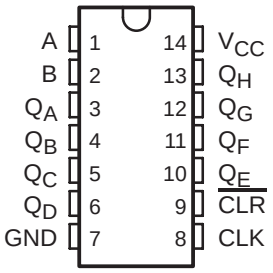
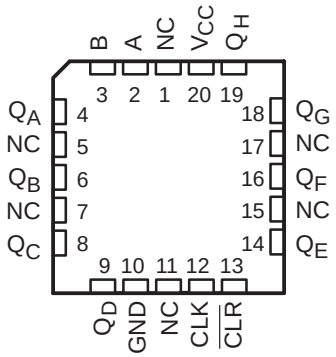
- ***EPIC*** ™ **(Enhanced-Performance Implanted CMOS) 2-μ Process**
- **Typical V_{OLP} (Output Ground Bounce) < 0.8 V at V_{CC}, T_A = 25°C**
- **Typical V_{OHV} (Output V_{OH} Undershoot) > 2 V at V_{CC}, T_A = 25°C**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)**
- **Latch-Up Performance Exceeds 250 mA Per JEDEC Standard JESD-17**
- **Package Options Include Plastic Small-Outline (D), Shrink Small-Outline (DB), Thin Shrink Small-Outline (PW), Ceramic Flat (W) Packages, Chip Carriers (FK), and (J) 300-mil DIPs**

SN54LV164 . . . J OR W PACKAGE
SN74LV164 . . . D, DB, OR PW PACKAGE
(TOP VIEW)



SN54LV164 . . . FK PACKAGE
(TOP VIEW)



NC − No internal connection

description

These 8-bit parallel-out serial shift registers are designed for 2.7-V to 5.5-V V_{CC} operation.

The ’LV164 feature AND-gated serial (A and B) inputs and an asynchronous clear ($\overline{CLR}$) input. The gated serial inputs permit complete control over incoming data as 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 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 the clock is high or low, provided the minimum setup time requirements are met. Clocking occurs on the low-to-high-level transition of the clock (CLK) input.

The SN74LV164 is available in TI’s shrink small-outline package (DB), which provides the same I/O pin count and functionality of standard small-outline packages in less than half the printed-circuit-board area.

The SN54LV164 is characterized for operation over the full military temperature range of −55°C to 125°C. The SN74LV164 is characterized for operation from −40°C to 85°C.

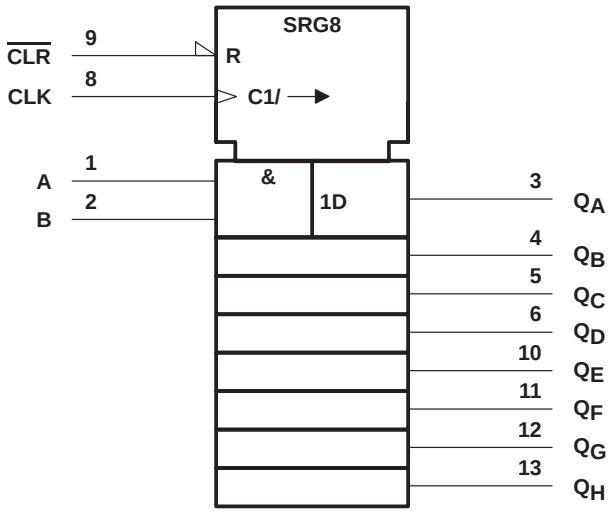
FUNCTION TABLE

INPUTS				OUTPUTS		
$\overline{CLR}$	CLK	A	B	Q_A	$Q_B \cdots Q_H$	
L	X	X	X	L	L	L
H	L	X	X	Q_{A0}	Q_{B0}	Q_{H0}
H	↑	H	H	H	Q_{An}	Q_{Gn}
H	↑	L	X	L	Q_{An}	Q_{Gn}
H	↑	X	L	L	Q_{An}	Q_{Gn}

Q_{A0}, Q_{B0}, Q_{H0} = the level of Q_A, Q_B, or Q_H, respectively, before the indicated steady-state inputs conditions were established

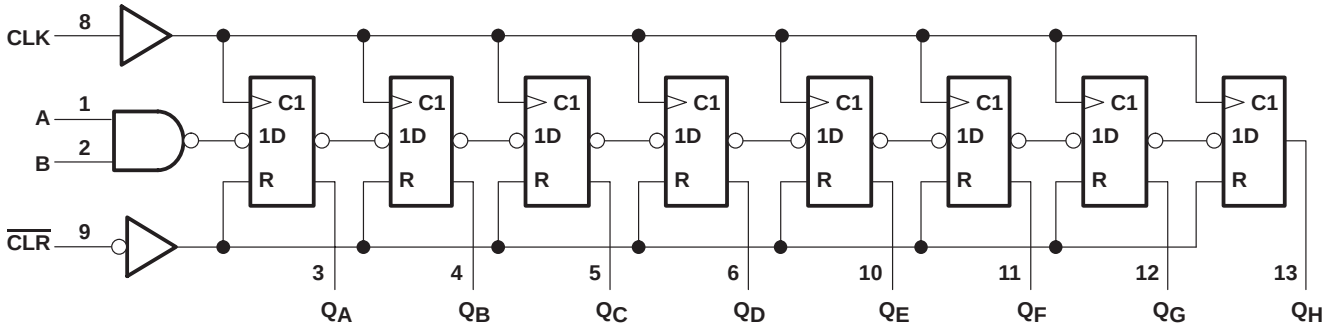
Q_{An}, Q_{Gn} = the level of Q_A or Q_G before the most recent ↑ transition of the clock: indicates a 1-bit shift

logic symbol†

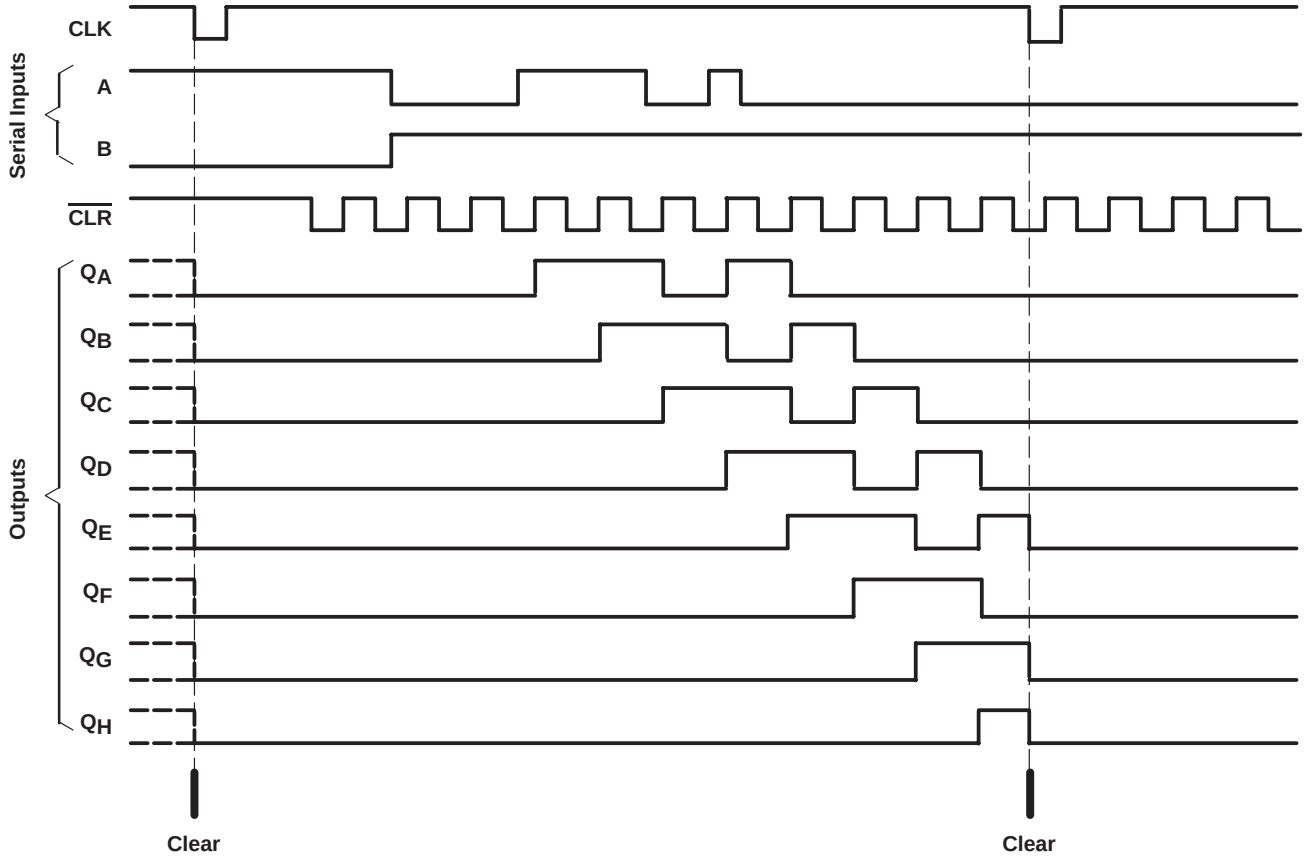


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for D, DB, J, PW, and W packages.

logic diagram (positive logic)



typical clear, shift, and clear sequences



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

Supply voltage range, V_{CC} . . . . . −0.5 V to 7 V
Input voltage range, V_I (see Note 1) . . . . . −0.5 V to V_{CC} + 0.5 V
Output voltage range, V_O (see Notes 1 and 2) . . . . . −0.5 V to V_{CC} + 0.5 V
Input clamp current, I_{IK} (V_I < 0 or V_I > V_{CC}) . . . . . ±20 mA
Output clamp current, I_{OK} (V_O < 0 or V_O > V_{CC}) . . . . . ±50 mA
Continuous output current, I_O (V_O = 0 to V_{CC}) . . . . . ±25 mA
Continuous current through V_{CC} or GND . . . . . ±50 mA
Maximum power dissipation at T_A = 55°C (in still air) (see Note 3): D package . . . . . 1.25 W
DB or PW package . . . . . 0.5 W
Storage temperature range, T_{stg} . . . . . −65°C to 150°C

† 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.

NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. This value is limited to 7 V maximum.
3. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

recommended operating conditions (see Note 4)

			SN54LV164		SN74LV164		UNIT
			MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		2.7	5.5	2.7	5.5	V
V_{IH}	High-level input voltage	V_{CC} = 2.7 V to 3.6 V	2		2		V
		V_{CC} = 4.5 V to 5.5 V	3.15		3.15		
V_{IL}	Low-level input voltage	V_{CC} = 2.7 V to 3.6 V		0.8		0.8	V
		V_{CC} = 4.5 V to 5.5 V		1.65		1.65	
V_I	Input voltage		0	V_{CC}	0	V_{CC}	V
V_O	Output voltage		0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 2.7 V to 3.6 V		−6		−6	mA
		V_{CC} = 4.5 V to 5.5 V		−12		−12	
I_{OL}	Low-level output current	V_{CC} = 2.7 V to 3.6 V		6		6	mA
		V_{CC} = 4.5 V to 5.5 V		12		12	
$\Delta t/\Delta v$	Input transition rise or fall rate		0	100	0	100	ns/V
T_A	Operating free-air temperature		−55	125	−40	85	°C

NOTE 4: Unused inputs must be held high or low to prevent them from floating.

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

PARAMETER	TEST CONDITIONS	V_{CC}†	SN54LV164			SN74LV164			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OH}	I_{OH} = −100 μA	MIN to MAX	V_{CC} − 0.2			V_{CC} − 0.2			V
	I_{OH} = −6 mA	3 V	2.4			2.4			
	I_{OH} = −12 mA	4.5 V	3.6			3.6			
V_{OL}	I_{OL} = 100 μA	MIN to MAX			0.2			0.2	V
	I_{OL} = 6 mA	3 V			0.4			0.4	
	I_{OL} = 12 mA	4.5 V			0.55			0.55	
I_I	V_I = V_{CC} or GND	3.6 V			±1			±1	μA
		5.5 V			±1			±1	
I_{CC}	V_I = V_{CC} or GND, I_O = 0	3.6 V			20			20	μA
		5.5 V			20			20	
ΔI_{CC}	One input at V_{CC} − 0.6 V, Other inputs at V_{CC} or GND	3 V to 3.6 V			500			500	μA
C_i	V_I = V_{CC} or GND	3.3 V		2.5			2.5		pF
		5 V		3			3		

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

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

			SN54LV164						UNIT
			V_{CC} = 5.5 V ± 0.5 V		V_{CC} = 3.3 V ± 0.3 V		V_{CC} = 2.7 V		
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		0	40	0	35	0	30	MHz
t_w	Pulse duration	$\overline{CLR}$ low	14		16		18		ns
		CLK high or low	14		16		18		
t_{su}	Setup time, data before CLK↑	Data	8		10		12		ns
		$\overline{CLR}$ inactive	5		6		7		
t_h	Hold time, data after CLK↑		3		3		3		ns

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

			SN74LV164						UNIT
			V_{CC} = 5.5 V ± 0.5 V		V_{CC} = 3.3 V ± 0.3 V		V_{CC} = 2.7 V		
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		0	40	0	35	0	30	MHz
t_w	Pulse duration	$\overline{CLR}$ low	14		16		18		ns
		CLK high or low	14		16		18		
t_{su}	Setup time, data before CLK↑	Data	8		10		12		ns
		$\overline{CLR}$ inactive	5		6		7		
t_h	Hold time, data after CLK↑		3		3		3		ns

switching characteristics over recommended operating free-air temperature range, C_L = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LV164								UNIT
			V_{CC} = 5.5 V ± 0.5 V			V_{CC} = 3.3 V ± 0.3 V			V_{CC} = 2.7 V		
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	MAX	
f_{max}			40	90		35	75		30		MHz
t_{pd}	CLK	Q		10	20		14	26		32	ns
t_{PHL}	$\overline{CLR}$	Q		12	20		16	26		32	ns

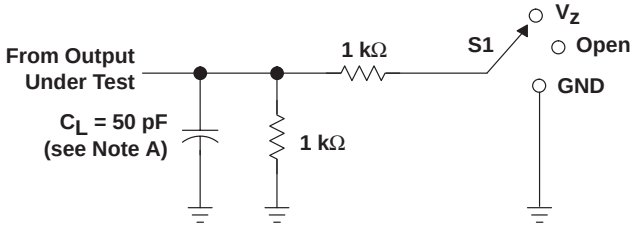
switching characteristics over recommended operating free-air temperature range, C_L = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74LV164								UNIT
			V_{CC} = 5.5 V ± 0.5 V			V_{CC} = 3.3 V ± 0.3 V			V_{CC} = 2.7 V		
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	MAX	
f_{max}			40	90		35	75		30		MHz
t_{pd}	CLK	Q		10	20		14	26		32	ns
t_{PHL}	$\overline{CLR}$	Q		12	20		16	26		32	ns

operating characteristics, T_A = 25°C

PARAMETER		TEST CONDITIONS	TYP	TYP	UNIT
C_{pd}	Power dissipation capacitance	C_L = 50 pF, f = 10 MHz	3.3 V	74	pF
			5 V	75	

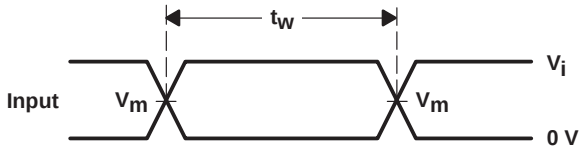
PARAMETER MEASUREMENT INFORMATION



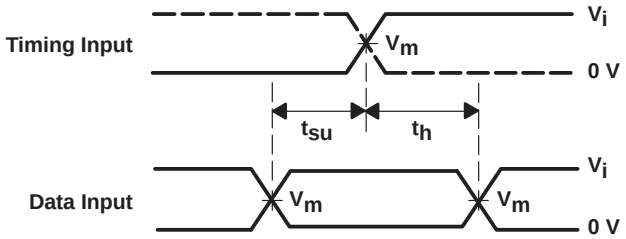
LOAD CIRCUIT

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_z
t_{PHZ}/t_{PZH}	GND

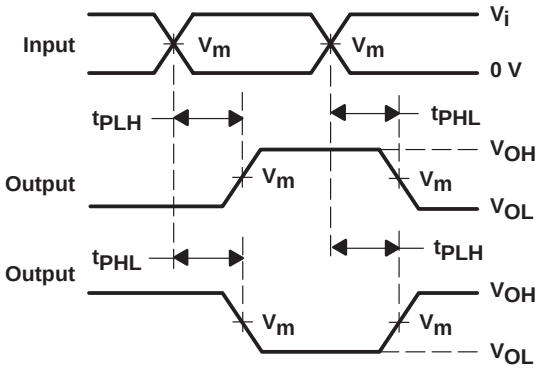
WAVEFORM CONDITION	V_{CC} = 4.5 V to 5.5 V	V_{CC} = 2.7 V to 3.6 V
V_m	0.5 × V_{CC}	1.5 V
V_i	V_{CC}	2.7 V
V_z	2 × V_{CC}	6 V



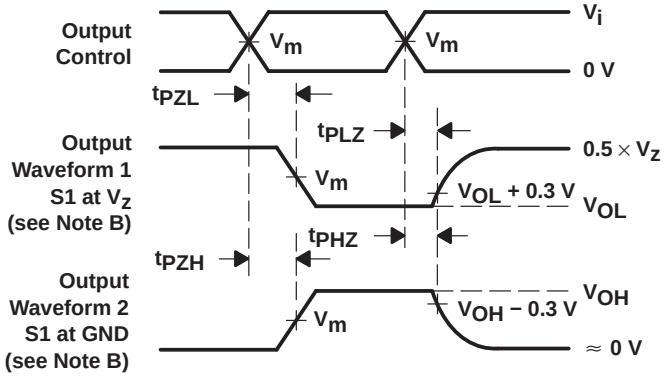
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

NOTES: A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
D. The outputs are measured one at a time with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
F. t_{PZL} and t_{PZH} are the same as t_{en}.
G. t_{PLH} and t_{PHL} are the same as t_{pd}.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
SN74LV164D	OBSOLETE	SOIC	D	14		TBD	Call TI	Call TI
SN74LV164DR	OBSOLETE	SOIC	D	14		TBD	Call TI	Call TI
SN74LV164PWLE	OBSOLETE	TSSOP	PW	14		TBD	Call TI	Call TI

(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.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), 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.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
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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