

# SN5405, SN54LS05, SN54S05, SN7405, SN74LS05, SN74S05

## HEX INVERTERS WITH OPEN-COLLECTOR OUTPUTS

DECEMBER 1983 — REVISED MARCH 1988

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

### description

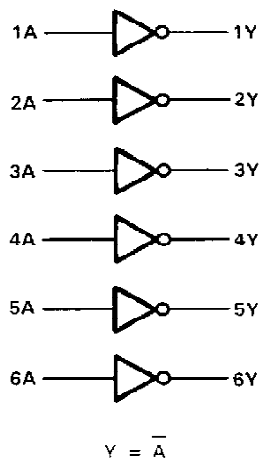
These devices contain six independent inverters. The open-collector outputs require pull-up resistors to perform correctly. They may be connected to other open-collector outputs to implement active-low wired-OR or active-high wired-AND functions. Open-collector devices are often used to generate high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

The SN5405, SN54LS05, and SN54S05 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7405, SN74LS05, and SN74S05 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

FUNCTION TABLE (each inverter)

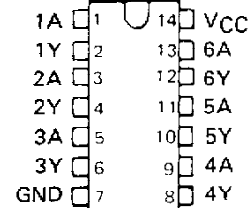
INPUT	OUTPUT
A	Y
H	L
L	H

### logic diagram (positive logic)

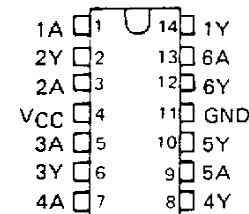


SN5405 . . . J PACKAGE  
SN54LS05, SN54S05 . . . J OR W PACKAGE  
SN7405 . . . N PACKAGE  
SN74LS05, SN74S05 . . . D OR N PACKAGE

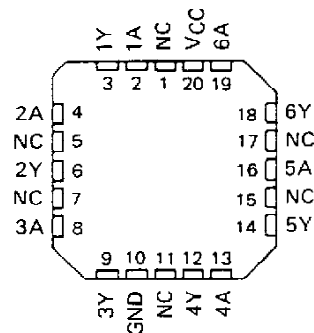
(TOP VIEW)



SN5405 . . . W PACKAGE  
(TOP VIEW)

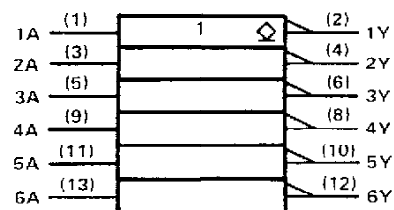


SN54LS05, SN54S05 . . . FK PACKAGE  
(TOP VIEW)



NC — No internal connection

### 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.

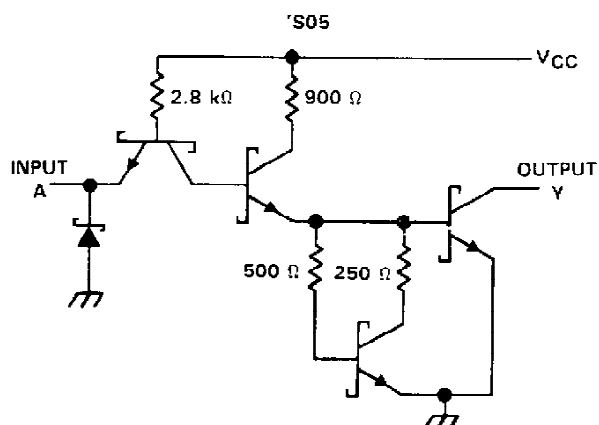
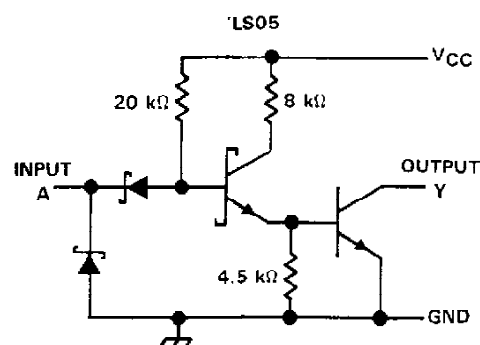
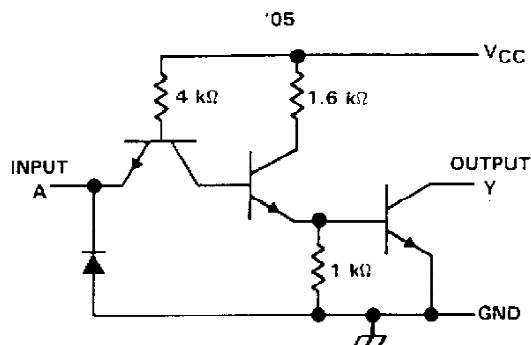
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# **SN5405, SN54LS05, SN54S05, SN7405, SN74LS05, SN74S05** **HEX INVERTERS WITH OPEN-COLLECTOR OUTPUTS**

schematics (each inverter)



Resistor values are nominal.

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

Supply voltage, $V_{CC}$ (see Note 1): '05, 'LS05, 'S05	7 V
Input voltage: '05, 'S05	5.5 V
'LS05	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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# SN5405, SN7405

## HEX INVERTERS WITH OPEN-COLLECTOR OUTPUTS

### recommended operating conditions

	SN5405			SN7405			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†	SN5405			SN7405			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
$V_{IK}$	$V_{CC} = \text{MIN.}$ , $I_I = -12 \text{ mA}$			-1.5			-1.5	V
$I_{OH}$	$V_{CC} = \text{MIN.}$ , $V_{IL} = 0.8 \text{ V}$ , $V_{OH} = 5.5 \text{ V}$						0.25	mA
	$V_{CC} = \text{MIN.}$ , $V_{IL} = 0.7 \text{ V}$ , $V_{OH} = 5.5 \text{ V}$			0.25				
$V_{OL}$	$V_{CC} = \text{MIN.}$ , $V_{IH} = 2 \text{ V}$ , $I_{OL} = 16 \text{ mA}$	0.2	0.4		0.2	0.4		V
$I_I$	$V_{CC} = \text{MAX.}$ , $V_I = 5.5 \text{ V}$			1			1	mA
$I_{IH}$	$V_{CC} = \text{MAX.}$ , $V_I = 2.4 \text{ V}$			40			40	μA
$I_{IL}$	$V_{CC} = \text{MAX.}$ , $V_I = 0.4 \text{ V}$			-1.6			-1.6	mA
$I_{CCH}$	$V_{CC} = \text{MAX.}$ , $V_I = 0$	6	12		6	12		mA
$I_{CCL}$	$V_{CC} = \text{MAX.}$ , $V_I = 4.5 \text{ V}$	18	33		18	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	Y	$R_L = 4 \text{ k}\Omega$ ,	$C_L = 15 \text{ pF}$		40	55	ns
$t_{PHL}$			$R_L = 400 \Omega$ ,	$C_L = 15 \text{ pF}$		8	15	ns

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

# **SN54LS05, SN74LS05** **HEX INVERTERS WITH OPEN-COLLECTOR OUTPUTS**

## **recommended operating conditions**

	SN54LS05			SN74LS05			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†	SN54LS05			SN74LS05			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
$V_{IK}$	$V_{CC} = \text{MIN.}$ , $I_I = -18 \text{ mA}$		-1.5			-1.5		V
$I_{OH}$	$V_{CC} = \text{MIN.}$ , $V_{IL} = \text{MAX.}$ , $V_{OH} = 5.5 \text{ V}$			0.1			0.1	mA
$V_{OL}$	$V_{CC} = \text{MIN.}$ , $V_{IH} = 2 \text{ V}$ , $I_{OL} = 4 \text{ mA}$		0.25	0.4		0.25	0.4	V
	$V_{CC} = \text{MIN.}$ , $V_{IH} = 2 \text{ V}$ , $I_{OL} = 8 \text{ mA}$					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
$I_{CCH}$	$V_{CC} = \text{MAX.}$ , $V_I = 0$		1.2	2.4		1.2	2.4	mA
$I_{CCL}$	$V_{CC} = \text{MAX.}$ , $V_I = 4.5 \text{ V}$		3.6	6.6		3.6	6.6	mA

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

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

## **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	Y	$R_L = 2 \text{ k}\Omega$ , $C_L = 15 \text{ pF}$		17	32	ns
$t_{PHL}$					15	28	ns

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



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# SN54S05, SN74S05

## HEX INVERTERS WITH OPEN-COLLECTOR OUTPUTS

### recommended operating conditions

	SN54S05			SN74S05			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†	SN54S05			SN74S05			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
$V_{IK}$	$V_{CC} = \text{MIN.}$ , $I_I = -18 \text{ mA}$		-1.2			-1.2		V
$I_{OH}$	$V_{CC} = \text{MIN.}$ , $V_{IL} = 0.8 \text{ V}$ , $V_{OH} = 5.5 \text{ V}$					0.25		mA
	$V_{CC} = \text{MIN.}$ , $V_{IL} = 0.7 \text{ V}$ , $V_{OH} = 5.5 \text{ V}$			0.25				
$V_{OL}$	$V_{CC} = \text{MIN.}$ , $V_{IH} = 2 \text{ V}$ , $I_{OL} = 20 \text{ mA}$			0.5			0.5	V
$I_I$	$V_{CC} = \text{MAX.}$ , $V_I = 5.5 \text{ V}$			1			1	mA
$I_{IH}$	$V_{CC} = \text{MAX.}$ , $V_I = 2.7 \text{ V}$			50			50	µA
$I_{IL}$	$V_{CC} = \text{MAX.}$ , $V_I = 0.5 \text{ V}$			-2			-2	mA
$I_{CCH}$	$V_{CC} = \text{MAX.}$ , $V_I = 0$		9	19.8		9	19.8	mA
$I_{CCL}$	$V_{CC} = \text{MAX.}$ , $V_I = 4.5 \text{ V}$		30	54		30	54	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	Y	$R_L = 280 \Omega$ , $C_L = 15 \text{ pF}$	2	5	7.5	ns
$t_{PHL}$				2	4.5	7	ns
$t_{PLH}$			$R_L = 280 \Omega$ , $C_L = 50 \text{ pF}$		7.5		ns
$t_{PHL}$					7		ns

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



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