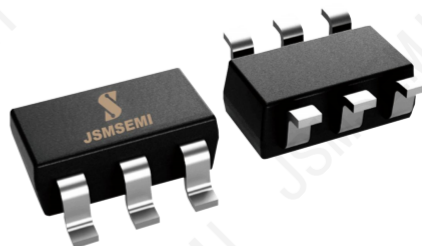


Description

The NC7SZ11 performs the Boolean function $Y = A \cdot B \cdot C$ or $Y = A + B + C$ in positive logic. This device is fully specified for partial-power-down applications using Ioff. The Ioff circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down. The NC7SZ11 is available in Green SOT23-6 and SOT-363 packages. It operates over an ambient temperature range of -40°C to +125°C.



Logic Diagram (Positive Logic)

Applications

- AV Receivers
- DLP Front Projection System
- Digital Picture Frames
- Digital Radio
- Digital Still Cameras
- Digital Video Cameras (DVC)
- Embedded PCs
- E-Books
- Ethernet Switches
- GPS: Personal Navigation Devices
- Handset: Smartphones
- High-Speed Data Acquisition and Generation
- Military: Radar and Sonar
- Mobile Internet Devices
- Notebook PC and Netbooks
- Network-Attached Storage (NAS)
- Power Line Communication Modems
- Server PSU
- STB, DVR, and Streaming Media
- Speakers: USB
- Tablets: Enterprise
- Video Broadcasting and Infrastructure: Scalable Platform and IP-Based Multi-Format Transcoders
- Wireless Headsets, Keyboards, and Mice

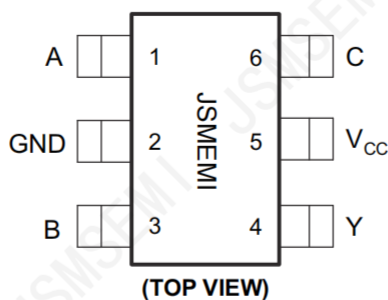
Features

- Latch-up performance exceeds 100mA
- ESD protection exceeds JESD 22
 - ±2000V human-body model
 - ±1000V charged-device model
- Packages: SOT23-6, SOT-363(SC70-6)
- Supports 5V V_{CC} operation
- Inputs accept voltages to 5.5V
- Typ t_{pd} of 4.2ns at 3.3V
- Low power consumption, 1μA maximum I_{CC}
- ±24mA output drive at 3V
- I_{off} supports partial-power-down mode operation
- Operating Temperature Range: -40°C to +125°C
- RoSH compatible

Ordering Information

Order number	Package	Marking	Operation Temperature Range	MSL Grade	Ship,Quantity	Green
NC7SZ11M6X-JSM	SOT-23-6L	C115	-40 to 125°C	3	TR&3000	Rohs
NC7SZ11P6X-JSM	SOT-363	C3J	-40 to 125°C	3	TR&3000	Rohs

Pin Configuration and Functions



Pin Functions

PIN		I/O	DESCRIPTION
NAME	SOT-23 SC70		
A	1	I	A Input
GND	2	—	Ground
B	3	I	B Input
Y	4	O	Y Output
V _{CC}	5	—	Power Supply
C	6	I	C Input

(1) I = input, O = output, P = power, FB = feedback, GND = ground, N/A = not applicable

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 applied to any output in the high-impedance or power-off state ⁽²⁾	−0.5	6.5	V
V _O	Voltage 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	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, 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.

(2) The input negative-voltage and output 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
		Charged-device model (CDM)	±1000

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 _{IH}	High-level input voltage	V _{CC} = 1.65 V to 1.95 V	0.65 × V _{CC}		V
		V _{CC} = 2.3 V to 2.7 V	1.7		
		V _{CC} = 3 V to 3.6 V	2		
		V _{CC} = 4.5 V to 5.5 V	0.7 × V _{CC}		
V _{IL}	Low-level input voltage	V _{CC} = 1.65 V to 1.95 V		0.35 × V _{CC}	V
		V _{CC} = 2.3 V to 2.7 V		0.7	
		V _{CC} = 3 V to 3.6 V		0.8	
		V _{CC} = 4.5 V to 5.5 V		0.3 × V _{CC}	
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	

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

			MIN	MAX	UNIT
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	
Δt/Δv	Input transition rise or fall rate	V _{CC} = 1.8 V ± 0.15 V, 2.5 V ± 0.2 V		20	ns/V
		V _{CC} = 3.3 V ± 0.3 V		10	
		V _{CC} = 5 V ± 0.5 V		10	
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 ensure proper device operation.

Thermal Information

THERMAL METRIC		NC7SZ11		UNIT
		SOT-23	SC70	
		6 PINS	6 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	195.9	260.1	°C/W

Electrical Characteristics—DC Limit Changes

over recommended operating free-air temperature range (TYP values are at $T_A = +25^\circ\text{C}$, Full= -40°C to 125°C , unless otherwise noted.) ⁽¹⁾

PARAMETER		TEST CONDITIONS	V _{CC}	TEMP	MIN ⁽²⁾	TYP ⁽³⁾	MAX ⁽²⁾	UNIT
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	All inputs	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
C _i (Input Capacitance)		V _I =V _{CC} or GND	3.3V	+25°C		4		pF

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

(2) Limits are 100% production tested at 25°C . Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.

(3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

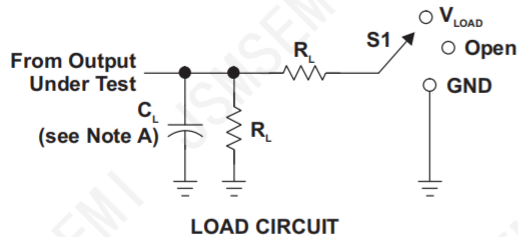
Electrical Characteristics—AC Limit Changes

PARAMETER	SYMBOL	TEST CONDITIONS		MIN ⁽²⁾	TYP ⁽³⁾	MAX ⁽²⁾	UNIT
Propagation Delay	t_{pd}	$V_{CC}=1.8\text{V}\pm 0.15\text{V}$	$C_L=30\text{pF}$, $R_L=1\text{K}\Omega$		13.6		ns
		$V_{CC}=2.5\text{V}\pm 0.2\text{V}$	$C_L=30\text{pF}$, $R_L=500\Omega$		5.5		
		$V_{CC}=3.3\text{V}\pm 0.3\text{V}$	$C_L=50\text{pF}$, $R_L=500\Omega$		4.2		
		$V_{CC}=5\text{V}\pm 0.5\text{V}$	$C_L=50\text{pF}$, $R_L=500\Omega$		3.7		
Power dissipation capacitance	C_{pd}	$V_{CC}=1.8\text{V}$	$f=10\text{MHz}$		16		pF
		$V_{CC}=2.5\text{V}$			18		
		$V_{CC}=3.3\text{V}$			18		
		$V_{CC}=5\text{V}$			20		

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

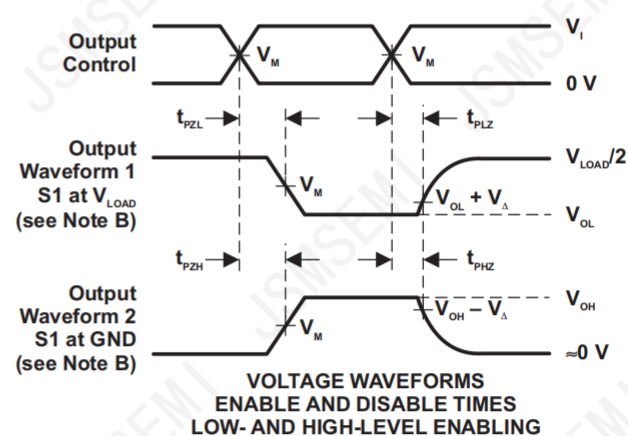
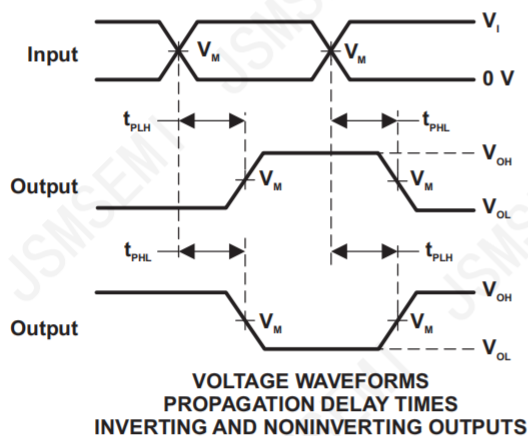
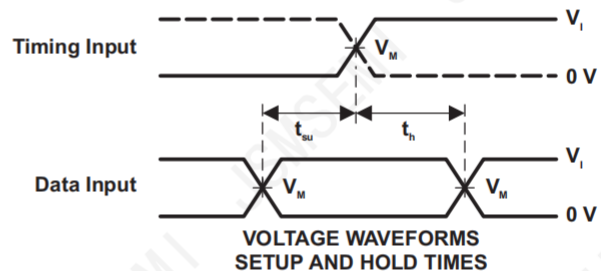
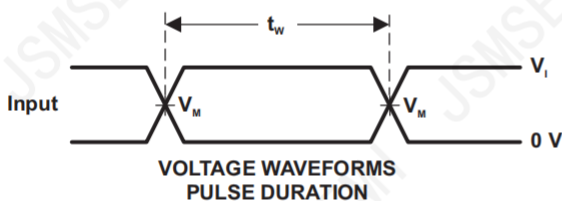
(2) This parameter is ensured by design and/or characterization and is not tested in production.

(3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

Parameter Measurement Information


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							
$1.8V \pm 0.15V$	V_{CC}	$\leq 2ns$	$V_{CC}/2$	$2 \times V_{CC}$	15pF	30pF	1M Ω	1k Ω	0.15V
$2.5V \pm 0.2V$	V_{CC}	$\leq 2ns$	$V_{CC}/2$	$2 \times V_{CC}$	15pF	30pF	1M Ω	500 Ω	0.15V
$3.3V \pm 0.3V$	3V	$\leq 2.5ns$	1.5V	6V	15pF	50pF	1M Ω	500 Ω	0.3V
$5V \pm 0.5V$	V_{CC}	$\leq 2.5ns$	$V_{CC}/2$	$2 \times V_{CC}$	15pF	50pF	1M Ω	500 Ω	0.3V



- 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: $PRR \leq 10 \text{ MHz}$, $Z_o = 50 \Omega$.
 - 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_{PLH} .
 - F. t_{PZL} and t_{PZH} are the same as t_{PHL} .
 - 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

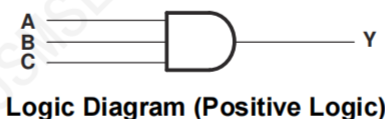
Overview

This 3-input AND gate is designed for 1.65-V to 5.5-V V_{CC} operation.

The NC7SZ11 device features a three-input AND gate. The output state is determined by eight patterns of 3-bit input. All inputs can be connected to V_{CC} or GND.

This device is fully-specified for partial-power-down applications using I_{off} . The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

Functional Block Diagram



Feature Description

The NC7SZ11 device has a wide operating V_{CC} range of 1.65 V to 5.5 V, which allows use in a broad range of systems. The 5.5V I/Os allow down translation and also allow voltages at the inputs when $V_{CC} = 0$ V.

Device Functional Modes

Table 1 lists the functional modes of NC7SZ11.

Table 1. Function Table

INPUTS			OUTPUT Y
A	B	C	
H	H	H	H
L	X	X	L
X	L	X	L
X	X	L	L

Application Information

The NC7SZ11 device offers logical AND configuration for many design applications. This example describes basic power sequencing using the AND gate configuration. Power sequencing is often used in applications that require a processor or other delicate device with specific voltage timing requirements in order to protect the device from malfunctioning. In the application below, the power-good signals from the supplies tell the MCU to continue an operation.

Typical Application

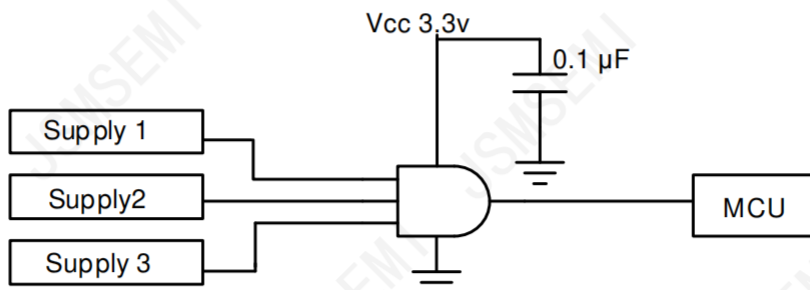


Figure 2. Typical Application Diagram

Detailed Design Procedure

The NC7SZ11 device uses CMOS technology and has balanced output drive. Avoid bus contentions that can drive currents that can exceed maximum limits.

The NC7SZ11 allows for performing the logical AND function with digital signals. Maintain input signals as close as possible to either 0 V or V_{CC} for optimal operation.

Power Supply Recommendations

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

To prevent power disturbance, ensure good bypass capacitance for each V_{CC} terminal. For devices with a single-supply, a $0.1\mu\text{F}$ bypass capacitor is recommended. If multiple pins are labeled V_{CC} , then a $0.01\mu\text{F}$ or $0.022\mu\text{F}$ capacitor is recommended for each V_{CC} because the V_{CC} pins are tied together internally. For devices with dual supply pins operating at different voltages, for example V_{CC} and V_{DD} , a $0.1\mu\text{F}$ bypass capacitor is recommended for each supply pin. To reject different frequencies of noise, use multiple bypass capacitors in parallel. Capacitors with values of $0.1\mu\text{F}$ and $1\mu\text{F}$ are commonly used in parallel. Place the bypass capacitor as close to the power terminal as possible for best results.

Layout

Layout Guidelines

When using multiple-bit logic devices, inputs must never float.

In many cases, functions (or parts of functions) of digital logic devices are unused, for example, when only two inputs of a triple-input AND gate are used or when only 3 of the 4 buffer gates are used. Such input pins must not be left unconnected, because the undefined voltages at the outside connections result in undefined operational states. Figure 3 specifies the rules that must be observed under all circumstances. All unused inputs of digital logic devices must be connected to a high or low bias to prevent them from floating. The logic level that must be applied to any particular unused input depends on the function of the device. Generally they are tied to GND or V_{CC} , whichever makes more sense or is more convenient. It is generally acceptable to float outputs, unless the part is a transceiver. If the transceiver has an output enable pin, it disables the output section of the part when asserted, which does not disable the input section of the I/Os. Therefore, the I/Os cannot float when disabled.

Layout Example

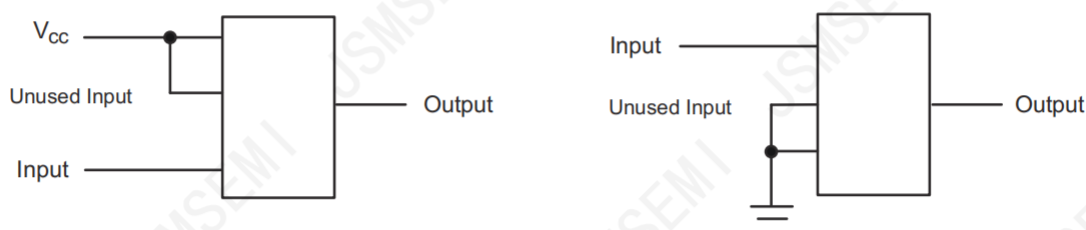
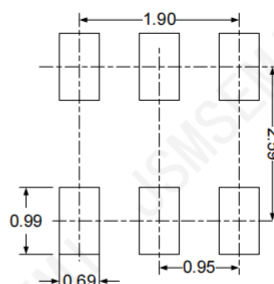
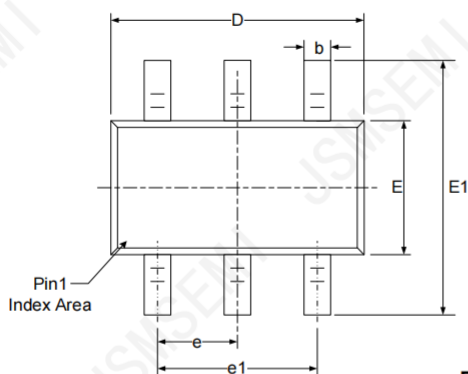


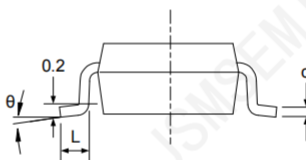
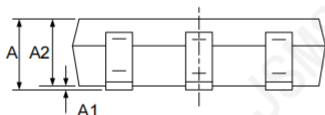
Figure 3. Layout Diagrams

Package Information

SOT-23-6L



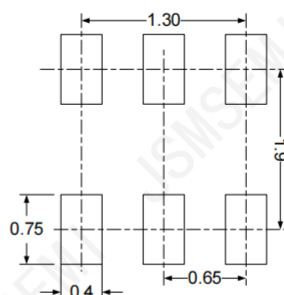
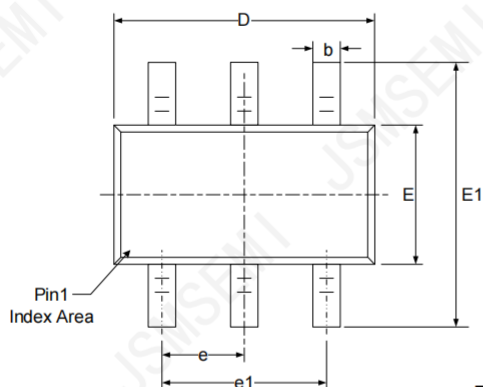
RECOMMENDED LAND PATTERN (Unit: mm)



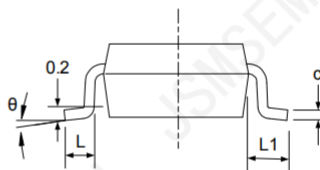
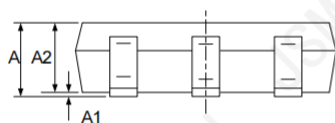
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
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-363(SC70-6)



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	2.000	2.200	0.079	0.087
E	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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