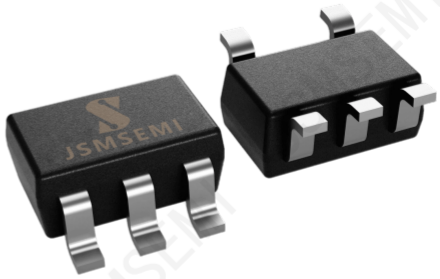
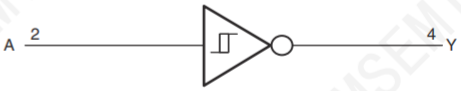
Description

This single Schmitt-trigger inverter is designed for 1.65V to 5.5V V_{CC} operation.

The SN74LVC1G14 device contains one inverter and performs the Boolean function $Y = \overline{A}$. The device functions as an independent inverter with Schmitt-trigger inputs, so the device has different input threshold levels for positive-going (V_{T+}) and negative-going (V_{T-}) signals to provide hysteresis (ΔV_T) which makes the device tolerant to slow or noisy input signals.

This device is fully specified for partial-power-down applications using Ioff. The Ioff circuitry disables the outputs when the device is powered down. This inhibits current backflow into the device which prevents damage to the device.The SN74LVC1G14 is available in Green SOT23-5 and SOT-353 packages. It operates over an ambient temperature range of -40°C to +125°C.





Logic Diagram (Positive Logic)

Features

- ESD protection exceeds JESD 22
  - 2000V human-body model
  - 200V machine model
  - 1000V charged-device model
- Packages: SOT23-5, SOT-353(SC70-5)
- Supports 5V V_{CC} operation
- Inputs accept voltages to 5.5V
- Typ t_{pd} of 3.1ns at 3.3V
- Low power consumption, 1μA maximum I_{CC}
- ±24mA output drive at 3.3V
- I_{off} supports partial-power-down mode operation
- Operating Temperature Range: -40°C to +125°C
- RoSH compatible

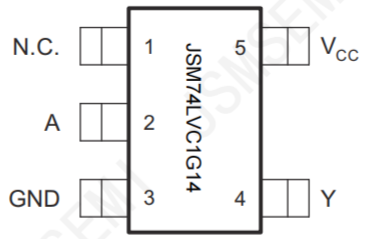
Applications

- AV receiver
- Audio dock: portable
- Blu-ray player and home theater
- Embedded PC
- MP3 player/recorder (portable audio)
- Personal Digital Assistant (PDA)
- Power: telecom/server AC/DC supply: single controller: analog and digital
- Solid State Drive (SSD): client and enterprise
- TV: LCD/Digital and High-Definition (HDTV)
- Tablet: enterprise
- Video analytics: server
- Wireless headset, keyboard, and mouse

Ordering Information

Order number	Package	Marking	Operation Temperature Range	MSL Grade	Ship,Quantity	Green
SN74LVC1G14DBVR-JSM	SOT-23-5L	C14F	-40 to 125°C	3	TR&3000	Rohs
SN74LVC1G14DCKR-JSM	SOT-353	CFR	-40 to 125°C	3	TR&3000	Rohs

Pin Configuration and Functions



Top View

Pin Functions

PIN		I/O	DESCRIPTION
SOT23-5 SOT-353	NAME		
1	N.C.	—	No internal connection (1)
2	A	I	Signal Input
3	GND	—	Ground
4	Y	O	Signal Output
5	V_{CC}	—	Positive Supply

(1) Pins labeled N.C. can be connected to any signal or voltage source, including ground. They should always be soldered to the board.

Specifications

Absolute Maximum Ratings

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage		–0.5	6.5	V
V_I	Input voltage (2)		–0.5	6.5	V
V_O	Voltage range applied to any output in the high-impedance or power-off state(2)		–0.5	6.5	V
V_O	Voltage range applied to any output in the high or low state(2) (3)		–0.5	V_{CC} + 0.5	V
I_{IK}	Input clamp current	V_I < 0		–50	mA
I_{OK}	Output clamp current	V_O < 0		–50	mA
I_O	Continuous output current			±50	mA
	Continuous current through V_{CC} or GND			±100	mA
T_j	Maximum junction temperature			150	°C
T_{stg}	Storage temperature		–65	150	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
(3) The value of V_{CC} is provided in the recommended operating conditions table.

ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM)	2000	V
		Charged-device model (CDM)	1000	
		Machine Model	200	

Recommended Operating Conditions

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage	Operating	1.65	5.5	V
		Data retention only	1.5		
V_I	Input voltage		0	5.5	V
V_O	Output voltage		0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 1.65 V		–4	mA
		V_{CC} = 2.3 V		–8	
		V_{CC} = 3 V		–16	
				–24	
		V_{CC} = 4.5 V		–32	
I_{OL}	Low-level output current	V_{CC} = 1.65 V		4	mA
		V_{CC} = 2.3 V		8	
		V_{CC} = 3 V		16	
				24	
		V_{CC} = 4.5 V		32	
T_A	Operating free-air temperature	All other packages	–40	125	°C

(1) All unused inputs of the device must be held at V_{CC} or GND to assure proper device operation.

Thermal Information

THERMAL METRIC(1)		SN74LVC1G14 (SOT-23) 5 PINS	SN74LVC1G14 (SC70) 5 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	273.8	214.7	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	126.8	127.1	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	85.9	60.0	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	10.9	33.4	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	84.9	59.8	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	N/A	°C/W

Electrical Characteristics

over recommended operating free-air temperature range (Full=-40°C to +125°C, typical values are at T_A = +25°C, unless otherwise noted.) (1)

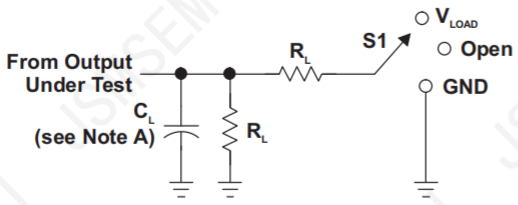
PARAMETER		TEST CONDITIONS	V_{CC}	TEMP	MIN	TYP	MAX	UNIT
V_{T+}	Positive going input threshold voltage		1.65V	Full	0.75		1.05	V
			2.3V		1.25		1.55	
			3V		1.5		2.1	
			4.5V		2.3		3.0	
			5.5V		2.8		3.4	
V_{T-}	Negative going input threshold voltage		1.65V	Full	0.3		0.6	V
			2.3V		0.35		0.65	
			3V		0.45		0.75	
			4.5V		0.7		1.0	
			5.5V		0.85		1.15	
ΔV_T	Hysteresis (V_{T+}-V_{T-})		1.65V	Full	0.35		0.6	V
			2.3V		0.6		1.2	
			3V		1.05		1.65	
			4.5V		1.6		2.0	
			5.5V		1.95		2.25	
V_{OH}		I_{OH} = -100μA	1.65V to 5.5V	Full	V_{CC}-0.1			V
		I_{OH} = -4mA	1.65V		1.2			
		I_{OH} = -8mA	2.3V		1.9			
		I_{OH} = -16mA	3V		2.4			
		I_{OH} =- 24mA			2.3			
		I_{OH} = -32mA	4.5V		3.8			
V_{OL}		I_{OL} = 100μA	1.65V to 5.5V	Full			0.1	V
		I_{OL} = 4mA	1.65V				0.45	
		I_{OL} = 8mA	2.3V				0.3	
		I_{OL} = 16mA	3V				0.4	
		I_{OL} = 24mA					0.55	
		I_{OL} = 32mA	4.5V				0.55	
I_I	A input	V_I=5.5V or GND	0V to 5.5V	+25°C		±0.1	±1	μA
				Full			±5	
I_{off}		V_I or V_O=5.5V	0	+25°C		±0.1	±1	μA
				Full			±10	
I_{CC}		V_I=5.5V or GND, I_O=0	1.65V to 5.5V	+25°C		0.1	1	μA
				Full			10	
ΔI_{CC}		One input at V_{CC}-0.6V, Other inputs at V_{CC} or GND	3V to 5.5V	Full			500	μA

Electrical Characteristics(continued)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Propagation Delay	t_{pd}	V_{CC}=1.8V±0.15V	C_L=30pF, R_L=500Ω		7.5		ns
		V_{CC}=2.5V±0.2V	C_L=30pF, R_L=500Ω		3.6		
		V_{CC}=3.3V±0.3V	C_L=50pF, R_L=500Ω		3.1		
		V_{CC}=5V±0.5V	C_L=50pF, R_L=500Ω		2.7		
Input Capacitance	C_i	V_{CC}=3.3V	V_I=V_{CC} or GND		4		pF
Power dissipation capacitance	C_{pd}	V_{CC}=1.8V	f=10MHz		20		pF
		V_{CC}=2.5V			21		
		V_{CC}=3.3V			22		
		V_{CC}=5V			25		

(1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation.

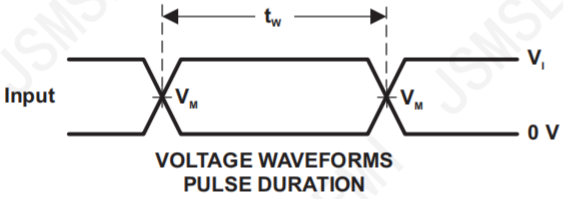
Parameter Measurement Information



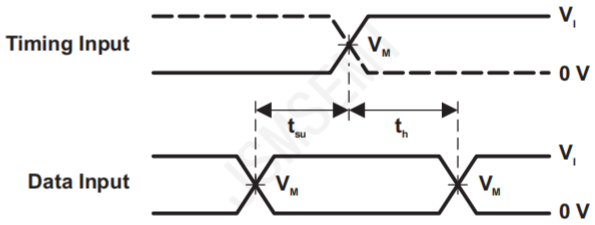
LOAD CIRCUIT

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

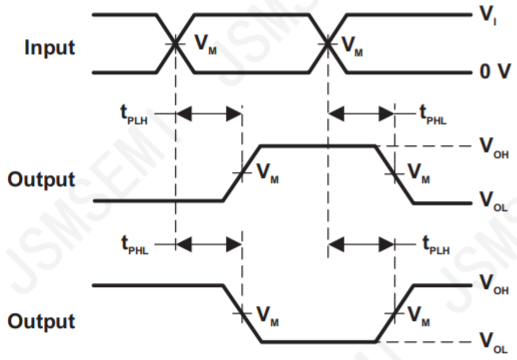
V_{CC}	INPUTS		V_M	V_{LOAD}	C_L		R_L		V_Δ
	V_I	t_r/t_f							
1.8V±0.15V	V_{CC}	≤2ns	$V_{CC}/2$	2 x V_{CC}	15pF	30pF	1MΩ	1kΩ	0.15V
2.5V±0.2V	V_{CC}	≤2ns	$V_{CC}/2$	2 x V_{CC}	15pF	30pF	1MΩ	500Ω	0.15V
3.3V±0.3V	3V	≤2.5ns	1.5V	6V	15pF	50pF	1MΩ	500Ω	0.3V
5V±0.5V	V_{CC}	≤2.5ns	$V_{CC}/2$	2 x V_{CC}	15pF	50pF	1MΩ	500Ω	0.3V



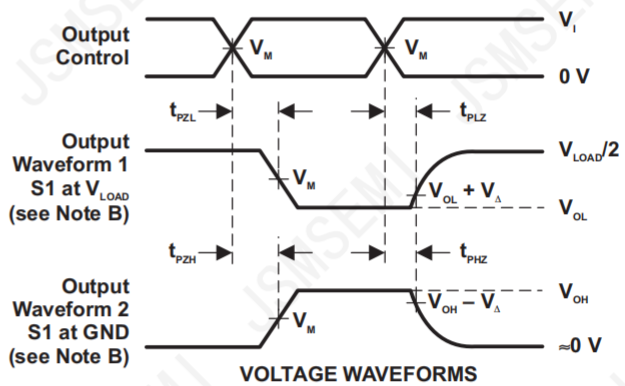
VOLTAGE WAVEFORMS
PULSE DURATION



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.
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}.
H. All parameters and waveforms are not applicable to all devices.

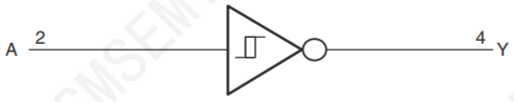
Figure 1. Load Circuit and Voltage Waveforms

Detailed Description

Overview

The SN74LVC1G14 single Schmitt-trigger inverter is designed for 1.65 V to 5.5 V operation and performs the Boolean function Y = $\overline{A}$. This device is fully specified for partial-power-down applications using I_{off}. The I_{off} circuitry disables the outputs when the device is powered down. This inhibits current backflow into the device which prevents damage to the device.

Functional Block Diagrams



Logic Diagram (Positive Logic)

Feature Description

Balanced High-Drive CMOS Push-Pull Outputs

A balanced output allows the device to sink and source similar currents. The high drive capability of this device creates fast edges into light loads so routing and load conditions should be considered to prevent ringing. Additionally, the outputs of this device are capable of driving larger currents than the device can sustain without being damaged. It is important for the power output of the device to be limited to avoid thermal runaway and damage due to over-current. The electrical and thermal limits defined the in the Absolute Maximum Ratings Absolute Maximum Ratings must be followed at all times.

Partial Power Down (I_{off})

The inputs and outputs for this device enter a high impedance state when the supply voltage is 0 V. The maximum leakage into or out of any input or output pin on the device is specified by I_{off} in the Electrical Characteristics.

Over-Voltage Tolerant Inputs

Input signals to this device can be driven above the supply voltage so long as they remain below the maximum input voltage value specified in the Absolute Maximum Ratings.

Device Functional Modes

Function Table

INPUT A	OUTPUT Y
H	L
L	H

Application Information

Mechanical input elements, such as push buttons or rotary knobs, offer simple ways to interact with electronic systems. Typically, these elements have recoil or bouncing, where the mechanical element makes and breaks contact multiple times during human interaction. This bouncing can cause one or more repeated signals to be passed, triggering multiple actions when only a single input was intended. One potential solution to mitigating these multiple inputs is by utilizing a Schmitt-trigger to create a debounce circuit. Figure 2 shows an example of this solution.

Typical Application

The input due to the push button switches multiple times, causing the output of a non Schmitt-trigger device to trigger multiple times, while the Schmitt-trigger input device with RC delay limits the output pulse to a single pulse desired by the user. The separated positive and negative input voltage threshold values, see Figure 7-2, prevent multiple triggers from occurring.

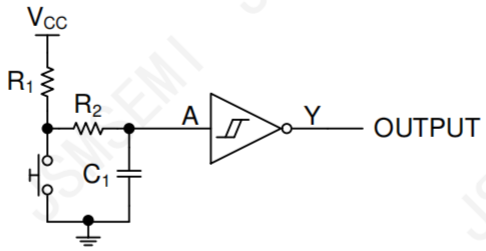


Figure 2. Push Button Debounce Circuit Schematic

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.

The V_{CC} pin must have a good bypass capacitor to prevent power disturbance. A 0.1μF capacitor is recommended, and it is ok to parallel multiple bypass caps to reject different frequencies of noise. 0.1μF and 1μF capacitors are commonly used in parallel. The bypass capacitor must be installed as close to the power pin as possible for best results.

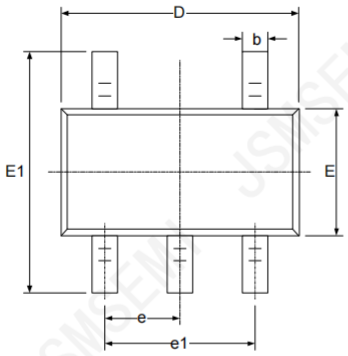
Layout

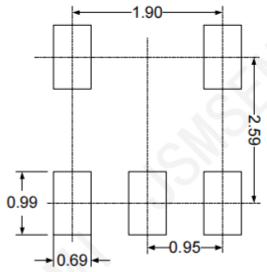
Layout Guidelines

Even low data rate digital signals can contain high-frequency signal components due to fast edge rates. When a printed-circuit board (PCB) trace turns a corner at a 90° angle, a reflection can occur. A reflection occurs primarily because of the change of width of the trace. At the apex of the turn, the trace width increases to 1.414 times the width. This increase upsets the transmission-line characteristics, especially the distributed capacitance and self–inductance of the trace which results in the reflection. Not all PCB traces can be straight and therefore some traces must turn corners.

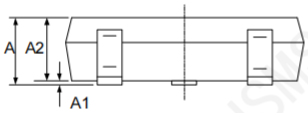
Package Information

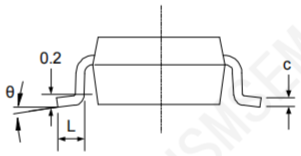
SOT-23-5L





RECOMMENDED LAND PATTERN (Unit: mm)

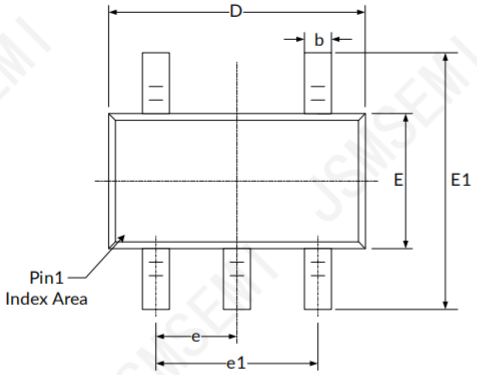


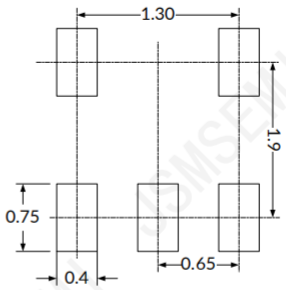


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

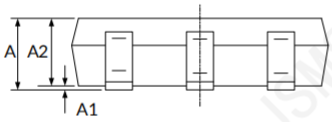
Package Information

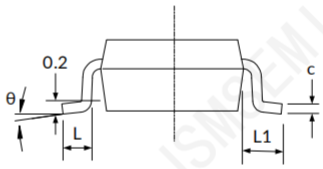
SOT-353(SC70-5)





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.150	0.003	0.006
D (1)	2.000	2.200	0.079	0.087
E (1)	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.650(BSC)		0.026(BSC)	
e1	1.300(BSC)		0.051(BSC)	
L	0.260	0.460	0.010	0.018
L1	0.525		0.021	
θ	0°	8°	0°	8°

Revision History

Rev.	Change	Date
V1.0	Initial version	6/27/2021

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