note 1) | Units |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| $V_{IH}$ | Input HIGH Voltage | | 2.0 | | | Guaranteed input HIGH Voltage for all Inputs | V |
| $V_{IL}$ | Input LOW Voltage | 54 | | | 0.7 | Guaranteed input LOW Voltage for all Inputs | V |
| | | 74 | | | 0.8 | | |
| $V_{CD}$ | Input Clamp Diode Voltage | | | −0.65 | −1.5 | $V_{CC}$ = MIN, $I_{IN}$ = −18mA | V |
| $V_{OH}$ | Output HIGH Voltage | 54 | 2.4 | 3.4 | | $I_{OH}$ = −1.0mA; $V_{CC}$ = MIN, $V_{IN}$ = $V_{IH}$ or $V_{IL}$ per Truth Table | V |
| | | 74 | 2.4 | 3.1 | | $I_{OH}$ = −2.6mA; $V_{CC}$ = MIN, $V_{IN}$ = $V_{IH}$ or $V_{IL}$ per Truth Table | V |
| $V_{OL}$ | Output LOW Voltage | 54,74 | | 0.25 | 0.4 | $I_{OL}$ = 4.0mA; $V_{CC}$ = MIN, $V_{IN}$ = $V_{IH}$ or $V_{IL}$ per Truth Table | V |
| | | 74 | | 0.35 | 0.5 | $I_{OL}$ = 8.0mA; $V_{CC}$ = MIN, $V_{IN}$ = $V_{IH}$ or $V_{IL}$ per Truth Table | V |
| $I_{OZH}$ | Output Off Current HIGH | | | | 20 | $V_{CC}$ = MAX, $V_{OUT}$ = 2.7V, $V_{\overline{E}}$ = 2.0V | μA |
| $I_{OZL}$ | Output Off Current LOW | | | | −20 | $V_{CC}$ = MAX, $V_{OUT}$ = 0.4V, $V_{\overline{E}}$ = 2.0V | μA |
| $I_{IH}$ | Input HIGH Current $\overline{E}_0$, $I_{0x}$, $I_{1x}$ | | | | 20 | $V_{CC}$ = MAX, $V_{IN}$ = 2.7V | μA |
| | S | | | | 40 | | |
| | Input HIGH Current at Max Input Voltage $\overline{E}_0$, $I_{0x}$, $I_{1x}$ | | | | 0.1 | $V_{CC}$ = MAX, $V_{IN}$ = 7.0V | mA |
| | S | | | | 0.2 | | |
| $I_{IL}$ | Input LOW Current $\overline{E}_0$, $I_{0x}$, $I_{1x}$ | | | | −0.4 | $V_{CC}$ = MAX, $V_{IN}$ = 0.4V | mA |
| | S | | | | −0.8 | | |
| $I_{OS}$ | Output Short Circuit Current (Note 2) | | −30 | | −130 | $V_{CC}$ = MAX, $V_{OUT}$ = 0V | mA |
| $I_{CC}$ | Power Supply Current Outputs HIGH | | | | 7 | $V_{CC}$ = MAX, $V_{IN}$ = 0V, $V_{\overline{E}}$ = 0V | mA |
| | Power Supply Current Outputs LOW | | | | 14 | $V_{CC}$ = MAX, $V_{IN}$ = 4.5V, $V_{\overline{E}}$ = 0V | mA |
| | Power Supply Current Outputs Off | | | | 19 | $V_{CC}$ = MAX, $V_{IN}$ = 0V, $V_{\overline{E}}$ = 4.5V | mA |

**Notes:**
1) Conditions for testing, not shown in the Table, are chosen to guarantee operation under "worst case" conditions.
2) Not more than one output should be shorted at a time.
3) Typical values are at $V_{CC}$ = 5.0V, $T_A$ = 25°C

## DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (T54LS/T74LS258A)

| Symbol | Parameter | | Limits | | | Test Conditions (Note 1) | Units |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| $V_{IH}$ | Input HIGH Voltage | | 2.0 | | | Guaranteed input HIGH Voltage for all Inputs | V |
| $V_{IL}$ | Input LOW Voltage | 54 | | | 0.7 | Guaranteed input LOW Voltage for all Inputs | V |
| | | 74 | | | 0.8 | | |
| $V_{CD}$ | Input Clamp Diode Voltage | | | −0.65 | −1.5 | $V_{CC}$ = MIN, $I_{IN}$ = −18mA | V |
| $V_{OH}$ | Output HIGH Voltage | 54 | 2.4 | 3.4 | | $I_{OH}$ = −1.0mA; $V_{CC}$ = MIN, $V_{IN}$ = $V_{IH}$ or $V_{IL}$ per Truth Table | V |
| | | 74 | 2.4 | 3.1 | | $I_{OH}$ = −2.6mA; $V_{CC}$ = MIN, $V_{IN}$ = $V_{IH}$ or $V_{IL}$ per Truth Table | V |
| $V_{OL}$ | Output LOW Voltage | 54,74 | | 0.25 | 0.4 | $I_{OL}$ = 12mA; $V_{CC}$ = MIN, $V_{IN}$ = $V_{IH}$ or $V_{IL}$ per Truth Table | V |
| | | 74 | | 0.35 | 0.5 | $I_{OL}$ = 24mA; $V_{CC}$ = MIN, $V_{IN}$ = $V_{IH}$ or $V_{IL}$ per Truth Table | V |
| $I_{OZH}$ | Output Off Current HIGH | | | | 20 | $V_{CC}$ = MAX, $V_{OUT}$ = 2.7V | μA |
| $I_{OZL}$ | Output Off Current LOW | | | | −20 | $V_{CC}$ = MAX, $V_{OUT}$ = 0.4V | μA |
| $I_{IH}$ | Output HIGH Current | Other Inputs | | | 20 | $V_{CC}$ = MAX, $V_{IN}$ = 2.7V | μA |
| | | S Input | | | 40 | | |
| | | Other Inputs | | | 0.1 | $V_{CC}$ = MAX, $V_{IN}$ = 7.0V | mA |
| | | S Input | | | 0.2 | | |
| $I_{IL}$ | Input LOW Current | Other Inputs | | | −0.4 | $V_{CC}$ = MAX, $V_{IN}$ = 0.4V | mA |
| | | S Input | | | −0.8 | | |
| $I_{OS}$ | Output Short Circuit Current (Note 2) | | −30 | | −130 | $V_{CC}$ = MAX, $V_{OUT}$ = 0V | mA |
| $I_{CC}$ | Power Supply Current Total, Output HIGH | | | | 7 | $V_{CC}$ = MAX | mA |
| | Total, Output LOW | | | | 14 | | |
| | Total, Output 3-State | | | | 19 | | |

**Notes:**

1) Conditions for testing, not shown in the Table, are chosen to guarantee operation under "worst case" conditions.
2) Not more than one output should be shorted at a time.
3) Typical values are at $V_{CC}$ = 5.0V, $T_A$ = 25°C

## AC CHARACTERISTICS: $T_A = 25°C$ (T54LS/T74LS258)

| Symbol | Parameter | Limits | | | Test Conditions | | Units |
|---|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay, Data to Output | | | 18<br>18 | Fig. 1 | $V_{CC} = 5.0V$<br>$C_L = 15pF$ | ns |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay, Select to Output | | | 21<br>21 | Fig. 1 | | ns |
| $t_{PZH}$ | Output Enable Time to HIGH Level | | | 30 | Figs. 4,5 | $V_{CC} = 5.0V$<br>$C_L = 15pF$<br>$R_L = 2\ k\Omega$ | ns |
| $t_{PZL}$ | Output Enable Time to LOW Level | | | 30 | Figs. 3,5 | | ns |
| $t_{PLZ}$ | Output Disable Time from LOW Level | | | 30 | Figs. 3,5 | $V_{CC} = 5.0V$<br>$C_L = 5pF$<br>$R_L = 2\ k\Omega$ | ns |
| $t_{PHZ}$ | Output Disable Time from HIGH Level | | | 25 | Figs. 4,5 | | ns |

## AC CHARACTERISTICS: $T_A = 25°C$ (T54LS/T74LS258A)

| Symbol | Parameter | Limits | | | Test Conditions | | Units |
|---|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay, Data to Output | | 8<br>11 | 18<br>18 | Fig. 1 | $V_{CC} = 5.0V$<br>$C_L = 45pF$<br>$R_L = 667\ \Omega$ | ns |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay, Select to Output | | 15<br>18 | 21<br>25 | Fig. 1 | | ns |
| $t_{PZH}$ | Output Enable Time to HIGH Level | | 18 | 30 | Figs. 4,5 | | ns |
| $t_{PZL}$ | Output Enable Time to LOW Level | | 18 | 30 | Figs. 3,5 | | ns |
| $t_{PLZ}$ | Output Disable Time from LOW Level | | 16 | 25 | Figs. 3,5 | $V_{CC} = 5.0V$<br>$C_L = 5pF$ | ns |
| $t_{PHZ}$ | Output Disable Time from HIGH Level | | 18 | 30 | Figs. 4,5 | | ns |

## WAVEFORMS

Fig. 1

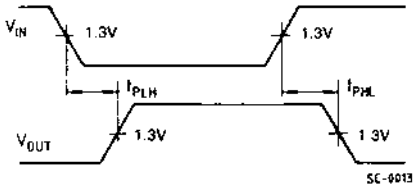



Fig. 2

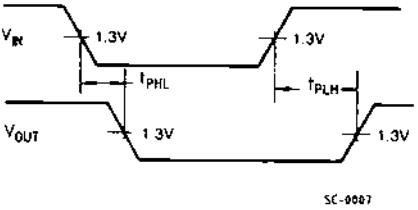



Fig. 3

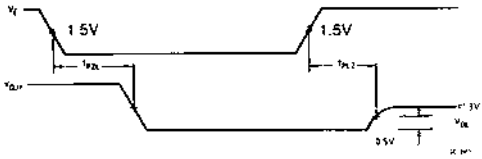



Fig. 4

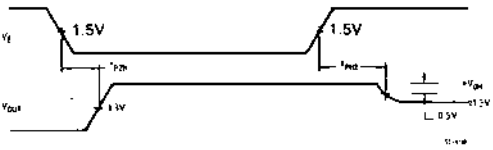
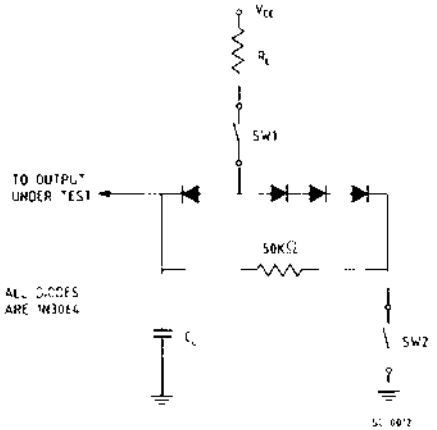



Fig. 5




**SWITCHING POSITIONS**

| Symbol | SW1 | SW2 |
|---|---|---|
| $t_{PZH}$ | Open | Closed |
| $t_{PZL}$ | Closed | Open |
| $t_{PLZ}$ | Closed | Closed |
| $t_{PHZ}$ | Closed | Closed |