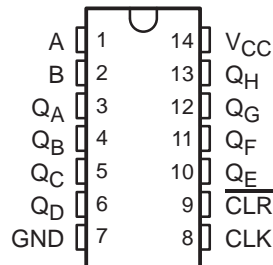


# SN54HC164, SN74HC164 8-BIT PARALLEL-OUT SERIAL SHIFT REGISTERS

SCLS115D – DECEMBER 1982 – REVISED AUGUST 2003

- Wide Operating Voltage Range of 2 V to 6 V
- Outputs Can Drive Up To 10 LSTTL Loads
- Low Power Consumption, 80- $\mu$ A Max  $I_{CC}$
- Typical  $t_{pd} = 20$  ns
- $\pm 4$ -mA Output Drive at 5 V
- Low Input Current of 1  $\mu$ A Max
- AND-Gated (Enable/Disable) Serial Inputs
- Fully Buffered Clock and Serial Inputs
- Direct Clear

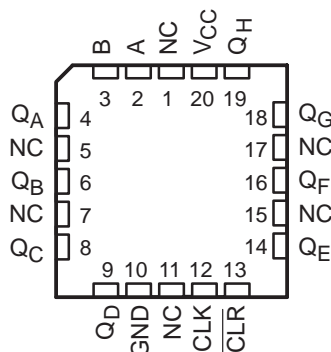
SN54HC164 . . . J OR W PACKAGE  
SN74HC164 . . . D, N, NS, OR PW PACKAGE  
(TOP VIEW)



## description/ordering information

These 8-bit shift registers feature AND-gated serial inputs and an asynchronous clear (CLR) input. The gated serial (A and B) inputs permit complete control over incoming data; a low at either input inhibits entry of the new data and resets the first flip-flop to the low level at the next clock (CLK) pulse. A high-level input enables the other input, which then determines the state of the first flip-flop. Data at the serial inputs can be changed while CLK is high or low, provided the minimum setup time requirements are met. Clocking occurs on the low-to-high-level transition of CLK.

SN54HC164 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## ORDERING INFORMATION

$T_A$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	PDIP – N	Tube of 25	SN74HC164N	SN74HC164N
	SOIC – D	Tube of 50	SN74HC164D	HC164
		Reel of 2500	SN74HC164DR	
		Reel of 250	SN74HC164DT	
	SOP – NS	Reel of 2000	SN74HC164NSR	HC164
	TSSOP – PW	Tube of 90	SN74HC164PW	HC164
Reel of 2000		SN74HC164PWR		
Reel of 250		SN74HC164PWT		
-55°C to 125°C	CDIP – J	Tube of 25	SNJ54HC164J	SNJ54HC164J
	CFP – W	Tube of 150	SNJ54HC164W	SNJ54HC164W
	LCCC – FK	Tube of 55	SNJ54HC164FK	SNJ54HC164FK

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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# SN54HC164, SN74HC164

## 8-BIT PARALLEL-OUT SERIAL SHIFT REGISTERS

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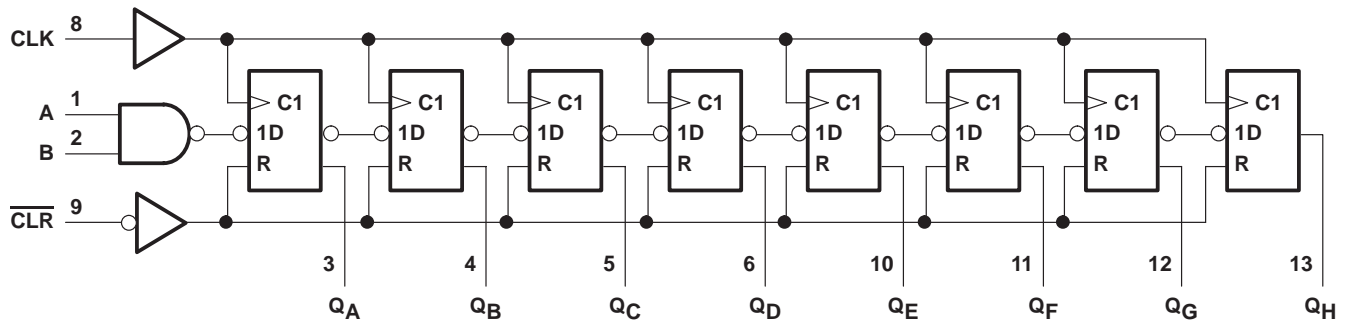
FUNCTION TABLE

INPUTS				OUTPUTS		
CLR	CLK	A	B	Q <sub>A</sub>	Q <sub>B</sub> ... Q <sub>H</sub>	
L	X	X	X	L	L	L
H	L	X	X	Q <sub>A0</sub>	Q <sub>B0</sub>	Q <sub>H0</sub>
H	↑	H	H	H	Q <sub>An</sub>	Q <sub>Gn</sub>
H	↑	L	X	L	Q <sub>An</sub>	Q <sub>Gn</sub>
H	↑	X	L	L	Q <sub>An</sub>	Q <sub>Gn</sub>

Q<sub>A0</sub>, Q<sub>B0</sub>, Q<sub>H0</sub> = the level of Q<sub>A</sub>, Q<sub>B</sub>, or Q<sub>H</sub>, respectively, before the indicated steady-state input conditions were established

Q<sub>An</sub>, Q<sub>Gn</sub> = the level of Q<sub>A</sub> or Q<sub>G</sub> before the most recent ↑ transition of CLK: indicates a 1-bit shift

### logic diagram (positive logic)

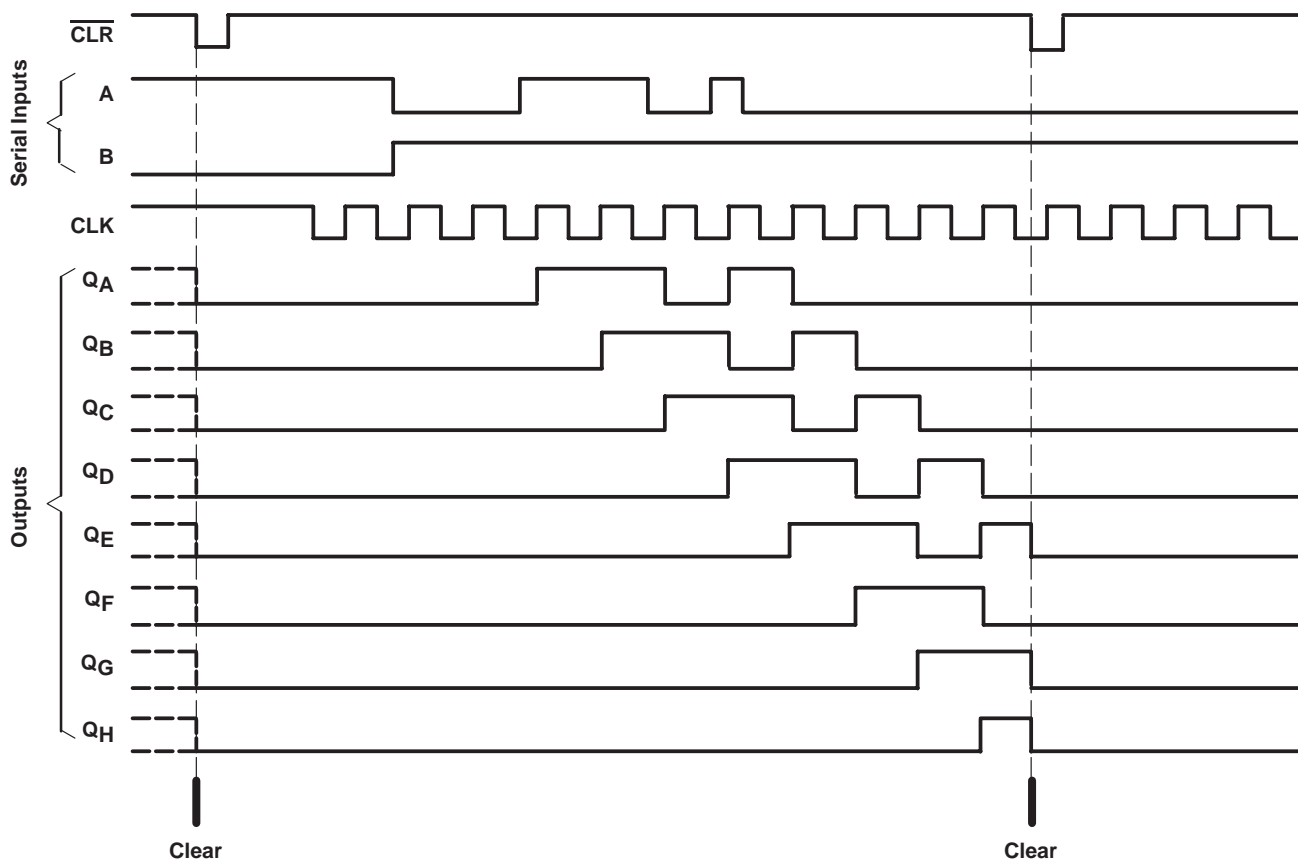


Pin numbers shown are for the D, J, N, NS, PW, and W packages.

# SN54HC164, SN74HC164 8-BIT PARALLEL-OUT SERIAL SHIFT REGISTERS

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## typical clear, shift, and clear sequence



## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, $V_{CC}$ .....	-0.5 V to 7 V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1) .....	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1) .....	$\pm 20$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....	$\pm 25$ mA
Continuous current through $V_{CC}$ or GND .....	$\pm 50$ mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): D package .....	86°C/W
N package .....	80°C/W
NS package .....	76°C/W
PW package .....	113°C/W
Storage temperature range, $T_{stg}$ .....	-65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The package thermal impedance is calculated in accordance with JESD 51-7.



# SN54HC164, SN74HC164

## 8-BIT PARALLEL-OUT SERIAL SHIFT REGISTERS

SCLS115D – DECEMBER 1982 – REVISED AUGUST 2003

### recommended operating conditions (see Note 3)

		SN54HC164			SN74HC164			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	2	5	6	2	5	6	V
$V_{IH}$	High-level input voltage	$V_{CC} = 2\text{ V}$		1.5	1.5		V	
		$V_{CC} = 4.5\text{ V}$		3.15	3.15			
		$V_{CC} = 6\text{ V}$		4.2	4.2			
$V_{IL}$	Low-level input voltage	$V_{CC} = 2\text{ V}$			0.5	0.5	V	
		$V_{CC} = 4.5\text{ V}$			1.35	1.35		
		$V_{CC} = 6\text{ V}$			1.8	1.8		
$V_I$	Input voltage	0		$V_{CC}$	0	$V_{CC}$	V	
$V_O$	Output voltage	0		$V_{CC}$	0	$V_{CC}$	V	
$\Delta t/\Delta v^\dagger$	Input transition rise/fall time	$V_{CC} = 2\text{ V}$			1000	1000	ns	
		$V_{CC} = 4.5\text{ V}$			500	500		
		$V_{CC} = 6\text{ V}$			400	400		
$T_A$	Operating free-air temperature	-55		125	-40	85	°C	

NOTE 3: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

† If this device is used in the threshold region (from  $V_{ILmax} = 0.5\text{ V}$  to  $V_{IHmin} = 1.5\text{ V}$ ), there is a potential to go into the wrong state from induced grounding, causing double clocking. Operating with the inputs at  $t_t = 1000\text{ ns}$  and  $V_{CC} = 2\text{ V}$  does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.

### electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HC164		SN74HC164		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$V_{OH}$	$V_I = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\ \mu\text{A}$	2 V	1.9	1.998	1.9	1.9	V		
			4.5 V	4.4	4.499	4.4	4.4			
			6 V	5.9	5.999	5.9	5.9			
		$I_{OH} = -4\text{ mA}$	4.5 V	3.98	4.3	3.7	3.84			
			6 V	5.48	5.8	5.2	5.34			
$V_{OL}$	$V_I = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\ \mu\text{A}$	2 V		0.002	0.1	0.1	V		
			4.5 V		0.001	0.1	0.1			
			6 V		0.001	0.1	0.1			
		$I_{OL} = 4\text{ mA}$	4.5 V		0.17	0.26	0.4		0.33	
			6 V		0.15	0.26	0.4		0.33	
$I_I$	$V_I = V_{CC}$ or 0	6 V		$\pm 0.1$	$\pm 100$	$\pm 1000$	$\pm 1000$	nA		
$I_{CC}$	$V_I = V_{CC}$ or 0, $I_O = 0$	6 V			8	160	80	$\mu\text{A}$		
$C_i$		2 V to 6 V		3	10	10	10	pF		



# SN54HC164, SN74HC164

## 8-BIT PARALLEL-OUT SERIAL SHIFT REGISTERS

SCLS115D – DECEMBER 1982 – REVISED AUGUST 2003

**timing requirements over recommended operating free-air temperature range (unless otherwise noted)**

		V <sub>CC</sub>	T <sub>A</sub> = 25°C		SN54HC164		SN74HC164		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency	2 V	6		4.2		5		MHz
		4.5 V	31		21		25		
		6 V	36		25		28		
t <sub>w</sub>	Pulse duration	CLR low	2 V	100	150	125	ns		
			4.5 V	20	30	25			
			6 V	17	25	21			
	CLK high or low	2 V	80	120	100				
		4.5 V	16	24	20				
		6 V	14	20	18				
t <sub>su</sub>	Data	Data	2 V	100	150	125	ns		
			4.5 V	20	30	25			
			6 V	17	25	21			
	CLR inactive	2 V	100	150	125				
		4.5 V	20	30	25				
		6 V	17	25	21				
t <sub>h</sub>	Hold time, data after CLK↑	2 V	5	5	5	ns			
		4.5 V	5	5	5				
		6 V	5	5	5				

**switching characteristics over recommended operating free-air temperature range, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub>	T <sub>A</sub> = 25°C			SN54HC164		SN74HC164		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f <sub>max</sub>			2 V	6	10		4.2		5	MHz	
			4.5 V	31	54		21		25		
			6 V	36	62		25		28		
t <sub>PHL</sub>	CLR	Any Q	2 V		140	205		295		255	ns
			4.5 V		28	41		59		51	
			6 V		24	35		51		46	
t <sub>pd</sub>	CLK	Any Q	2 V		115	175		265		220	ns
			4.5 V		23	35		53		44	
			6 V		20	30		45		38	
t <sub>t</sub>			2 V		38	75		110		95	ns
			4.5 V		8	15		22		19	
			6 V		6	13		19		16	

**operating characteristics, T<sub>A</sub> = 25°C**

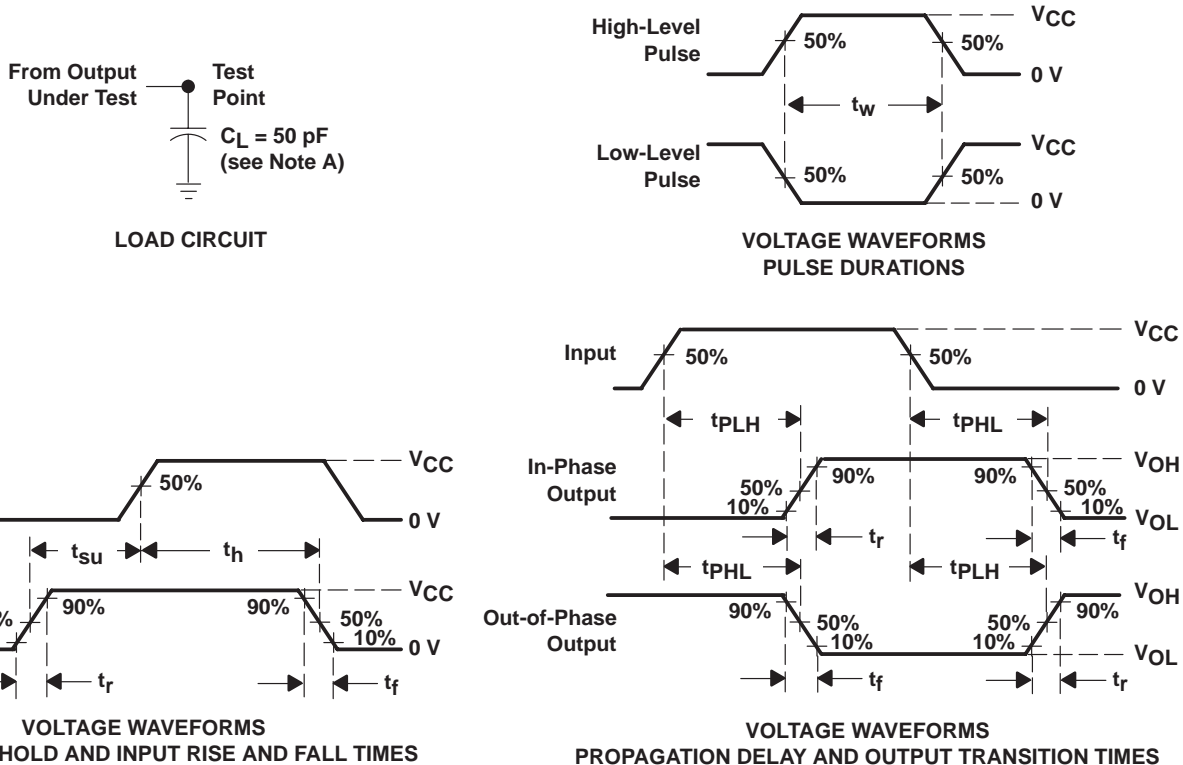
PARAMETER	TEST CONDITIONS	TYP	UNIT
C <sub>pd</sub> Power dissipation capacitance	No load	135	pF



# SN54HC164, SN74HC164 8-BIT PARALLEL-OUT SERIAL SHIFT REGISTERS

SCLS115D – DECEMBER 1982 – REVISED AUGUST 2003

## PARAMETER MEASUREMENT INFORMATION



- NOTES:
- $C_L$  includes probe and test-fixture capacitance.
  - Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r = 6 \text{ ns}$ ,  $t_f = 6 \text{ ns}$ .
  - For clock inputs,  $f_{max}$  is measured when the input duty cycle is 50%.
  - The outputs are measured one at a time with one input transition per measurement.
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 1. Load Circuit and Voltage Waveforms

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>
5962-8416201VCA	ACTIVE	CDIP	J	14	1	None	Call TI	Level-NC-NC-NC
5962-8416201VDA	ACTIVE	CFP	W	14	1	None	Call TI	Level-NC-NC-NC
84162012A	ACTIVE	LCCC	FK	20	1	None	Call TI	Level-NC-NC-NC
8416201CA	ACTIVE	CDIP	J	14	1	None	Call TI	Level-NC-NC-NC
SN54HC164J	ACTIVE	CDIP	J	14	1	None	Call TI	Level-NC-NC-NC
SN74HC164D	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74HC164DR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74HC164DT	ACTIVE	SOIC	D	14	250	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74HC164N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74HC164N3	OBSOLETE	PDIP	N	14		None	Call TI	Call TI
SN74HC164NSR	ACTIVE	SO	NS	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74HC164PW	ACTIVE	TSSOP	PW	14	90	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74HC164PWR	ACTIVE	TSSOP	PW	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74HC164PWT	ACTIVE	TSSOP	PW	14	250	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SNJ54HC164FK	ACTIVE	LCCC	FK	20	1	None	Call TI	Level-NC-NC-NC
SNJ54HC164J	ACTIVE	CDIP	J	14	1	None	Call TI	Level-NC-NC-NC
SNJ54HC164W	ACTIVE	CFP	W	14	1	None	Call TI	Level-NC-NC-NC

<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 - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**None:** Not yet available Lead (Pb-Free).

**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.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

<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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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.

W (R-GDFP-F14)

CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only.
  - E. Falls within MIL STD 1835 GDFP1-F14 and JEDEC MO-092AB

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a metal lid.
  - D. The terminals are gold plated.
  - E. Falls within JEDEC MS-004

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.

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.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-012 variation AB.

## 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.

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

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