

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

REVISED DECEMBER 1983

- Package Options Include Both Plastic and Ceramic Chip Carriers in Addition to Plastic and Ceramic DIPs
- Dependable Texas Instruments Quality and Reliability

## 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  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7409, SN74LS09 and SN74S09 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

FUNCTION TABLE (each gate)

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

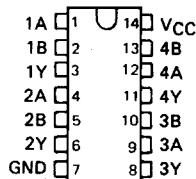
## logic diagram (each gate)



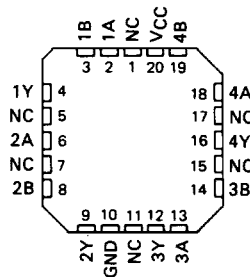
## positive logic

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

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



SN54LS09, SN54S09 ... FK PACKAGE  
SN74LS09, SN74S09 ... FN PACKAGE  
(TOP VIEW)

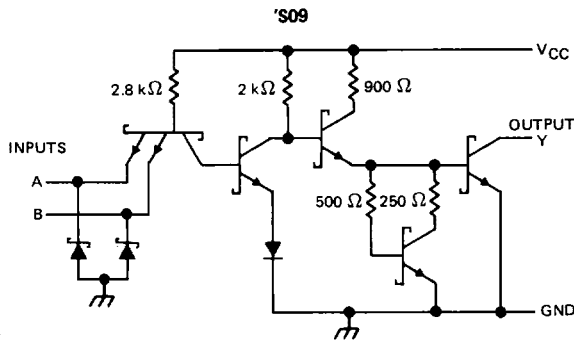
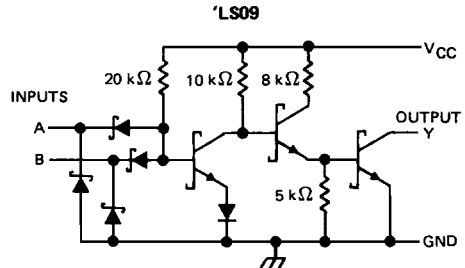
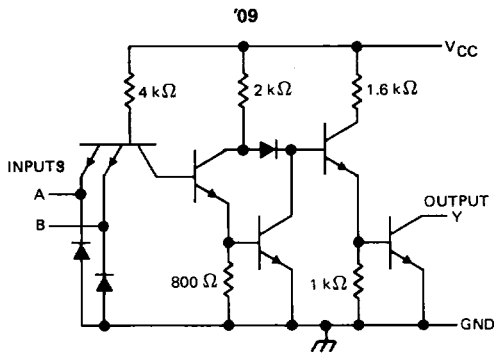


NC - No internal connection

TYPES 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.

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# TYPES 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 <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
V <sub>OH</sub> High-level output voltage			5.5			5.5	V
I <sub>OL</sub> Low-level output current			16			16	mA
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†	MIN	TYP‡	MAX	UNIT
V <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = -12 mA		-1.5		V
I <sub>OH</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>OH</sub> = 5.5 V		0.25		mA
V <sub>OL</sub>	V <sub>CC</sub> = MIN, V <sub>IL</sub> = 0.8 V, I <sub>OL</sub> = 16 mA		0.2	0.4	V
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V		1		mA
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.4 V		40		μA
I <sub>IL</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V		-1.6		mA
I <sub>CCH</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 4.5 V		11	21	mA
I <sub>CCL</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0 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<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

### switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see note 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t <sub>PLH</sub>	A or B	Y	R <sub>L</sub> = 400 Ω, C <sub>L</sub> = 15 pF		21	32	ns
t <sub>PHL</sub>					16	24	ns

NOTE 2: See General Information Section for load circuits and voltage waveforms.

# TYPES 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			°C

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

PARAMETER	TEST CONDITIONS †	SN54LS09		SN74LS09		UNIT
		MIN	TYP ‡	MAX	MIN	
$V_{IK}$	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$	- 1.5		- 1.5		V
$I_{OH}$	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{OH} = 5.5 \text{ V}$	0.1		0.1		mA
$V_{OL}$	$V_{CC} = \text{MIN}, V_{IL} = \text{MAX}, I_{OL} = 4 \text{ mA}$	0.25	0.4	0.25	0.4	V
	$V_{CC} = \text{MIN}, V_{IL} = \text{MAX}, I_{OL} = 8 \text{ mA}$			0.35	0.5	
$I_I$	$V_{CC} = \text{MAX}, V_I = 7 \text{ V}$	0.1		0.1		mA
$I_{IH}$	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$	20		20		µA
$I_{IL}$	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$	- 0.4		- 0.4		mA
$I_{CCH}$	$V_{CC} = \text{MAX}, V_I = 4.5 \text{ V}$	2.4	4.8	2.4	4.8	mA
$I_{CCL}$	$V_{CC} = \text{MAX}, V_I = 0 \text{ V}$	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  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

### 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	$R_L = 2 \text{ k}\Omega,$	$C_L = 15 \text{ pF}$	20	35		ns
$t_{PHL}$					17	35		ns

NOTE 2: See General Information Section for load circuits and voltage waveforms.

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TTL DEVICES

# TYPES 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			0.8	V
$V_{OH}$ High-level output voltage			5.5			5.5	V
$I_{OL}$ Low-level output current			20			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	
$V_{IK}$	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$			-1.2	V	
$I_{OH}$	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{OH} = 5.5 \text{ V}$			0.25	mA	
$V_{OL}$	$V_{CC} = \text{MIN}, V_{IL} = 0.8 \text{ V}, I_{OL} = 20 \text{ mA}$			0.5	V	
$I_I$	$V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$			1	mA	
$I_{IH}$	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$			50	μA	
$I_{IL}$	$V_{CC} = \text{MAX}, V_I = 0.5 \text{ V}$			-2	mA	
$I_{CCH}$	$V_{CC} = \text{MAX}, V_I = 4.5 \text{ V}$			18	32	mA
$I_{CCL}$	$V_{CC} = \text{MAX}, V_I = 0 \text{ V}$			32	57	mA

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

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

### 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	$R_L = 280 \Omega, C_L = 15 \text{ pF}$	6.5	10		ns
$t_{PHL}$				6.5	10		ns
$t_{PLH}$			$R_L = 280 \Omega, C_L = 50 \text{ pF}$	9			ns
$t_{PHL}$				9			ns

NOTE 2: See General Information Section for load circuits and voltage waveforms.