

CMOS Programmable Timer High Voltage Types (20V Rating)

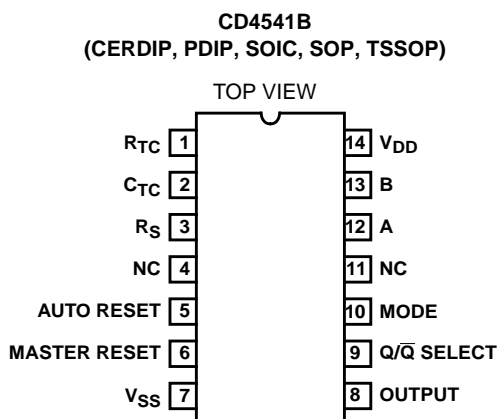
Features

- Low Symmetrical Output Resistance, Typically 100Ω at V_{DD} = 15V
- Built-In Low-Power RC Oscillator
- Oscillator Frequency Range DC to 100kHz
- External Clock (Applied to Pin 3) can be Used Instead of Oscillator
- Operates as 2^N Frequency Divider or as a Single-Transition Timer
- Q/ \bar{Q} Select Provides Output Logic Level Flexibility
- AUTO or MASTER RESET Disables Oscillator During Reset to Reduce Power Dissipation
- Operates With Very Slow Clock Rise and Fall Times
- Capable of Driving Six Low Power TTL Loads, Three Low-Power Schottky Loads, or Six HTL Loads Over the Rated Temperature Range
- Symmetrical Output Characteristics
- 100% Tested for Quiescent Current at 20V
- 5V, 10V, and 15V Parametric Ratings
- Meets All Requirements of JEDEC Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

Description

CD4541B programmable timer consists of a 16-stage binary counter, an oscillator that is controlled by external R-C components (2 resistors and a capacitor), an automatic power-on reset circuit, and output control logic. The counter increments on positive-edge clock transitions and can also be reset via the MASTER RESET input.

Pinout



The output from this timer is the Q or \bar{Q} output from the 8th, 10th, 13th, or 16th counter stage. The desired stage is chosen using time-select inputs A and B (see Frequency Select Table).

The output is available in either of two modes selectable via the MODE input, pin 10 (see Truth Table). When this MODE input is a logic "1", the output will be a continuous square wave having a frequency equal to the oscillator frequency divided by 2^N. With the MODE input set to logic "0" and after a MASTER RESET is initiated, the output (assuming Q output has been selected) changes from a low to a high state after 2^{N-1} counts and remains in that state until another MASTER RESET pulse is applied or the MODE input is set to a logic "1".

Timing is initialized by setting the AUTO RESET input (pin 5) to logic "0" and turning power on. If pin 5 is set to logic "1", the AUTO RESET circuit is disabled and counting will not start until after a positive MASTER RESET pulse is applied and returns to a low level. The AUTO RESET consumes an appreciable amount of power and should not be used if low-power operation is desired. For reliable automatic power-on reset, V_{DD} should be greater than 5V.

The RC oscillator, shown in Figure 2, oscillates with a frequency determined by the RC network and is calculated using:

$$f = \frac{1}{2.3 R_{TC} C_{TC}}$$

Where f is between 1kHz and 100kHz and R_S ≥ 10kΩ and ≈ 2R_{TC}

Ordering Information

| PART NUMBER | TEMP. RANGE (°C) | PACKAGE |
|-------------|------------------|--------------|
| CD4541BF3A | -55 to 125 | 14 Ld CERDIP |
| CD4541BE | -55 to 125 | 14 Ld PDIP |
| CD4541BM | -55 to 125 | 14 Ld SOIC |
| CD4541BMT | -55 to 125 | 14 Ld SOIC |
| CD4541BM96 | -55 to 125 | 14 Ld SOIC |
| CD4541BNSR | -55 to 125 | 14 Ld SOP |
| CD4541BPW | -55 to 125 | 14 Ld TSSOP |
| CD4541BPWR | -55 to 125 | 14 Ld TSSOP |

NOTE: When ordering, use the entire part number. The suffixes 96 and R denote tape and reel. The suffix T denotes a small-quantity reel of 250.

CD4541B

Functional Diagram

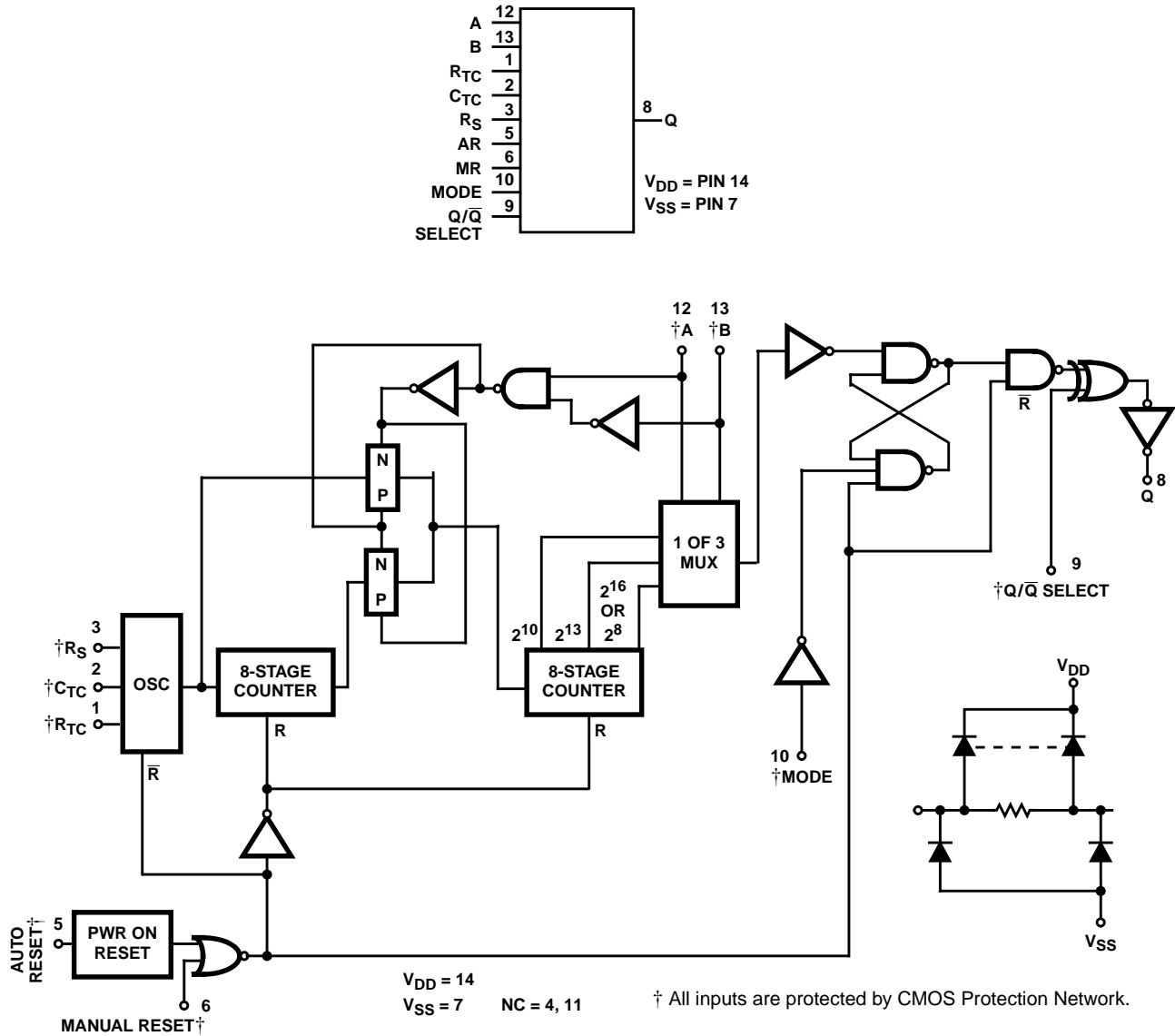


FIGURE 1.

FREQUENCY SELECTION TABLE

| A | B | NO. OF STAGES N | COUNT 2 ^N |
|---|---|-----------------|----------------------|
| 0 | 0 | 13 | 8192 |
| 0 | 1 | 10 | 1024 |
| 1 | 0 | 8 | 256 |
| 1 | 1 | 16 | 65536 |

TRUTH TABLE

| PIN | STATE | |
|-----|--------------------------------------|---|
| | 0 | 1 |
| 5 | Auto Reset On | Auto Reset Disable |
| 6 | Master Reset Off | Master Reset On |
| 9 | Output Initially Low After Reset (Q) | Output Initially High After Reset (\bar{Q}) |
| 10 | Single Transition Mode | Recycle Mode |

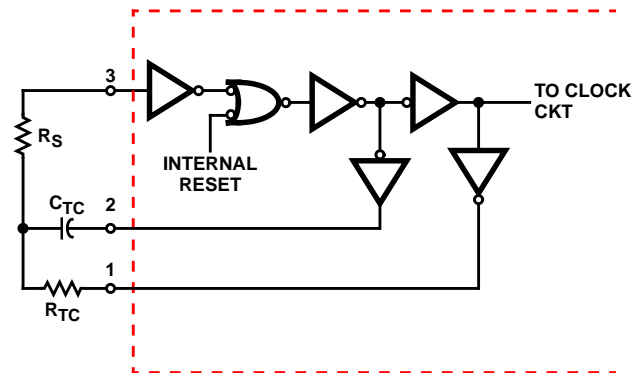


FIGURE 2. RC OSCILLATOR CIRCUIT

CD4541B

Absolute Maximum Ratings

DC Supply - Voltage Range, V_{DD}
 Voltages Referenced to V_{SS} Terminal -0.5V to +20V
 Input Voltage Range, All Inputs -0.5V to $V_{DD} + 0.5V$
 DC Input Current, Any One Input $\pm 10mA$
 Device Dissipation Per Output Transistor
 For T_A = Full Package Temperature Range
 (All Package Types) 100mW

Operating Conditions

Temperature Range T_A -55°C to 125°C
 Supply Voltage Range
 For T_A = Full Package Temperature Range 3V (Min), 18V (Typ)

Thermal Information

Package Thermal Impedance, θ_{JA} (see Note 1)
 PDIP package 80°C/W
 SOIC package 86°C/W
 SOP package 76°C/W
 TSSOP package 113°C/W
 Maximum Junction Temperature (Plastic Package) 150°C
 Maximum Storage Temperature Range (T_{STG}) -65°C to 150°C
 Maximum Lead Temperature (Soldering 10s)
 At Distance 1/16in \pm 1/32in (1.59mm \pm 0.79mm)
 from case for 10s Maximum 265°C
 (SOIC - Lead Tips Only)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

- The package thermal impedance is calculated in accordance with JESD 51-7.

Electrical Specifications

| PARAMETER | CONDITIONS | | | LIMITS AT INDICATED TEMPERATURES (°C) | | | | | | | UNITS |
|---|--------------|-----------------|-----------------|---------------------------------------|-------|-------|-------|-------|------|------|---------|
| | V_O (V) | V_{IN} (V) | V_{DD} (V) | -55 | -40 | 85 | 125 | 25 | | | |
| | | | | | | | | MIN | TYP | MAX | |
| Quiescent Device Current, (Note 2) I_{DD} (Max) | - | 0, 5 | 5 | 5 | 5 | 150 | 150 | - | 0.04 | 5 | μA |
| | - | 0, 10 | 10 | 10 | 10 | 300 | 300 | - | 0.04 | 10 | μA |
| | - | 0, 15 | 15 | 20 | 20 | 600 | 600 | - | 0.04 | 20 | μA |
| | - | 0, 20 | 20 | 100 | 100 | 3000 | 3000 | - | 0.08 | 100 | μA |
| Output Low (Sink) Current I_{OL} (Min) | 0.4 | 0, 5 | 5 | 1.9 | 1.85 | 1.26 | 1.08 | 1.55 | 3.1 | - | mA |
| | 0.5 | 0, 10 | 10 | 5 | 4.8 | 3.3 | 2.8 | 4 | 8 | - | mA |
| | 1.5 | 0, 15 | 15 | 12.6 | 12 | 8.4 | 7.2 | 10 | 20 | - | mA |
| Output High (Source) Current, I_{OH} (Min) | 4.6 | 0, 5 | 5 | -1.9 | -1.85 | -1.26 | -1.08 | -1.55 | -3.1 | - | mA |
| | 2.5 | 0, 5 | 5 | -6.2 | -6 | -4.1 | -3 | -5 | -10 | - | mA |
| | 9.5 | 0, 10 | 10 | -5 | -4.8 | -3.3 | -2.8 | -4 | -8 | - | mA |
| | 13.5 | 0, 15 | 15 | -12.6 | -12 | -8.4 | -7.2 | -10 | -20 | - | mA |
| Output Voltage: Low-Level, V_{OL} (Max) | - | 0, 5 | 5 | - | | 0.05 | | - | 0 | 0.05 | V |
| | - | 0, 10 | 10 | - | | 0.05 | | - | 0 | 0.05 | V |
| | - | 0, 15 | 15 | - | | 0.05 | | - | 0 | 0.05 | V |
| Output Voltage: High-Level, V_{OH} (Min) | - | 0, 5 | 5 | - | | 4.95 | | 4.95 | 5 | - | V |
| | - | 0, 10 | 10 | - | | 9.95 | | 9.95 | 10 | - | V |
| | - | 0, 15 | 15 | - | | 14.95 | | 14.95 | 15 | - | V |
| Input Low Voltage, V_{IL} (Max) | 0.5, 4.5 | - | 5 | - | | 1.5 | | - | - | 1.5 | V |
| | 1, 9 | - | 10 | - | | 3 | | - | - | 3 | V |
| | 1.5, 13.5 | - | 15 | - | | 4 | | - | - | 4 | V |

CD4541B

Electrical Specifications (Continued)

| PARAMETER | CONDITIONS | | | LIMITS AT INDICATED TEMPERATURES (°C) | | | | | | | UNITS |
|---|-----------------------|------------------------|------------------------|---------------------------------------|------|-----|-----|-----|-------------------|------|-------|
| | V _O (V) | V _{IN} (V) | V _{DD} (V) | -55 | -40 | 85 | 125 | 25 | | | |
| | | | | | | | | MIN | TYP | MAX | |
| Input High Voltage, V _{IH} (Min) | 0.5, 4.5 | - | 5 | - | | 3.5 | | 3.5 | - | - | V |
| | 1, 9 | - | 10 | - | | 7 | | 7 | - | - | V |
| | 1.5, 13.5 | - | 15 | - | | 11 | | 11 | - | - | V |
| Input Current, I _{IN} (Max) | - | 0, 18 | 18 | ±0.1 | ±0.1 | ±1 | ±1 | - | ±10 ⁻⁵ | ±0.1 | µA |

NOTE:

2. With AUTO RESET enabled, additional current drain at 25°C is:
 7µA (Typ), 200µA (Max) at 5V;
 30µA (Typ), 350µA (Max) at 10V;
 80µA (Typ), 500µA (Max) at 15V

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

| PARAMETER | SYMBOL | V _{DD} (V) | MIN | TYP | MAX | UNITS |
|--|--|---------------------|-----------|------|------|-------|
| Propagation Delay Times Clock to Q | (2 ⁸) t _{PHL} , t _{PLH} | 5 | - | 3.5 | 10.5 | µs |
| | | 10 | - | 1.25 | 3.8 | µs |
| | | 15 | - | 0.9 | 2.9 | µs |
| | (2 ¹⁶) t _{PHL} , t _{PLH} | 5 | - | 6.0 | 18 | µs |
| | | 10 | - | 3.5 | 10 | µs |
| | | 15 | - | 2.5 | 7.5 | µs |
| Transition Time | t _{THL} | 5 | - | 100 | 200 | ns |
| | | 10 | - | 50 | 100 | ns |
| | | 15 | - | 40 | 80 | ns |
| | t _{THL} | 5 | - | 180 | 360 | ns |
| | | 10 | - | 90 | 180 | ns |
| | | 15 | - | 65 | 130 | ns |
| MASTER RESET, CLOCK Pulse Width | | 5 | 900 | 300 | - | ns |
| | | 10 | 300 | 100 | - | ns |
| | | 15 | 225 | 85 | - | ns |
| Maximum Clock Pulse Input Frequency | f _{CL} | 5 | - | 1.5 | - | MHz |
| | | 10 | - | 4 | - | MHz |
| | | 15 | - | 6 | - | MHz |
| Maximum Clock Pulse Input Rise or Fall time | t _r , t _f | 5, 10, 15 | Unlimited | | | µs |

Digital Timer Application

A positive pulse on MASTER RESET resets the counters and latch. The output goes high and remains high until the number of pulses, selected by A and B, are counted. This circuit is retriggerable and is as accurate as the input frequency. If additional accuracy is desired, an external clock can be used on pin 3. A setup time equal to the width of the one-shot output is required immediately following initial power up, during which time the output will be high.

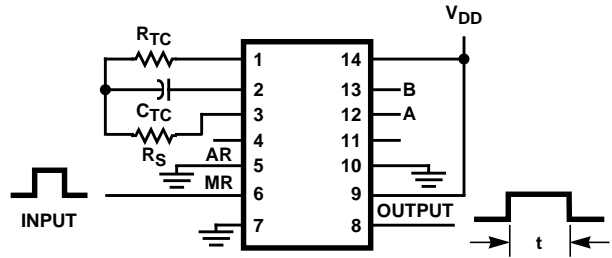


FIGURE 3. DIGITAL TIMER APPLICATION CIRCUIT

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| CD4541BE | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| CD4541BEE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| CD4541BF | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| CD4541BF3A | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| CD4541BM | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BM96 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BM96E4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BM96G4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BME4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BMG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BMT | ACTIVE | SOIC | D | 14 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BMTE4 | ACTIVE | SOIC | D | 14 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BMTG4 | ACTIVE | SOIC | D | 14 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BNSR | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BNSRE4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BNSRG4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BPW | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BPWE4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BPWG4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BPWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BPWRE4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4541BPWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

⁽¹⁾ 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.

(2) 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 |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD4541BM96 | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4541BNSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| CD4541BPWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 7.0 | 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) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD4541BM96 | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| CD4541BNSR | SO | NS | 14 | 2000 | 346.0 | 346.0 | 33.0 |
| CD4541BPWR | TSSOP | PW | 14 | 2000 | 346.0 | 346.0 | 29.0 |

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 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC |
| B MAX | 0.785 (19,94) | .840 (21,34) | 0.960 (24,38) | 1.060 (26,92) |
| B MIN | — | — | — | — |
| C MAX | 0.300 (7,62) | 0.300 (7,62) | 0.310 (7,87) | 0.300 (7,62) |
| C MIN | 0.245 (6,22) | 0.245 (6,22) | 0.220 (5,59) | 0.245 (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



4040047-3/H 11/2006

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ 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.
 - $\triangle D$ 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



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| Video & Imaging | www.ti.com/video |
| Wireless | www.ti.com/wireless |

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