

Data sheet acquired from Harris Semiconductor SCHS104C - Revised October 2003

# CMOS Hex 'D'-Type Flip-Flop

High-Voltage Types (20-Volt Rating)

■ CD40174B consists of six identical 'D'-type flip-flops having independent DATA inputs. The CLOCK and CLEAR inputs are common to all six units. Data is transferred to the Q outputs on the positive-going transition of the clock pulse. All six flip-flops are simultaneously reset by a low level on the CLEAR input.

The CD40174B types are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix), 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (M, M96, MT, and NSR suffixes), and 16-lead thin shrink small-outline packages (PW and PWR

DC SUPPLY-VOLTAGE RANGE, (VDD)

POWER DISSIPATION PER PACKAGE (PD):

DEVICE DISSIPATION PER OUTPUT TRANSISTOR

LEAD TEMPERATURE (DURING SOLDERING):

MAXIMUM RATINGS, Absolute-Maximum Values:

#### Features:

Voltages referenced to VSS Terminal) ......-0.5V to +20V INPUT VOLTAGE RANGE, ALL INPUTS .....-0.5V to VDD +0.5V DC INPUT CURRENT, ANY ONE INPUT ...... ±10mA

For T<sub>A</sub> = -55°C to +100°C ...... 500mW For T<sub>A</sub> = +100°C to +125°C ...... Derate Linearity at 12mW/°C to 200mW

FOR TA = FULL PACKAGE-TEMPERATURE RANGE (All Package Types)................. 100mW OPERATING-TEMPERATURE RANGE (TA) .....-55°C to +125°C STORAGE TEMPERATURE RANGE (Tstg) .....-65°C to +150°C

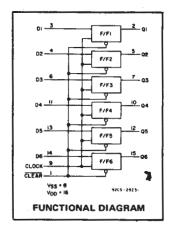
At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10s max . . . . . . . . . +265°C

- # 5-V, 10-V, and 15-V parametric rating
- Standardized symmetrical output characteristics
- 100% tested for quiescent current at 20 V
- Maximum input current of 1 µA at 18 V 100 nA at 18 V and 25°C
- M Noise margin (over full package-temperature

range):  $1 \vee \text{at } \vee_{DD} = 5 \vee$ 

2 V at V<sub>DD</sub> = 10 V 2.5 V at V<sub>DD</sub> = 15 V

■ Meets all requirements of JEDEC Tentative Standard No. 13A, "Standard Specifications for Description of 'B' Series CMOS Devices"



#### Applications:

- Shift Registers
- Buffer/Storage Registers

CD40174B Types

■ Pattern Generators

#### TRUTH TABLE FOR 1 OF 6 FLIP-FLOPS

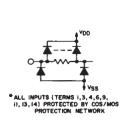
	INPUTS		OUTPUT
CLOCK	DATA	CLEAR	Q
	0	1	0
	1	1	1
_	Х	1	NC
Х	Х	0	0

1 = High Level

X = Don't Care

0 = Low Level

NC = No Change



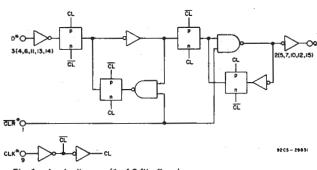


Fig. 1 — Logic diagram (1 of 6 flip-flops).

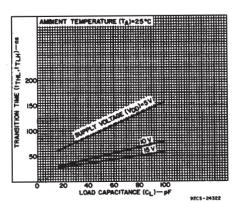
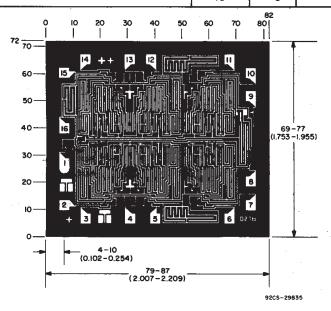


Fig. 2- Typical transition time as a function of load capacitance.

#### CD40174B Types

RECOMMENDED OPERATING CONDITIONS at  $T_A = 25^{\circ}$ C, Except as Noted. For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	V <sub>DD</sub>	LIN	MITS	UNITS
· 	(V)	Min.	Max.	
Supply-Voltage Range (For T <sub>A</sub> = Full Package- Temperature Range)	_	3	18	V
Temperature Hange,			10	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
	,5	40	~	1
Data Setup Time, t <sub>SU</sub>	10	20	-	ns
	15	10	_	Ì
	5	80	_	
Data Hold Time, tH	10	40	-	ns
	15	30	-	
	5	1 -	3.5	
Clock Input Frequency, fCL	10	dc	6	MHz
	15		8	
	5	_	15 .	
Clock Input Rise or Fall Time, trCL, trCL	10		15	μs
	15	-	15	'
	5	130	-	
Clock Input Pulse Width, tWL, tWH	10	60	_	ns
	15	40	-	1
	5	100	_	
Clear Pulse Width, tWL	10	50	-	ns
<del>.</del>	15	40	_	
	5	0	_	
Clear Removal Time, tREM	10	0	-	ns
· · <del>- · · ·</del>	15	0	-	



Dimensions and pad layout for CD401748H.

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10<sup>-3</sup> inch).

The photographs and dimensions of each CMOS chip represent a chip when it is part of the water. When the water is separated into individual chips, the angle of cleavage may vary with respect to the chip face for different chips. The actual dimensions of the isolated chip, therefore, may differ slightly from the nominal dimensions shown. The user should consider a tolerance of -3 mils to +16 mils applicable to the nominal dimensions shown.

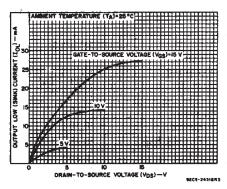
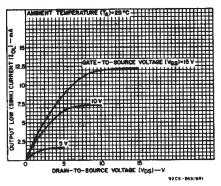


Fig. 3- Typical output low (sink) current characteristics.



Minimum output low (sink) current characteristics.

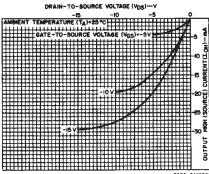


Fig. 5— Typical output high (source) current characteristics.

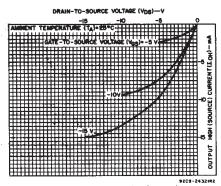


Fig. 6-- Minimum output high (source) current characteristics.

## CD40174B Types

STATIC	EL S	ECTRICA	AL CH	ADA	CTED	CTICC
SIMIL		cu i niu		ARA		3116.3

CHARAC-	CONI	OITIO	NS					ICATE ES (°C		***	U N
TERISTIC	Vo	VIN	$v_{DD}$				1 600		+25		<del> </del>
	(V)	(V)	(V)	<b>-55</b>	<b>–40</b>	+85	+125	Min.	Typ.	Max.	s
Quiescent	_	0,5	5	1	1	30	- 30		0.02	1	
Device	· <b>_</b>	0,10	10	2	2	60	60	-	0.02	2	μÄ
Current, I <sub>DD</sub>	- ·	0,15	15	4	4	120	120	<u> </u>	0.02	4	ľ
Max.	_	0,20	20	20	20	600	600		0.04	20	1
Output Low (Sink)	0.4	0,5	5	0.64	0.61	0.42	0.36	0.51	1	_	
Current	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6		
I <sub>OL</sub> Min.	1.5	0,15	15	4.2	4	2.8	2.4	3.4	6.8	-	-
Output High (Source) Current, IOH 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	_	1
	9.5	0,10	10	-1.6	-1.5	-1.1	-0.9	-1.3	-2.6		1
	13.5	0,15	15	-4.2	-4	-2.8	-2.4	-3.4	6.8		
Output Voltage:		0,5	5	0.05				_	0	0.05	
Low-Level,		0,10	-10		0	.05		-	,	0.05	1
VOL Max.	ļ. <del>-</del>	0,15	15		0	.05			0	0.05	V
Output Voltage:	- :	0,5	5		4	.95		4.95	5	_	*
High-Level,	-	0,10	10		9	.95		9,95	10		
V <sub>OH</sub> Min.	_	0,15	15		14	.95		14.95	15	-	
Input Low	0.5,4.5		5		1	.5		_	_	1.5	Г
Voltage,	1,9	_	10			3		_		3	
VIL Max.	1.5,13.5	_	15			4		-	-	4	l,
Input High	0.5,4.5	_	5.		3	3.5		3.5		_	ľ
Voltage,	1,9	-	10	7			75	, <u>1</u>	_		
∨ <sub>IH</sub> Min.	1.5,13.5	-	15			11		11	-	/i	
Input Current	-	0,18	18	±0.1	±0.1	±1	±1	- ;	±10 <sup>-5</sup>	±0.1	μA

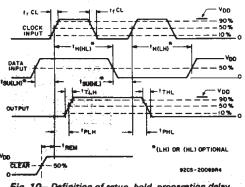


Fig. 10— Definition of setup, hold, propagation delay, and removal times.

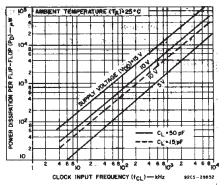


Fig. 7— Typical dynamic power dissipation as a function of CLOCK frequency.

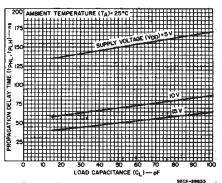


Fig. 8— Typical propagation delay time (CLOCK to OUTPUT) as a function of load capacitance.

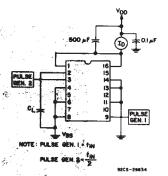


Fig. 9— Dynamic power dissipation test circuit.

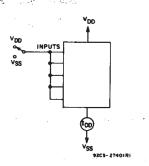


Fig. 11 - Quiescent device current test circuit.

# DYNAMIC ELECTRICAL CHARACTERISTICS at T $_A$ = 25°C; Input t\_r, t\_f = 20 ns, C $_L$ = 50 pF, R $_L$ = 200 k $\Omega$

CHARACTERISTIC	TEST	- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	LIMITS	3.	UNITS
	V <sub>DD</sub> (V)	Min.	Тур.	Max.	
Propagation Delay Time	5		150	300	
	10	_	70	.140	ns ,
Clock to Output, tpHL, tpLH	15	_	50	100	
. ·	5	<u>-</u>	100	200	
Clear to Output, tPHL	10	_	50	100	ns
	15		40	80	1
	5	_	100	200	
Transition Time, t <sub>THL</sub> , t <sub>TLH</sub>	10	_	50	100	ns
	15		40	80	
Minimum Pulse Width.	5	-	65	130	
· · · · · · · · · · · · · · · · · · ·	10	-	30	60	ns
Clock, t <sub>WL</sub> , t <sub>WH</sub>	15	_	20	40	
ear <u>and an annual search</u>	5		50	100	
Clear, t <sub>WL</sub>	10	· —	25	50	ns
	15		20	40	
	5	10° 12' 12' 12' 12' 12' 12' 12' 12' 12' 12'	20	40	
Minimum Data Setup Time, t <sub>SU</sub>	10	-	10	20	ns
	15	-	0	10	
	5	_	40	80	į .
Minimum Data Hold Time, t <sub>H</sub>	10	_	20	40	ns
	15	_	15	30	. * * *
	5	3.5	7	_	
Maximum Clock Frequency, f <sub>CL</sub>	10	6	12		MHz
	15	- 8	- 16		
	5	15	3	1-	
Maximum Clock Rise or Fall	10	15	-	_	μs
Time, t <sub>r</sub> CL, t <sub>f</sub> CL	15	15	- ; .	<u></u>	17. 1
Input Capacitance, C <sub>IN</sub>	_	_	25	40	pF
All other	_	_	5	7.5	1
	5		-40	0	
Minimum Clear Removal	10		15	ő	ns.
Time, t <sub>REM</sub>	15		-10	o	

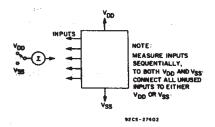


Fig. 12 - Input current test circuit.

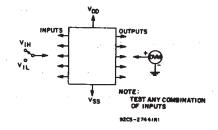


Fig. 13 — Input voltage test circuit.

# TERMINAL ASSIGNMENT CLEAR 18 16 V00 Q1 2 15 Q6 D1 3 44 D6 Q2 4 13 O6 Q2 5 12 Q6 Q3 7 10 Q4 VSS 8 9 CLOCK



28-Aug-2010

#### **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>	Samples (Requires Login)
CD40174BE	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	Contact TI Distributo or Sales Office
CD40174BEE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	Contact TI Distributo or Sales Office
CD40174BF	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	Purchase Samples
CD40174BF3A	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	Purchase Samples
CD40174BM	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BM96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BM96E4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BM96G4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BME4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BMG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BMT	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BMTE4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BMTG4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BNSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BNSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples
CD40174BPWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples



#### PACKAGE OPTION ADDENDUM

28-Aug-2010

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
CD40174BPWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Purchase Samples

(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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#### OTHER QUALIFIED VERSIONS OF CD40174B, CD40174B-MIL:

Catalog: CD40174B

Military: CD40174B-MIL

NOTE: Qualified Version Definitions:

Catalog - TI's standard catalog product





28-Aug-2010

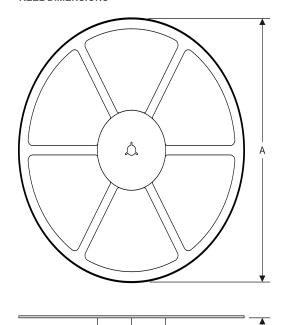
• Military - QML certified for Military and Defense Applications

# PACKAGE MATERIALS INFORMATION

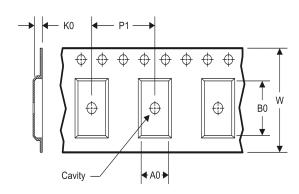
www.ti.com 14-Jul-2012

#### TAPE AND REEL INFORMATION

#### **REEL DIMENSIONS**



#### **TAPE DIMENSIONS**



A0	Dimension designed to accommodate the component width
В0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

#### TAPE AND REEL INFORMATION

#### \*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD40174BM96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD40174BNSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1

**PACKAGE MATERIALS INFORMATION** 

www.ti.com 14-Jul-2012



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD40174BM96	SOIC	D	16	2500	333.2	345.9	28.6
CD40174BNSR	SO	NS	16	2000	367.0	367.0	38.0

#### 14 LEADS SHOWN



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

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

## PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- 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.



# D (R-PDS0-G16)

#### PLASTIC SMALL OUTLINE



- 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 AC.



# D (R-PDSO-G16)

# PLASTIC SMALL OUTLINE



- 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-G16)

### PLASTIC SMALL OUTLINE

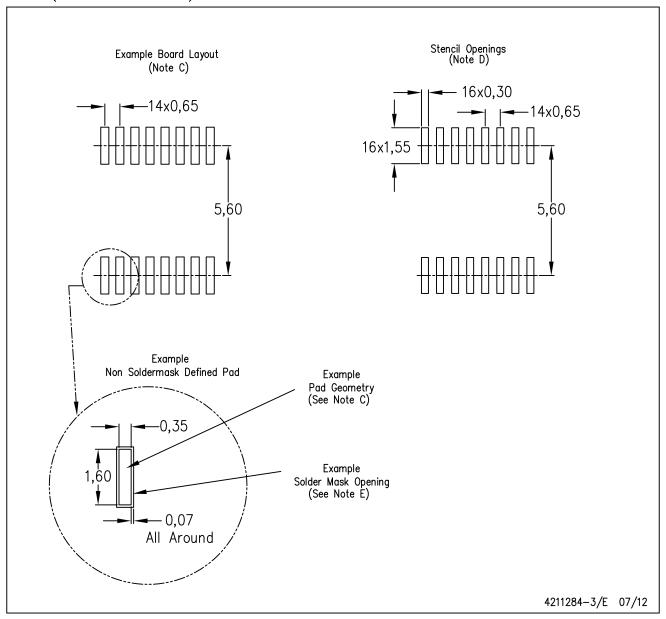


- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M—1994.
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
- Body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



# PW (R-PDSO-G16)

# PLASTIC SMALL OUTLINE



- 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.



#### **MECHANICAL DATA**

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

# 14-PINS SHOWN

#### PLASTIC SMALL-OUTLINE PACKAGE



- 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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