

SDLS034

QUADRUPLE 2-INPUT POSITIVE-AND GATES WITH OPEN-COLLECTOR OUTPUTS

SN5409, SN54LS09, SN54S09,
SN7409, SN74LS09, SN74S09
DECEMBER 1983—REVISED MARCH 1988

- Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers and Flat Packages, and Plastic and Ceramic DIPs
- Dependable Texas Instruments Quality and Reliability

SN5409, SN54LS09, SN54S09 . . . J OR W PACKAGE
SN7409 . . . N PACKAGE
SN74LS09, SN74S09 . . . D OR N PACKAGE
(TOP VIEW)



description

These devices contain four independent 2-input AND gates. The open-collector outputs require pull-up resistors to perform correctly. They may be connected to other open-collector outputs to implement active-low wired-OR or active-high wired-AND functions. Open-collector devices are often used to generate higher V_{OH} levels.

The SN5409, SN54LS09, and SN54S09 are characterized for operation over the full military temperature range of -55°C to 125°C . The SN7409, SN74LS09, and SN74S09 are characterized for operation from 0°C to 70°C .

SN54LS09, SN54S09 . . . FK PACKAGE
(TOP VIEW)



FUNCTION TABLE (each gate)

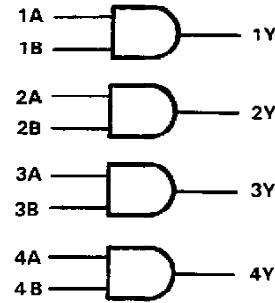
INPUTS		OUTPUT
A	B	Y
H	H	H
L	X	L
X	L	L

NC—No internal connection

logic symbol



logic diagram (positive logic)



$$Y = A \cdot B \text{ or } Y = \overline{\overline{A} + \overline{B}}$$

† 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.

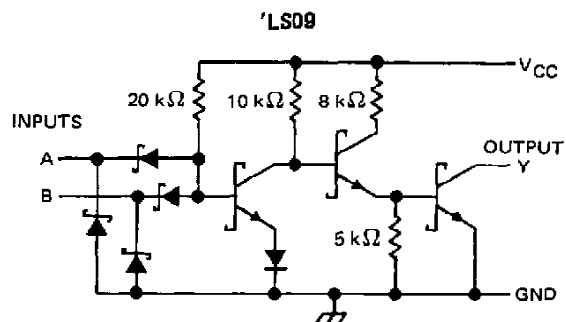
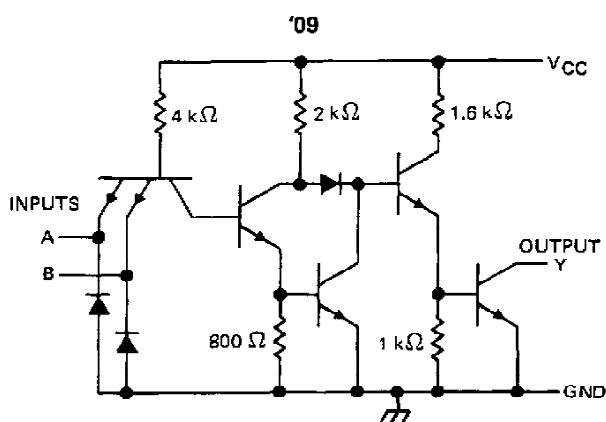
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**SN5409, SN54LS09, SN54S09,
SN7409, SN74LS09, SN74S09
QUADRUPLE 2-INPUT POSITIVE-AND GATES WITH OPEN-COLLECTOR OUTPUTS**

schematics (each gate)



Resistor values shown are nominal.

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

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage: '09, 'S09	5.5 V
'LS09	7 V
Off-state output voltage	7 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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SN5409, SN7409
QUADRUPLE 2-INPUT POSITIVE-AND GATES WITH OPEN-COLLECTOR OUTPUTS

recommended operating conditions

	SN5409			SN7409			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			0.8			0.8	V
V_{OH} High-level output voltage			5.5			5.5	V
I_{OL} Low-level output current			16			16	mA
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†	MIN	TYP‡	MAX	UNIT
V_{IK}	$V_{CC} = \text{MIN}$, $I_I = -12 \text{ mA}$			-1.5	V
I_{OH}	$V_{CC} = \text{MIN}$, $V_{IH} = 2 \text{ V}$, $V_{OH} = 5.5 \text{ V}$			0.25	mA
V_{OL}	$V_{CC} = \text{MIN}$, $V_{IL} = 0.8 \text{ V}$, $I_{OL} = 16 \text{ mA}$		0.2	0.4	V
I_I	$V_{CC} = \text{MAX}$, $V_I = 5.5 \text{ V}$			1	mA
I_{IH}	$V_{CC} = \text{MAX}$, $V_I = 2.4 \text{ V}$			40	μA
I_{IL}	$V_{CC} = \text{MAX}$, $V_I = 0.4 \text{ V}$			-1.6	mA
I_{CCH}	$V_{CC} = \text{MAX}$, $V_I = 4.5 \text{ V}$		11	21	mA
I_{CCL}	$V_{CC} = \text{MAX}$, $V_I = 0 \text{ V}$		20	33	mA

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

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

switching characteristics, $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$ (see note 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	A or B	Y	$R_L = 400 \Omega$, $C_L = 15 \text{ pF}$		21	32	ns
t_{PHL}					16	24	ns

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.



SN54LS09, SN74LS09 QUADRUPLE 2-INPUT POSITIVE-AND GATES WITH OPEN-COLLECTOR OUTPUTS

recommended operating conditions

	SN54LS09			SN74LS09			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
V _{OH} High-level output voltage			5.5			5.5	V
I _{OL} Low-level output current			4			8	mA
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†	SN54LS09			SN74LS09			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V _{IK}	V _{CC} = MIN, I _I = -18 mA			-1.5			-1.5	V
I _{OH}	V _{CC} = MIN, V _{IH} = 2 V, V _{OH} = 5.5 V			0.1			0.1	mA
V _{OL}	V _{CC} = MIN, V _{IL} = MAX, I _{OL} = 4 mA		0.25	0.4		0.25	0.4	V
	V _{CC} = MIN, V _{IL} = MAX, I _{OL} = 8 mA					0.35	0.5	
I _I	V _{CC} = MAX, V _I = 7 V			0.1			0.1	mA
I _{IH}	V _{CC} = MAX, V _I = 2.7 V			20			20	μA
I _{IL}	V _{CC} = MAX, V _I = 0.4 V			-0.4			-0.4	mA
I _{CCH}	V _{CC} = MAX, V _I = 4.5 V		2.4	4.8		2.4	4.8	mA
I _{CCL}	V _{CC} = MAX, V _I = 0 V		4.4	8.8		4.4	8.8	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 V, T_A = 25°C.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see note 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{PLH}	A or B	Y	R _L = 2 kΩ, C _L = 15 pF		20	35	ns
t _{PHL}					17	35	ns

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

TEXAS
INSTRUMENTS

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SN54S09, SN74S09
QUADRUPLE 2-INPUT POSITIVE-AND GATES WITH OPEN-COLLECTOR OUTPUTS

recommended operating conditions

	SN54S09			SN74S09			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				0.8			V
V _{OH} High-level output voltage				5.5			V
I _{OL} Low-level output current				20			mA
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†	MIN	TYP‡	MAX	UNIT
V _{IK}	V _{CC} = MIN, I _I = - 18 mA			- 1.2	V
I _{OH}	V _{CC} = MIN, V _{IH} = 2 V, V _{OH} = 5.5 V			0.25	mA
V _{OL}	V _{CC} = MIN, V _{IL} = 0.8 V, I _{OL} = 20 mA			0.5	V
I _I	V _{CC} = MAX, V _I = 5.5 V			1	mA
I _{IH}	V _{CC} = MAX, V _I = 2.7 V			50	µA
I _{IL}	V _{CC} = MAX, V _I = 0.5 V			- 2	mA
I _{CCH}	V _{CC} = MAX, V _I = 4.5 V			18 32	mA
I _{CCL}	V _{CC} = MAX, V _I = 0 V			32 57	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 V, T_A = 25°C.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see note 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{PLH}	A or B	Y	R _L = 280 Ω, C _L = 15 pF	6.5	10	ns	
t _{PHL}				6.5	10	ns	
t _{PLH}			R _L = 280 Ω, C _L = 50 pF	9	ns		
t _{PHL}				9	ns		

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.



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PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
80019012A	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
8001901CA	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
8001901CA	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
8001901DA	ACTIVE	CFP	W	14	1	TBD	Call TI	Level-NC-NC-NC
8001901DA	ACTIVE	CFP	W	14	1	TBD	Call TI	Level-NC-NC-NC
SN54LS09J	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
SN54LS09J	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
SN54S09J	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
SN54S09J	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
SN7409N	OBSOLETE	PDIP	N	14		TBD	Call TI	Call TI
SN7409N	OBSOLETE	PDIP	N	14		TBD	Call TI	Call TI
SN74LS09D	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74LS09D	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74LS09DE4	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74LS09DE4	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74LS09DR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74LS09DR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74LS09DRE4	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74LS09DRE4	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74LS09J	OBSOLETE	CDIP	J	14		TBD	Call TI	Call TI
SN74LS09J	OBSOLETE	CDIP	J	14		TBD	Call TI	Call TI
SN74LS09N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74LS09N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74LS09N3	OBSOLETE	PDIP	N	14		TBD	Call TI	Call TI
SN74LS09N3	OBSOLETE	PDIP	N	14		TBD	Call TI	Call TI
SN74LS09NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74LS09NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74LS09NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS09NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS09NSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS09NSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN74S09D	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74S09D	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74S09DE4	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74S09DE4	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74S09DR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74S09DR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74S09DRE4	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74S09DRE4	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74S09N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74S09N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74S09NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74S09NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74S09NSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74S09NSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54LS09FK	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
SNJ54LS09FK	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
SNJ54LS09J	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
SNJ54LS09J	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
SNJ54LS09W	ACTIVE	CFP	W	14	1	TBD	Call TI	Level-NC-NC-NC
SNJ54LS09W	ACTIVE	CFP	W	14	1	TBD	Call TI	Level-NC-NC-NC
SNJ54S09FK	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
SNJ54S09FK	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
SNJ54S09J	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
SNJ54S09J	ACTIVE	CDIP	J	14	1	TBD	Call TI	Level-NC-NC-NC
SNJ54S09W	ACTIVE	CFP	W	14	1	TBD	Call TI	Level-NC-NC-NC
SNJ54S09W	ACTIVE	CFP	W	14	1	TBD	Call TI	Level-NC-NC-NC

⁽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.

OBSELETE: 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.

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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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)

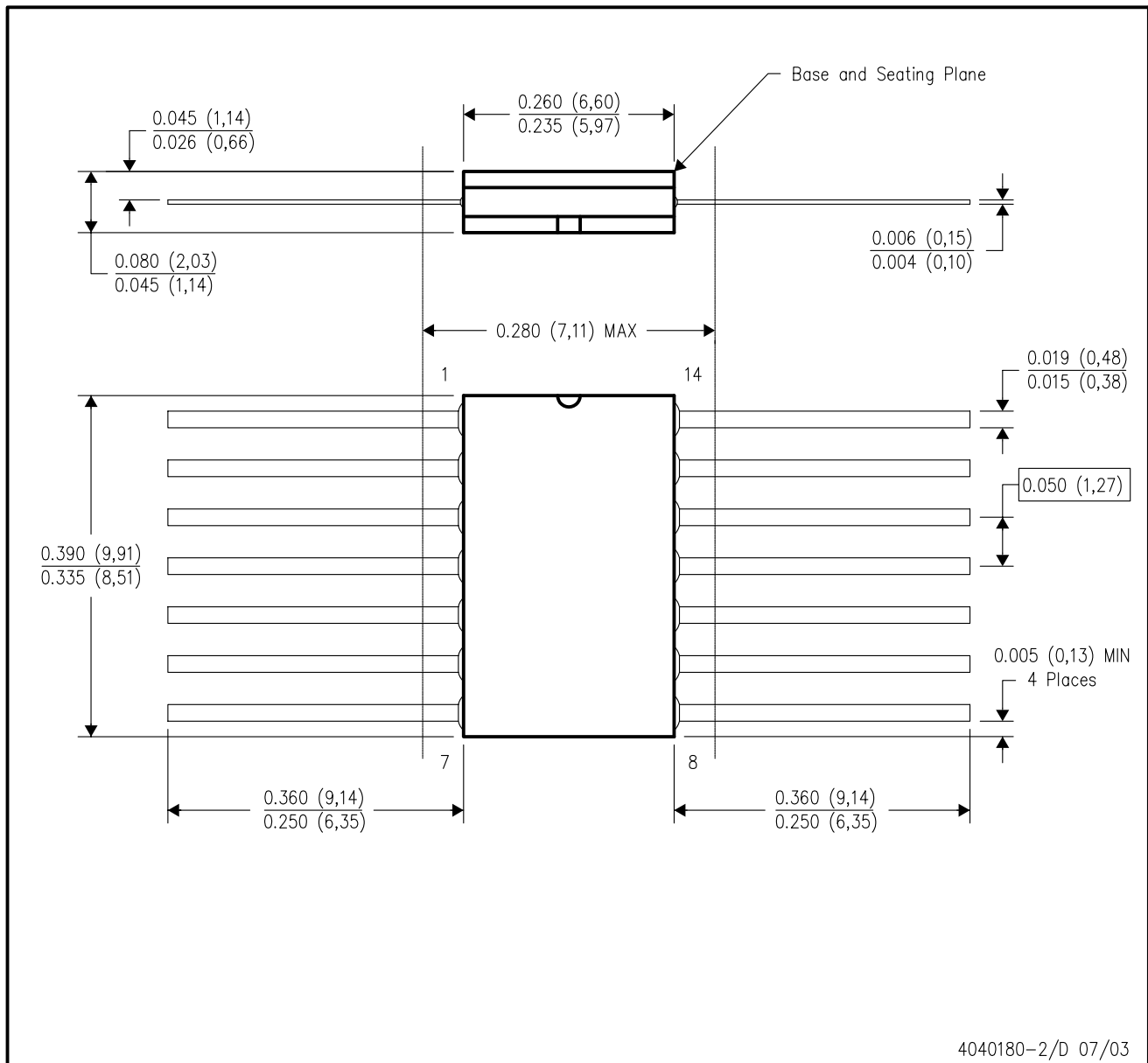


4040083/F 03/03

- 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



4040140/D 10/96

- 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.

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