

## CD40174BM/CD40174BC Hex D Flip-Flop CD40175BM/CD40175BC Quad D Flip-Flop

### General Description

The CD40174B consists of six positive-edge triggered D-type flip-flops; the true outputs from each flip-flop are externally available. The CD40175B consists of four positive-edge triggered D-type flip-flops; both the true and complement outputs from each flip-flop are externally available.

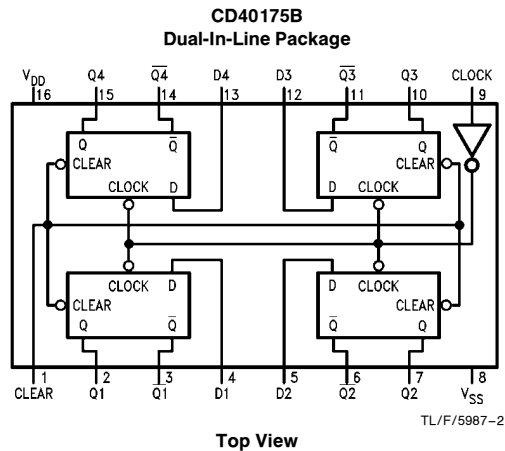
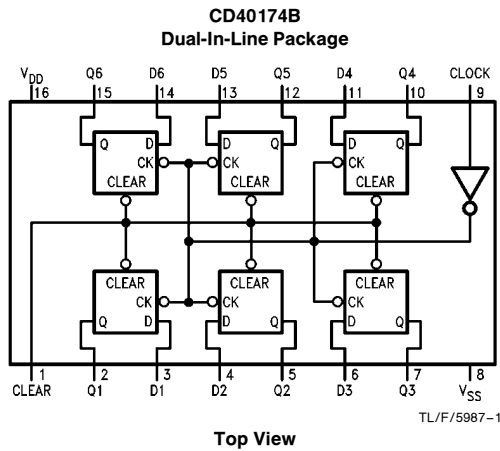
All flip-flops are controlled by a common clock and a common clear. Information at the D inputs meeting the set-up time requirements is transferred to the Q outputs on the positive-going edge of the clock pulse. The clearing operation, enabled by a negative pulse at Clear input, clears all Q outputs to logical "0" and Qs (CD40175B only) to logical "1".

All inputs are protected from static discharge by diode clamps to  $V_{DD}$  and  $V_{SS}$ .

### Features

- Wide supply voltage range 3V to 15V
- High noise immunity 0.45  $V_{DD}$  (typ.)
- Low power TTL fan out of 2 driving 74L compatibility or 1 driving 74 LS
- Equivalent to MC14174B, MC14175B
- Equivalent to MM74C174, MM74C175

### Connection Diagrams



Order Number CD40174B or CD40175B

### Truth Table

| Inputs |            |   | Outputs |             |
|--------|------------|---|---------|-------------|
| Clear  | Clock      | D | Q       | $\bar{Q}^*$ |
| L      | X          | X | L       | H           |
| H      | $\uparrow$ | H | H       | L           |
| H      | $\uparrow$ | L | L       | H           |
| H      | H          | X | NC      | NC          |
| H      | L          | X | NC      | NC          |

H = High level  
L = Low level  
X = Irrelevant  
 $\uparrow$  = Transition from low to high level  
NC = No change  
\* =  $\bar{Q}$  for CD40175B only

CD40174BM/CD40174BC Hex D Flip-Flop  
CD40175BM/CD40175BC Quad D Flip-Flop

**Absolute Maximum Ratings** (Notes 1 & 2)

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

|                                     |                                        |
|-------------------------------------|----------------------------------------|
| DC Supply Voltage ( $V_{DD}$ )      | –0.5V to +18V                          |
| Input Voltage ( $V_{IN}$ )          | –0.5V to $V_{DD}$ + 0.5V <sub>DC</sub> |
| Storage Temperature Range ( $T_S$ ) | –65°C to +150°C                        |
| Power Dissipation ( $P_D$ )         |                                        |
| Dual-In-Line                        | 700 mW                                 |
| Small Outline                       | 500 mW                                 |
| Lead Temperature ( $T_L$ )          |                                        |
| (Soldering, 10 seconds)             | 260°C                                  |

**Recommended Operating Conditions** (Note 2)

|                                       |                                |
|---------------------------------------|--------------------------------|
| DC Supply Voltage ( $V_{DD}$ )        | 3V to 15 V <sub>DC</sub>       |
| Input Voltage ( $V_{IN}$ )            | 0V to $V_{DD}$ V <sub>DC</sub> |
| Operating Temperature Range ( $T_A$ ) | –55°C to +125°C                |
| CD40XXXBM                             | –40°C to +85°C                 |
| CD40XXXBC                             |                                |

**DC Electrical Characteristics** CD40174BM/CD40175BM (Note 2)

| Symbol   | Parameter                             | Conditions                                  | –55°C |      | +25°C |            |      | +125°C |      | Units   |
|----------|---------------------------------------|---------------------------------------------|-------|------|-------|------------|------|--------|------|---------|
|          |                                       |                                             | Min   | Max  | Min   | Typ        | Max  | Min    | Max  |         |
| $I_{DD}$ | Quiescent Device Current              | $V_{DD} = 5V, V_{IN} = V_{DD}$ or $V_{SS}$  |       | 1.0  |       |            | 1.0  |        | 30   | $\mu A$ |
|          |                                       | $V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$ |       | 2.0  |       |            | 2.0  |        | 60   | $\mu A$ |
|          |                                       | $V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$ |       | 4.0  |       |            | 4.0  |        | 120  | $\mu A$ |
| $V_{OL}$ | Low Level Output Voltage              | $ I_O  < 1 \mu A$                           |       |      |       |            |      |        |      |         |
|          |                                       | $V_{DD} = 5V$                               |       | 0.05 |       |            | 0.05 |        | 0.05 | V       |
|          |                                       | $V_{DD} = 10V$                              |       | 0.05 |       |            | 0.05 |        | 0.05 | V       |
| $V_{OH}$ | High Level Output Voltage             | $ I_O  < 1 \mu A$                           |       |      |       |            |      |        |      |         |
|          |                                       | $V_{DD} = 5V$                               | 4.95  |      | 4.95  | 5          |      | 4.95   |      | V       |
|          |                                       | $V_{DD} = 10V$                              | 9.95  |      | 9.95  | 10         |      | 9.95   |      | V       |
| $V_{IL}$ | Low Level Input Voltage               | $V_{DD} = 5V, V_O = 0.5V$ or 4.5V           |       | 1.5  |       |            | 1.5  |        | 1.5  | V       |
|          |                                       | $V_{DD} = 10V, V_O = 1V$ or 9V              |       | 3.0  |       |            | 3.0  |        | 3.0  | V       |
|          |                                       | $V_{DD} = 15V, V_O = 1.5V$ or 13.5V         |       | 4.0  |       |            | 4.0  |        | 4.0  | V       |
| $V_{IH}$ | High Level Input Voltage              | $V_{DD} = 5V, V_O = 0.5V$ or 4.5V           | 3.5   |      | 3.5   |            |      | 3.5    |      | V       |
|          |                                       | $V_{DD} = 10V, V_O = 1V$ or 9V              | 7.0   |      | 7.0   |            |      | 7.0    |      | V       |
|          |                                       | $V_{DD} = 15V, V_O = 1.5V$ or 13.5V         | 11.0  |      | 11.0  |            |      | 11.0   |      | V       |
| $I_{OL}$ | Low Level Output Current<br>(Note 3)  | $V_{DD} = 5V, V_O = 0.4V$                   | 0.64  |      | 0.51  | 0.88       |      | 0.36   |      | mA      |
|          |                                       | $V_{DD} = 10V, V_O = 0.5V$                  | 1.6   |      | 1.3   | 2.25       |      | 0.9    |      | mA      |
|          |                                       | $V_{DD} = 15V, V_O = 1.5V$                  | 4.2   |      | 3.4   | 8.8        |      | 2.4    |      | mA      |
| $I_{OH}$ | High Level Output Current<br>(Note 3) | $V_{DD} = 5V, V_O = 4.6V$                   | –0.64 |      | –0.51 | –0.88      |      | –0.36  |      | mA      |
|          |                                       | $V_{DD} = 10V, V_O = 9.5V$                  | –1.6  |      | –1.3  | –2.25      |      | –0.9   |      | mA      |
|          |                                       | $V_{DD} = 15V, V_O = 13.5V$                 | –4.2  |      | –3.4  | –8.8       |      | –2.4   |      | mA      |
| $I_{IN}$ | Input Current                         | $V_{DD} = 15V, V_{IN} = 0V$                 |       | –0.1 |       | $-10^{-5}$ | –0.1 |        | –1.0 | $\mu A$ |
|          |                                       | $V_{DD} = 15V, V_{IN} = 15V$                |       | 0.1  |       | $10^{-5}$  | 0.1  |        | 1.0  | $\mu A$ |

**DC Electrical Characteristics** CD40174BC/CD40175BC (Note 2)

| Symbol   | Parameter                | Conditions                                  | –40°C |     | +25°C |     |     | +85°C |     | Units   |
|----------|--------------------------|---------------------------------------------|-------|-----|-------|-----|-----|-------|-----|---------|
|          |                          |                                             | Min   | Max | Min   | Typ | Max | Min   | Max |         |
| $I_{DD}$ | Quiescent Device Current | $V_{DD} = 5V, V_{IN} = V_{DD}$ or $V_{SS}$  |       | 4   |       |     | 4   |       | 30  | $\mu A$ |
|          |                          | $V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$ |       | 8   |       |     | 8   |       | 60  | $\mu A$ |
|          |                          | $V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$ |       | 16  |       |     | 16  |       | 120 | $\mu A$ |

**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 devices should be operated at these limits. The tables of “Recommended Operating Conditions” and “Electrical Characteristics” provide conditions for actual device operation.

**Note 2:**  $V_{SS} = 0V$  unless otherwise specified.

**Note 3:**  $I_{OH}$  and  $I_{OL}$  are tested one output at a time.

## DC Electrical Characteristics CD40174BC/CD40175BC (Note 2) (Continued)

| Symbol          | Parameter                             | Conditions                                            | −40°C |       | +25°C |                   |       | +85°C |      | Units |
|-----------------|---------------------------------------|-------------------------------------------------------|-------|-------|-------|-------------------|-------|-------|------|-------|
|                 |                                       |                                                       | Min   | Max   | Min   | Typ               | Max   | Min   | Max  |       |
| V <sub>OL</sub> | Low Level Output Voltage              | V <sub>DD</sub> = 5V                                  |       | 0.05  |       |                   | 0.05  |       | 0.05 | V     |
|                 |                                       | V <sub>DD</sub> = 10V                                 |       | 0.05  |       |                   | 0.05  |       | 0.05 | V     |
|                 |                                       | V <sub>DD</sub> = 15V                                 |       | 0.05  |       |                   | 0.05  |       | 0.05 | V     |
| V <sub>OH</sub> | High Level Output Voltage             | V <sub>DD</sub> = 5V                                  | 4.95  |       | 4.95  | 5                 |       | 4.95  |      | V     |
|                 |                                       | V <sub>DD</sub> = 10V                                 | 9.95  |       | 9.95  | 10                |       | 9.95  |      | V     |
|                 |                                       | V <sub>DD</sub> = 15V                                 | 14.95 |       | 14.95 | 15                |       | 14.95 |      | V     |
| V <sub>IL</sub> | Low Level Input Voltage               | V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.5V or 4.5V   |       | 1.5   |       |                   | 1.5   |       | 1.5  | V     |
|                 |                                       | V <sub>DD</sub> = 10V, V <sub>O</sub> = 1V or 9V      |       | 3.0   |       |                   | 3.0   |       | 3.0  | V     |
|                 |                                       | V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V or 13.5V |       | 4.0   |       |                   | 4.0   |       | 4.0  | V     |
| V <sub>IH</sub> | High Level Input Voltage              | V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.5V or 4.5V   | 3.5   |       | 3.5   |                   |       | 3.5   |      | V     |
|                 |                                       | V <sub>DD</sub> = 10V, V <sub>O</sub> = 1V or 9V      | 7.0   |       | 7.0   |                   |       | 7.0   |      | V     |
|                 |                                       | V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V or 13.5V | 11.0  |       | 11.0  |                   |       | 11.0  |      | V     |
| I <sub>OL</sub> | Low Level Output Current<br>(Note 3)  | V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.4V           | 0.52  |       | 0.44  | 0.88              |       | 0.36  |      | mA    |
|                 |                                       | V <sub>DD</sub> = 10V, V <sub>O</sub> = 0.5V          | 1.3   |       | 1.1   | 2.25              |       | 0.9   |      | mA    |
|                 |                                       | V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V          | 3.6   |       | 3.0   | 8.8               |       | 2.4   |      | mA    |
| I <sub>OH</sub> | High Level Output Current<br>(Note 3) | V <sub>DD</sub> = 5V, V <sub>O</sub> = 4.6V           | −0.52 |       | −0.44 | −0.88             |       | −0.36 |      | mA    |
|                 |                                       | V <sub>DD</sub> = 10V, V <sub>O</sub> = 9.5V          | −1.3  |       | −1.1  | −2.25             |       | −0.9  |      | mA    |
|                 |                                       | V <sub>DD</sub> = 15V, V <sub>O</sub> = 13.5V         | −3.6  |       | −3.0  | −8.8              |       | −2.4  |      | mA    |
| I <sub>IN</sub> | Input Current                         | V <sub>DD</sub> = 15V, V <sub>IN</sub> = 0V           |       | −0.30 |       | −10 <sup>−5</sup> | −0.30 |       | −1.0 | μA    |
|                 |                                       | V <sub>DD</sub> = 15V, V <sub>IN</sub> = 15V          |       | 0.30  |       | 10 <sup>−5</sup>  | 0.30  |       | 1.0  | μA    |

## AC Electrical Characteristics\*

T<sub>A</sub> = 25°C, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 200k and t<sub>r</sub> = t<sub>f</sub> = 20 ns, unless otherwise specified

| Symbol                              | Parameter                                                                                          | Conditions            | Min | Typ | Max | Units |
|-------------------------------------|----------------------------------------------------------------------------------------------------|-----------------------|-----|-----|-----|-------|
| t <sub>PHL</sub> , t <sub>PLH</sub> | Propagation Delay Time to a Logical “0” or Logical “1” from Clock to Q or $\bar{Q}$ (CD40175 Only) | V <sub>DD</sub> = 5V  |     | 190 | 300 | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 10V |     | 75  | 110 | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 15V |     | 60  | 90  | ns    |
| t <sub>PHL</sub>                    | Propagation Delay Time to a Logical “0” from Clear to Q                                            | V <sub>DD</sub> = 5V  |     | 180 | 300 | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 10V |     | 70  | 110 | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 15V |     | 60  | 90  | ns    |
| t <sub>PLH</sub>                    | Propagation Delay Time to a Logical “1” from Clear to $\bar{Q}$ (CD40175 Only)                     | V <sub>DD</sub> = 5V  |     | 230 | 400 | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 10V |     | 90  | 150 | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 15V |     | 75  | 120 | ns    |
| t <sub>SU</sub>                     | Time Prior to Clock Pulse that Data must be Present                                                | V <sub>DD</sub> = 5V  |     | 45  | 100 | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 10V |     | 15  | 40  | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 15V |     | 13  | 35  | ns    |
| t <sub>H</sub>                      | Time after Clock Pulse that Data Must be Held                                                      | V <sub>DD</sub> = 5V  |     | −11 | 0   | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 10V |     | −4  | 0   | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 15V |     | −3  | 0   | ns    |
| t <sub>THL</sub> , t <sub>TLH</sub> | Transition Time                                                                                    | V <sub>DD</sub> = 5V  |     | 100 | 200 | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 10V |     | 50  | 100 | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 15V |     | 40  | 80  | ns    |
| t <sub>WH</sub> , t <sub>WL</sub>   | Minimum Clock Pulse Width                                                                          | V <sub>DD</sub> = 5V  |     | 130 | 250 | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 10V |     | 45  | 100 | ns    |
|                                     |                                                                                                    | V <sub>DD</sub> = 15V |     | 40  | 80  | ns    |

## AC Electrical Characteristics\*

$T_A = 25^\circ\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$  and  $t_r = t_f = 20\text{ ns}$ , unless otherwise specified (Continued)

| Symbol    | Parameter                 | Conditions                                                             | Min               | Typ             | Max              | Units                                           |
|-----------|---------------------------|------------------------------------------------------------------------|-------------------|-----------------|------------------|-------------------------------------------------|
| $t_{WL}$  | Minimum Clear Pulse Width | $V_{DD} = 5\text{V}$<br>$V_{DD} = 10\text{V}$<br>$V_{DD} = 15\text{V}$ |                   | 120<br>45<br>40 | 250<br>100<br>80 | ns<br>ns<br>ns                                  |
| $t_{RCL}$ | Maximum Clock Rise Time   | $V_{DD} = 5\text{V}$<br>$V_{DD} = 10\text{V}$<br>$V_{DD} = 15\text{V}$ | 15<br>5.0<br>5.0  |                 |                  | $\mu\text{s}$<br>$\mu\text{s}$<br>$\mu\text{s}$ |
| $t_{fCL}$ | Maximum Clock Fall Time   | $V_{DD} = 5\text{V}$<br>$V_{DD} = 10\text{V}$<br>$V_{DD} = 15\text{V}$ | 15<br>5.0<br>5.0  | 50<br>50<br>50  |                  | $\mu\text{s}$<br>$\mu\text{s}$<br>$\mu\text{s}$ |
| $f_{CL}$  | Maximum Clock Frequency   | $V_{DD} = 5\text{V}$<br>$V_{DD} = 10\text{V}$<br>$V_{DD} = 15\text{V}$ | 2.0<br>5.0<br>6.0 | 3.5<br>10<br>12 |                  | MHz<br>MHz<br>MHz                               |
| $C_{IN}$  | Input Capacitance         | Clear Input<br>Other Input                                             |                   | 10<br>5.0       | 15<br>7.5        | pF<br>pF                                        |
| $C_{PD}$  | Power Dissipation         | Per Package (Note 4)                                                   |                   | 130             |                  | pF                                              |

\*AC Parameters are guaranteed by DC correlated testing.

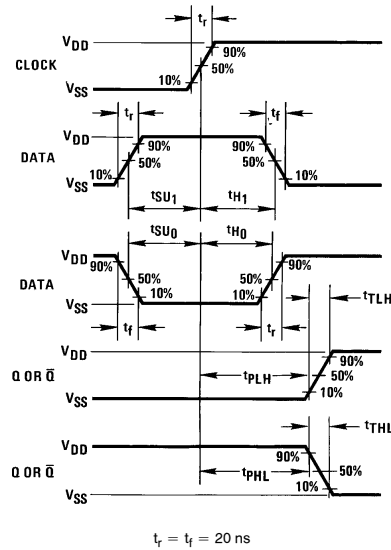
**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Recommended Operating Conditions" and "Electrical Characteristics" provide conditions for actual device operation.

**Note 2:**  $V_{SS} = 0\text{V}$  unless otherwise specified.

**Note 3:**  $I_{OH}$  and  $I_{OL}$  are tested one output at a time.

**Note 4:**  $C_{PD}$  determines the no load AC power consumption of any CMOS device. For complete explanation, see 54C/74C Family Characteristics application note, AN-90.

## Switching Time Waveforms



TL/F/5987-3

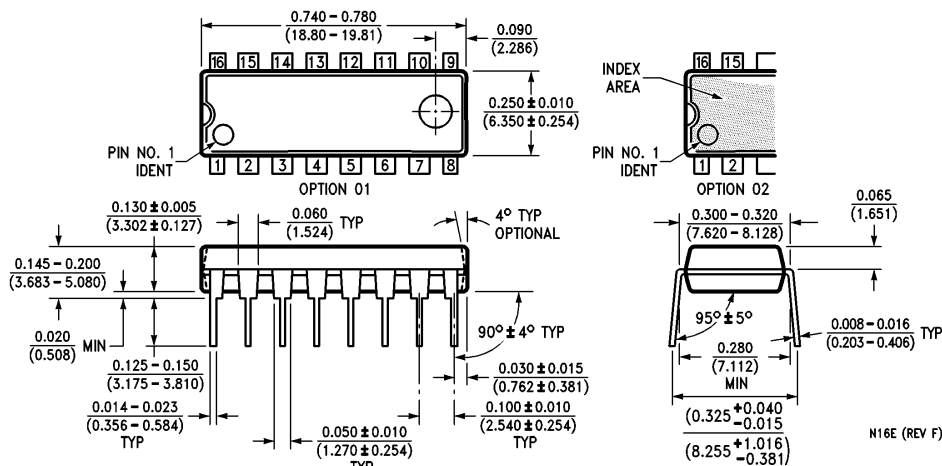
The drawing consists of three views of the J16A (REV L) component:

- Top View:** Shows a rectangular component with 16 pins. Dimensions include a total width of 0.785 [19.94] MAX, a pin pitch of 0.037 ± 0.005 [0.94 ± 0.13] TYP, and a pin diameter of 0.025 [0.64]. The component has a thickness of 0.220-0.310 [5.59-7.87] and a corner radius of R 0.005-0.020 [0.13-0.51] TYP.
- Side View:** Shows the component's profile with a height of 0.290-0.320 [7.37-8.13]. It features a glass sealant layer and a base with a thickness of 0.180 MAX [4.57]. The base has a width of 0.310-0.410 [7.87-10.41] and a 95° ± 5° TYP angle.
- End View:** Shows the component's end profile with a height of 0.200 [5.08] MAX TYP and a base thickness of 0.100 ± 0.010 [2.54 ± 0.25] TYP. The base has a width of 0.125-0.200 [3.18-5.08] TYP and a 90° ± 4° TYP angle.

J16A (REV L)

J16A (REV L)

## Physical Dimensions inches (millimeters) (Continued)



### Molded Dual-In-Line Package (N)

Order Number CD40174BMN, CD40174BCN, CD40174BMN or CD40175BCN

NS Package Number N16E

## LIFE SUPPORT POLICY

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



**National Semiconductor Corporation**  
1111 West Bardin Road  
Arlington, TX 76017  
Tel: 1(800) 272-9959  
Fax: 1(800) 737-7018

**National Semiconductor Europe**  
Fax: (+49) 0-180-530 85 86  
Email: onjwge@tevm2.nsc.com  
Deutsch Tel: (+49) 0-180-530 85 85  
English Tel: (+49) 0-180-532 78 32  
Français Tel: (+49) 0-180-532 93 58  
Italiano Tel: (+49) 0-180-534 16 80

**National Semiconductor Hong Kong Ltd.**  
13th Floor, Straight Block,  
Ocean Centre, 5 Canton Rd.  
Tsimshatsui, Kowloon  
Hong Kong  
Tel: (852) 2737-1600  
Fax: (852) 2736-9960

**National Semiconductor Japan Ltd.**  
Tel: 81-043-299-2309  
Fax: 81-043-299-2408

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