

## Absolute Maximum Ratings <br> Above which the useful life may be impaired

| If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications. |  | Operating Range |  | -5.7 V to -4.7 V |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Lead Temperature (Soldering, 10 sec.$)$ |  | $300^{\circ} \mathrm{C}$ |  |
|  |  |  |  |  |  |
| Storage Temperature | $-65^{\circ} \mathrm{C}$ to $+150^{\circ} \mathrm{C}$ | Recommended | era |  |  |
| Maximum Junction Temperature ( $\mathrm{T}_{\mathrm{J}}$ ) | $+150^{\circ} \mathrm{C}$ | Conditions |  |  |  |
| Supply Voltage Range | -7.0 V to GND |  | Min | Typ | Max |
| Input Voltage (DC) | $\mathrm{V}_{\mathrm{EE}}$ to GND | Supply Voltage ( $\mathrm{V}_{\mathrm{EE}}$ ) | -5.7V | -5.2V | -4.7V |
| Output Current (DC Output HIGH) | -50 mA | Ambient Temperature ( $\mathrm{T}_{\mathrm{A}}$ ) | $0^{\circ} \mathrm{C}$ |  | $+75^{\circ} \mathrm{C}$ |

## DC Electrical Characteristics

$\mathrm{V}_{\mathrm{EE}}=-5.2 \mathrm{~V}, \mathrm{~V}_{\mathrm{CC}}=\mathrm{GND}$

| Symbol | Parameter | Min | Typ | Max | Units | TA | Conditions |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{V}_{\mathrm{OH}}$ | Output Voltage HIGH | $\begin{gathered} -1000 \\ -960 \\ -900 \\ \hline \end{gathered}$ |  | $\begin{array}{r} -840 \\ -810 \\ -720 \\ \hline \end{array}$ | mV <br> mV <br> mV | $\begin{array}{r}  \\ 0^{\circ} \mathrm{C} \\ +25^{\circ} \mathrm{C} \\ +75^{\circ} \mathrm{C} \\ \hline \end{array}$ | $\mathrm{V}_{\mathrm{IN}}=\mathrm{V}_{\mathrm{IH}}$ (Max) or $\mathrm{V}_{\mathrm{IL}}$ (Min) per Truth Table Loading $50 \Omega$ to -2 V |
| $\mathrm{V}_{\mathrm{OL}}$ | Output Voltage LOW | $\begin{aligned} & -1870 \\ & -1850 \\ & -1830 \end{aligned}$ |  | $\begin{aligned} & -1635 \\ & -1620 \\ & -1595 \end{aligned}$ | $\begin{aligned} & \mathrm{mV} \\ & \mathrm{mV} \\ & \mathrm{mV} \end{aligned}$ | $\begin{gathered} 0^{\circ} \mathrm{C} \\ +25^{\circ} \mathrm{C} \\ +75^{\circ} \mathrm{C} \end{gathered}$ |  |
| $\mathrm{V}_{\text {OHC }}$ | Output Voltage HIGH | $\begin{gathered} -1020 \\ -980 \\ -920 \end{gathered}$ |  |  | $\begin{aligned} & \mathrm{mV} \\ & \mathrm{mV} \\ & \mathrm{mV} \end{aligned}$ | $\begin{gathered} 0^{\circ} \mathrm{C} \\ +25^{\circ} \mathrm{C} \\ +75^{\circ} \mathrm{C} \end{gathered}$ | $\mathrm{V}_{\mathrm{IN}}=\mathrm{V}_{\mathrm{IH}}$ (Min) or $\mathrm{V}_{\mathrm{IL}}$ (Max) for $\mathrm{D}_{\mathrm{n}}$ Inputs Loading $50 \Omega$ to -2 V |
| V OLC | Output Voltage LOW |  |  | $-1615$ <br> -1600 <br> $-1575$ | mV <br> mV <br> mV | $\begin{array}{r}  \\ 0^{\circ} \mathrm{C} \\ +25^{\circ} \mathrm{C} \\ +75^{\circ} \mathrm{C} \\ \hline \end{array}$ |  |
| $\mathrm{V}_{\mathrm{IH}}$ | Input Voltage HIGH | $\begin{aligned} & -1135 \\ & -1095 \\ & -1035 \end{aligned}$ |  | $\begin{aligned} & -840 \\ & -810 \\ & -720 \end{aligned}$ | $\begin{aligned} & \mathrm{mV} \\ & \mathrm{mV} \\ & \mathrm{mV} \end{aligned}$ | $\begin{gathered} 0^{\circ} \mathrm{C} \\ +25^{\circ} \mathrm{C} \\ +75^{\circ} \mathrm{C} \end{gathered}$ | Guaranteed Input Voltage HIGH for All Inputs |
| $\mathrm{V}_{\text {IL }}$ | Input Voltage LOW | $\begin{aligned} & -1870 \\ & -1850 \\ & -1830 \end{aligned}$ |  | $\begin{aligned} & -1500 \\ & -1485 \\ & -1460 \end{aligned}$ | $\begin{aligned} & \mathrm{mV} \\ & \mathrm{mV} \\ & \mathrm{mV} \end{aligned}$ | $\begin{gathered} 0^{\circ} \mathrm{C} \\ +25^{\circ} \mathrm{C} \\ +75^{\circ} \mathrm{C} \end{gathered}$ | Guaranteed Input Voltage LOW for All Inputs |
| $\mathrm{I}_{\mathrm{H}}$ | Input Current HIGH <br> Clock Input <br> Data Input |  |  | $\begin{aligned} & 250 \\ & 270 \end{aligned}$ | $\begin{aligned} & \mu \mathrm{A} \\ & \mu \mathrm{~A} \end{aligned}$ | $\begin{aligned} & +25^{\circ} \mathrm{C} \\ & +25^{\circ} \mathrm{C} \end{aligned}$ | $\mathrm{V}_{\mathrm{IN}}=\mathrm{V}_{\mathrm{IH}}(\mathrm{Max})$ |
| $\mathrm{I}_{\mathrm{IL}}$ | Input Current LOW | 0.5 |  |  | $\mu \mathrm{A}$ | $+25^{\circ} \mathrm{C}$ | $\mathrm{V}_{\mathrm{IN}}=\mathrm{V}_{\mathrm{IH}(\mathrm{Min})}$ |
| $\mathrm{I}_{\mathrm{EE}}$ | Power Supply Current | -59 | -40 |  | mA | $+25^{\circ} \mathrm{C}$ | All Inputs Open |

## AC Electrical Characteristics

$\mathrm{V}_{\mathrm{EE}}=-5.2 \mathrm{~V}, \mathrm{~V}_{\mathrm{CC}}=\mathrm{GND}, \mathrm{T}_{\mathrm{A}}=+25^{\circ} \mathrm{C}$

| Symbol | Parameter | Min | Typ | Max | Units | Conditions |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $t_{\text {PHL }}$ | Propagation Delay (CP-Q) | 0.7 | 1.0 | 1.2 | ns | See Figure 1 |
| $t_{\text {PLH }}$ | Propagation Delay (CP-Q) | 0.7 | 1.0 | 1.2 | ns |  |
| $\mathrm{t}_{\text {TLH }}$ | Transition Time 20\% to 80\% | 0.5 | 0.8 | 1.0 | ns |  |
| $\mathrm{t}_{\text {THL }}$ | Transition Time 80\% to 20\% | 0.5 | 0.8 | 1.0 | ns |  |
| ts | Set-up Time |  | 0.2 |  | ns |  |
| $\mathrm{t}_{\mathrm{H}}$ | Hold Time |  | 0.2 |  | ns |  |
| $\left.\mathrm{f}_{\text {TOG ( }} \mathrm{MAX}\right)$ | Toggle Frequency (CP) | 650 | 750 |  | MHz | See Figure 2, Note |

Note: The device is guaranteed for $\mathrm{f}_{\mathrm{TOG}}(\mathrm{CP}) \geq 600 \mathrm{MHz}, \mathrm{f}_{\mathrm{TOG}}(\mathrm{CE}) \geq 550 \mathrm{MHz}$ over the $0^{\circ} \mathrm{C}$ to $+75^{\circ} \mathrm{C}$ temperature range.

## Functional Description

While the clock is LOW, the slave is held steady and the information on the $D$ input is permitted to enter the master. The next transition from LOW to HIGH locks the master in its present state making it insensitive to the D input. This transition simultaneously connects the slave to the master causing the new information to appear on the outputs. Master and slave clock thresholds are internally offset in opposite directions to avoid race conditions or simultaneous
master-slave changes when the clock has slow rise or fall times.
The CP and $\overline{\mathrm{CE}}$ inputs are logically identical, but physical constraints associated with the Dual-In-Line package make the $\overline{\mathrm{CE}}$ input slower at the upper end of the toggle range. To prevent new data from entering the master on the next CP LOW cycle, $\overline{\mathrm{CE}}$ should go HIGH while CP is still HIGH.

$L_{1}=50 \Omega$ impedance lines
All input transition times are $2.0 \mathrm{~ns} \pm 0.2 \mathrm{~ns}$
FIGURE 1. Propagation Delay (CP to Q)


[^0]Adjust $\mathrm{V}_{\text {BIAS }}$ for +0.7 V baseline of
800 mV peak-to-peak sinewave input
All input transition times are $2.0 \mathrm{~ns} \pm 0.2 \mathrm{~ns}$
FIGURE 2. Toggle Frequency Test Circuit

## Typical Waveforms



## Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:



Physical Dimensions inches (millimeters) (Continued)


16 Lead Ceramic Flatpak (F)
NS Package Number W16A

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[^0]:    $R_{T}=50 \Omega$ termination of scope
    $L_{1}=50 \Omega$ impedance lines

