

# SN54LS112A, SN54S112, SN74LS112A, SN74S112A DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESET AND CLEAR

D2661, APRIL 1982—REVISED MARCH 1988

SDLS011

- Fully Buffered to Offer Maximum Isolation from External Disturbance
- Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers and Flat Packages, and Plastic and Ceramic DIPs
- Dependable Texas Instruments Quality and Reliability

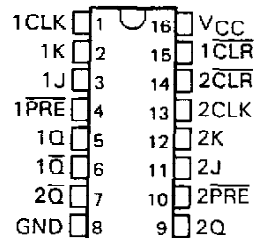
## description

These devices contain two independent J-K negative-edge-triggered flip-flops. A low level at the preset and clear inputs sets or resets the outputs regardless of the levels of the other inputs. When preset and clear are inactive (high), data at the J and K inputs meeting the setup time requirements are transferred to the outputs on the negative-going edge of the clock pulse. Clock triggering occurs at a voltage level and is not directly related to the rise time of the clock pulse. Following the hold time interval, data at the J and K inputs may be changed without affecting the levels at the outputs. These versatile flip-flops can perform as toggle flip-flops by tying J and K high.

The SN54LS112A and SN54S112 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74LS112A and SN74S112A are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

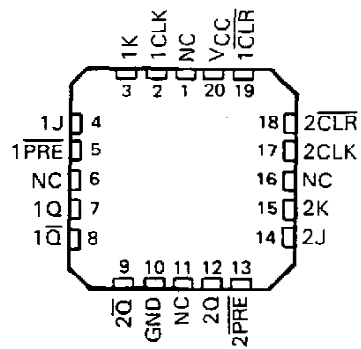
SN54LS112A, SN54S112 . . . J OR W PACKAGE  
SN74LS112A, SN74S112A . . . D OR N PACKAGE

(TOP VIEW)



SN54LS112A, SN54S112 . . . FK PACKAGE

(TOP VIEW)



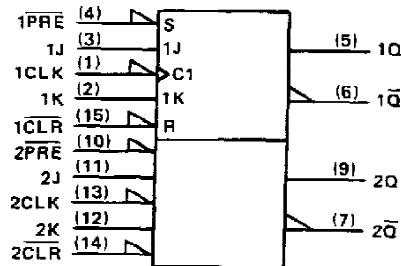
NC—No internal connection

FUNCTION TABLE (each flip-flop)

INPUTS					OUTPUTS	
PRE	CLR	CLK	J	K	Q	Q̄
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H†	H†
H	H	↓	L	L	Q <sub>0</sub>	Q̄ <sub>0</sub>
H	H	↓	H	L	H	L
H	H	↓	L	H	L	H
H	H	↓	H	H	TOGGLE	
H	H	H	X	X	Q <sub>0</sub>	Q̄ <sub>0</sub>

† The output levels in this configuration are not guaranteed to meet the minimum levels for  $V_{OH}$  if the lows at preset and clear are near  $V_{IL}$  minimum. Furthermore, this configuration is nonstable; that is, it will not persist when either preset or clear returns to its inactive (high) level.

## logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

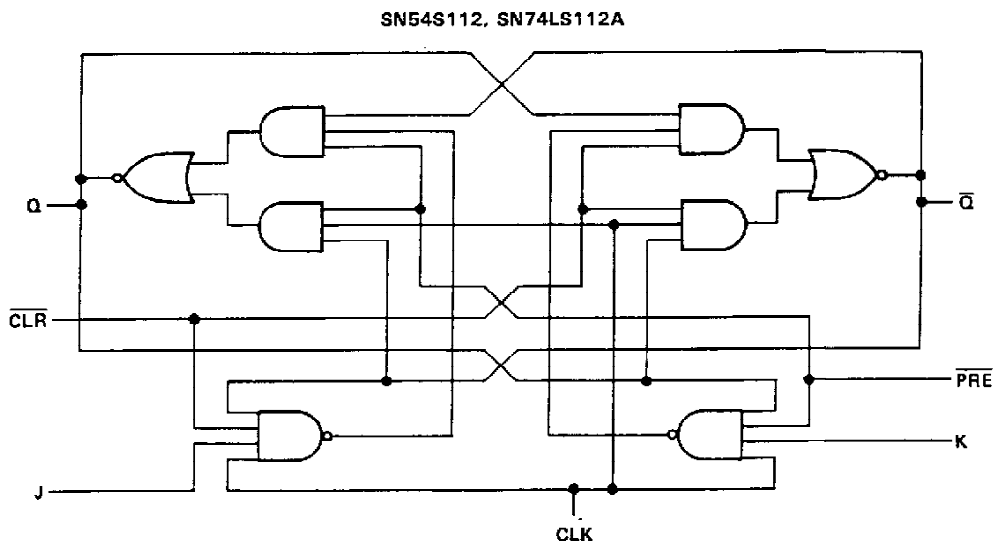
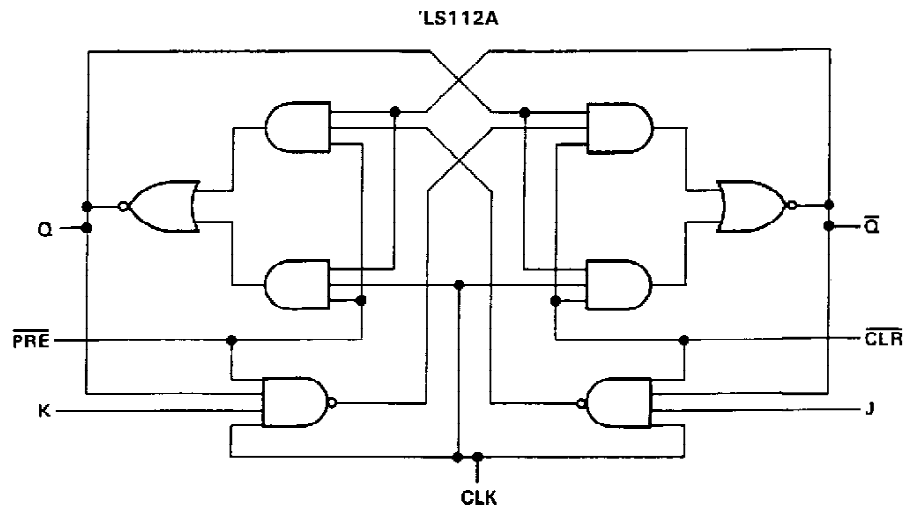


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# SN54LS112A, SN54S112, SN74LS112A, SN74S112A DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESET AND CLEAR

logic diagrams (positive logic)



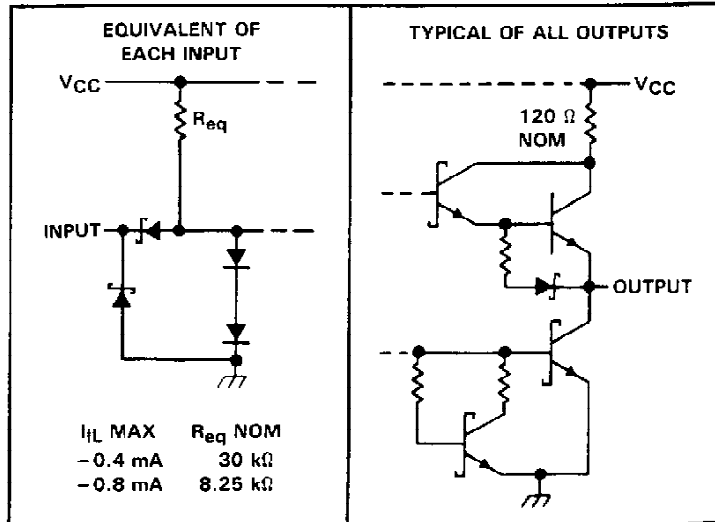
**TEXAS**  
**INSTRUMENTS**

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**SN54LS112A, SN54S112, SN74LS112A, SN74S112A**  
**DUAL J-K NEGATIVE-EDGE-TRIGGERED**  
**FLIP-FLOPS WITH PRESET AND CLEAR**

schematics of inputs and outputs

'LS112A



SN54S112, SN74S112A



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

Supply voltage, $V_{CC}$ (see Note 1) .....	7 V
Input voltage: 'LS112A .....	7 V
SN54LS112, SN74LS112A .....	5.5 V
Operating free-air temperature range: SN54' .....	-55°C to 125°C
SN74' .....	0°C to 70°C
Storage temperature range .....	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

  
**TEXAS**  
**INSTRUMENTS**

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# SN54LS112A, SN74LS112A

## DUAL J-K NEGATIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESET AND CLEAR

### recommended operating conditions

		SN54LS112A			SN74LS112A			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
$V_{IH}$	High-level input voltage	2			2			V
$V_{IL}$	Low-level input voltage			0.7			0.8	V
$I_{OH}$	High-level output current			-0.4			-0.4	mA
$I_{OL}$	Low-level output current			4			8	mA
$f_{clock}$	Clock frequency	0		30	0		30	MHz
$t_w$	Pulse duration	CLK high		20			20	ns
		PRE or CLR low		25			25	
$t_{su}$	Set up time-before CLK↓	Data high or low		20			20	ns
		CLR inactive		25			25	
		PRE inactive		20			20	
$t_h$	Hold time-data after CLK↓	0			0			ns
$T_A$	Operating free-air temperature	-55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS†	SN54LS112A			SN74LS112A			UNIT
			MIN	TYP‡	MAX	MIN	TYP‡	MAX	
$V_{IK}$		$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$			-1.5			-1.5	V
$V_{OH}$		$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = \text{MAX}, I_{OH} = -0.4 \text{ mA}$	2.5	3.4		2.7	3.4		V
$V_{OL}$		$V_{CC} = \text{MIN}, V_{IL} = \text{MAX}, V_{IH} = 2 \text{ V}, I_{OL} = 4 \text{ mA}$	0.25	0.4		0.25	0.4		V
		$V_{CC} = \text{MIN}, V_{IL} = \text{MAX}, V_{IH} = 2 \text{ V}, I_{OL} = 8 \text{ mA}$				0.35	0.5		
$I_I$	J or K	$V_{CC} = \text{MAX}, V_I = 7 \text{ V}$			0.1			0.1	mA
	CLR or PRE				0.3			0.3	
	CLK				0.4			0.4	
$I_{IH}$	J or K	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$			20			20	$\mu\text{A}$
	CLR or PRE				60			60	
	CLK				80			80	
$I_{IL}$	J or K	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$			-0.4			-0.4	mA
	All other				-0.8			-0.8	
$I_{OS}^{\S}$		$V_{CC} = \text{MAX},$ see Note 2	-20		-100	-20		-100	mA
$I_{CC}$ (Total)		$V_{CC} = \text{MAX},$ see Note 3		4	6		4	6	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second.

NOTES: 2. For certain devices where state commutation can be caused by shorting an output to ground, an equivalent test may be performed with  $V_O = 2.25 \text{ V}$  and  $2.125 \text{ V}$  for the '54 family and the '74 family, respectively, with the minimum and maximum limits reduced to one half of their stated values.

3. With all outputs open,  $I_{CC}$  is measured with the Q and  $\bar{Q}$  outputs high in turn. At the time of measurement, the clock input is grounded.

TEXAS  
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**SN54LS112A, SN74LS112A**  
**DUAL J-K NEGATIVE-EDGE-TRIGGERED**  
**FLIP-FLOPS WITH PRESET AND CLEAR**

switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (see Note 4)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
$f_{\max}$			$R_L = 2\text{ k}\Omega$ , $C_L = 15\text{ pF}$	30	45		MHz	
$t_{PLH}$	$\overline{\text{CLR}}$ , $\overline{\text{PRE}}$ or CLK	Q or $\overline{\text{Q}}$			15	20		ns
$t_{PHL}$					15	20		ns

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.

**SN54S112, SN74S112A**  
**DUAL J-K NEGATIVE-EDGE-TRIGGERED**  
**FLIP-FLOPS WITH PRESET AND CLEAR**

**recommended operating conditions**

		SN54S112			SN74S112A			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
V <sub>IH</sub>	High-level input voltage	2			2			V
V <sub>IL</sub>	Low-level input voltage	0.8			0.8			V
I <sub>OH</sub>	High-level output current	-1			-1			mA
I <sub>OL</sub>	Low-level output current	20			20			mA
t <sub>w</sub>	Pulse duration	CLK high		6	6		ns	
		CLK low		6.5	6.5			
		PRE or CLR low		8	8			
t <sub>su</sub>	Set up time-before CLK↓	Data high or low		7	7		ns	
t <sub>h</sub>	Hold time-data after CLK↓	0			0			ns
T <sub>A</sub>	Operating free-air temperature	-55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS†		SN54S112			SN74S112A			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V <sub>IK</sub>		V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA		-1.2			-1.2			V
V <sub>OH</sub>		V <sub>CC</sub> = MIN, I <sub>OH</sub> = -1 mA, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX,		2.5	3.4		2.7	3.4		V
V <sub>OL</sub>		V <sub>CC</sub> = MIN, I <sub>OL</sub> = 20 mA, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V,		0.5			0.5			V
I <sub>I</sub>		V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V		1			1			mA
I <sub>IH</sub>	J or K	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V		50			50			μA
	All other			100			100			
I <sub>IL</sub>	J or K	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.5 V		-1.6			-1.6			mA
	CLR‡			-7			-7			
	PRE‡			-7			-7			
	CLK			-4			-4			
I <sub>OS</sub> †		V <sub>CC</sub> = MAX		-40	-100		-40	-100	mA	
I <sub>CC</sub> #		V <sub>CC</sub> = MAX, see Note 3		15	25		15	25	mA	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

§ Clear is tested with preset high and preset is tested with clear high.

¶ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second.

# Values are average per flip-flop.

NOTE 3: With all outputs open, I<sub>CC</sub> is measured with the Q and Q̄ outputs high in turn. At the time of measurement, the clock input is grounded.



**SN54S112, SN74S112A**  
**DUAL J-K NEGATIVE-EDGE-TRIGGERED**  
**FLIP-FLOPS WITH PRESET AND CLEAR**

switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (see Note 4)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$f_{max}$			$R_L = 280\ \Omega, \quad C_L = 15\ \text{pF}$	80	125		MHz
$t_{PLH}$	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$	$Q$ or $\overline{Q}$			4	7	ns
$t_{PHL}$	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ (CLK high)	$\overline{Q}$ or $Q$			5	7	ns
	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ (CLK low)				5	7	
$t_{PLH}$	CLK	$Q$ or $\overline{Q}$			4	7	ns
$t_{PHL}$					5	7	ns

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.

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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>
JM38510/07102BEA	ACTIVE	CDIP	J	16	1	TBD	Call TI	Level-NC-NC-NC
JM38510/07102BFA	ACTIVE	CFP	W	16	1	TBD	Call TI	Level-NC-NC-NC
JM38510/30103B2A	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
JM38510/30103BEA	ACTIVE	CDIP	J	16	1	TBD	Call TI	Level-NC-NC-NC
JM38510/30103BFA	ACTIVE	CFP	W	16	1	TBD	Call TI	Level-NC-NC-NC
SN54LS112AJ	ACTIVE	CDIP	J	16	1	TBD	Call TI	Level-NC-NC-NC
SN54S112J	ACTIVE	CDIP	J	16	1	TBD	Call TI	Level-NC-NC-NC
SN74LS112AD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS112ADE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS112ADR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS112ADRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS112AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74LS112AN3	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74LS112ANE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74LS112ANSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS112ANSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74S112AD	OBSOLETE	SOIC	D	16		TBD	Call TI	Call TI
SN74S112ADR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74S112ADRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74S112AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74S112AN3	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74S112ANE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74S112ANSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74S112ANSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54LS112AFK	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
SNJ54LS112AJ	ACTIVE	CDIP	J	16	1	TBD	Call TI	Level-NC-NC-NC
SNJ54LS112AW	ACTIVE	CFP	W	16	1	TBD	Call TI	Level-NC-NC-NC
SNJ54S112FK	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
SNJ54S112J	ACTIVE	CDIP	J	16	1	TBD	Call TI	Level-NC-NC-NC
SNJ54S112W	ACTIVE	CFP	W	16	1	TBD	Call TI	Level-NC-NC-NC

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

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

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**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) 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.

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(3) 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-F16)

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-F16 and JEDEC MO-092AC

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

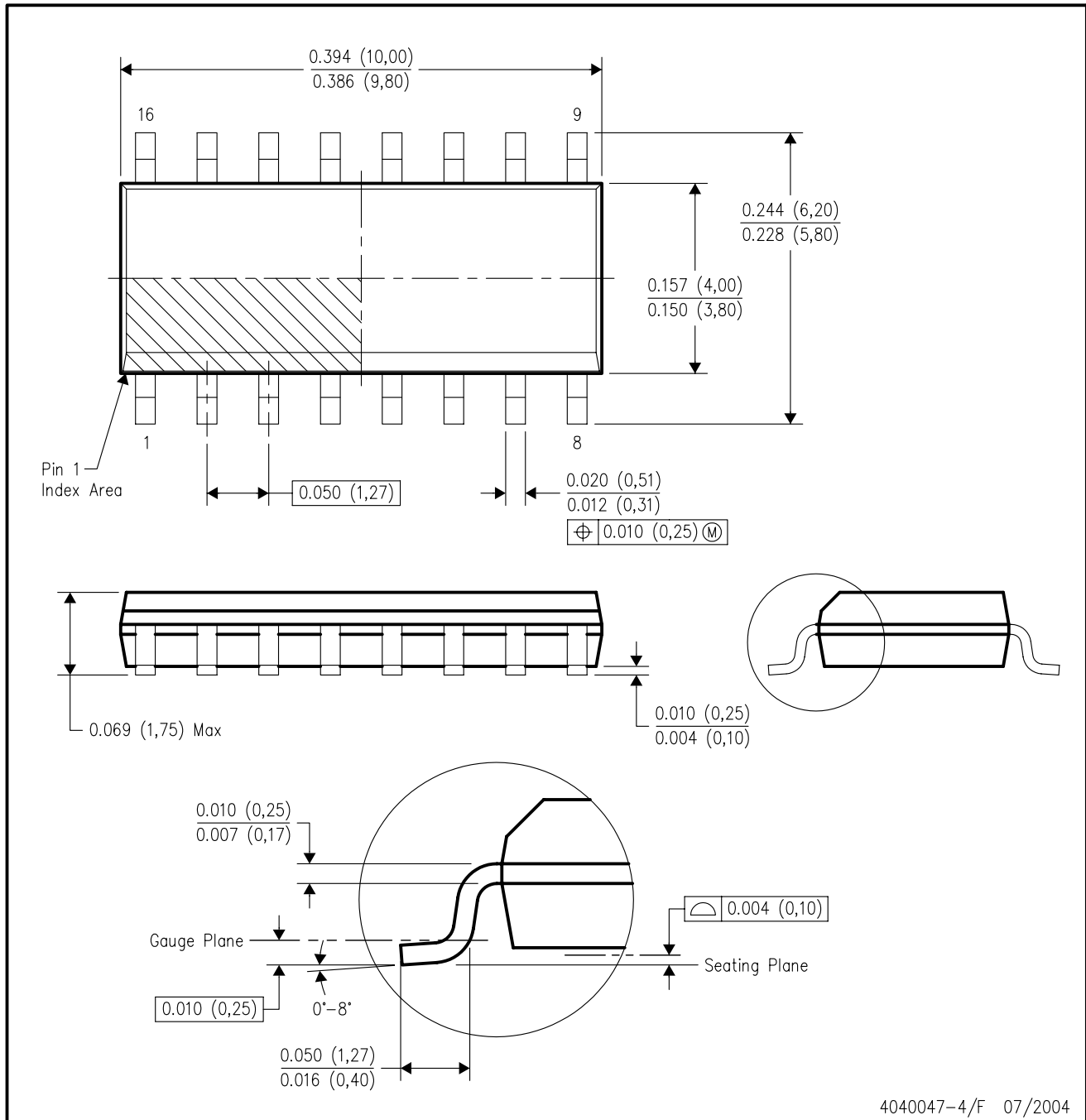
16 PINS SHOWN



- 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-G16)

PLASTIC SMALL-OUTLINE PACKAGE



4040047-4/F 07/2004

- 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 AC.

# 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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