

# CD4007UB Types

## CMOS Dual Complementary Pair Plus Inverter

High-Voltage Types (20-Volt Rating)

■ CD4007UB types are comprised of three n-channel and three p-channel enhancement-type MOS transistors. The transistor elements are accessible through the package terminals to provide a convenient means for constructing the various typical circuits as shown in Fig. 2.

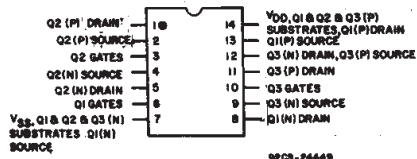
More complex functions are possible using multiple packages. Numbers shown in parentheses indicate terminals that are connected together to form the various configurations listed.

The CD4007UB 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).

### Applications:

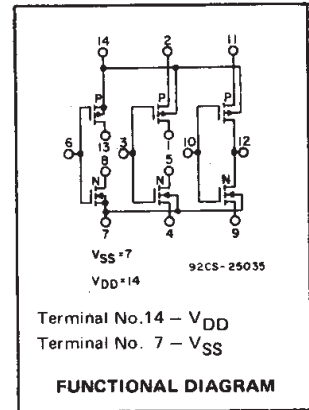
- Extremely high-input impedance amplifiers
- Shapers
- Inverters
- Threshold detector
- Linear amplifiers
- Crystal oscillators

### TERMINAL DIAGRAM Top View



### Features:

- Standardized symmetrical output characteristics
- Medium Speed Operation –  $t_{PHL}$ ,  $t_{PLH}$  = 30 ns (typ.) at 10 V
- 100% tested for quiescent current at 20 V
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"
- Maximum input current of 1  $\mu$ A at 18 V over full package-temperature range; 100 nA at 18 V and 25°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<br>(For $T_A$ = Full Package Temperature Range) | 3      | 18   | V     |

### STATIC ELECTRICAL CHARACTERISTICS

| CHARACTERISTIC                              | CONDITIONS   |                 |                 | LIMITS AT INDICATED TEMPERATURES (°C) |           |         |         |       |               |           | UNITS   |
|---|--------------|-----------------|-----------------|---------------------------------------|-----------|---------|---------|-------|---------------|-----------|---------|
|   | $V_O$<br>(V) | $V_{IN}$<br>(V) | $V_{DD}$<br>(V) | +25                                   |           |         |         |       |               |           |         |
|   |              |                 |                 | -55                                   | -40       | +85     | +125    | Min.  | Typ.          | Max.      |         |
| Quiescent Device Current, $I_{DD}$ Max.     | –            | 0,5             | 5               | 0,25                                  | 0,25      | 7,5     | 7,5     | –     | 0,01          | 0,25      | $\mu$ A |
|   | –            | 0,10            | 10              | 0,5                                   | 0,5       | 15      | 15      | –     | 0,01          | 0,5       |         |
|   | –            | 0,15            | 15              | 1                                     | 1         | 30      | 30      | –     | 0,01          | 1         |         |
|   | –            | 0,20            | 20              | 5                                     | 5         | 150     | 150     | –     | 0,02          | 5         |         |
| Output Low (Sink) Current, $I_{OL}$ 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, $I_{OH}$ 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          | –         |         |
|   | 13,5         | 0,15            | 15              | -4,2                                  | -4        | -2,8    | -2,4    | -3,4  | -6,8          | –         |         |
| Output Voltage: Low-Level, $V_{OL}$ Max.    | –            | 0,5             | 5               | 0,05                                  |           |         |         | –     | 0             | 0,05      | V       |
|   | –            | 0,10            | 10              | 0,05                                  |           |         |         | –     | 0             | 0,05      |         |
|   | –            | 0,15            | 15              | 0,05                                  |           |         |         | –     | 0             | 0,05      |         |
| Output Voltage: High-Level, $V_{OH}$ 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, $V_{IL}$ Max.            | 4,5          | –               | 5               | 1                                     |           |         |         | –     | –             | 1         | V       |
|   | 9            | –               | 10              | 2                                     |           |         |         | –     | –             | 2         |         |
|   | 13,5         | –               | 15              | 2,5                                   |           |         |         | –     | –             | 2,5       |         |
| Input High Voltage, $V_{IH}$ Min.           | 0,5          | –               | 5               | 4                                     |           |         |         | 4     | –             | –         | V       |
|   | 1            | –               | 10              | 8                                     |           |         |         | 8     | –             | –         |         |
|   | 1,5          | –               | 15              | 12,5                                  |           |         |         | 12,5  | –             | –         |         |
| Input Current $I_{IN}$ Max.                 |              | 0,18            | 18              | $\pm 0,1$                             | $\pm 0,1$ | $\pm 1$ | $\pm 1$ | –     | $\pm 10^{-5}$ | $\pm 0,1$ | $\mu$ A |

# CD4007UB Types

## 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

DYNAMIC ELECTRICAL CHARACTERISTICS at T<sub>A</sub> = 25°C; Input t<sub>r</sub>, t<sub>f</sub> = 20 ns, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 200 KΩ

| CHARACTERISTIC          | CONDITIONS       | LIMITS                |      | UNITS |      |
|-------------------------|------------------|-----------------------|------|-------|------|
|                         |                  | V <sub>DD</sub> Volts | Typ. |       | Max. |
| Propagation Delay Time: | t <sub>PHL</sub> | 5                     | 55   | 110   | ns   |
|                         | t <sub>PLH</sub> | 10                    | 30   | 60    |      |
|                         |                  | 15                    | 25   | 50    |      |
| Transition Time         | t <sub>THL</sub> | 5                     | 100  | 200   | ns   |
|                         | t <sub>TLH</sub> | 10                    | 50   | 100   |      |
|                         |                  | 15                    | 40   | 80    |      |
| Input Capacitance       | C <sub>IN</sub>  | Any Input             | 10   | 15    | pF   |

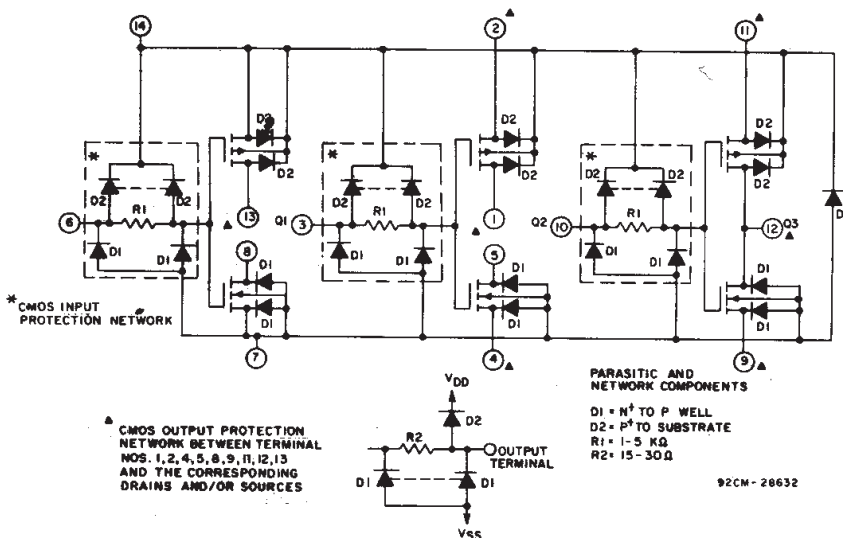
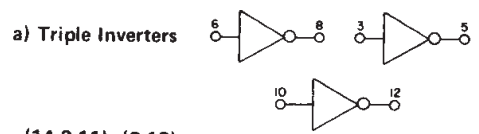
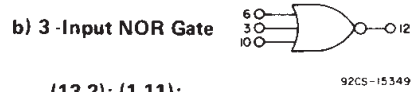


Fig. 1 — Detailed schematic diagram of CD4007UB showing input, output, and parasitic diodes.



(14,2,11); (8,13);  
(1,5); (7,4,9)

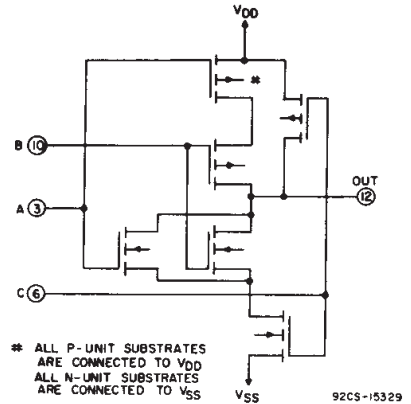


(13,2); (1,11);  
(12,5,8); (7,4,9)



(1,12,13); (2,14,11);  
(4,8); (5,9)

### d) Tree (Relay) Logic



(13,12,5); (4,9,8);  
(14,2); (1,11)

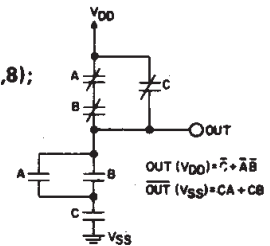
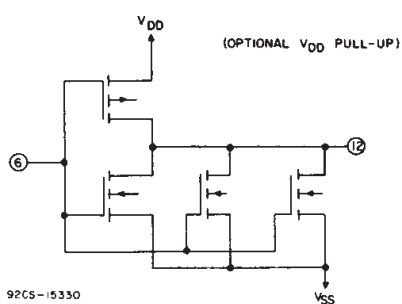


Fig. 2 — Sample CMOS logic circuit arrangements using type CD4007UB.

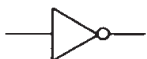
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# CD4007UB Types

e) High Sink-Current Driver



(6,3,10); (8.5, 12);  
(11,14); (7,4,9)



f) High Source-Current Driver



(6,3,10); (13,1,12);  
(14,2,11); (7,9)

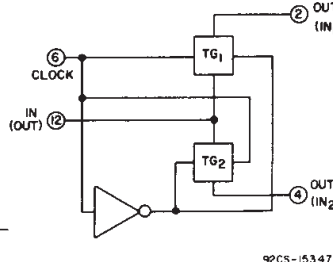


g) High Sink - and Source-Current Driver



(6,3,10); (14,2,11);  
(7,4,9); (13,8,1,5,12)

h) Dual Bi-Directional Transmission Gating



(1,5,12); (2,9);  
(11,4); (8,13,10);  
(6,3)

Fig. 2 - Sample CMOS logic circuit arrangements using type CD4007UB (Cont'd).

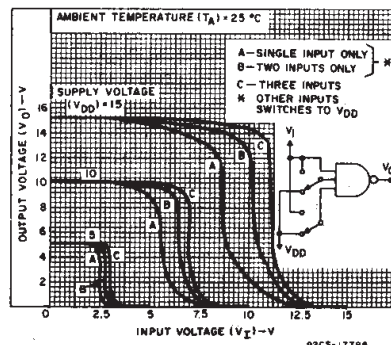


Fig. 3 - Typical voltage-transfer characteristics for NAND gate.

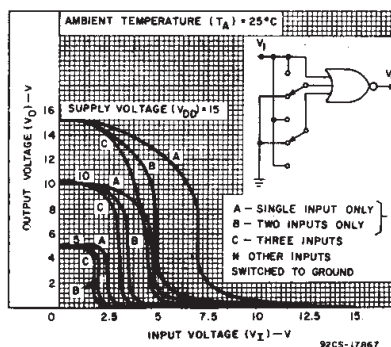


Fig. 4 - Typical voltage-transfer characteristics for NOR gate.

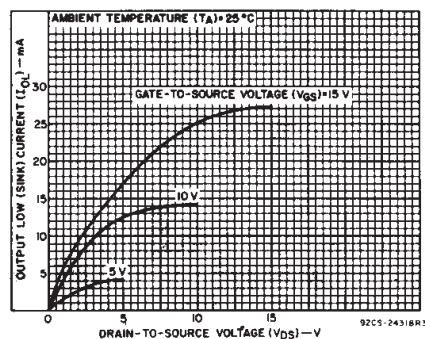


Fig. 5 - Typical output low (sink) current characteristics.



Fig. 6 - Minimum and maximum voltage-transfer characteristics for inverter.



Fig. 7 - Typical current and voltage-transfer characteristics for inverter.

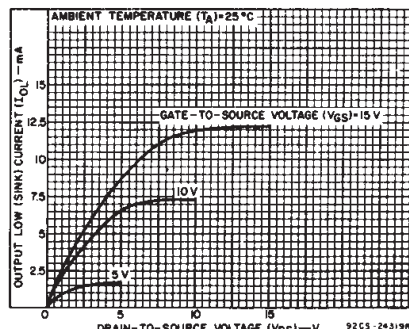


Fig. 8 - Minimum output low (sink) current characteristics.

# CD4007UB Types

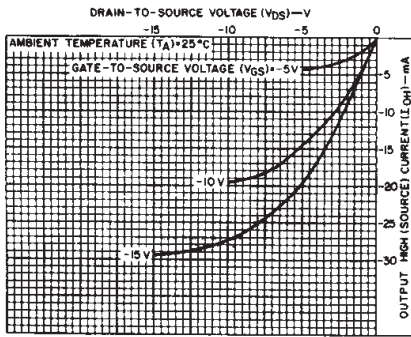


Fig. 9 - Typical output high (source) current characteristics.

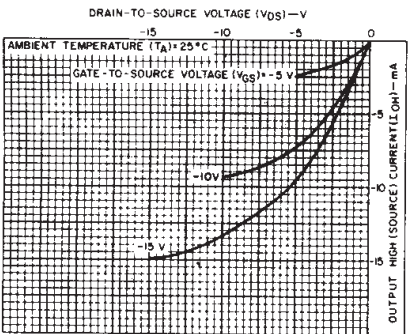


Fig. 10 - Minimum output high (source) current characteristics.

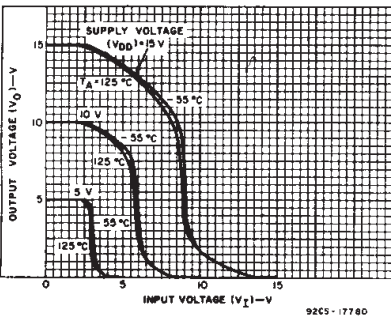


Fig. 11 - Typical voltage-transfer characteristics as a function of temperature.

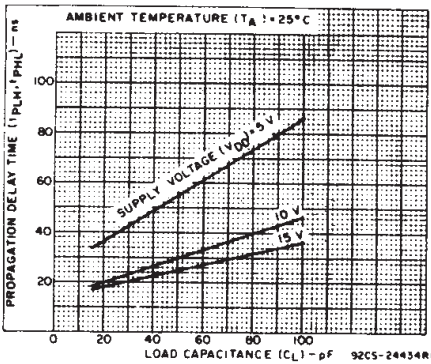


Fig. 12 - Typical propagation delay time vs. load capacitance.

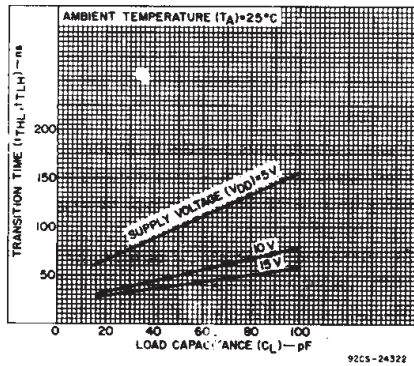


Fig. 13 - Typical transition time vs. load capacitance.

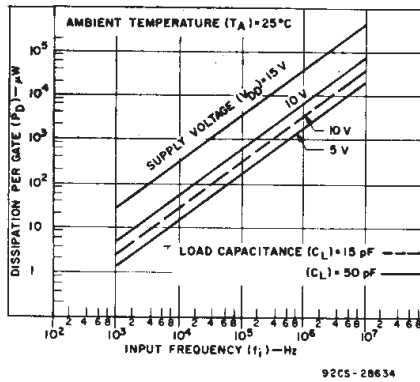


Fig. 14 - Typical dissipation vs. frequency characteristics.

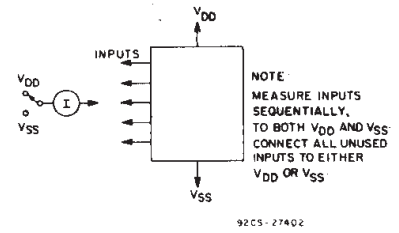


Fig. 15 - Input current test circuit.

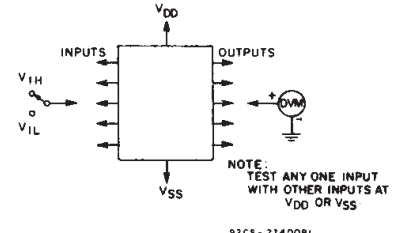


Fig. 16 - Input voltage test circuit.

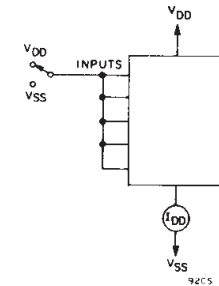
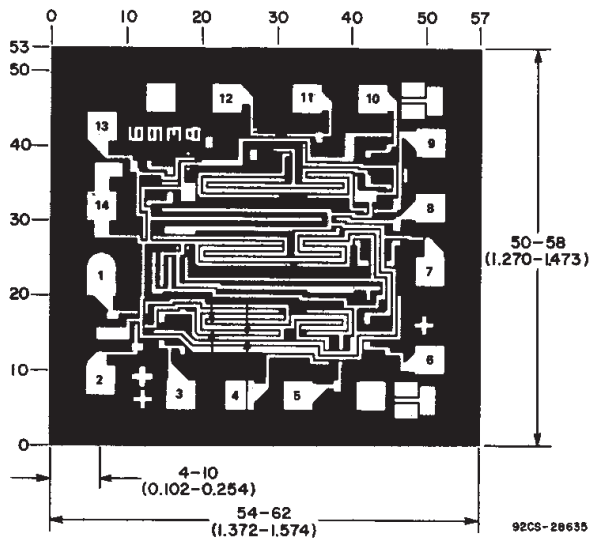


Fig. 17 - Quiescent device current test circuit.



DIMENSIONS AND PAD LAYOUT FOR CD4007UBH

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

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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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| CD4007UBE        | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD4007UBEE4      | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD4007UBF        | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | A42              | N / A for Pkg Type           |
| CD4007UBF3A      | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | A42              | N / A for Pkg Type           |
| CD4007UBF3A116   | OBSOLETE              | CDIP         | J               | 14   |             | TBD                     | Call TI          | Call TI                      |
| CD4007UBM        | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBM96      | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBM96E4    | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBM96G4    | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBME4      | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBMG4      | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBMT       | ACTIVE                | SOIC         | D               | 14   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBMTE4     | ACTIVE                | SOIC         | D               | 14   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBMTG4     | ACTIVE                | SOIC         | D               | 14   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBNSR      | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBNSRE4    | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBNSRG4    | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBPW       | ACTIVE                | TSSOP        | PW              | 14   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBPWE4     | ACTIVE                | TSSOP        | PW              | 14   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBPWG4     | ACTIVE                | TSSOP        | PW              | 14   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBPWR      | ACTIVE                | TSSOP        | PW              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBPWRE4    | ACTIVE                | TSSOP        | PW              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD4007UBPWG4     | ACTIVE                | TSSOP        | PW              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

<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)

<sup>(3)</sup> 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 |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD4007UBM96 | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| CD4007UBMT  | SOIC         | D               | 14   | 250  | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| CD4007UBNSR | SO           | NS              | 14   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| CD4007UBPWR | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device      | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD4007UBM96 | SOIC         | D               | 14   | 2500 | 346.0       | 346.0      | 33.0        |
| CD4007UBMT  | SOIC         | D               | 14   | 250  | 346.0       | 346.0      | 33.0        |
| CD4007UBNSR | SO           | NS              | 14   | 2000 | 346.0       | 346.0      | 33.0        |
| CD4007UBPWR | TSSOP        | PW              | 14   | 2000 | 346.0       | 346.0      | 29.0        |





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.
  - $\triangle C$  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - $\triangle D$  The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G14)

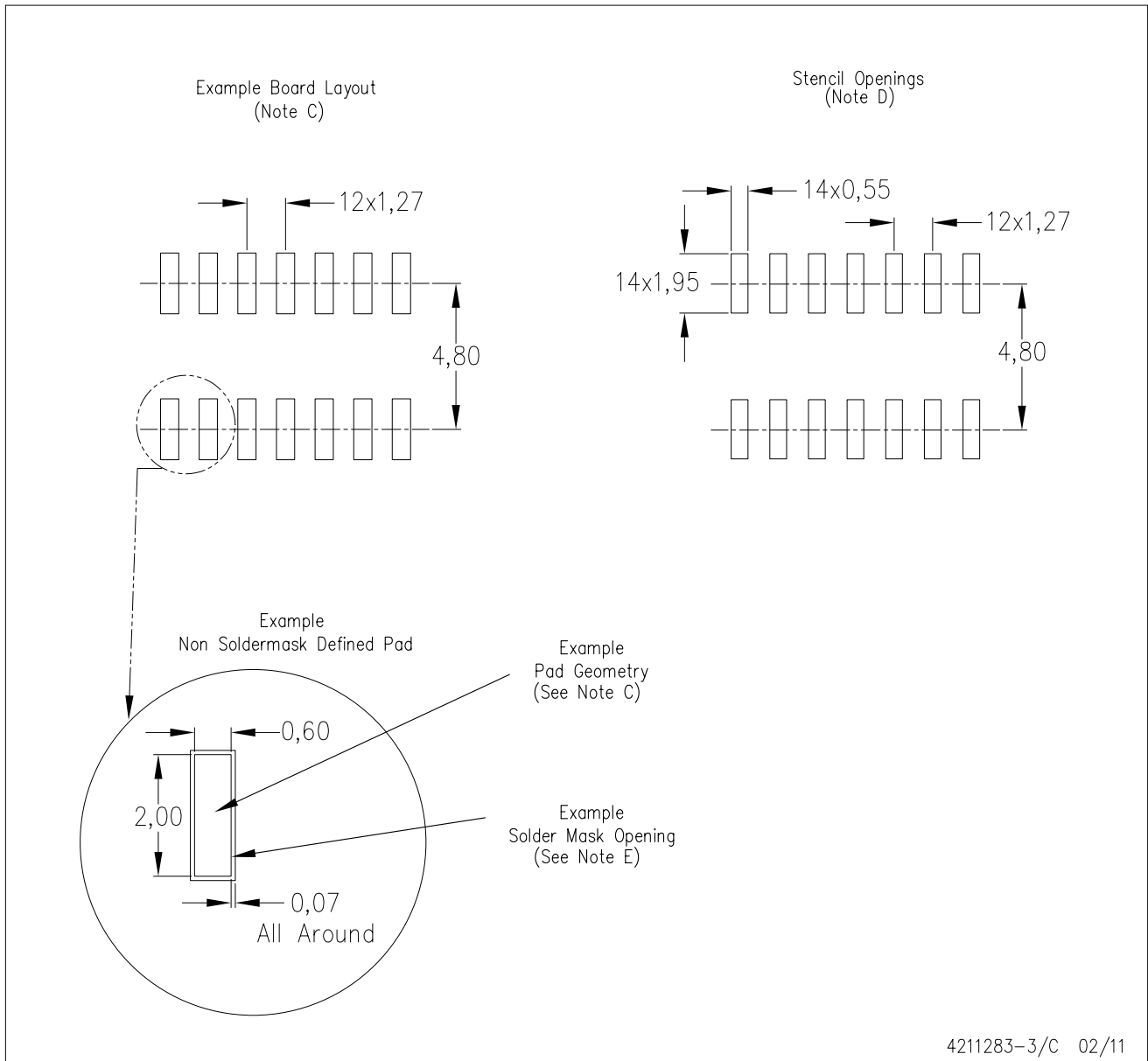
PLASTIC SMALL OUTLINE



- 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 0.006 (0,15) each side.
  -  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G14)

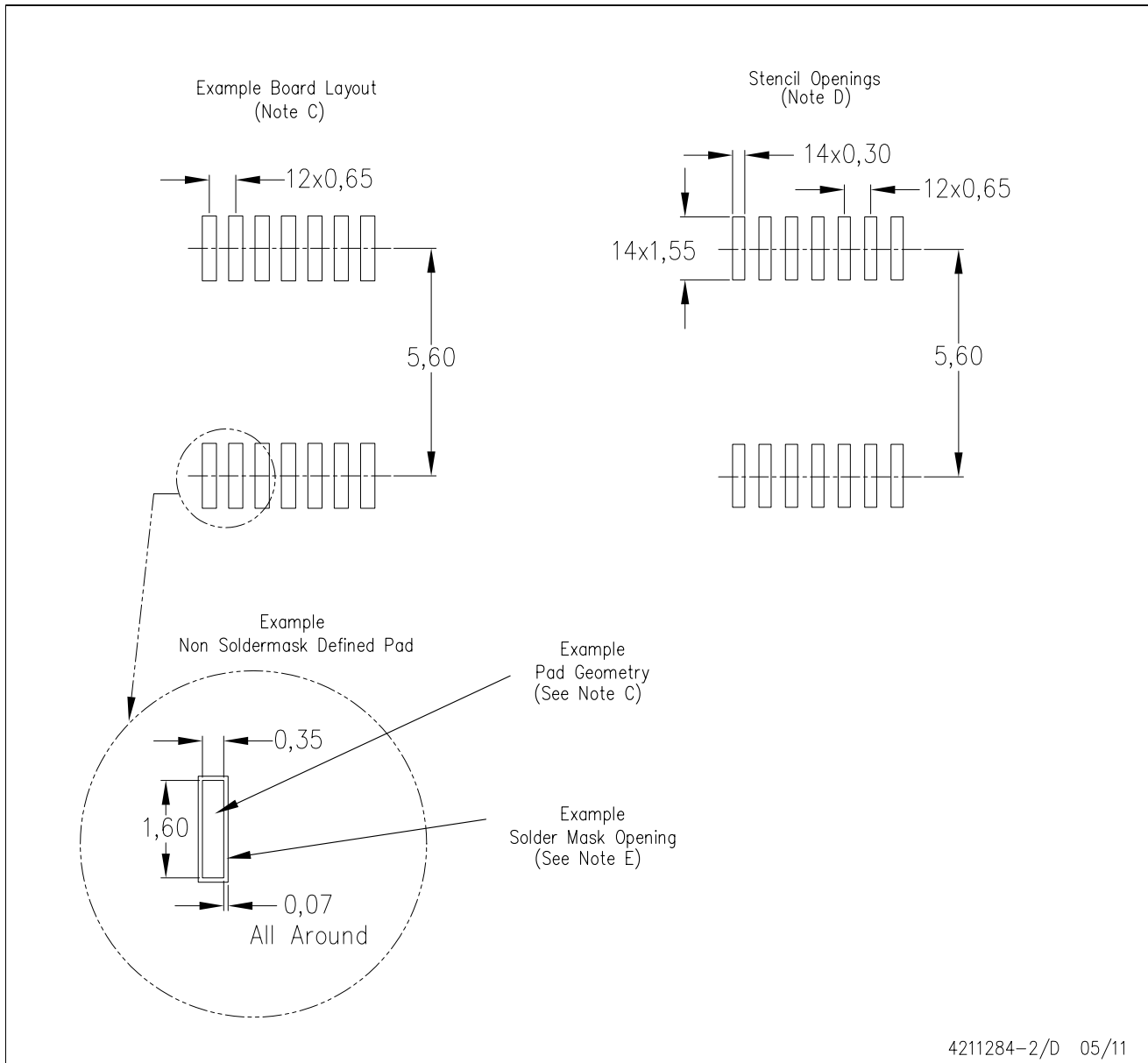
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

# 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.

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