

## CMOS Expandable 4-Wide 2-Input AND-OR-INVERT Gate

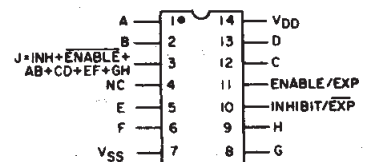
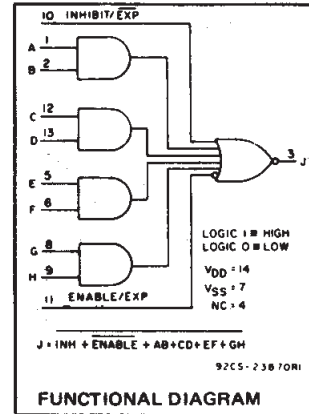
High-Voltage Types (20-Volt Rating)

■ CD4086B contains one 4-wide 2-input AND-OR-INVERT gate with an INHIBIT/EXP input and an ENABLE/EXP input. For a 4-wide A-O-I function INHIBIT/EXP is tied to V<sub>SS</sub> and ENABLE/EXP to V<sub>DD</sub>. See Fig.10 and its associated explanation for applications where a capability greater than 4-wide is required.

The CD4086B types are supplied in 14-lead hermetic dual-in-line ceramic packages (F3A suffix), 14-lead dual-in-line plastic packages (E suffix), 14-lead small-outline packages (M, MT, M96, and NSR suffixes), and 14-lead thin shrink small-outline packages (PW and PWR suffixes).

### Features:

- Medium-speed operation – t<sub>pHL</sub> = 90 ns; t<sub>pLH</sub> = 140 ns (typ.) at 10 V
- INHIBIT and ENABLE inputs
- Buffered outputs
- 100% tested for quiescent current at 20 V
- Maximum input leakage current of 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- Noise margin (over full package temperature range):
  - 1 V at V<sub>DD</sub> = 5 V
  - 2 V at V<sub>DD</sub> = 10 V
  - 2.5 V at V<sub>DD</sub> = 15 V
- Standardized, symmetrical output characteristics
- 5-V, 10-V, and 15-V parametric ratings
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"



Top View  
TERMINAL ASSIGNMENT

### MAXIMUM RATINGS, Absolute-Maximum Values:

|   |  |                                     |
|---|--|-------------------------------------|
| DC SUPPLY-VOLTAGE RANGE, (V <sub>DD</sub> )                             |  |                                     |
| Voltages referenced to V <sub>SS</sub> Terminal)                        |  | -0.5V to +20V                       |
| INPUT VOLTAGE RANGE, ALL INPUTS   |  | -0.5V to V <sub>DD</sub> + 0.5V     |
| DC INPUT CURRENT, ANY ONE INPUT   |  | ±10mA                               |
| POWER DISSIPATION PER PACKAGE (P <sub>D</sub> ):                        |  |                                     |
| For T <sub>A</sub> = -55°C to +100°C                                    |  | 500mW                               |
| For T <sub>A</sub> = +100°C to +125°C                                   |  | Derate Linearly at 12mW/°C to 200mW |
| DEVICE DISSIPATION PER OUTPUT TRANSISTOR                                |  |                                     |
| FOR T <sub>A</sub> = FULL PACKAGE-TEMPERATURE RANGE (All Package Types) |  | 100mW                               |
| OPERATING-TEMPERATURE RANGE (T <sub>A</sub> )                           |  | -55°C to +125°C                     |
| STORAGE TEMPERATURE RANGE (T <sub>stg</sub> )                           |  | -65°C to +150°C                     |
| LEAD TEMPERATURE (DURING SOLDERING):                                    |  |                                     |
| At distance 1/16 ± 1/32 Inch (1.59 ± 0.79mm) from case for 10s max      |  | +265°C                              |

### RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

| CHARACTERISTIC   | LIMITS |      | UNITS |
|--|--------|------|-------|
|  | MIN.   | MAX. |       |
| Supply-Voltage Range (For T <sub>A</sub> = Full Package-Temperature Range) | 3      | 18   | V     |

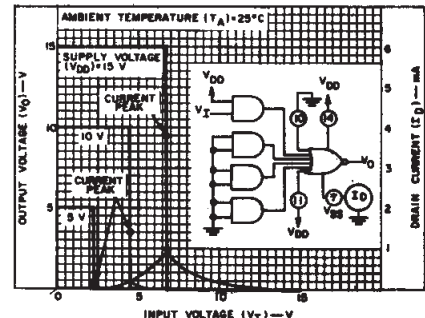


Fig. 1 – Typical voltage and current transfer characteristics.

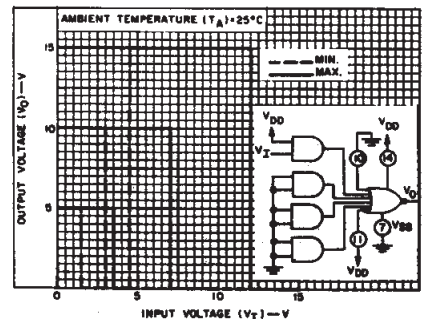


Fig. 2 – Minimum and maximum voltage transfer characteristics.

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# CD4086B Types

## STATIC ELECTRICAL CHARACTERISTICS

| CHARACTERISTIC                                     | CONDITIONS            |                        |                        | LIMITS AT INDICATED TEMPERATURES (°C) |       |       |       |       |                   |      | UNITS |
|--|-----------------------|------------------------|------------------------|---------------------------------------|-------|-------|-------|-------|-------------------|------|-------|
|  | V <sub>O</sub><br>(V) | V <sub>IN</sub><br>(V) | V <sub>DD</sub><br>(V) | -55                                   | -40   | +85   | +125  | +25   |                   |      |       |
|  |                       |                        |                        |                                       |       |       |       | Min.  | Typ.              | Max. |       |
| Quiescent Device Current I <sub>DD</sub> Max.      | —                     | 0.5                    | 5                      | 1                                     | 1     | 30    | 30    | —     | 0.02              | 1    | μA    |
|  | —                     | 0.10                   | 10                     | 2                                     | 2     | 60    | 60    | —     | 0.02              | 2    |       |
|  | —                     | 0.15                   | 15                     | 4                                     | 4     | 120   | 120   | —     | 0.02              | 4    |       |
| Output Low (Sink) Current, I <sub>OL</sub> Min.    | 0.4                   | 0.5                    | 5                      | 0.64                                  | 0.61  | 0.42  | 0.36  | 0.51  | 1                 | —    | mA    |
|  | 0.5                   | 0.10                   | 10                     | 1.6                                   | 1.5   | 1.1   | 0.9   | 1.3   | 2.6               | —    |       |
|  | 1.5                   | 0.15                   | 15                     | 4.2                                   | 4     | 2.8   | 2.4   | 3.4   | 6.8               | —    |       |
| Output High (Source) Current, I <sub>OH</sub> Min. | 4.6                   | 0.5                    | 5                      | -0.64                                 | -0.61 | -0.42 | -0.36 | -0.51 | -1                | —    | mA    |
|  | 2.5                   | 0.5                    | 5                      | -2                                    | -1.8  | -1.3  | -1.15 | -1.6  | -3.2              | —    |       |
|  | 9.5                   | 0.10                   | 10                     | -1.6                                  | -1.5  | -1.1  | -0.9  | -1.3  | -2.6              | —    |       |
| Output Voltage: Low-Level, V <sub>OL</sub> Max.    | —                     | 0.5                    | 5                      | 0.05                                  |       |       | —     |       |                   | 0    | V     |
|  | —                     | 0.10                   | 10                     | 0.05                                  |       |       | —     |       |                   | 0    |       |
|  | —                     | 0.15                   | 15                     | 0.05                                  |       |       | —     |       |                   | 0    |       |
| Output Voltage: High-Level, V <sub>OH</sub> Min.   | —                     | 0.5                    | 5                      | 4.95                                  |       |       | 4.95  |       |                   | 5    | V     |
|  | —                     | 0.10                   | 10                     | 9.95                                  |       |       | 9.95  |       |                   | 10   |       |
|  | —                     | 0.15                   | 15                     | 14.95                                 |       |       | 14.95 |       |                   | 15   |       |
| Input Low Voltage, V <sub>IL</sub> Max.            | 0.5, 4.5              | —                      | 5                      | 1.5                                   |       |       | —     |       |                   | 1.5  | V     |
|  | 1.9                   | —                      | 10                     | 3                                     |       |       | —     |       |                   | 3    |       |
|  | 1.5, 13.5             | —                      | 15                     | 4                                     |       |       | —     |       |                   | 4    |       |
| Input High Voltage, V <sub>IH</sub> Min.           | 0.5, 4.5              | —                      | 5                      | 3.5                                   |       |       | 3.5   |       |                   | —    | V     |
|  | 1.9                   | —                      | 10                     | 7                                     |       |       | 7     |       |                   | —    |       |
|  | 1.5, 13.5             | —                      | 15                     | 11                                    |       |       | 11    |       |                   | —    |       |
| Input Current, I <sub>IN</sub> Max.                | —                     | 0.18                   | 18                     | ±0.1                                  | ±0.1  | ±1    | ±1    | —     | ±10 <sup>-5</sup> | ±0.1 | μA    |

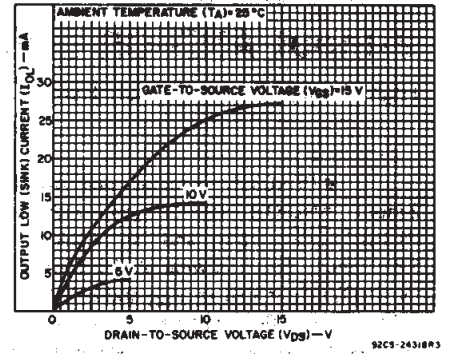


Fig. 3 — Typical output low (sink) current characteristics.

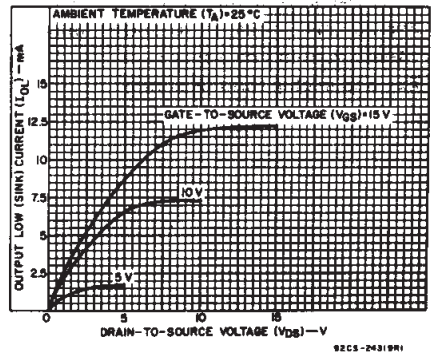


Fig. 4 — Minimum output low (sink) current characteristics.

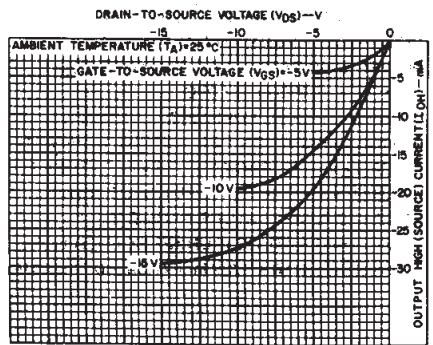


Fig. 5 — Typical output high (source) current characteristics.

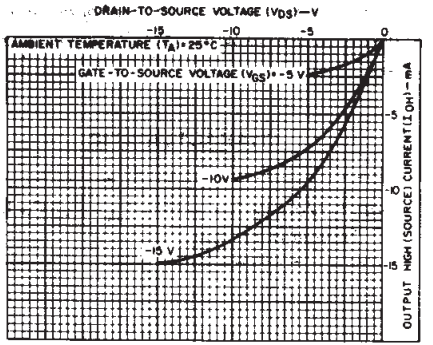


Fig. 8 — Minimum output high (source) current characteristics.

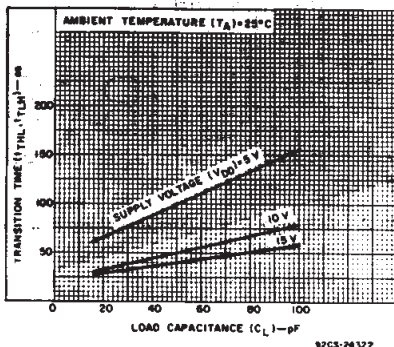


Fig. 6 — Typical transition time vs. load capacitance.

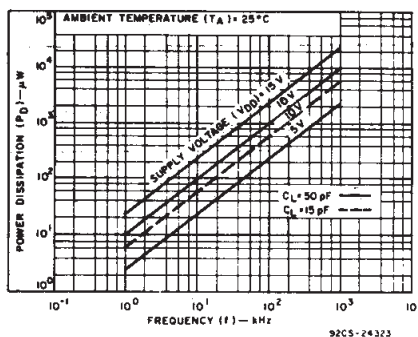


Fig. 7 — Typical power dissipation vs. frequency.

# CD4086B Types

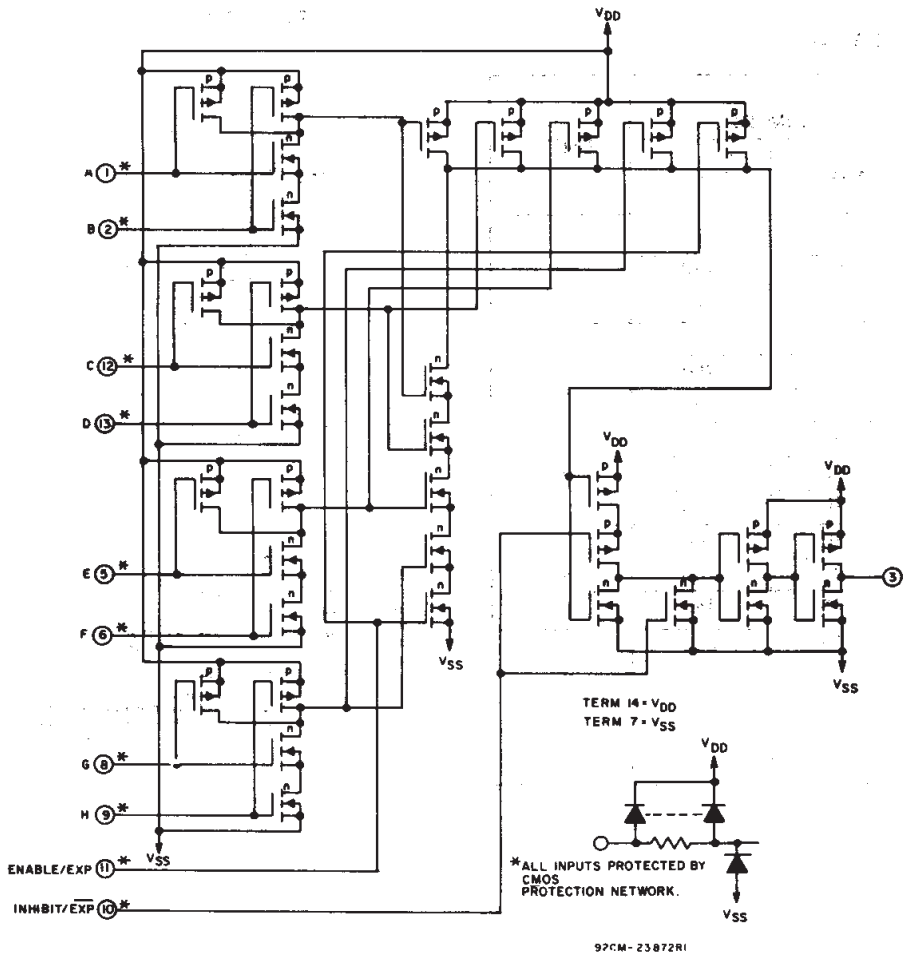


Fig. 9 - CD4086B schematic diagram.

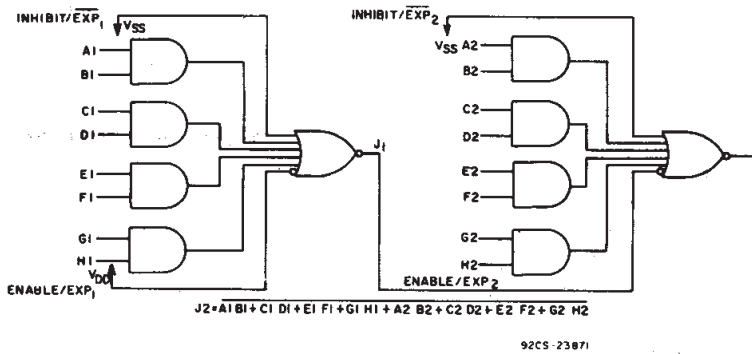


Fig. 10 - Two CD4086's connected as an 8-wide 2-input A-O-I gate.

Fig. 10 above shows two CD4086's utilized to obtain an 8-wide 2-input A-O-I function. The output (J1) of one CD4086 is fed directly to the ENABLE/EXP2 line of the second CD4086. In a similar fashion, any

NAND gate output can be fed directly into the ENABLE/EXP input to obtain a 5-wide A-O-I function. In addition, any AND gate output can be fed directly into the INHIBIT/EXP input with the same result.

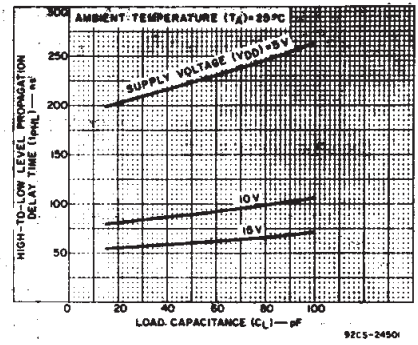


Fig. 11 - Typical DATA or ENABLE high-to-low level propagation delay time vs. load capacitance.

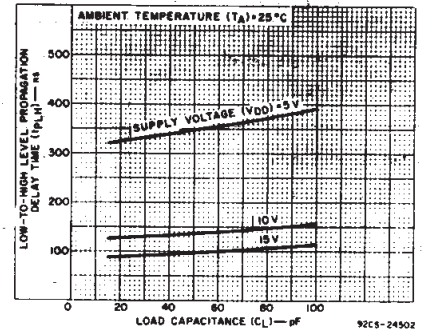


Fig. 12 - Typical DATA or ENABLE low-to-high level propagation delay time vs. load capacitance.

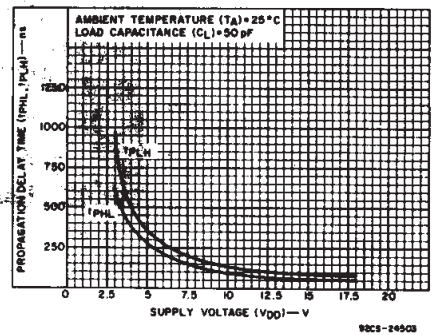


Fig. 13 - Typical DATA or ENABLE propagation delay time vs. supply voltage.

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# CD4086B Types

## DYNAMIC ELECTRICAL CHARACTERISTICS

At  $T_A = 25^\circ\text{C}$ ; Input  $t_r, t_f = 20\text{ ns}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$

| CHARACTERISTIC  | CONDITIONS | LIMITS       |      | UNITS |      |
|---|------------|--------------|------|-------|------|
|   |            | $V_{DD}$ (V) | TYP. |       | MAX. |
| Propagation Delay Time (Data):<br>High-to-Low Level, $t_{pHL}$      |            | 5            | 225  | 450   | ns   |
|   |            | 10           | 90   | 180   |      |
|   |            | 15           | 60   | 120   |      |
| Low-to-High Level, $t_{pLH}$  |            | 5            | 310  | 620   | ns   |
|   |            | 10           | 125  | 250   |      |
|   |            | 15           | 90   | 180   |      |
| Propagation Delay Time (Inhibit): High-to-Low Level, $t_{pHL(INH)}$ |            | 5            | 150  | 300   | ns   |
|   |            | 10           | 60   | 120   |      |
|   |            | 15           | 40   | 80    |      |
| Low-to-High Level, $t_{pLH(INH)}$                                   |            | 5            | 250  | 500   | ns   |
|   |            | 10           | 100  | 200   |      |
|   |            | 15           | 70   | 140   |      |
| Transition Time, $t_{THL}, t_{TLH}$                                 |            | 5            | 100  | 200   | ns   |
|   |            | 10           | 50   | 100   |      |
|   |            | 15           | 40   | 80    |      |
| Input Capacitance $C_{iN}$  | Any Input  |              | 5    | 7.5   | pF   |

## TEST CIRCUITS

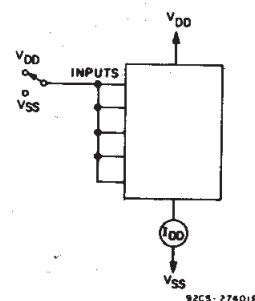


Fig. 14 - Quiescent device current.

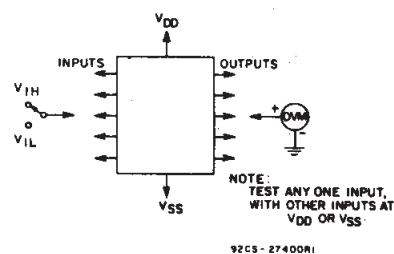
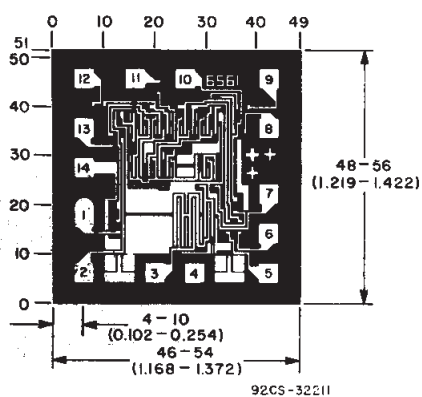


Fig. 15 - Input voltage.



Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils ( $10^{-3}$  inch).

## Dimensions and Pad Layout for the CD4086BH

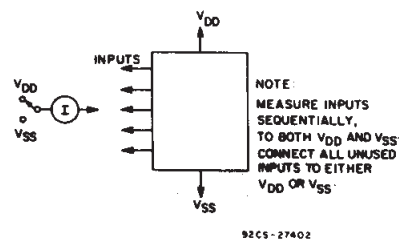


Fig. 16 - Input leakage current.

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| Microcontrollers      | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a> | Security            | <a href="http://www.ti.com/security">www.ti.com/security</a>             |
| Low Power<br>Wireless | <a href="http://www.ti.com/lpw">www.ti.com/lpw</a>                 | Telephony           | <a href="http://www.ti.com/telephony">www.ti.com/telephony</a>           |
|                       |  | Video & Imaging     | <a href="http://www.ti.com/video">www.ti.com/video</a>                   |
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**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| CD4086BE         | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD4086BEE4       | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD4086BF3A       | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | A42              | N / A for Pkg Type           |
| CD4086BM         | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4086BM96       | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4086BM96E4     | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4086BM96G4     | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4086BME4       | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4086BMG4       | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4086BMT        | ACTIVE                | SOIC         | D               | 14   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4086BMTE4      | ACTIVE                | SOIC         | D               | 14   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4086BMTG4      | ACTIVE                | SOIC         | D               | 14   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4086BNSR       | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4086BNSRE4     | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4086BNSRG4     | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4086BPWE4      | ACTIVE                | TSSOP        | PW              | 14   |             | TBD                     | Call TI          | Call TI                      |
| CD4086BPWG4      | ACTIVE                | TSSOP        | PW              | 14   |             | TBD                     | Call TI          | Call TI                      |
| CD4086BPWRE4     | ACTIVE                | TSSOP        | PW              | 14   |             | TBD                     | Call TI          | Call TI                      |
| CD4086BPWRG4     | ACTIVE                | TSSOP        | PW              | 14   |             | TBD                     | Call TI          | Call TI                      |

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBsolete:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame

retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

| Device     | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD4086BM96 | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| CD4086BNSR | SO           | NS              | 14   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |



**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device     | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD4086BM96 | SOIC         | D               | 14   | 2500 | 346.0       | 346.0      | 33.0        |
| CD4086BNSR | SO           | NS              | 14   | 2000 | 346.0       | 346.0      | 33.0        |

PW (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| DIM \ PINS ** | 14                     | 16                     | 18                     | 20                     |
|---------------|------------------------|------------------------|------------------------|------------------------|
| A             | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC |
| B MAX         | 0.785<br>(19,94)       | .840<br>(21,34)        | 0.960<br>(24,38)       | 1.060<br>(26,92)       |
| B MIN         | —                      | —                      | —                      | —                      |
| C MAX         | 0.300<br>(7,62)        | 0.300<br>(7,62)        | 0.310<br>(7,87)        | 0.300<br>(7,62)        |
| C MIN         | 0.245<br>(6,22)        | 0.245<br>(6,22)        | 0.220<br>(5,59)        | 0.245<br>(6,22)        |

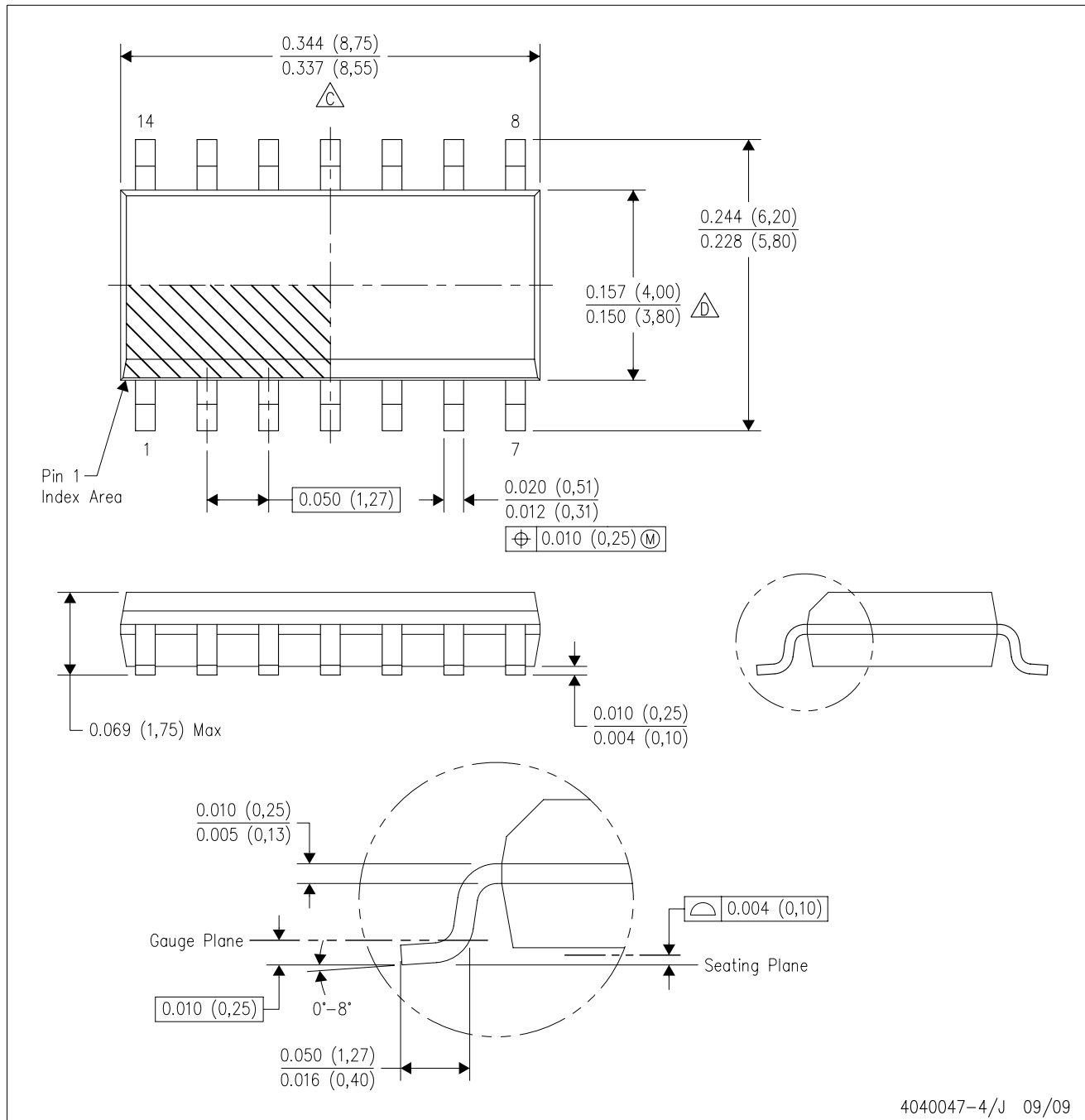




4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  -  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
  -  Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
  - E. Reference JEDEC MS-012 variation AB.

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.