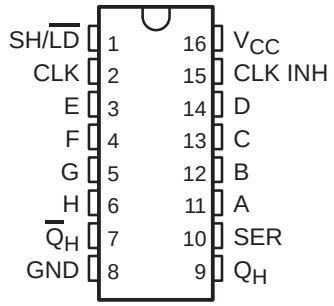
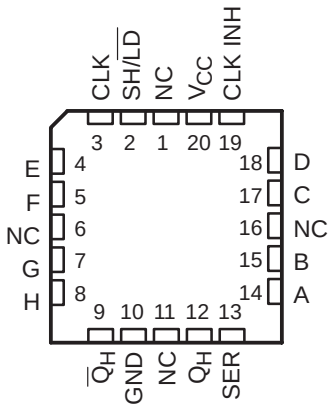
- **EPIC™ (Enhanced-Performance Implanted CMOS) 2-μ Process**
- **Typical V_{OLP} (Output Ground Bounce) < 0.8 V at V_{CC}, T_A = 25°C**
- **Typical V_{OHV} (Output V_{OH} Undershoot) < 2 V at V_{CC}, T_A = 25°C**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015; Exceeds 200 V Using Machine 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**

SN54LV165 . . . J OR W PACKAGE
SN74LV165 . . . D, DB, OR PW PACKAGE
(TOP VIEW)



SN54LV165 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description

The ’LV165 parallel-load, 8-bit shift registers are designed for 2.7-V to 5.5-V V_{CC} operation.

When the device is clocked, data is shifted toward the serial output Q_H. Parallel-in access to each stage is provided by eight individual direct data inputs that are enabled by a low level at the SH/$\overline{LD}$ input. The ’LV165 feature a clock inhibit function and a complemented serial output $\overline{Q}_H$.

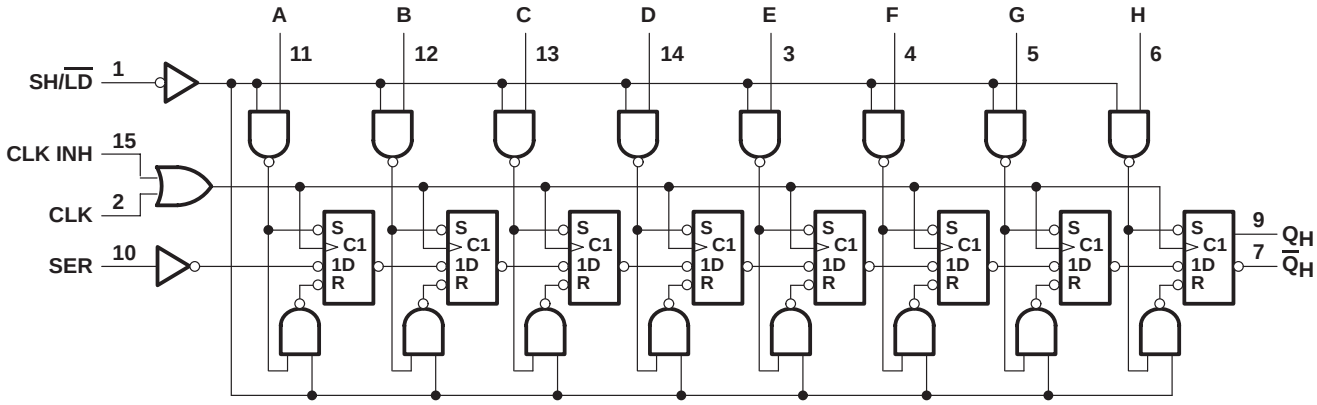
Clocking is accomplished by a low-to-high transition of the clock (CLK) input while SH/$\overline{LD}$ is held high and clock inhibit (CLK INH) is held low. The functions of the CLK and CLK INH inputs are interchangeable. Since a low CLK input and a low-to-high transition of CLK INH accomplishes clocking, CLK INH should be changed to the high level only while CLK is high. Parallel loading is inhibited when SH/$\overline{LD}$ is held high. The parallel inputs to the register are enabled while SH/$\overline{LD}$ is held low independently of the levels of CLK, CLK INH, or SER.

The SN54LV165 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74LV165 is characterized for operation from –40°C to 85°C.

FUNCTION TABLE

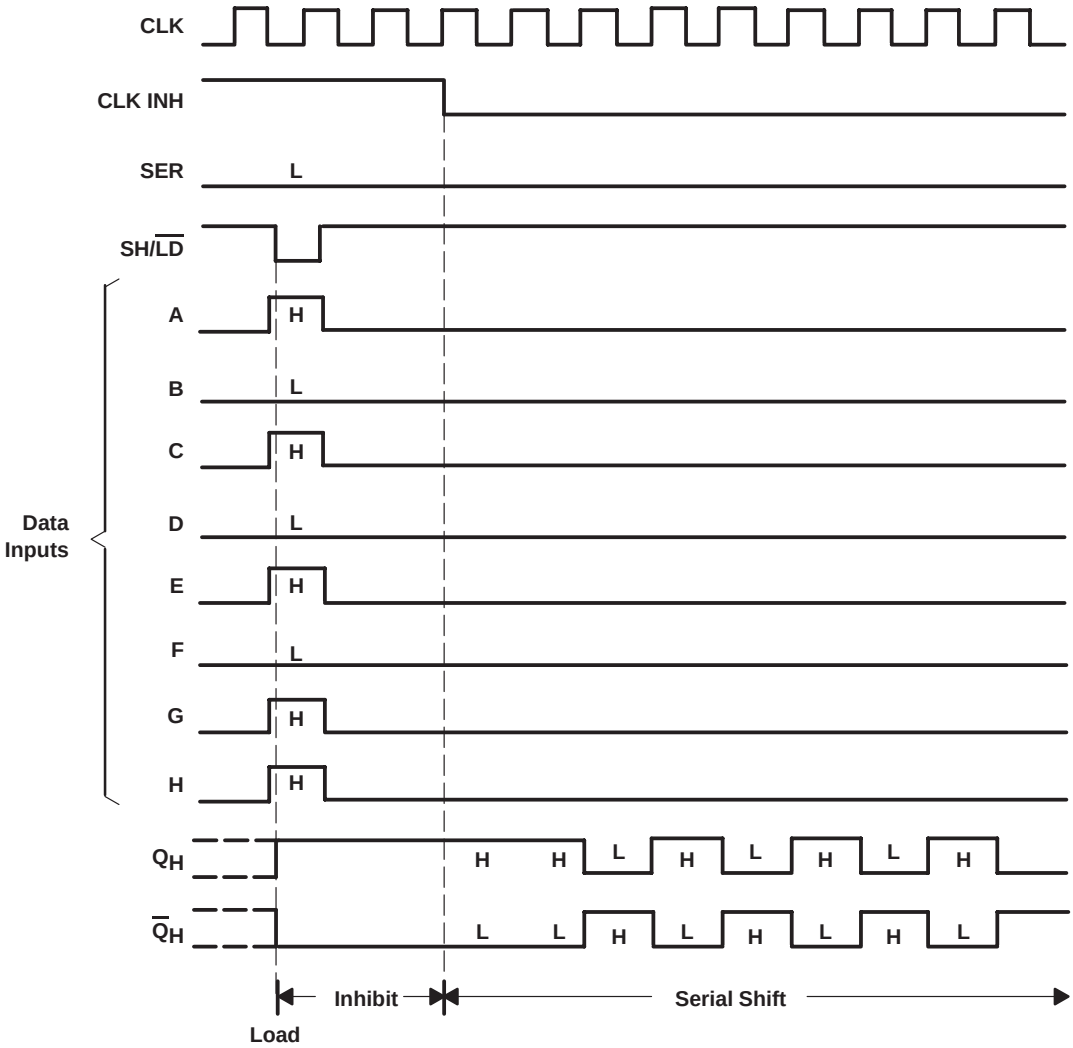
INPUTS			OPERATION
SH/$\overline{LD}$	CLK	CLK INH	
L	X	X	Parallel load
H	H	X	Q_0
H	X	H	Q_0
H	L	↑	Shift
H	↑	L	Shift

logic diagram (positive logic)



Pin numbers shown are for D, DB, J, PW, and W packages.

typical shift, load, and inhibit sequences



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

Supply voltage range, V_{CC} . . . . . –0.5 V to 4.6 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 . . . . . 1.30 W
DB package . . . . . 0.55 W
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)

			SN54LV165		SN74LV165		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}†	SN54LV165			SN74LV165			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)

			SN54LV165						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	50	0	40	0	30	MHz
t_w	Pulse duration	$\overline{CLK}$ high or low	14		18		22		ns
		SH/$\overline{LD}$ low	14		18		22		
t_{su}	Setup time	SH/$\overline{LD}$ high before $\overline{CLK}\uparrow$	10		13		17		ns
		SER before $\overline{CLK}\uparrow$	8		11		14		
		CLK INH before $\overline{CLK}\uparrow$	10		12		15		
		Data before SH/$\overline{LD}\uparrow$	8		12		17		
t_h	Hold time	SER data after $\overline{CLK}\uparrow$	6		6		5		ns
		Parallel data after SH/$\overline{LD}\uparrow$	6		6		5		

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

			SN74LV165						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	50	0	40	0	30	MHz
t_w	Pulse duration	$\overline{CLK}$ high or low	14		18		22		ns
		SH/$\overline{LD}$ low	14		18		22		
t_{su}	Setup time	SH/$\overline{LD}$ high before $\overline{CLK}\uparrow$	10		13		17		ns
		SER before $\overline{CLK}\uparrow$	8		11		14		
		CLK INH before $\overline{CLK}\uparrow$	10		12		15		
		Data before SH/$\overline{LD}\uparrow$	8		12		17		
t_h	Hold time	SER data after $\overline{CLK}\uparrow$	6		6		5		ns
		Parallel data after SH/$\overline{LD}\uparrow$	6		6		5		

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LV165								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}			50	90		40	75		30		MHz
t_{pd}	CLK	Q_H or $\overline{Q}_H$		20	24		20	38		47	ns
	SH/$\overline{LD}$			19	24		19	36		44	
	H			15	20		15	29		36	

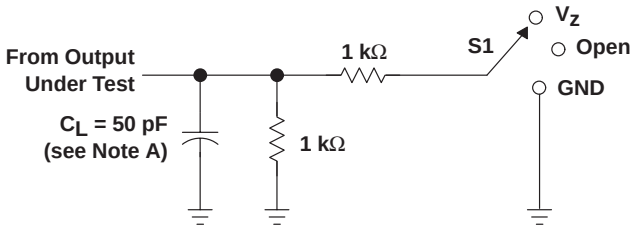
switching characteristics over recommended operating free-air temperature range, C_L = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74LV165								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}			50	90		40	75		30		MHz
t_{pd}	CLK	Q_H or $\overline{Q}_H$		20	24		20	38		47	ns
	SH/$\overline{LD}$			19	24		19	36		44	
	H			15	20		15	29		36	

operating characteristics, T_A = 25°C

PARAMETER		TEST CONDITIONS	V_{CC}	TYP	UNIT
C_{pd}	Power dissipation capacitance	C_L = 50 pF, f = 10 MHz	3.3 V	33	pF
			5 V	57	

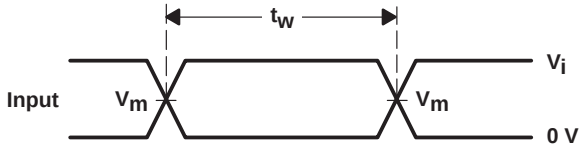
PARAMETER MEASUREMENT INFORMATION



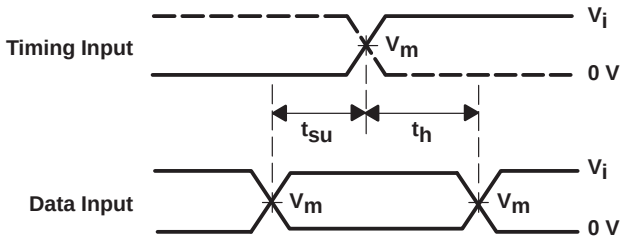
LOAD CIRCUIT

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

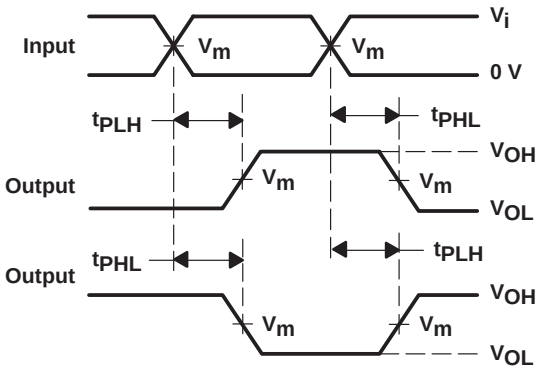
WAVEFORM CONDITION	V_{CC} = 4.5 V to 5.5 V	V_{CC} = 2.7 V to 3.6 V
V_m	$0.5 \times V_{CC}$	1.5 V
V_i	V_{CC}	2.7 V
V_z	$2 \times V_{CC}$	6 V



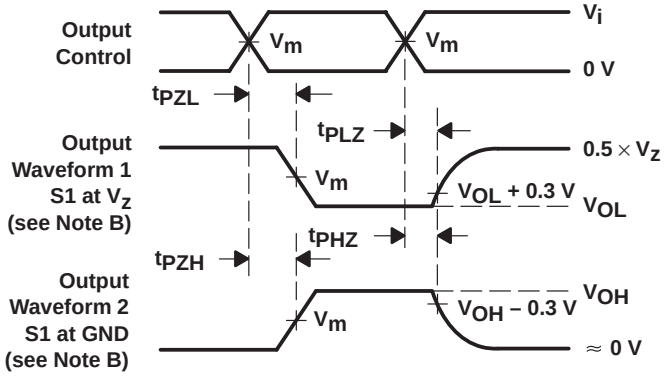
VOLTAGE WAVEFORMS
PULSE DURATION



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)
SN74LV165D	OBSOLETE	SOIC	D	16		TBD	Call TI	Call TI
SN74LV165DBLE	OBSOLETE	SSOP	DB	16		TBD	Call TI	Call TI
SN74LV165DR	OBSOLETE	SOIC	D	16		TBD	Call TI	Call TI
SN74LV165PWLE	OBSOLETE	TSSOP	PW	16		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) 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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