











#### SN54HC164, SN74HC164

SCLS115G - DECEMBER 1982 - REVISED SEPTEMBER 2015

# SNx4HC164 8-Bit Parallel-Out Serial Shift Registers

#### **Features**

- Wide Operating Voltage Range of 2 V to 6 V
- Outputs Can Drive Up to 10 LSTTL Loads
- Low Power Consumption, 80-µA Maximum I<sub>CC</sub>
- Typical  $t_{pd} = 20 \text{ ns}$
- ±4-mA Output Drive at 5 V
- Low Input Current of 1-µA Maximum
- AND-Gated (Enable/Disable) Serial Inputs
- Fully Buffered Clock and Serial Inputs
- **Direct Clear**
- On Products Compliant to MIL-PRF-38535, All Parameters Are Tested Unless Otherwise Noted. On All Other Products, Production Processing Does Not Necessarily Include Testing of All Parameters.

### 2 Applications

- Programable Logic Controllers
- **Appliances**
- Video Display Systems
- Output Expander

### 3 Description

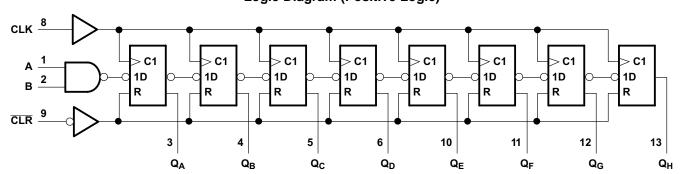
These 8-bit shift registers feature AND-gated serial inputs and an asynchronous clear (CLR) input. The gated serial (A and B) inputs permit complete control over incoming data; a low at either input inhibits entry of the new data and resets the first flip-flop to the low level at the next clock (CLK) 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 set-up time requirements are met. Clocking occurs on the low-to-high-level transition of CLK.

### Device Information<sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE (NOM)		
	SOIC (14)	8.65 mm × 3.91 mm		
SN74HC164	PDIP (14)	19.30 mm × 6.35 mm		
SN/4HC164	SO (14)	10.30 mm × 5.30 mm		
	TSSOP (14)	5.00 mm × 4.40 mm		
	CDIP (14)	19.94 mm × 6.92 mm		
SN54HC164	CFP (14)	9.21 mm × 6.29 mm		
	LCCC (14)	9.39 mm × 9.39 mm		

<sup>(1)</sup> For all available packages, see the orderable addendum at the end of the data sheet.

### Logic Diagram (Positive Logic)



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



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### 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

### Changes from Revision F (October 2013) to Revision G

Page

•	Added Applications section, Device Information table, Pin Configuration and Functions section, ESD Ratings table,	
	Thermal Information table, Typical Characteristics section, Feature Description section, Device Functional Modes,	
	Application and Implementation section, Power Supply Recommendations section, Layout section, Device and	
	Documentation Support section, and Mechanical, Packaging, and Orderable Information section	1
•	Added Military Disclaimer to Features list.	1
•	Added Handling Ratings table	6

#### Changes from Revision E (November 2010) to Revision F

Page

•	Updated document to new TI data sheet format
•	Removed Ordering Information table.

Updated operating temperature range.



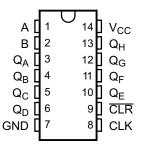
## 5 Device Comparison Table

PART NUMBER	PACKAGE	BODY SIZE (NOM)
SN74HC164D	SOIC (14)	8.65 mm × 3.91 mm
SN74HC164N	PDIP (14)	19.30 mm × 6.35 mm
SN74HC164NS	SO (14)	10.30 mm × 5.30 mm
SN74HC164PW	TSSOP (14)	5.00 mm × 4.40 mm
SN54HC164J	CDIP (14)	19.94 mm × 6.92 mm
SN54HC164W	CFP (14)	9.21 mm × 6.29 mm
SN54HC164FK	LCCC (14)	9.39 mm × 9.39 mm



### 6 Pin Configuration and Functions

D, N, NS, J, W, or PW Package 14-Pin SOIC, PDIP, SO, CDIP, CFP, or TSSOP Top View

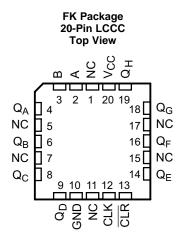


#### **Pin Functions**

PI	IN		
SOIC, PDIP, SO, CDIP, CFP, or TSSOP NO.	NAME	I/O	DESCRIPTION
1	Α	1	Gated Serial Input 1
2	В	1	Gated Serial Input 2
3	$Q_A$	0	Parallel Output
4	$Q_{B}$	0	Parallel Output
5	Q <sub>C</sub>	0	Parallel Output
6	$Q_D$	0	Parallel Output
7	GND	-	Ground
8	CLK	I	Clock
9	CLR	1	Clear 1 Active-Low
10	Q <sub>E</sub>	0	Parallel Output
11	$Q_{F}$	0	Parallel Output
12	$Q_{G}$	0	Parallel Output
13	Q <sub>H</sub>	0	Parallel Output
14	V <sub>CC</sub>	_	Power

Product Folder Links: SN54HC164 SN74HC164





NC - No internal connection

### **Pin Functions**

P	IN		DEGODIDATION
LCCC NO.	NAME	1/0	DESCRIPTION
1	NC	_	No Connect
2	Α	I	Gated Serial Input 1
3	В	I	Gated Serial Input 2
4	$Q_A$	0	Parallel Output
5	NC	_	No Connect
6	$Q_{B}$	0	Parallel Output
7	NC	_	No Connect
8	$Q_{C}$	0	Parallel Output
9	Q <sub>D</sub>	0	Parallel Output
10	GND	_	Ground
11	NC	_	No Connect
12	CLK	I	Clock
13	CLR	I	Clear 1 Active-Low
14	Q <sub>E</sub>	0	Parallel Output
15	NC	_	No Connect
16	$Q_{F}$	0	Parallel Output
17	NC	_	No Connect
18	$Q_G$	0	Parallel Output
19	Q <sub>H</sub>	0	Parallel Output
20	VCC	_	Power



### 7 Specifications

#### 7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) (1)

			MIN	MAX	UNITS
V <sub>CC</sub>	Supply voltage		-0.5	7	V
I <sub>IK</sub>	Input clamp current <sup>(2)</sup>	$V_I < 0$ or $V_I > V_{CC}$		±20	mA
I <sub>OK</sub>	Output clamp current (2)	$V_O < 0$ or $V_O > V_{CC}$		±20	mA
Io	Continuous output current	$V_{O} = 0$ to $V_{CC}$		±25	mA
	Continuous current through V <sub>CC</sub> or GND			±50	mA
T <sub>stg</sub>	Storage temperature		-65	150	°C

<sup>(1)</sup> 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.

### 7.2 ESD Ratings

			VALUE	UNIT
\/		Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 (1)	±2000	V
V <sub>(E</sub>	SD) Electrostatic discharge	Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup>	±1000	V

<sup>(1)</sup> JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

### 7.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)(1)

			SN	54HC164		SI	N74HC164		LINUT
			MIN	NOM	MAX	MIN	NOM	MAX	UNIT
V <sub>CC</sub>	Supply voltage		2	5	6	2	5	6	V
		$V_{CC} = 2 V$	1.5			1.5			
$V_{IH}$	High-level input voltage	$V_{CC} = 4.5 \text{ V}$	3.15			3.15			V
		$V_{CC} = 6 V$	4.2			4.2			
V <sub>IL</sub>	Low-level input voltage	$V_{CC} = 2 V$			0.5			0.5	V
		V <sub>CC</sub> = 4.5 V			1.35			1.35	
		V <sub>CC</sub> = 6 V			1.8			1.8	
VI	Input voltage		0		$V_{CC}$	0		$V_{CC}$	V
Vo	Output voltage		0		$V_{CC}$	0		$V_{CC}$	V
		$V_{CC} = 2 V$			1000			1000	ns
$\Delta t/\Delta v^{(2)}$	Input transition rise and fall time	V <sub>CC</sub> = 4.5 V			500			500	
	umo	V <sub>CC</sub> = 6 V			400			400	
T <sub>A</sub>	Operating free-air temperature	e	-55		125	-40		125	°C

All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, Implications of Slow or Floating CMOS Inputs, SCBA004.

<sup>2)</sup> The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

<sup>(2)</sup> JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

<sup>(2)</sup> If this device is used in the threshold region (from V<sub>IL</sub> max = 0.5 V to V<sub>IH</sub> min = 1.5 V), there is a potential to go into the wrong state from induced grounding, causing double clocking. Operating with the inputs at t<sub>t</sub> = 1000 ns and V<sub>CC</sub> = 2 V does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.



#### 7.4 Thermal Information

		S	N54HC164			SN74H	C164		
THERMAL METRIC <sup>(1)</sup>		J (CDIP)	W (CFP)	FK (LCCC)	D (SOIC)	N (PDIP)	NS (SO)	PW (TSSOP)	UNIT
		14 PINS	14 PINS	20 PINS	14 PINS	14 PINS	14 PINS	14 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	_	_	_	86	80	76	113	°C/W

For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report, SPRA953.

### 7.5 Electrical Characteristics, $T_A = 25^{\circ}C$

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

PARAMETER	TES	ST CONDITIONS	V <sub>cc</sub>	MIN	TYP	MAX	UNIT
			2 V	1.9	1.998		
		$I_{OH} = -20 \mu A$	4.5 V	4.4	4.499		
V <sub>OH</sub>	$V_I = V_{IH}$ or $V_{IL}$		6 V	5.9	5.999		V
		I <sub>OH</sub> = -4 mA	4.5 V	3.98	4.3		
		I <sub>OH</sub> = -5.2 mA	6 V	5.48	5.8		
	$V_{I} = V_{IH}$ or $V_{IL}$		2 V		0.002	0.1	
		I <sub>OL</sub> = 20 μA	4.5 V		0.001	0.1	
V <sub>OL</sub>			6 V		0.001	0.1	V
		I <sub>OL</sub> = 4 mA	4.5 V		0.17	0.26	
		I <sub>OL</sub> = 5.2 mA	6 V		0.15	0.26	
l <sub>1</sub>	$V_I = V_{CC}$ or 0		6 V		±0.1	±100	nA
lcc	V <sub>I</sub> = V <sub>CC</sub> or 0	I <sub>O</sub> = 0	6 V			8	μA
Ci			2 V to 6 V		3	10	pF

## 7.6 Electrical Characteristics, $T_A = -55^{\circ}C$ to 125°C

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

PARAMETER	TEST O	CONDITIONS	V <sub>cc</sub>	SN	SN54HC164			Recommended SN74HC164			
				MIN	TYP	MAX	MIN	TYP	MAX		
			2 V	1.9			1.9				
		$I_{OH} = -20 \mu A$	4.5 V	4.4			4.4				
$V_{OH}$	$V_I = V_{IH}$ or $V_{IL}$		6 V	5.9			5.9			V	
			$I_{OH} = -4 \text{ mA}$	4.5 V	3.7			3.7			
		I <sub>OH</sub> = -5.2 mA	6 V	5.2			5.2				
			2 V			0.1			0.1		
		$I_{OL} = 20 \mu A$	4.5 V			0.1			0.1		
$V_{OL}$	$V_I = V_{IH}$ or $V_{IL}$		6 V			0.1			0.1	V	
		I <sub>OL</sub> = 4 mA	4.5 V			0.4			0.4		
		I <sub>OL</sub> = 5.2 mA	6 V			0.4			0.4		
I	$V_I = V_{CC}$ or 0		6 V			±1000			±1000	nA	
I <sub>CC</sub>	$V_I = V_{CC}$ or 0	I <sub>O</sub> = 0	6 V			160			160	μΑ	
C <sub>i</sub>			2 V to 6 V			10			10	pF	



## 7.7 Electrical Characteristics, $T_A = -55^{\circ}C$ to $85^{\circ}C$

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

DADAMETER	TEC	T CONDITIONS	V	SN	74HC164		UNIT
PARAMETER	IES	T CONDITIONS	V <sub>cc</sub>	MIN	TYP	MAX	UNII
			2 V	1.9			
		$I_{OH} = -20 \mu A$	4.5 V	4.4			
$V_{OH}$	$V_I = V_{IH}$ or $V_{IL}$		6 V	5.9			V
		$I_{OH} = -4 \text{ mA}$	4.5 V	3.84			
		$I_{OH} = -5.2 \text{ mA}$	6 V	5.34			
			2 V			0.1	
		$I_{OL} = 20 \mu A$	4.5 V		0.1		
V <sub>OL</sub>	$V_I = V_{IH}$ or $V_{IL}$		6 V			0.1	V
		I <sub>OL</sub> = 4 mA	4.5 V			0.33	
		I <sub>OL</sub> = 5.2 mA	6 V			0.33	
I	$V_I = V_{CC}$ or 0		6 V			±1000	nA
cc	$V_I = V_{CC}$ or 0	I <sub>O</sub> = 0	6 V			80	μA
Ç <sub>i</sub>			2 V to 6 V			10	pF

## 7.8 Timing Requirements, $T_A = 25^{\circ}C$

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

	PARAMET	rer	V <sub>cc</sub>	MIN	NOM	MAX	UNIT
			2 V			6	
f <sub>clock</sub>	Clock frequency		4.5 V			31	MHz
			6 V			36	
			2 V	100			
		CLR low	4.5 V	20			
	Pulse duration		6 V	17			ns
t <sub>w</sub>	Pulse duration		2 V	80			
		CLK high or low	4.5 V	16			
			6 V	14			
			2 V	100			
		Data	4.5 V	20			
	Catua tima hafara CLIVA		6 V	17			
t <sub>su</sub>	Setup time before CLK↑		2 V	100			ns
		CLR inactive	4.5 V	20			
			6 V	17			
			2 V	5			
t <sub>h</sub>	Hold time, data after CLK↑		4.5 V	5			ns
			6 V	5			



## 7.9 Timing Requirements, $T_A = -55^{\circ}C$ to 125°C

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

	PARAMETER		V <sub>cc</sub>	SN	54HC164	1	RECOMMENDED SN74HC164			UNIT
				MIN	NOM	MAX	MIN	NOM	MAX	
			2 V			4.2			4.2	
f <sub>clock</sub>	Clock frequency		4.5 V			21			21	MHz
			6 V			25			25	
			2 V	150			125			
		CLR low	4.5 V	30			25			
	Pulse duration		6 V	25			21			20
t <sub>w</sub>	<sub>W</sub> i dise duration		2 V	120			120			ns
		CLK high or low	4.5 V	24			24			
			6 V	20			20			
			2 V	150			125			
		Data	4.5 V	30			25			
	Catum time a hafama Cl I/A		6 V	25			25			
t <sub>su</sub>	Setup time before CLK↑		2 V	150			125			ns
		CLR inactive	4.5 V	30			25			
			6 V	25			25			
			2 V	5			5			
$t_h$ Hold time, data after CLK $\uparrow$		4.5 V	5			5			ns	
				5			5			

## 7.10 Timing Requirements, $T_A = -55^{\circ}C$ to $85^{\circ}C$

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

	DADA	METER	V	SN	174HC164		LINUT
	PARA	METER	V <sub>CC</sub>	\$N74HC164 MIN NOM  125 25 21 100 20 18 125 25 21 125 25 21 125 25 21 125 25 21 125 25	NOM	MAX	UNIT
			2 V			5	
f <sub>clock</sub>	Clock frequency		4.5 V			25	MHz
			6 V			28	
			2 V	125			
		CLR low	4.5 V	25			
	Pulse duration		6 V	21			
t <sub>w</sub>	Pulse duration		2 V	100			ns
		CLK high or low	4.5 V	20			
			6 V	18			
			2 V	125			
		Data	4.5 V	25			
	Catua tima hafara CLIVA		6 V	21			
t <sub>su</sub>	Setup time before CLK↑		2 V	125			ns
		CLR inactive	4.5 V	25			
			6 V	21			
			2 V	5			
t <sub>h</sub>	h Hold time, data after CLK↑	•	4.5 V	5			ns
			6 V	5			



### 7.11 Switching Characteristics, $T_A = 25^{\circ}C$

over recommended operating free-air temperature range,  $C_L = 50 \text{ pF}$  (unless otherwise noted) (see Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>cc</sub>	MIN	TYP	MAX	UNIT
			2 V	6	10		
f <sub>max</sub>			4.5 V	31	54		MHz
			6 V	36	62		
			2 V		140	205	
t <sub>PHL</sub>	CLR	Any Q	4.5 V		28	41	ns
			6 V		24	35	
			2 V		115	175	
t <sub>pd</sub>	CLK	Any Q	4.5 V		23	35	
			6 V		20	30	
			2 V		38	75	
t <sub>t</sub>			4.5 V		8	15	ns
			6 V		6	13	

## 7.12 Switching Characteristics, $T_A = -55^{\circ}C$ to 125°C

over recommended operating free-air temperature range,  $C_L = 50 \text{ pF}$  (unless otherwise noted) (see Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	PUT) V <sub>CC</sub> SN54HC164					MMENDI '4HC164		UNIT
	(INPOT)		MIN TYP MAX					TYP	MAX	MHz
			2 V	4.2			4.2			
f <sub>max</sub>			4.5 V	21			21			MHz
			6 V	25			25			
			2 V			295			255	
t <sub>PHL</sub>	CLR	Any Q	4.5 V			59			51	ns
			6 V			51			46	
			2 V			265			220	
t <sub>pd</sub>	CLK	Any Q	4.5 V			53			44	
			6 V			45			38	
			2 V			110			110	
t <sub>t</sub>			4.5 V			22			22	ns
			6 V			19			19	



## 7.13 Switching Characteristics, $T_A = -55^{\circ}C$ to $85^{\circ}C$

over recommended operating free-air temperature range,  $C_L = 50 \text{ pF}$  (unless otherwise noted) (see Figure 3)

DADAMETED	EDOM (INDUIT)	TO (OUTDUT)	V	SN7	'4HC164		LINUT
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub>	MIN	TYP	MAX	UNIT
			2 V	5			
f <sub>max</sub>			4.5 V	25			MHz
			6 V	28			
			2 V			255	
t <sub>PHL</sub>	CLR	Any Q	4.5 V			51	ns
			6 V			46	
			2 V			220	
t <sub>pd</sub>	CLK	Any Q	4.5 V			44	
			6 V			38	
			2 V			95	
t <sub>t</sub>			4.5 V			19	ns
			6 V			16	

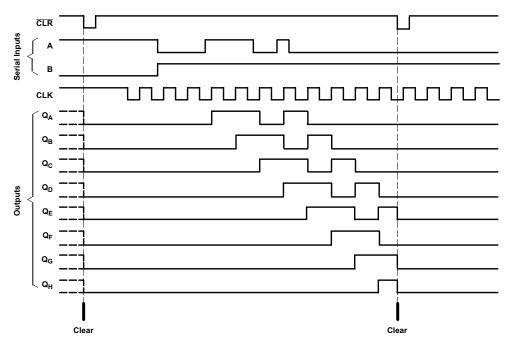
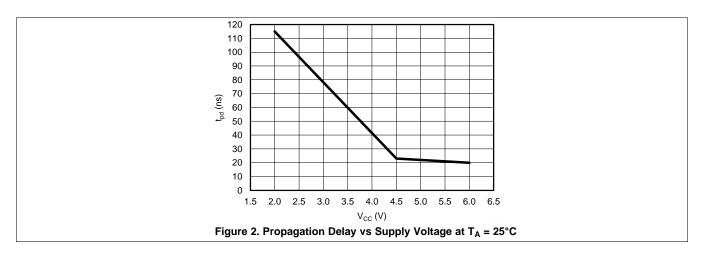


Figure 1. SN74HC164 Example Timing Diagram



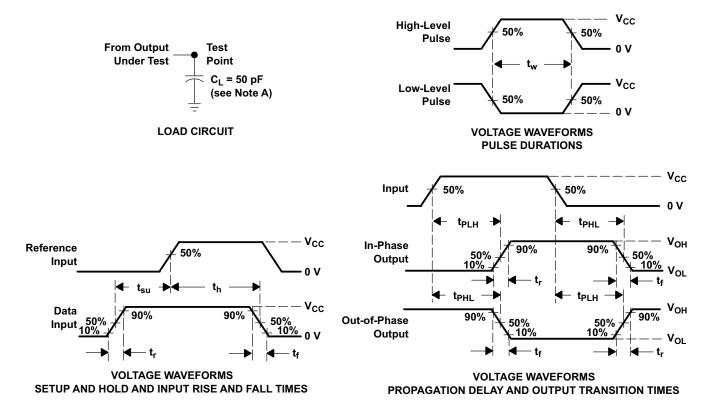
### 7.14 Typical Characteristics

 $T_A = 25^{\circ}C$ 





#### 8 Parameter Measurement Information



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

Figure 3. Load Circuit and Voltage Waveforms



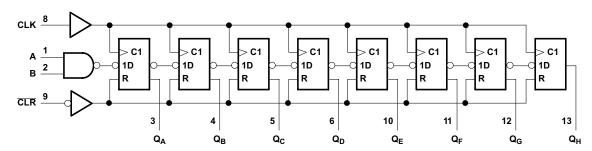
### 9 Detailed Description

#### 9.1 Overview

The SN74HC164 is an 8-bit shift register with 2 serial inputs (A and B) connected through an AND gate, as well as an asynchronous clear (CLR). The device requires a high signal on both A and B in order to set the input data line high; a low signal on either input will set the input data line low. Data at A and B can be changed while CLK is high or low, provided that the minimum set-up time requirements are met.

The CLK pin of the SN74HC164 is triggered on a positive or rising-edge signal, from LOW to HIGH. Upon a positive-edge trigger, the device will store the result of the (A ● B) input data line in the first register and propagate each register's data to the next register. The data of the last register, QH, will be discarded at each clock trigger. If a low signal is applied to the CLR pin of the SN74HC164, the device will set all registers to a value of 0 immediately.

#### 9.2 Functional Block Diagram



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

#### 9.3 Feature Description

The HC164 has a wide operating voltage range of 2 V to 6 V, outputs that can drive up to 10 LSTTL loads and Low Power Consumption,  $80-\mu A$  maximum I. It is typically  $t_{pd}=20$  ns and has  $\pm 4$ -mA output drive at 5 V with low input current of  $1-\mu A$  maximum. It also has AND-gated (enable/disable) serial inputs a fully buffered clock and serial inputs as well as a direct clear.

#### 9.4 Device Functional Modes

Table 1 lists the functional modes of the SNx4HC164.

Table 1. Function Table (1)(2)

	INF	PUTS		OUTPUTS					
CLR	CLK	Α	В	$Q_A$	Q <sub>B</sub>		QH		
L	X	Х	Х	L	L		٦		
Н	L	Х	Х	$Q_{A0}$	Q <sub>B0</sub>		$Q_{H0}$		
Н	1	Н	Н	Н	Q <sub>An</sub>		$Q_{Gn}$		
Н	1	L	X	L	Q <sub>An</sub>		$Q_{Gn}$		
Н	1	X	L	L	$Q_{An}$		$Q_{Gn}$		

- 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.
- (2) 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.

Submit Documentation Feedback

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### 10 Application and Implementation

### 10.1 Application Information

The SNx4HC164 is an 8-bit shift register that can be used as a deserializer in order to reduce the number of GPIO's needed when driving multiple LED's. In order to correctly display the proper output in the LED's a sink MOSFET was added to prevent the LED's from lighting up until the correct data or the proper clock signal has been achieved.

### 10.2 Typical Application

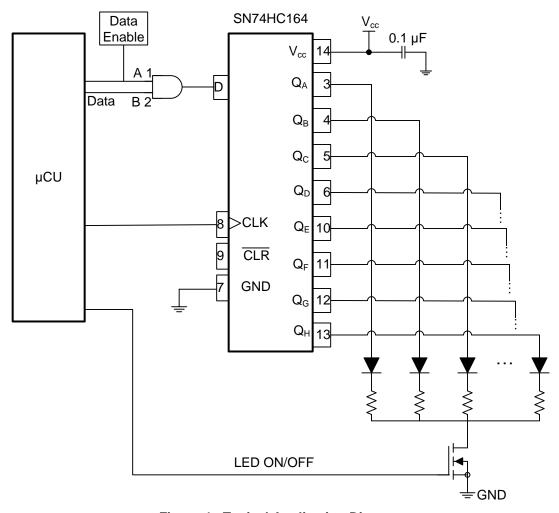


Figure 4. Typical Application Diagram

#### 10.2.1 Design Requirements

Ensure that the incoming clock rising edge meets the criteria in *Recommended Operating Conditions*.

#### 10.2.2 Detailed Design Procedure

Ensure that input and output voltages do not exceed ratings in Absolute Maximum Ratings.

Input voltage threshold information can be found in Recommended Operating Conditions.

Detailed timing requirements can be found in *Timing Requirements*,  $T_A = 25$ °C.

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### **Typical Application (continued)**

### 10.2.3 Application Curve

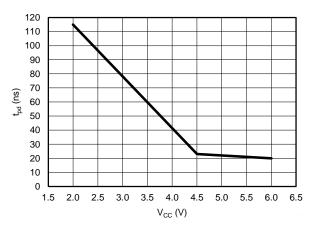


Figure 5. Propagation Delay vs Supply Voltage at T<sub>A</sub> = 25°C



### 11 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the *Recommended Operating Conditions* table.

Each  $V_{CC}$  pin must have a good bypass capacitor in order to prevent power disturbance. For devices with a single supply, a 0.1- $\mu$ F capacitor is recommended and if there are multiple  $V_{CC}$  pins then a 0.01- $\mu$ F or 0.022- $\mu$ F capacitor is recommended for each power pin. It is ok to parallel multiple bypass caps to reject different frequencies of noise. 0.1- $\mu$ F and 1- $\mu$ F capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power pin as possible for best results.

### 12 Layout

### 12.1 Layout Guidelines

Reflections and matching are closely related to loop antenna theory, but different enough to warrant their own discussion. When a PCB trace turns a corner at a 90° angle, a reflection can occur. This is primarily due to the change of width of the trace. At the apex of the turn, the trace width is increased to 1.414 times its width. This upsets the transmission line characteristics, especially the distributed capacitance and self–inductance of the trace — resulting in the reflection. It is a given that not all PCB traces can be straight, and so they will have to turn corners. Figure 6 shows progressively better techniques of rounding corners. Only the last example maintains constant trace width and minimizes reflections.

#### 12.2 Layout Example

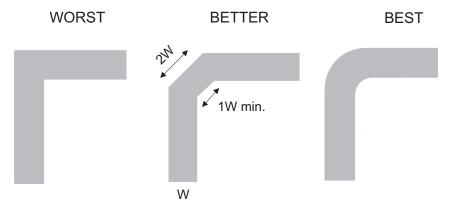


Figure 6. Trace Example

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### 13 Device and Documentation Support

#### 13.1 Documentation Support

#### 13.1.1 Related Documentation

For related documentation, see the following:

Implications of Slow or Floating CMOS Inputs, SCBA004

#### 13.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 2. Related Links

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
SN54HC164	Click here	Click here	Click here	Click here	Click here
SN74HC164	Click here	Click here	Click here	Click here	Click here

### 13.3 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community.* Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

#### 13.4 Trademarks

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

### 13.5 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 13.6 Glossary

SLYZ022 — TI Glossary.

This glossary lists and explains terms, acronyms, and definitions.

### 14 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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### **PACKAGING INFORMATION**

Orderable part number	Status (1)	Material type	Package   Pins	Package qty   Carrier	<b>RoHS</b> (3)	Lead finish/ Ball material	MSL rating/ Peak reflow	Op temp (°C)	Part marking (6)
5962-8416201VCA	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8416201VC A SNV54HC164J
5962-8416201VCA.A	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8416201VC A SNV54HC164J
5962-8416201VDA	Active	Production	CFP (W)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8416201VD A SNV54HC164W
5962-8416201VDA.A	Active	Production	CFP (W)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8416201VD A SNV54HC164W
84162012A	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	84162012A SNJ54HC 164FK
8416201CA	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	8416201CA SNJ54HC164J
SN54HC164J	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	SN54HC164J
SN54HC164J.A	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	SN54HC164J
SN74HC164D	Obsolete	Production	SOIC (D)   14	-	=	Call TI	Call TI	-40 to 125	HC164
SN74HC164DR	Active	Production	SOIC (D)   14	2500   LARGE T&R	Yes	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 125	HC164
SN74HC164DR.A	Active	Production	SOIC (D)   14	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC164
SN74HC164DRG3	Active	Production	SOIC (D)   14	2500   LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	HC164
SN74HC164DRG3.A	Active	Production	SOIC (D)   14	2500   LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	HC164
SN74HC164DRG4	Active	Production	SOIC (D)   14	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC164
SN74HC164DRG4.A	Active	Production	SOIC (D)   14	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC164
SN74HC164DT	Obsolete	Production	SOIC (D)   14	-	-	Call TI	Call TI	-40 to 125	HC164
SN74HC164N	Active	Production	PDIP (N)   14	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 125	SN74HC164N
SN74HC164N.A	Active	Production	PDIP (N)   14	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 125	SN74HC164N
SN74HC164NE4	Active	Production	PDIP (N)   14	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 125	SN74HC164N
SN74HC164NE4.A	Active	Production	PDIP (N)   14	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 125	SN74HC164N
SN74HC164NSR	Active	Production	SOP (NS)   14	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC164



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Orderable part number	Status (1)	Material type	Package   Pins	Package qty   Carrier	<b>RoHS</b> (3)	Lead finish/ Ball material	MSL rating/ Peak reflow	Op temp (°C)	Part marking (6)
SN74HC164NSR.A	Active	Production	SOP (NS)   14	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC164
SN74HC164PW	Obsolete	Production	TSSOP (PW)   14	-	-	Call TI	Call TI	-40 to 125	HC164
SN74HC164PWR	Active	Production	TSSOP (PW)   14	2000   LARGE T&R	Yes	NIPDAU   SN	Level-1-260C-UNLIM	-40 to 125	HC164
SN74HC164PWR.A	Active	Production	TSSOP (PW)   14	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC164
SN74HC164PWRE4	Active	Production	TSSOP (PW)   14	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC164
SN74HC164PWRG4	Active	Production	TSSOP (PW)   14	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC164
SN74HC164PWRG4.A	Active	Production	TSSOP (PW)   14	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC164
SN74HC164PWT	Obsolete	Production	TSSOP (PW)   14	-	-	Call TI	Call TI	-40 to 125	HC164
SNJ54HC164FK	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	84162012A SNJ54HC 164FK
SNJ54HC164FK.A	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	84162012A SNJ54HC 164FK
SNJ54HC164J	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	8416201CA SNJ54HC164J
SNJ54HC164J.A	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	8416201CA SNJ54HC164J
SNJ54HC164W	Active	Production	CFP (W)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	8416201DA SNJ54HC164W
SNJ54HC164W.A	Active	Production	CFP (W)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	8416201DA SNJ54HC164W

<sup>(1)</sup> Status: For more details on status, see our product life cycle.

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> RoHS values: Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

<sup>(4)</sup> Lead finish/Ball material: Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

### PACKAGE OPTION ADDENDUM

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(5) MSL rating/Peak reflow: The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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#### OTHER QUALIFIED VERSIONS OF SN54HC164, SN54HC164-SP, SN74HC164:

Catalog: SN74HC164, SN54HC164

Military: SN54HC164

Space: SN54HC164-SP

NOTE: Qualified Version Definitions:

- Catalog TI's standard catalog product
- Military QML certified for Military and Defense Applications
- Space Radiation tolerant, ceramic packaging and qualified for use in Space-based application



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### TAPE AND REEL INFORMATION





A0	Dimension designed to accommodate the component width
В0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

#### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



#### \*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74HC164DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74HC164DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74HC164DRG3	SOIC	D	14	2500	330.0	16.8	6.5	9.5	2.1	8.0	16.0	Q1
SN74HC164DRG4	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74HC164DRG4	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74HC164NSR	SOP	NS	14	2000	330.0	16.4	8.1	10.4	2.5	12.0	16.0	Q1
SN74HC164PWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74HC164PWRG4	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1



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\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74HC164DR	SOIC	D	14	2500	340.5	336.1	32.0
SN74HC164DR	SOIC	D	14	2500	340.5	336.1	32.0
SN74HC164DRG3	SOIC	D	14	2500	364.0	364.0	27.0
SN74HC164DRG4	SOIC	D	14	2500	340.5	336.1	32.0
SN74HC164DRG4	SOIC	D	14	2500	353.0	353.0	32.0
SN74HC164NSR	SOP	NS	14	2000	353.0	353.0	32.0
SN74HC164PWR	TSSOP	PW	14	2000	356.0	356.0	35.0
SN74HC164PWRG4	TSSOP	PW	14	2000	353.0	353.0	32.0



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### **TUBE**



\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
5962-8416201VDA	W	CFP	14	25	506.98	26.16	6220	NA
5962-8416201VDA.A	W	CFP	14	25	506.98	26.16	6220	NA
84162012A	FK	LCCC	20	55	506.98	12.06	2030	NA
SN74HC164N	N	PDIP	14	25	506	13.97	11230	4.32
SN74HC164N	N	PDIP	14	25	506	13.97	11230	4.32
SN74HC164N.A	N	PDIP	14	25	506	13.97	11230	4.32
SN74HC164N.A	N	PDIP	14	25	506	13.97	11230	4.32
SN74HC164NE4	N	PDIP	14	25	506	13.97	11230	4.32
SN74HC164NE4	N	PDIP	14	25	506	13.97	11230	4.32
SN74HC164NE4.A	N	PDIP	14	25	506	13.97	11230	4.32
SN74HC164NE4.A	N	PDIP	14	25	506	13.97	11230	4.32
SNJ54HC164FK	FK	LCCC	20	55	506.98	12.06	2030	NA
SNJ54HC164FK.A	FK	LCCC	20	55	506.98	12.06	2030	NA
SNJ54HC164W	W	CFP	14	25	506.98	26.16	6220	NA
SNJ54HC164W.A	W	CFP	14	25	506.98	26.16	6220	NA



SMALL OUTLINE INTEGRATED CIRCUIT



#### NOTES:

- 1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

  2. This drawing is subject to change without notice.

  3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not
- exceed 0.15 mm, per side.
- 4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
- 5. Reference JEDEC registration MS-012, variation AB.



SMALL OUTLINE INTEGRATED CIRCUIT



NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SMALL OUTLINE INTEGRATED CIRCUIT



NOTES: (continued)

- 8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
- 9. Board assembly site may have different recommendations for stencil design.



### **MECHANICAL DATA**

## NS (R-PDSO-G\*\*)

# 14-PINS SHOWN

### PLASTIC SMALL-OUTLINE PACKAGE



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.



# 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



8.89 x 8.89, 1.27 mm pitch

LEADLESS CERAMIC CHIP CARRIER

This image is a representation of the package family, actual package may vary. Refer to the product data sheet for package details.



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CERAMIC DUAL IN LINE PACKAGE



Images above are just a representation of the package family, actual package may vary. Refer to the product data sheet for package details.

4040083-5/G





CERAMIC DUAL IN LINE PACKAGE



#### NOTES:

- 1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- 2. This drawing is subject to change without notice.
- 3. This package is hermitically sealed with a ceramic lid using glass frit.
- His package is remitted by sealed with a ceramic its using glass mit.
   Index point is provided on cap for terminal identification only and on press ceramic glass frit seal only.
   Falls within MIL-STD-1835 and GDIP1-T14.



CERAMIC DUAL IN LINE PACKAGE



## 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.





SMALL OUTLINE PACKAGE



#### NOTES:

- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.

  2. This drawing is subject to change without notice.

  3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not
- exceed 0.15 mm per side.
- 4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
- 5. Reference JEDEC registration MO-153.



SMALL OUTLINE PACKAGE



NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SMALL OUTLINE PACKAGE



NOTES: (continued)

- 8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
- 9. Board assembly site may have different recommendations for stencil design.



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