SN74HC4851-Q1 Automotive 8-Channel Analog Multiplexer/Demultiplexer With Injection-Current Effect Control

1 Features

- AEC-Q100 qualified for automotive applications
  - Device Temperature Grade 1: –40°C to 125°C ambient operating temperature
- Injection-current cross coupling <1mV/mA (see Section 8.1 in *Application Information*)
- Low crosstalk between switches
- Terminal compatible with CD74HC4051, SN74LV4051A, and CD4051B devices
- 2V to 5.5V V_{CC} operation
- Latch-up performance exceeds 100mA per JESD 78, class II

2 Applications

- Analog and digital multiplexing and demultiplexing
- Diagnostics and monitoring
- Zonal Architecture
- Body control modules
- Battery management systems (BMS)
- HVAC control module
- Automotive head unit
- Telematics
- On-board (OBC) and wireless charging

3 Description

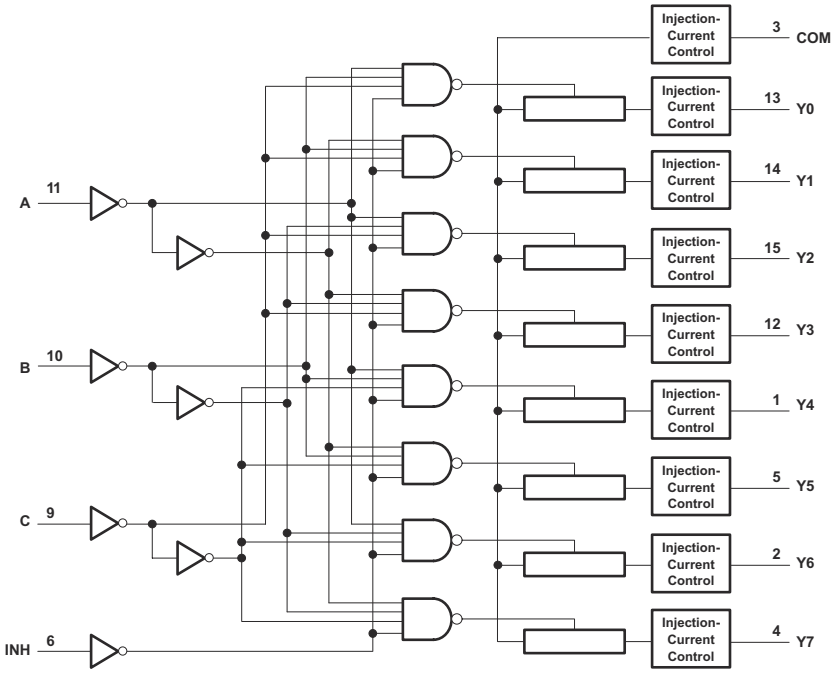
This eight-channel CMOS analog multiplexer/demultiplexer is terminal compatible with the function of the '4051 device, and features injection-current effect control, which has excellent value in automotive applications where voltages in excess of normal supply voltages are common.

The injection-current effect control allows signals at disabled analog input channels to exceed the supply voltage without affecting the signal of the enabled analog channel. This feature eliminates the need for external diode/resistor networks typically used to keep the analog channel signals within the supply-voltage range.

Package Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE(2)
SN74HC4851-Q1	PW (TSSOP, 16)	5mm × 6.4mm

(1) For more information, see Section 11
(2) The package size (length × width) is a nominal value and includes pins, where applicable.



Logic Diagram (Positive Logic)

Table of Contents

4 Pin Configuration and Functions

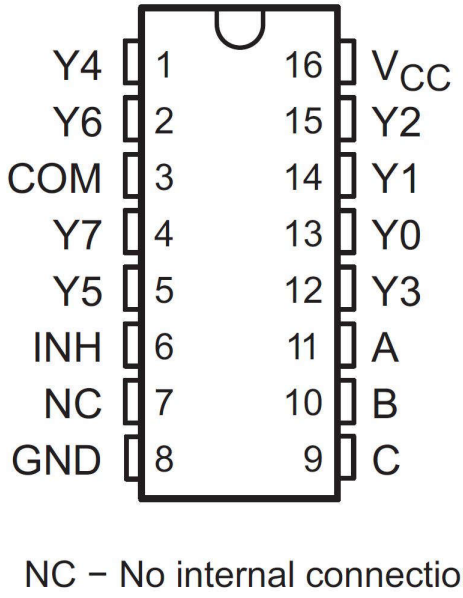


Figure 4-1. SN74HC4851-Q1 PW Package, 16-Pin TSSOP (Top View)

Table 4-1. Function Table

Inputs				On Channel
INH	C	B	A	Yx
L	L	L	L	Y0
L	L	L	H	Y1
L	L	H	L	Y2
L	L	H	H	Y3
L	H	L	L	Y4
L	H	L	H	Y5
L	H	H	L	Y6
L	H	H	H	Y7
H	X	X	X	None

5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1) (2)

		MIN	MAX	UNIT
V_{CC}	Supply voltage	–0.5	6	V
V_{SEL} or V_{EN}	Logic control input pin voltage ($\overline{EN}$, A0, A1, A2)	–0.5	V_{CC}+0.5V	V
V_S or V_D	Source or drain voltage (Sx, D)	–0.5	V_{CC}+0.5V	V
I_{IK}	Input clamp current (V_I < 0 or V_I > V_{CC})	–20	20	mA
I_{IOK}	I/O diode current (V_{IO} < 0 or V_{IO} > V_{CC})	–20	20	mA
I_T	Switch through current (V_{IO} = 0 to V_{CC})	–25	25	mA
I_{GND}	Continuous current through V_{CC} or GND	–50	50	mA
T_{stg}	Storage temperature	–65	150	°C
T_J	Junction temperature		150	

(1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. Absolute maximum ratings do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If briefly operating outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not sustain damage, but it may not be fully functional. Operating the device in this manner may affect device reliability, functionality, performance, and shorten the device lifetime.
(2) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

5.2 Thermal Information: SN74HC485x-Q1

THERMAL METRIC(1)		SN74HC485x-Q1	UNIT
		PW (TSSOP)	
		PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	139.6	°C/W

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

5.3 Recommended Operating Conditions

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

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		2		5.5	V
V_{IH}	Input logic high	2V	1.5			V
		2.5V	2.1			
		3.3V	2.3			
		4.5V	3.15			
		5.5V	4.2			
V_{IL}	Input logic low	2V	0		0.5	V
		2.5V	0		0.7	
		3.3V	0		0.8	
		4.5V	0		0.95	
		5.5V	0		1.05	
V_{SEL} or V_{EN}	Logic control input pin voltage ($\overline{EN}$, A0, A1, A2)		0		V_{CC}	V
V_S or V_D	Signal path input/output voltage (source or drain pin) (Sx, D)		0		V_{CC}	V
Δt/Δv	Input transition rise or fall time	V_{CC} = 2V			1000	ns
		V_{CC} = 3V			800	
		V_{CC} = 3.3V			700	
		V_{CC} = 4.5V			500	
		V_{CC} = 5.5V			400	
T_A	Ambient temperature		–40		125	°C

5.4 Electrical Characteristics

At specified V_{CC} ±10%
Typical values measured at nominal V_{CC}.

PARAMETER		TEST CONDITIONS	V_{CC}	Operating free-air temperature (T_A)									UNIT
				25°C			–40°C to 85°C			–40°C to 125°C			
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
R_{ON}	On-state switch resistance	V_S = 0V to V_{CC} I_{SD} = 0.5mA	2V		500	650			670			700	Ω
			3V		215	280			320			360	
			3.3V		210	270			305			345	
			4.5V		160	210			240			270	
Δ_{RON}	On-state switch resistance matching between inputs	V_S = V_{CC} / 2 I_{SD} = 0.5mA	2V		4	13			18			23	Ω
			3V		2	10			12			16	
			3.3V		2	9			12			16	
			4.5V		2	9			12			16	
I_I	Control input current	V_I = V_{CC} or GND	5V			±0.1			±0.1			±1	μA
$I_{S(OFF)}$	Off-state switch leakage current (any one channel)	Switch Off V_{INH}=V_{IH} V_D = V_{CC} / GND V_S = GND / V_{CC}	5V			±0.1			±0.5			±1	μA
	Off-state switch leakage current (common channel)					±0.2			±2			±4	μA
$I_{S(ON)}$	Channel on-state leakage current	Switch Off V_{INH}=V_{IL} V_D = V_{CC} / GND V_S = GND / V_{CC}	5V			±0.1			±0.5			±1	μA
I_{DD}	V_{CC} supply current	Logic inputs = 0V or V_{CC}	5V			2			20			40	μA
C_{IC}	Control input capacitance	A, B, C, INH			3.5	10			10			10	pF
C_{IS}	Common terminal capacitance	Switch off			22	40			40			40	pF
C_{OS}	Switch terminal capacitance	Switch off			6.7	15			15			15	pF
C_{PD}	Power Dissipation Capacitance	No Load t_r = t_f = 1ns f = 1MHz	3.3V		32								pF
			5V		37								

5.5 Timing Characteristics

At specified V_{CC} ±10%
Typical values measured at nominal V_{CC}.

PARAMETER		TEST CONDITIONS	V_{CC}	Operating free-air temperature (T_A)									UNIT
				25°C			–40°C to 85°C			–40°C to 125°C			
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
SWITCHING CHARACTERISTICS(1)													
t_{PD}	Propagation delay	C_L = 50pF Sx to D, D to Sx	2V		19.5	30			34			37	ns
			3V		12	17.5			19.5			21.5	
			3.3V		11	16.5			18.5			20.5	
			5.5V		8.6	14			15			16	
t_{TRAN}	Transition-time between inputs	R_L = 10kΩ, C_L = 50pF Ax to D, Ax to Sx	2V		44	94			103			103	ns
			3V		30	63			67			67	
			3.3V		23	51			54			54	
			5.5V		18	43			46			46	
$t_{ON(EN)}$	Turnon-time from enable	R_L = 10kΩ, C_L = 50pF EN to D, EN to Sx	2V			95			105			115	ns
			3V			90			100			110	
			3.3V			85			95			105	
			5V			80			90			100	
$t_{OFF(EN)}$	Turnoff time from enable	R_L = 10kΩ, C_L = 50pF EN to D, EN to Sx	2V			95			105			115	ns
			3V			90			100			110	
			3.3V			85			95			105	
			5.5V			80			90			100	

(1) t_{PLH}/t_{PHL}= t_{PD} propagation delay time, t_{PZH}/t_{PZL}= $t_{ON(EN)}$ enable delay time, t_{PHZ}/t_{PLZ} = $t_{OFF(EN)}$ disable delay time, t_{PLH}/t_{PHL} Channel select = t_{TRAN}

5.6 Injection Current Coupling

At specified V_{CC} ±10%
Typical values measured at nominal V_{CC} and T_A = 25°C.

PARAMETER		V_{CC}	TEST CONDITIONS		-40°C to 125°C			UNIT
					MIN	TYP	MAX	
INJECTION CURRENT COUPLING								
ΔV_{OUT}	Maximum shift of output voltage of enabled analog input(1)	3.3V	R_S ≤ 3.9kΩ	I_{INJ} ≤ 1mA		0.05	1	mV
		5V				0.1	1	
		3.3V		I_{INJ} ≤ 10mA		0.345	5	
		5V				0.067	5	
		3.3V	R_S ≤ 20kΩ	I_{INJ} ≤ 1mA		0.05	2	
		5V				0.11	2	
		3.3V		I_{INJ} ≤ 10mA		0.05	20	
		5V				0.024	20	

(1) I_{INJ} = total current injected into all disabled channels

6 Parameter Measurement Information

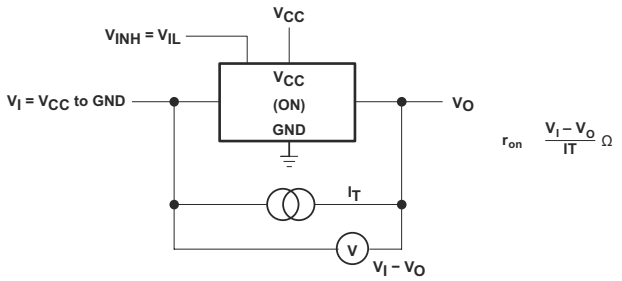


Figure 6-1. On-State-Resistance Test Circuit

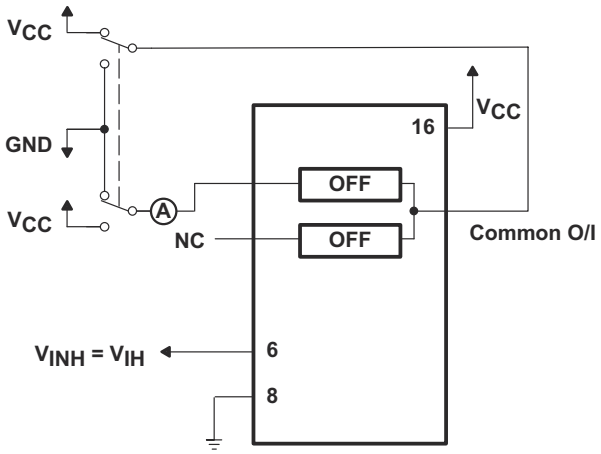


Figure 6-2. Maximum Off-Channel Leakage Current, Any One Channel, Test Setup

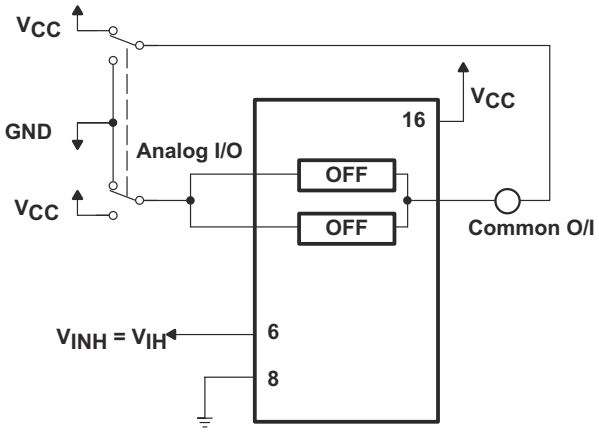


Figure 6-3. Maximum Off-Channel Leakage Current, Common Channel, Test Setup

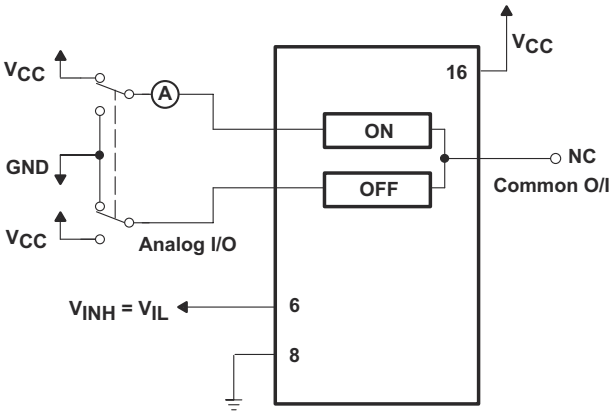


Figure 6-4. Maximum On-Channel Leakage Current, Channel To Channel, Test Setup

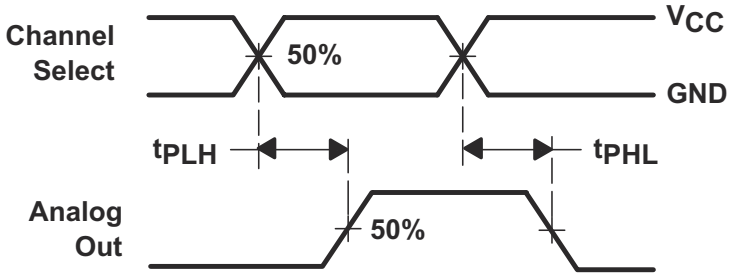


Figure 6-5. Propagation Delays, Channel Select to Analog Out

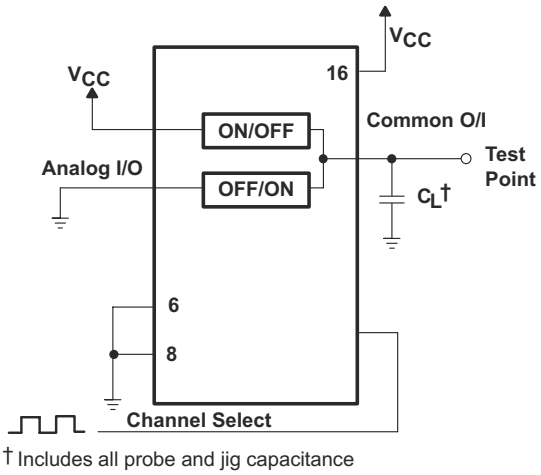


Figure 6-6. Propagation-Delay Test Setup, Channel Select to Analog Out

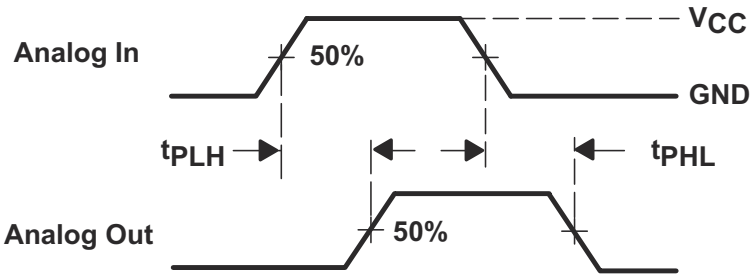
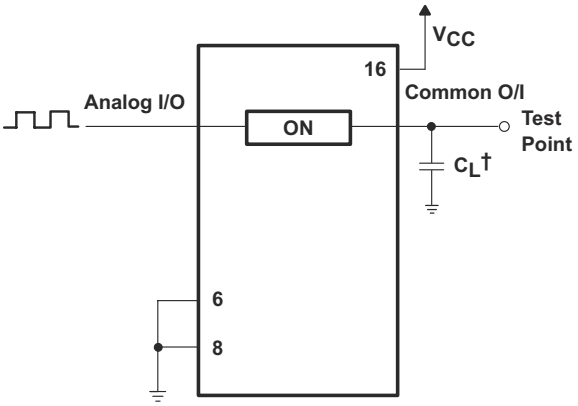


Figure 6-7. Propagation Delays, Analog In to Analog Out



† Includes all probe and jig capacitance

Figure 6-8. Propagation-Delay Test Setup, Analog In to Analog Out

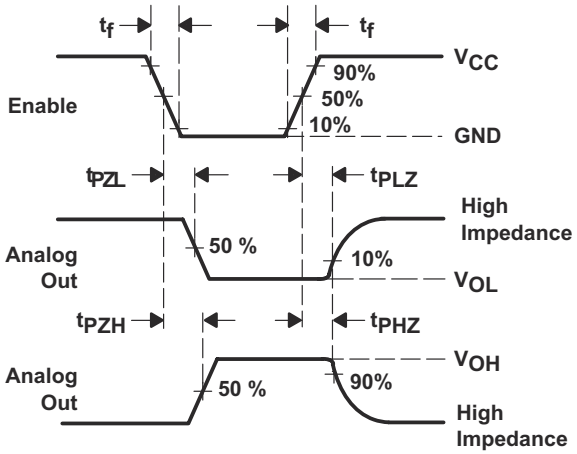


Figure 6-9. Propagation Delays, Enable to Analog Out

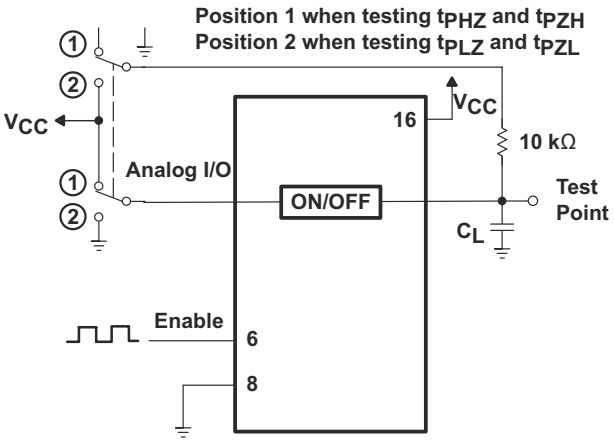


Figure 6-10. Propagation-Delay Test Setup, Enable to Analog Out

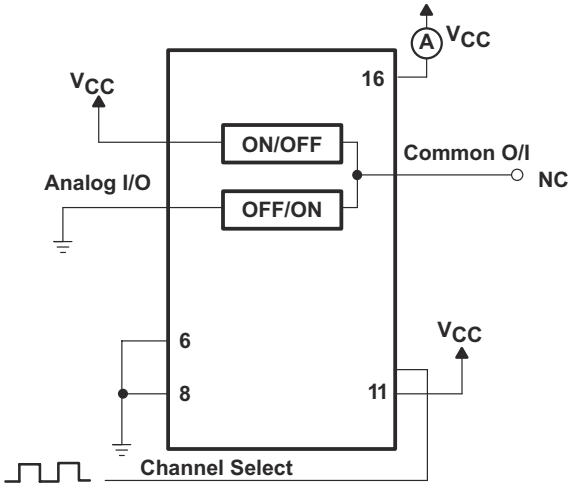


Figure 6-11. Power-Dissipation Capacitance Test Setup

7 Detailed Description

7.1 Functional Block Diagram

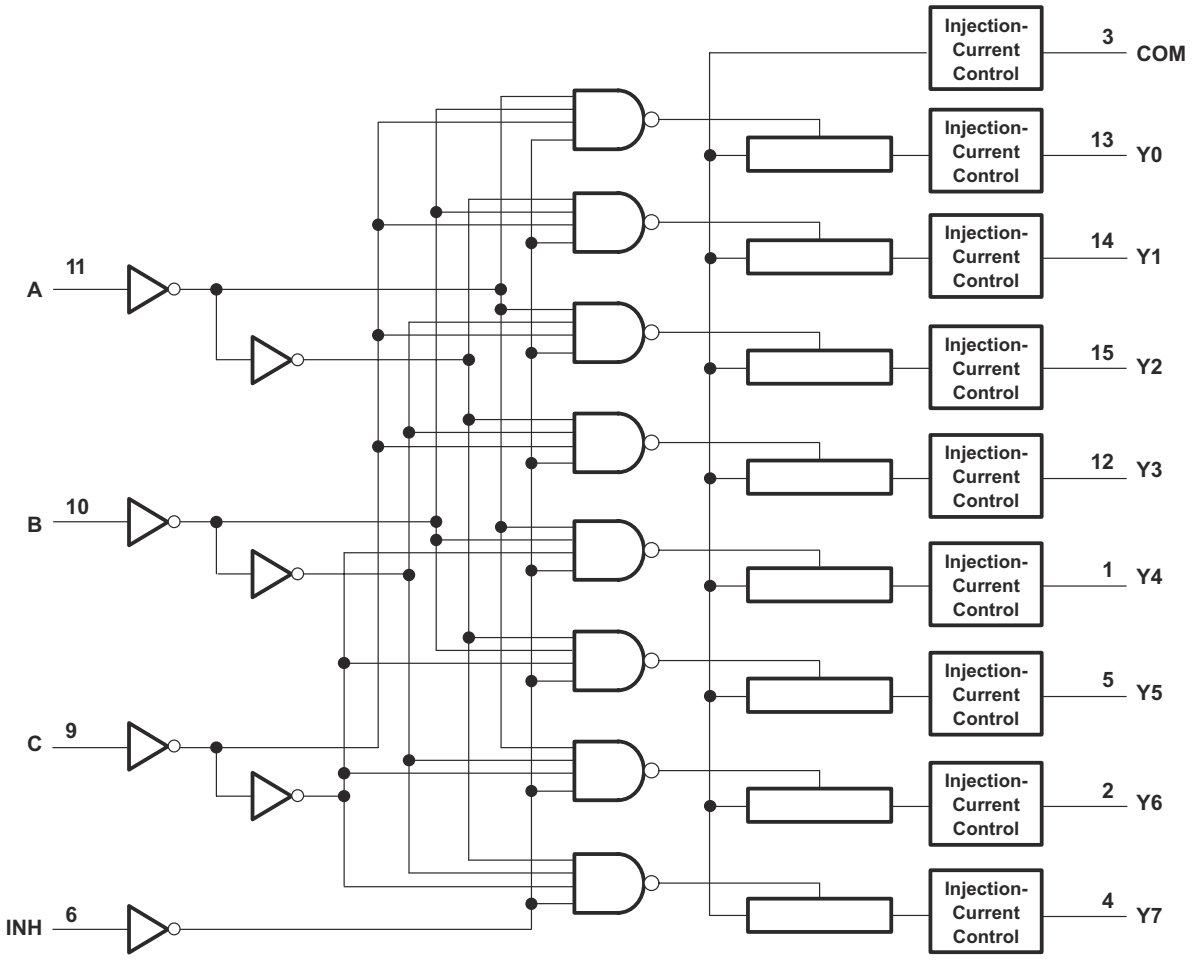


Figure 7-1. Logic Diagram (Positive Logic)

8 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

8.1 Application Information

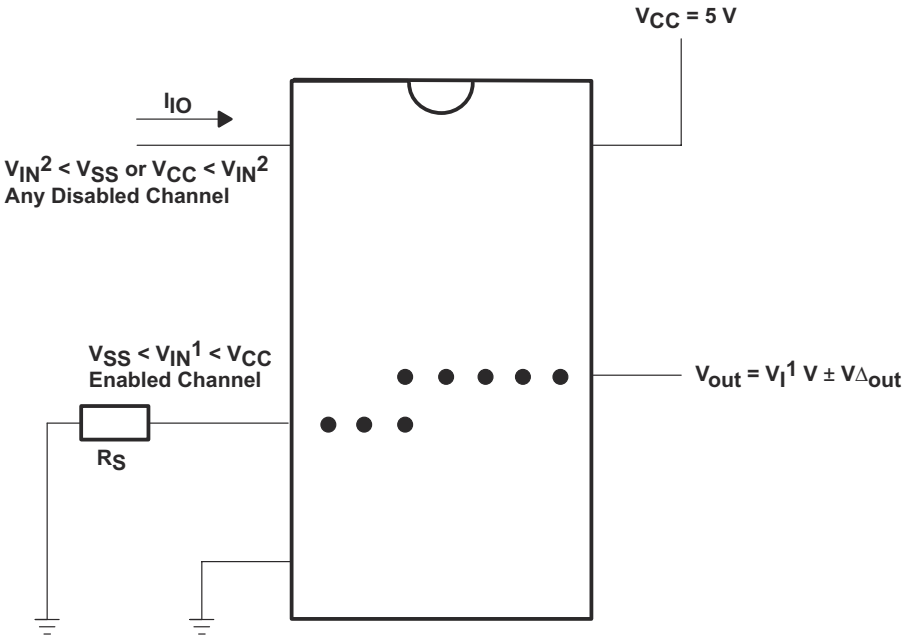


Figure 8-1. Injection-Current Coupling Specification

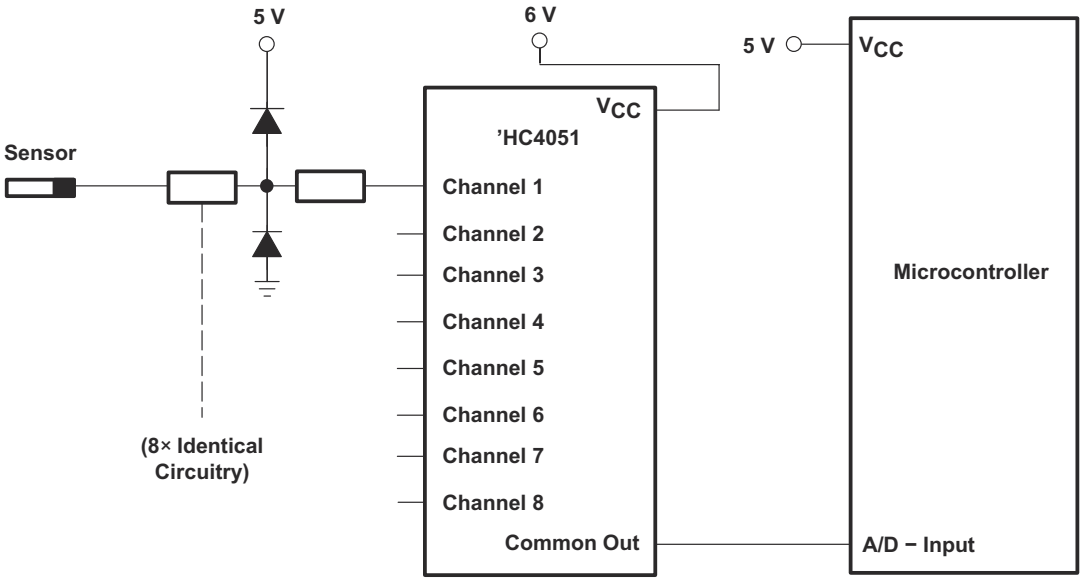


Figure 8-2. Alternate Solution Requires 32 Passive Components and One Extra 6V Regulator to Suppress Injection Current Into a Standard 'HC4051 Multiplexer

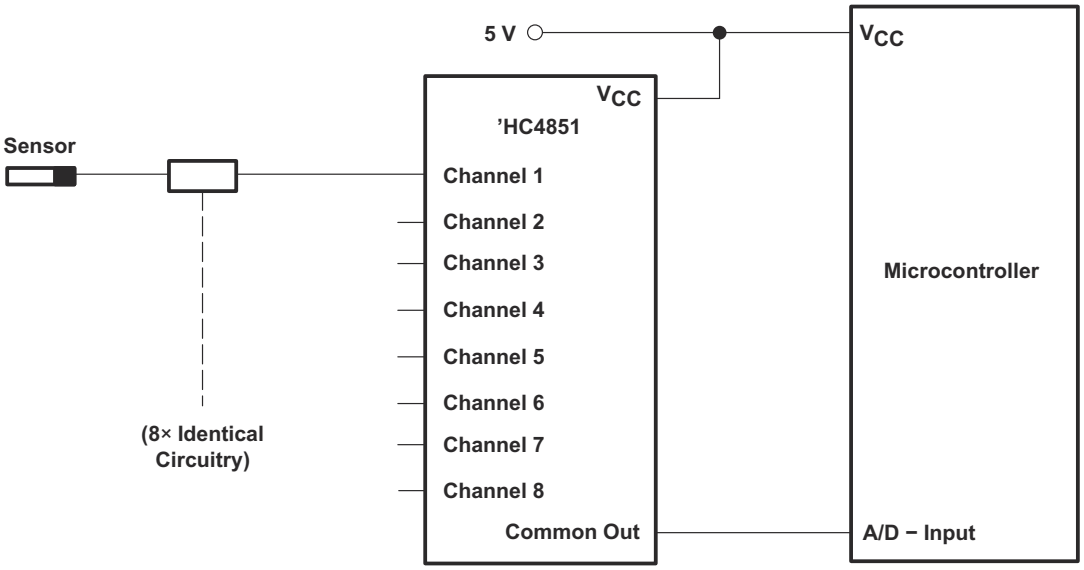


Figure 8-3. Solution by Applying the 'HC4851 Multiplexer

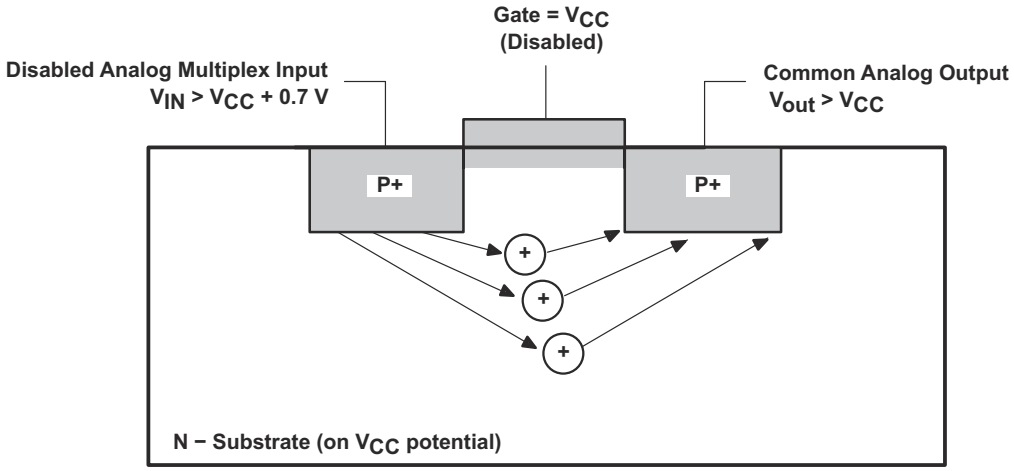


Figure 8-4. Diagram of Bipolar Coupling Mechanism (Appears if V_{IN} Exceeds V_{CC}, Driving Injection Current Into the Substrate)

9 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

9.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

9.2 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is 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.

9.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.
All trademarks are the property of their respective owners.

9.4 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

9.5 Glossary

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

10 Revision History

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

Changes from Revision D (June 2024) to Revision E (January 2025)	Page
• Updated first point to "AEC-Q100 qualified" and added Device Temperature Grade	1

Changes from Revision C (October 2012) to Revision D (June 2024)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document	1
• Changed VCC ABS Max from 7V to 6V	4
• Changed RθJA	4
• Recommended supply changed from 6V to 5.5V and all test conditions using 6V were removed	5
• Changed ttran, tON, tOFF parameters	7

11 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.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
SN74HC4851QDRG4Q1	NRND	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4851Q
SN74HC4851QDRG4Q1.A	NRND	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4851Q
SN74HC4851QDRQ1	NRND	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4851Q
SN74HC4851QDRQ1.A	NRND	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4851Q
SN74HC4851QPWRG4Q1	NRND	Production	TSSOP (PW) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4851Q
SN74HC4851QPWRG4Q1.A	NRND	Production	TSSOP (PW) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4851Q
SN74HC4851QPWRQ1	Active	Production	TSSOP (PW) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4851Q
SN74HC4851QPWRQ1.A	Active	Production	TSSOP (PW) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4851Q

(1) **Status:** For more details on status, see our product life cycle.

(2) **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.

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

(4) **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.

(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.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF SN74HC4851-Q1 :

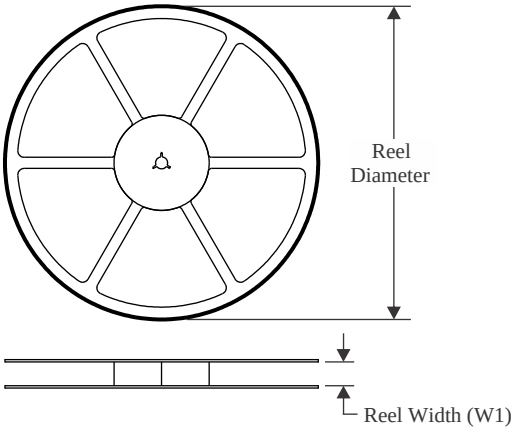
- Catalog : SN74HC4851

NOTE: Qualified Version Definitions:

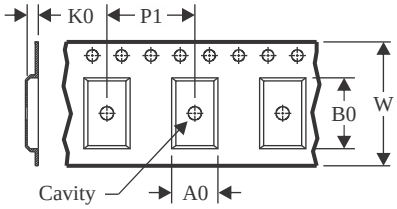
- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

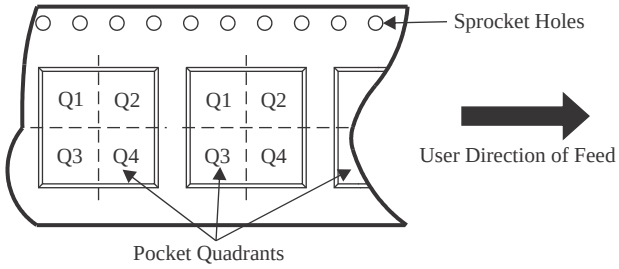


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	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

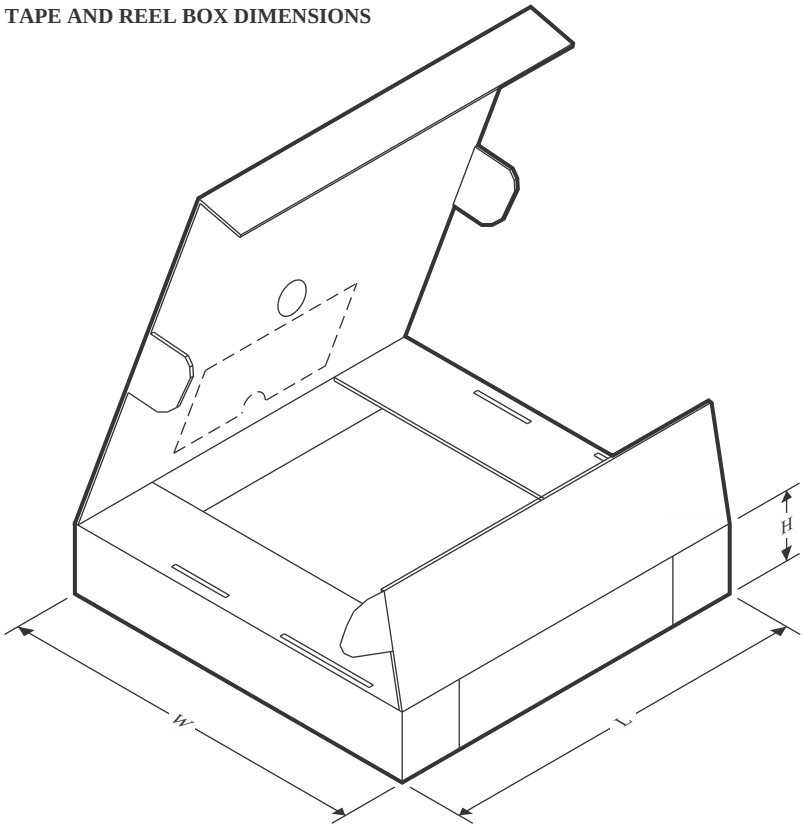
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74HC4851QPWRG4Q1	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74HC4851QPWRQ1	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

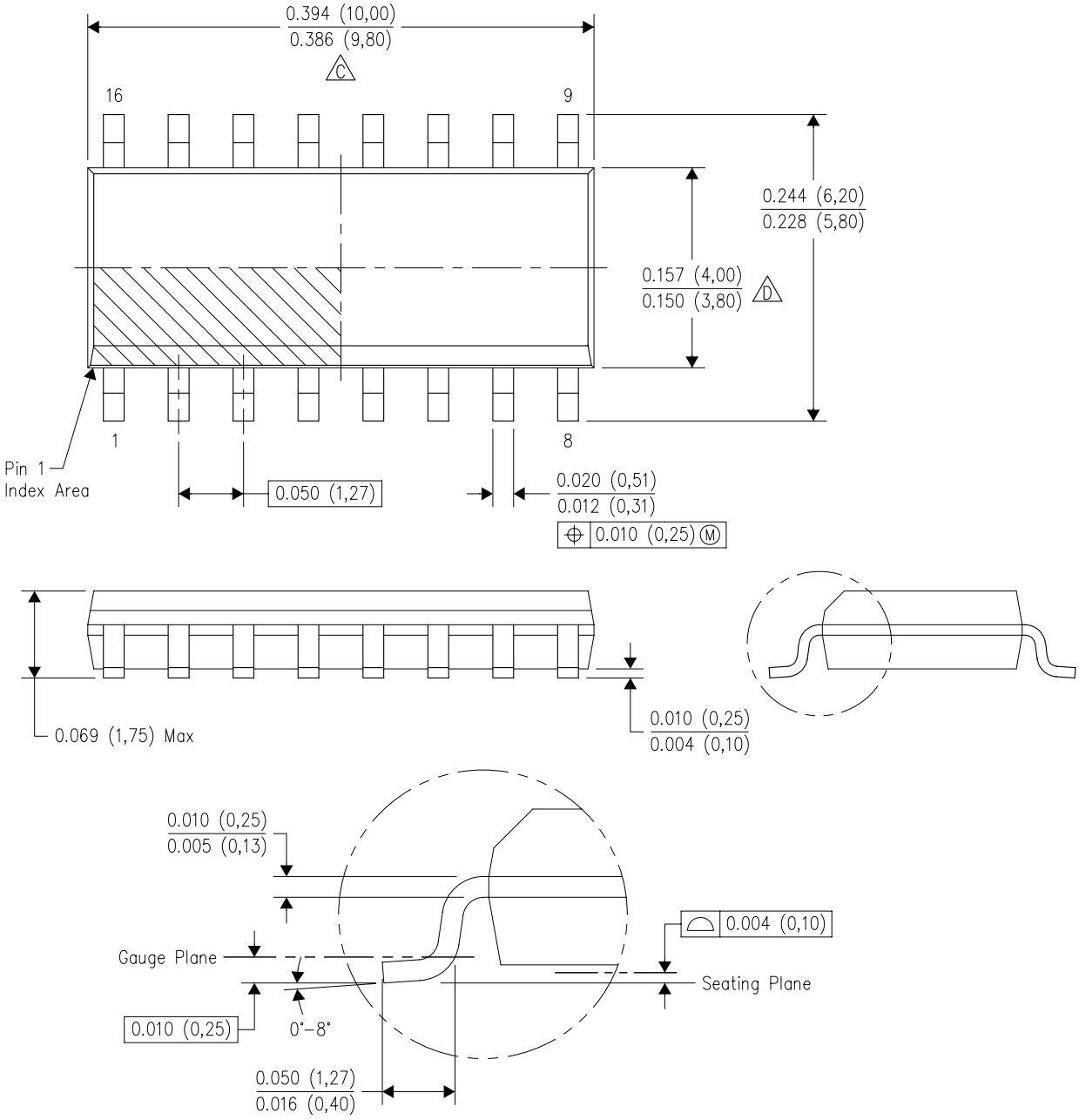
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74HC4851QPWRG4Q1	TSSOP	PW	16	2000	353.0	353.0	32.0
SN74HC4851QPWRQ1	TSSOP	PW	16	2000	353.0	353.0	32.0

D (R–PDSO–G16) PLASTIC SMALL OUTLINE



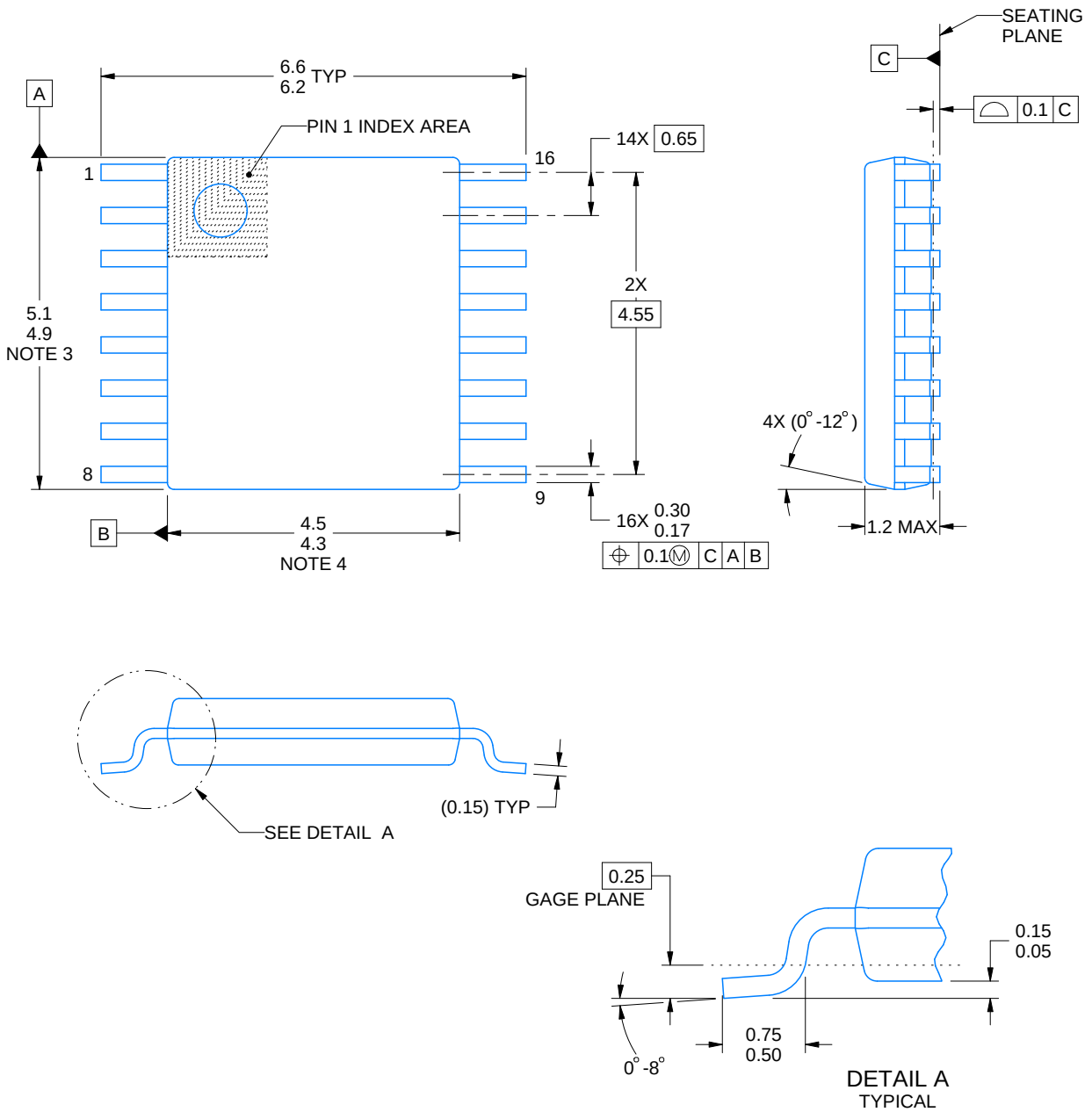
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AC.

PACKAGE OUTLINE

PW0016A

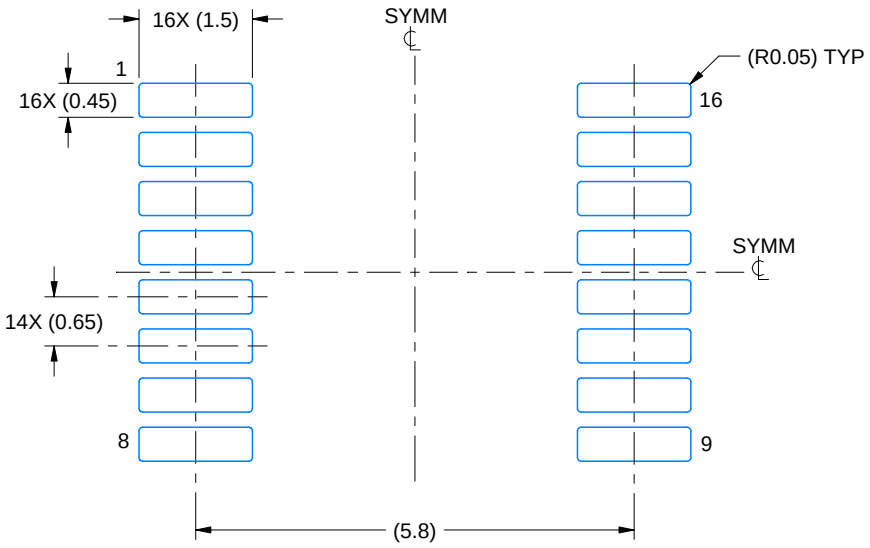
TSSOP - 1.2 mm max height

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.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X

SOLDER MASK DETAILS

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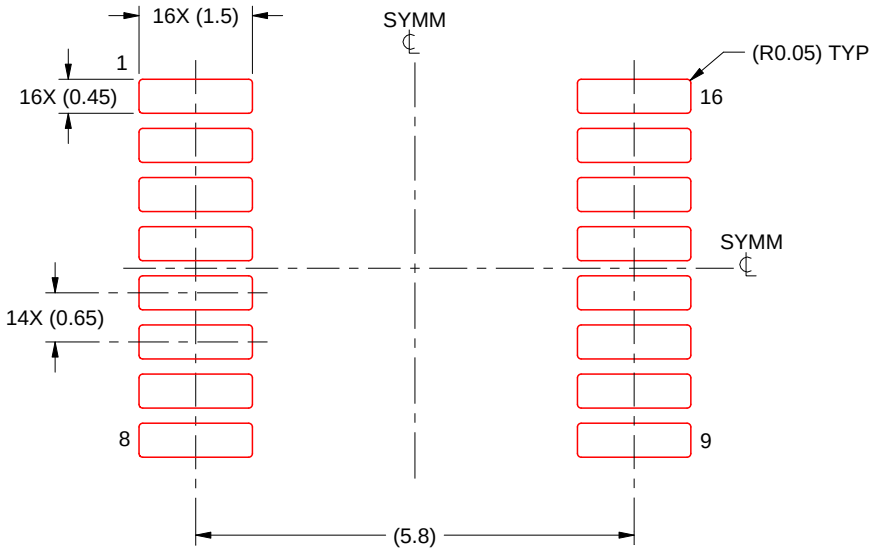
NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

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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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