SDLS048

# SN54136, SN54LS136, SN74136, SN74LS136
# QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES WITH OPEN-COLLECTOR OUTPUTS

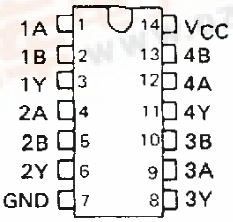
DECEMBER 1972 – REVISED MARCH 1988

FUNCTION TABLE

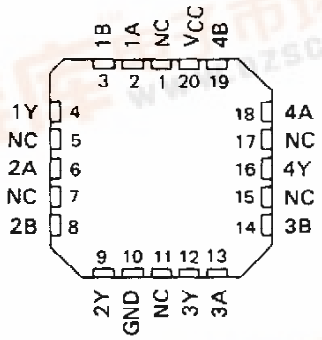
| INPUTS | | OUTPUT |
|---|---|---|
| A | B | Y |
| L | L | L |
| L | H | H |
| H | L | H |
| H | H | L |

H = high level, L = low level

SN54136, SN54LS136 . . . J OR W PACKAGE
SN74136 . . . N PACKAGE
SN74LS136 . . . D OR N PACKAGE
(TOP VIEW)

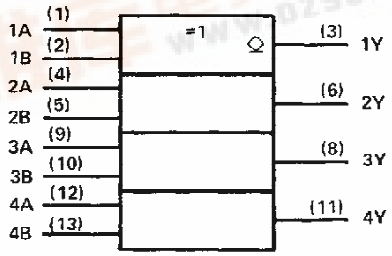



SN54LS136 . . . FK PACKAGE
(TOP VIEW)



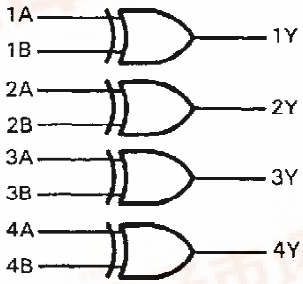

NC – No internal connection

## logic symbol†




†This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for D, J, N, and W packages.

## logic diagram (each gate)

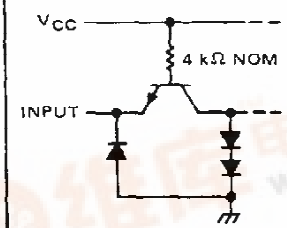



## positive logic

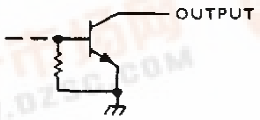
$$Y = A \oplus B = \overline{A} \cdot B + A \cdot \overline{B}$$

## schematics of inputs and outputs

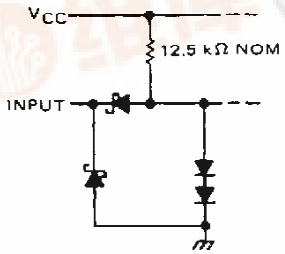
EQUIVALENT OF EACH INPUT OF '136



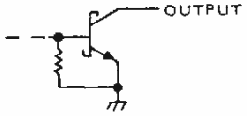

TYPICAL OF ALL OUTPUTS OF '136




EQUIVALENT OF EACH INPUT OF 'LS136




TYPICAL OF ALL OUTPUTS OF 'LS136




Resistor values shown are nominal.



TEXAS INSTRUMENTS
POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, $V_{CC}$ (see Note 1) . . . . . 7 V
Input voltage . . . . . 5.5 V
Operating free-air temperature range: SN54136 . . . . . −55°C to 125°C
SN74136 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

## recommended operating conditions

| | SN54136 | | | SN74136 | | | UNIT |
|---|---|---|---|---|---|---|---|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| Supply voltage, $V_{CC}$ | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| High-level input voltage, $V_{IH}$ | 2 | | | 2 | | | V |
| Low-level input voltage, $V_{IL}$ | | | 0.8 | | | 0.8 | V |
| High-level output voltage, $V_{OH}$ | | | 5.5 | | | 5.5 | V |
| Low-level output current, $I_{OL}$ | | | 16 | | | 16 | mA |
| Operating free-air temperature, $T_A$ | −55 | | 125 | 0 | | 70 | °C |

## electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | SN54136 | | | SN74136 | | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| $V_{IK}$ | $V_{CC}$ = MIN, $I_I$ = −8 mA | | | −1.5 | | | −1.5 | V |
| $I_{OH}$ | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = 0.8 V, $V_{OH}$ = 5.5 V | | | | | | 0.25 | mA |
| | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = 0.7 V, $V_{OH}$ = 5.5 V | | | 0.25 | | | | |
| $V_{OL}$ | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = 0.8 V, $I_{OL}$ = 16 mA | | 0.2 | 0.4 | | 0.2 | 0.4 | V |
| $I_I$ | $V_{CC}$ = MAX, $V_I$ = 5.5 V | | | 1 | | | 1 | mA |
| $I_{IH}$ | $V_{CC}$ = MAX, $V_I$ = 2.4 V | | | 40 | | | 40 | μA |
| $I_{IL}$ | $V_{CC}$ = MAX, $V_I$ = 0.4 V | | | −1.6 | | | −1.6 | mA |
| $I_{CC}$ | $V_{CC}$ = MAX, See Note 2 | | 30 | 43 | | 30 | 50 | mA |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
NOTE 2: $I_{CC}$ is measured with one input of each gate at 4.5 V, the other inputs grounded, and the outputs open.

## switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C

| PARAMETER¶ | FROM (INPUT) | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | A or B | Other input low | $C_L$ = 15 pF, $R_L$ = 400 Ω, See Note 3 | | 12 | 18 | ns |
| $t_{PHL}$ | | | | | 39 | 50 | |
| $t_{PLH}$ | A or B | Other input high | | | 14 | 22 | ns |
| $t_{PHL}$ | | | | | 42 | 55 | |

¶ $t_{PLH}$ propagation delay time, low-to-high-level output
$t_{PLH}$ propagation delay time, high-to-low-level output
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, $V_{CC}$ (see Note 1) . . . . . 7 V
Input voltage . . . . . 7 V
Operating free-air temperature range: SN54LS136 . . . . . −55°C to 125°C
SN74LS136 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

## recommended operating conditions

| | SN54LS136 | | | SN74LS136 | | | UNIT |
|---|---|---|---|---|---|---|---|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| Supply voltage, $V_{CC}$ | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| High-level output voltage, $V_{OH}$ | | | 5.5 | | | 5.5 | V |
| Low-level output current, $I_{OL}$ | | | 4 | | | 8 | mA |
| Operating free-air temperature, $T_A$ | −55 | | 125 | 0 | | 70 | °C |

## electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS† | | SN54LS136 | | | SN74LS136 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| $V_{IH}$ | High-level input voltage | | | 2 | | | 2 | | | V |
| $V_{IL}$ | Low-level input voltage | | | | | 0.7 | | | 0.8 | V |
| $V_{IK}$ | Input clamp voltage | $V_{CC}$ = MIN, | $I_I$ = −18 mA | | | −1.5 | | | −1.5 | V |
| $I_{OH}$ | High-level output current | $V_{CC}$ = MIN, $V_{IL}$ = $V_{IL}$ max, | $V_{IH}$ = 2 V, $V_{OH}$ = 5.5 V | | | 100 | | | 100 | μA |
| $V_{OL}$ | Low-level output voltage | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = $V_{IL}$ max | $I_{OL}$ = 4 mA | | 0.25 | 0.4 | | 0.25 | 0.4 | V |
| | | | $I_{OL}$ = 8 mA | | | | | 0.35 | 0.5 | |
| $I_I$ | Input current at maximum input voltage | $V_{CC}$ = MAX, | $V_I$ = 7 V | | | 0.2 | | | 0.2 | mA |
| $I_{IH}$ | High-level input current | $V_{CC}$ = MAX, | $V_I$ = 2.7 V | | | 40 | | | 40 | μA |
| $I_{IL}$ | Low-level input current | $V_{CC}$ = MAX, | $V_I$ = 0.4 V | | | −0.8 | | | −0.8 | mA |
| $I_{CC}$ | Supply current | $V_{CC}$ = MAX, | See Note 2 | | 6.1 | 10 | | 6.1 | 10 | mA |

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
‡All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
NOTE 2: $I_{CC}$ is measured with one input of each gate at 4.5 V, the other inputs grounded, and the outputs open.

## switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C

| PARAMETER¶ | FROM (INPUT) | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | A or B | Other input low | $C_L$ = 15 pF, $R_L$ = 2 kΩ, (See Note 3) | | 18 | 30 | ns |
| $t_{PHL}$ | | | | | 18 | 30 | |
| $t_{PLH}$ | A or B | Other input high | | | 18 | 30 | ns |
| $t_{PHL}$ | | | | | 18 | 30 | |

¶$t_{PLH}$ propagation delay time, low-to-high-level output
$t_{PLH}$ propagation delay time, high-to-low-level output
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

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