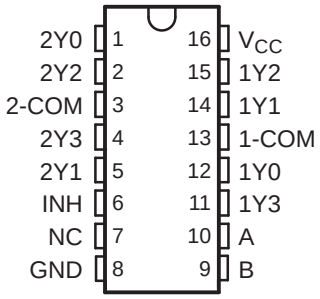
SN74HC4852-Q1
DUAL 4-TO-1 CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER WITH INJECTION-CURRENT EFFECT CONTROL

SCLS705A–DECEMBER 2006–REVISED FEBRUARY 2008

FEATURES

- **Qualified for Automotive Applications**
- **Injection-Current Cross Coupling <1 mV/mA (see Figure 1)**
- **Low Crosstalk Between Switches**
- **Pin Compatible With SN74HC4052, SN74LV4052A, and CD4052B**
- **2-V to 6-V V_{CC} Operation**

D OR PW PACKAGE
(TOP VIEW)



NC − No internal connection

DESCRIPTION/ORDERING INFORMATION

This dual 4-to-1 CMOS analog multiplexer/demultiplexer is pin compatible with the 4052 function and also features injection-current effect control. This feature 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 eliminates the need for external diode/resistor networks typically used to keep the analog channel signals within the supply voltage range.

ORDERING INFORMATION(1)

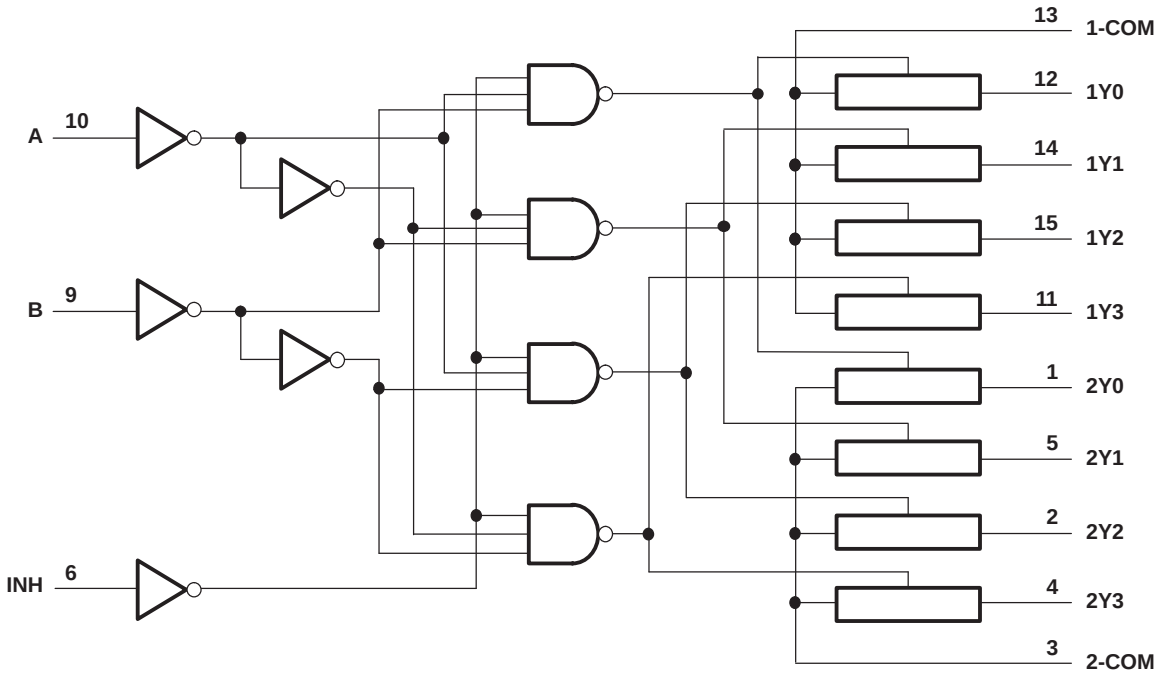
T_A	PACKAGE(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 125°C	SOIC – D	Reel of 2500	SN74HC4852QDRQ1	HC4852Q
	TSSOP – PW	Reel of 2000	SN74HC4852QPWRQ1	HC4852Q

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

FUNCTION TABLE

INPUTS			ON CHANNEL
INH	B	A	
L	L	L	1Y0, 2Y0
L	L	H	1Y1, 2Y1
L	H	L	1Y2, 2Y2
L	H	H	1Y3, 2Y3
H	X	X	None

LOGIC DIAGRAM (POSITIVE LOGIC)



Absolute Maximum Ratings(1)

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage range		–0.5	7	V
V_I	Input voltage range(2)		–0.5	V_{CC} + 0.5	V
V_{IO}	Switch I/O voltage range(2)(3)		–0.5	V_{CC} + 0.5	V
I_{IK}	Input clamp current	V_I < 0 or V_I > V_{CC}		±20	mA
I_{IOK}	I/O diode current	V_{IO} < 0 or V_{IO} > V_{CC}		±20	mA
I_S	Switch through current	V_{IO} = 0 to V_{CC}		±25	mA
	Continuous current through V_{CC} or GND			±50	mA
θ_{JA}	Package thermal impedance(4)	D package		73	°C/W
		PW package		108	
T_{stg}	Storage temperature range		–65	150	°C
ESD	Electrostatic discharge protection	Human-Body Model (HBM)		2000	V
		Machine Model (MM)		200	
		Charged-Device Model (CDM)		1000	

(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 and output voltage ratings may be exceeded if the input and output current ratings are observed.
(3) This value is limited to 5.5 V maximum.
(4) The package thermal impendance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions(1)

			MIN	MAX	UNIT
V_{CC}	Supply voltage		2	6	V
V_{IH}	High-level input voltage, control inputs	V_{CC} = 2 V	1.5		V
		V_{CC} = 3 V	2.1		
		V_{CC} = 3.3 V	2.3		
		V_{CC} = 4.5 V	3.15		
		V_{CC} = 6 V	4.2		
V_{IL}	Low-level input voltage, control inputs	V_{CC} = 2 V		0.5	V
		V_{CC} = 3 V		0.9	
		V_{CC} = 3.3 V		1	
		V_{CC} = 4.5 V		1.35	
		V_{CC} = 6 V		1.8	
V_I	Control input voltage		0	V_{CC}	V
V_{IO}	Input/output voltage		0	V_{CC}	V
Δt/Δv	Input transition rise or fall rate	V_{CC} = 2 V		1000	ns
		V_{CC} = 3 V		800	
		V_{CC} = 3.3 V		700	
		V_{CC} = 4.5 V		500	
		V_{CC} = 6 V		400	
T_A	Operating free-air temperature		–40	125	°C

(1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

Electrical Characteristics

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

PARAMETER		TEST CONDITIONS	V_{CC}	T_A = 25°C			–40°C to 85°C		–40°C to 125°C		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
r_{on}	On-state switch resistance	I_S ≤ 2 mA, V_I = V_{CC} to GND, V_{INH} = V_{IL} (see Figure 5)	2 V		500	650		670		700	Ω
			3 V		215	280		320		360	
			3.3 V		210	270		305		345	
			4.5 V		160	210		240		270	
			6 V		150	195		220		250	
Δr_{on}	Difference in on-state resistance between switches	I_S ≤ 2 mA, V_I = V_{CC}/2, V_{INH} = V_{IL}	2 V		4	20		24		26	Ω
			3 V		2	14		16		18	
			3.3 V		2	14		16		18	
			4.5 V		2	10		14		18	
			6 V		3	11		15		20	
I_I	Control input current	V_I = V_{CC} or GND	6 V			±0.1		±0.1		±1	µA
$I_{S(off)}$	Off-state switch leakage current (any one channel)	V_I = V_{CC} or GND, V_{INH} = V_{IH} (see Figure 6)	6 V			±0.1		±0.5		±1	µA
	Off-state switch leakage current (common channel)	V_I = V_{CC} or GND, V_{INH} = V_{IH} (see Figure 7)				±0.2		±2		±4	
$I_{S(on)}$	On-state switch leakage current	V_I = V_{CC} or GND, V_{INH} = V_{IL} (see Figure 8)	6 V			±0.1		±0.5		±1	µA
I_{CC}	Supply current	V_I = V_{CC} or GND	6 V			2		5		10	µA
C_{IC}	Control input capacitance	A, B, 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

Injection-Current Coupling Specifications

T_A = –40°C to 125°C (see Figure 1)

PARAMETER		V_{CC}	TEST CONDITIONS		MIN	TYP(1)	MAX	UNIT
$V_{\Delta out}$	Maximum shift of output voltage of enabled analog channel	3.3 V	I_I(2) ≤ 1 mA	R_S ≤ 3.9 kΩ		0.05	1	mV
		5 V				0.1	1	
		3.3 V	I_I(2) ≤ 10 mA			0.345	5	
		5 V				0.067	5	
		3.3 V	I_I(2) ≤ 1 mA	R_S ≤ 20 kΩ		0.05	2	
		5 V				0.11	2	
		3.3 V	I_I(2) ≤ 10 mA			0.05	20	
		5 V				0.024	20	

(1) Typical values are measured at T_A = 25°C.
(2) I_I = total current injected into all disabled channels

Switching Characteristics

V_{CC} = 2 V, C_L = 50 pF, over recommended operating free-air temperature range (unless otherwise noted) (see Figure 9 through Figure 14)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	T_A = 25°C			–40°C to 85°C		–40°C to 125°C		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH} t_{PHL}	Propagation delay time	COM or Yn	Yn or COM	9.5	19.5	33	8	34	7	35	ns
t_{PLH} t_{PHL}	Propagation delay time	Channel Select	COM or Yn	14.6	24.5	38	14.4	40	12.8	42	ns
t_{PZH} t_{PZL}	Enable delay time	INH	COM or Yn	15	23.6	47.5	13.8	52.5	12.5	57.5	ns
t_{PHZ} t_{PLZ}	Disable delay time	INH	COM or Yn	34.5	48.4	100	34.3	105	34	115	ns

Switching Characteristics

V_{CC} = 3 V, C_L = 50 pF, over recommended operating free-air temperature range (unless otherwise noted) (see Figure 9 through Figure 14)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	T_A = 25°C			–40°C to 85°C		–40°C to 125°C		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH} t_{PHL}	Propagation delay time	COM or Yn	Yn or COM	3.6	12	17.5	4.5	19	3.2	20.5	ns
t_{PLH} t_{PHL}	Propagation delay time	Channel Select	COM or Yn	7.4	14.6	21	8.3	22.5	7.2	24	ns
t_{PZH} t_{PZL}	Enable delay time	INH	COM or Yn	7.9	13.8	45	6.2	50	5.5	55	ns
t_{PHZ} t_{PLZ}	Disable delay time	INH	COM or Yn	31.2	44.5	90	31.5	100	31	110	ns

Switching Characteristics

V_{CC} = 3.3 V, C_L = 50 pF, over recommended operating free-air temperature range (unless otherwise noted) (see Figure 9 through Figure 14)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	T_A = 25°C			–40°C to 85°C		–40°C to 125°C		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH} t_{PHL}	Propagation delay time	COM or Yn	Yn or COM	3.9	11	15.5	4	17	3.2	18.5	ns
t_{PLH} t_{PHL}	Propagation delay time	Channel Select	COM or Yn	6.4	13.5	19	6.5	20.5	5.5	22.5	ns
t_{PZH} t_{PZL}	Enable delay time	INH	COM or Yn	7	12.7	42.5	6.4	47.5	5.4	52.5	ns
t_{PHZ} t_{PLZ}	Disable delay time	INH	COM or Yn	30	43.9	85	29.6	95	29.5	105	ns

Switching Characteristics

V_{CC} = 4.5 V, C_L = 50 pF, over recommended operating free-air temperature range (unless otherwise noted) (see Figure 9 through Figure 14)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	T_A = 25°C			–40°C to 85°C		–40°C to 125°C		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH} t_{PHL}	Propagation delay time	COM or Yn	Yn or COM	2.3	8.6	13	2.1	13.8	2	15.2	ns
t_{PLH} t_{PHL}	Propagation delay time	Channel Select	COM or Yn	5.3	11	16.6	5.5	18	4.6	19	ns
t_{PZH} t_{PZL}	Enable delay time	INH	COM or Yn	4	9.9	40	4.3	45	3.4	50	ns
t_{PHZ} t_{PLZ}	Disable delay time	INH	COM or Yn	24.5	41.4	80	24.2	90	24	100	ns

Switching Characteristics

V_{CC} = 6 V, C_L = 50 pF, over recommended operating free-air temperature range (unless otherwise noted) (see Figure 9 through Figure 14)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	T_A = 25°C			–40°C to 85°C		–40°C to 125°C		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH} t_{PHL}	Propagation delay time	COM or Yn	Yn or COM	2	8	11.8	2.3	13	1.8	13.5	ns
t_{PLH} t_{PHL}	Propagation delay time	Channel Select	COM or Yn	3.4	9.5	14.6	3.7	16	2.8	17.5	ns
t_{PZH} t_{PZL}	Enable delay time	INH	COM or Yn	2.8	8.4	39	3	40	2	40	ns
t_{PHZ} t_{PLZ}	Disable delay time	INH	COM or Yn	12.4	38	78	11.5	80	11	80	ns

Operating Characteristics

T_A = 25°C (see Figure 15)

PARAMETER		V_{CC}	TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	3.3 V	No load	48	pF
		5 V		60	

APPLICATION INFORMATION

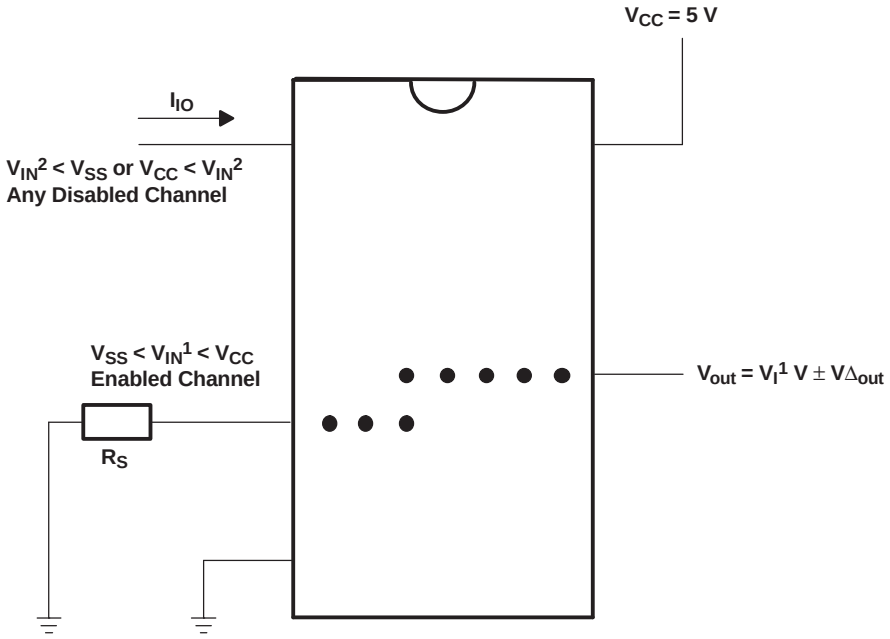


Figure 1. Injection-Current Coupling Specification

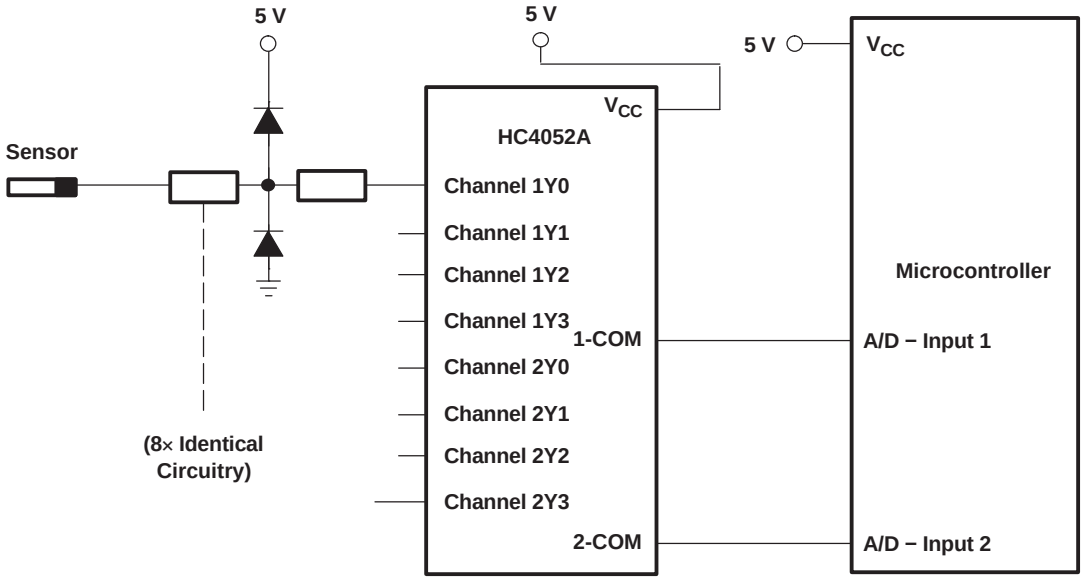


Figure 2. Actual Technology Requires 32 Passive Components and One Extra 6-V Regulator to Suppress Injection Current Into a Standard HC4052 Multiplexer

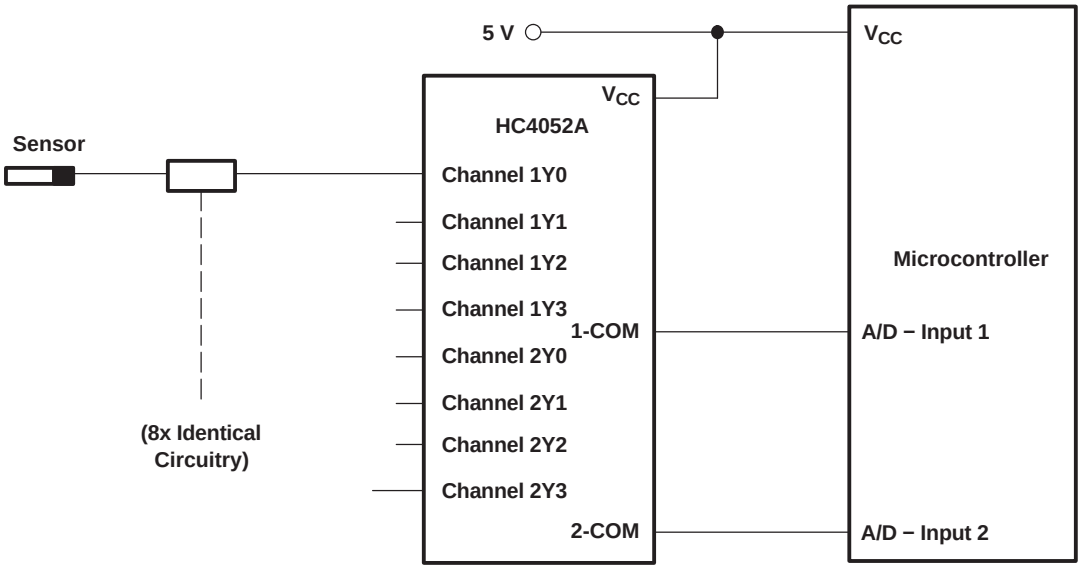


Figure 3. Solution by Applying the HC4852 Multiplexer

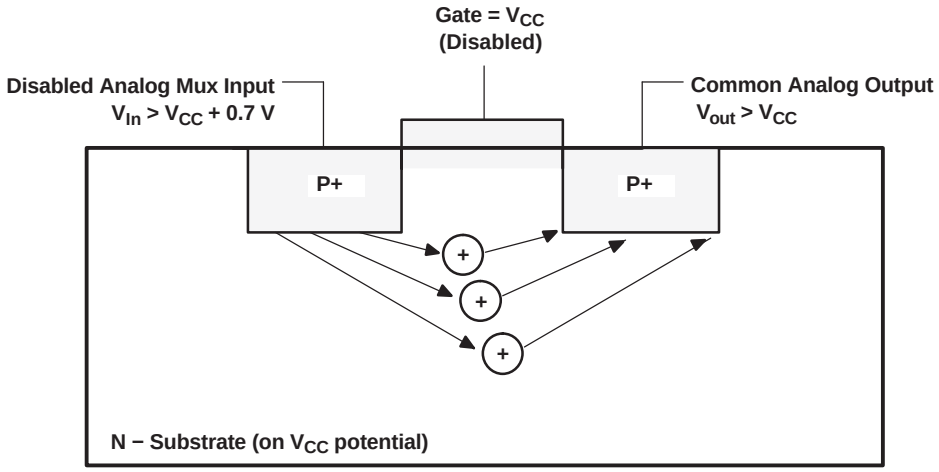


**Figure 4. Diagram of Bipolar Coupling Mechanism
(Appears if V_{IN} Exceeds V_{CC}, Driving Injection Current Into the Substrate)**

PARAMETER MEASUREMENT INFORMATION

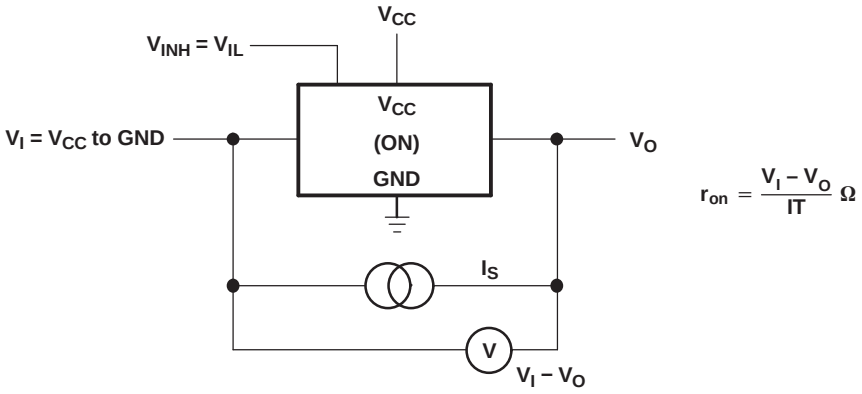


Figure 5. On-State Resistance Test Circuit

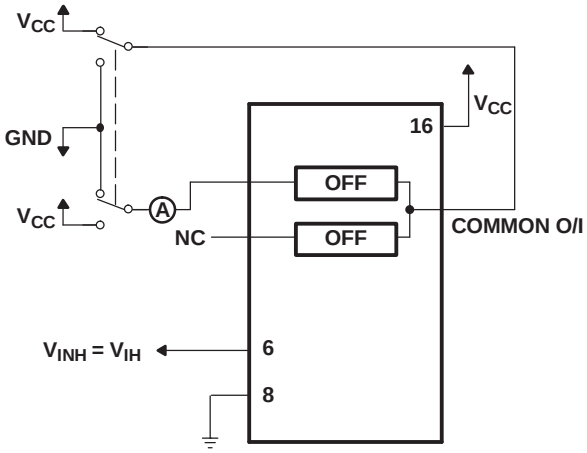


Figure 6. Maximum Off-Channel Leakage Current, Any One Channel, Test Setup

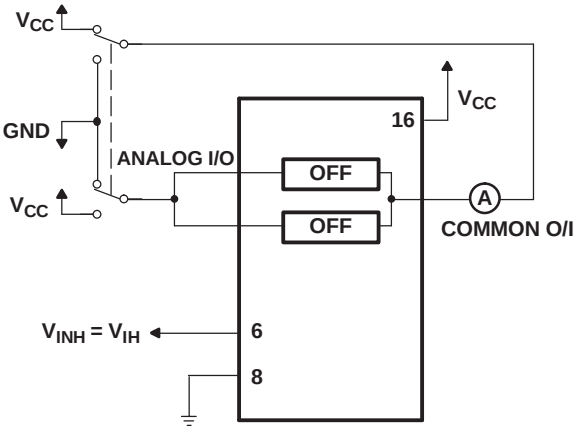


Figure 7. Maximum Off-Channel Leakage Current, Common Channel, Test Setup

PARAMETER MEASUREMENT INFORMATION (continued)

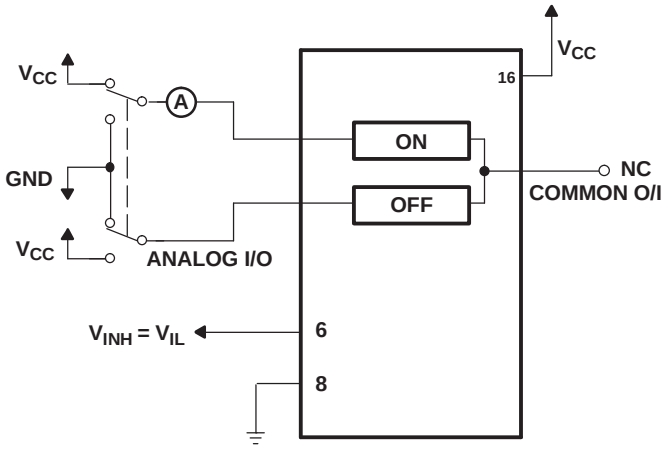


Figure 8. Maximum On-Channel Leakage Current, Channel to Channel, Test Setup

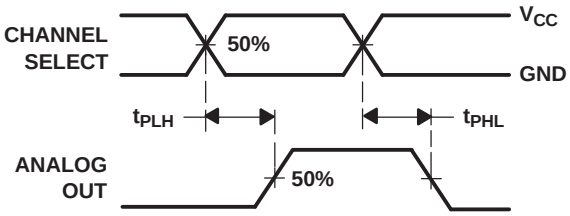


Figure 9. Propagation Delays, Channel Select to Analog Out

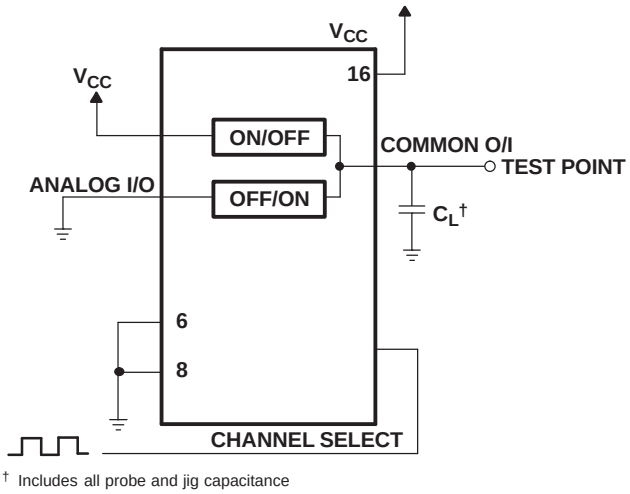


Figure 10. Propagation Delay, Channel Select to Analog Out, Test Setup

PARAMETER MEASUREMENT INFORMATION (continued)

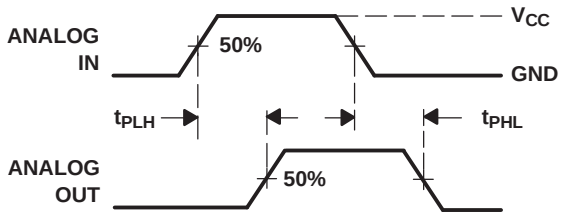
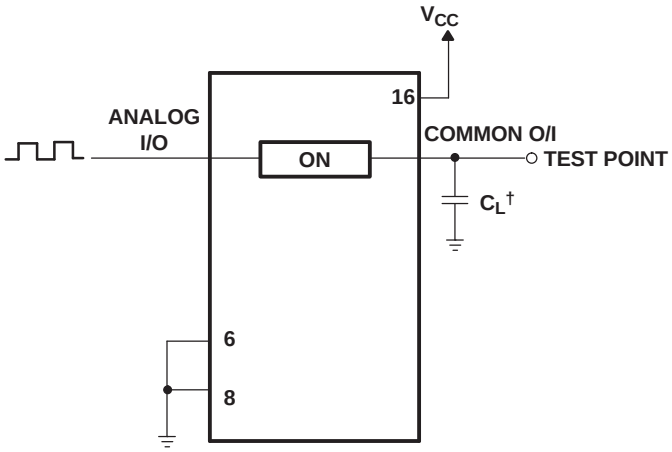


Figure 11. Propagation Delays, Analog In to Analog Out



† Includes all probe and jig capacitance

Figure 12. Propagation Delay, Analog In to Analog Out, Test Setup

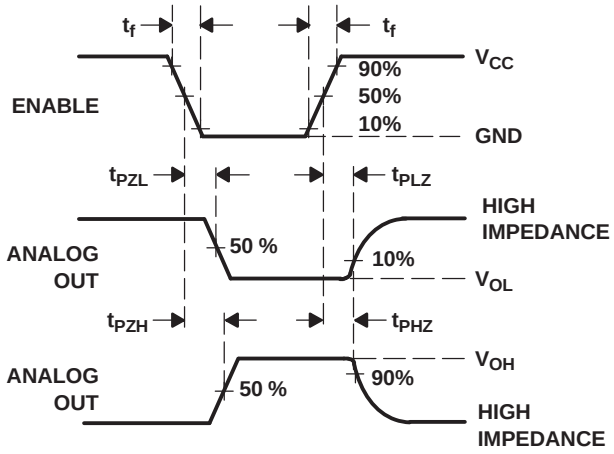


Figure 13. Propagation Delays, Enable to Analog Out

PARAMETER MEASUREMENT INFORMATION (continued)

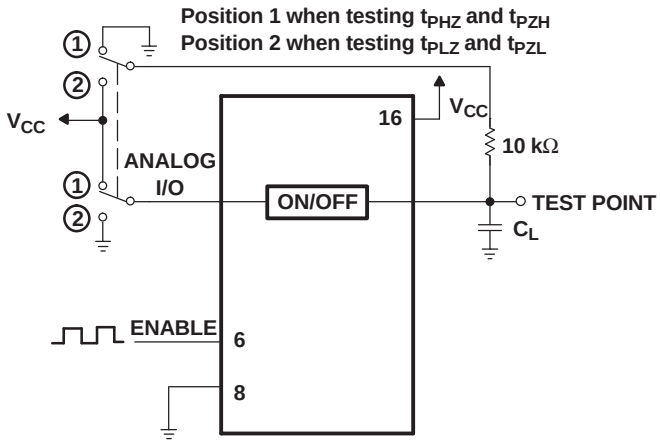


Figure 14. Propagation Delay, Enable to Analog Out, Test Setup

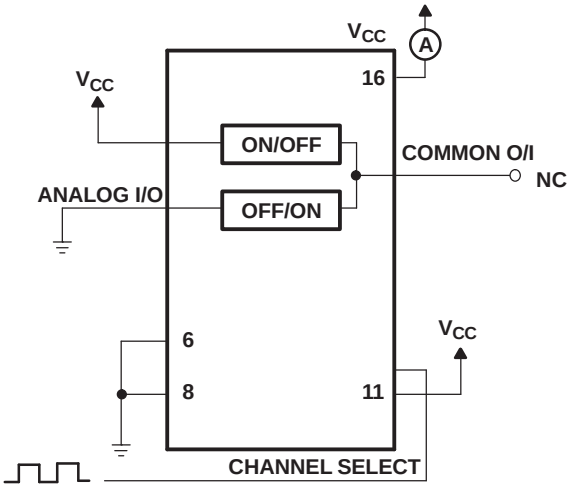


Figure 15. Power-Dissipation Capacitance, Test Setup

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74HC4852QDRQ1	NRND	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4852Q	
SN74HC4852QPWRQ1	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4852Q	Samples

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices 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.

OTHER QUALIFIED VERSIONS OF SN74HC4852-Q1 :

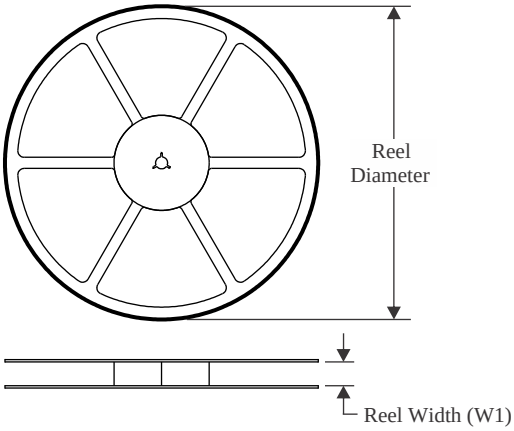
- Catalog : SN74HC4852

NOTE: Qualified Version Definitions:

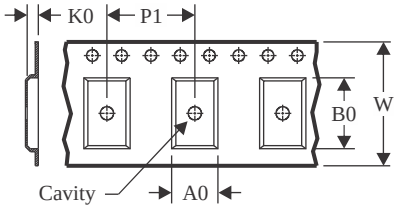
- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

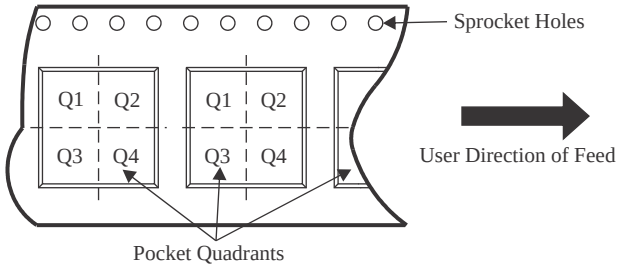


TAPE DIMENSIONS



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

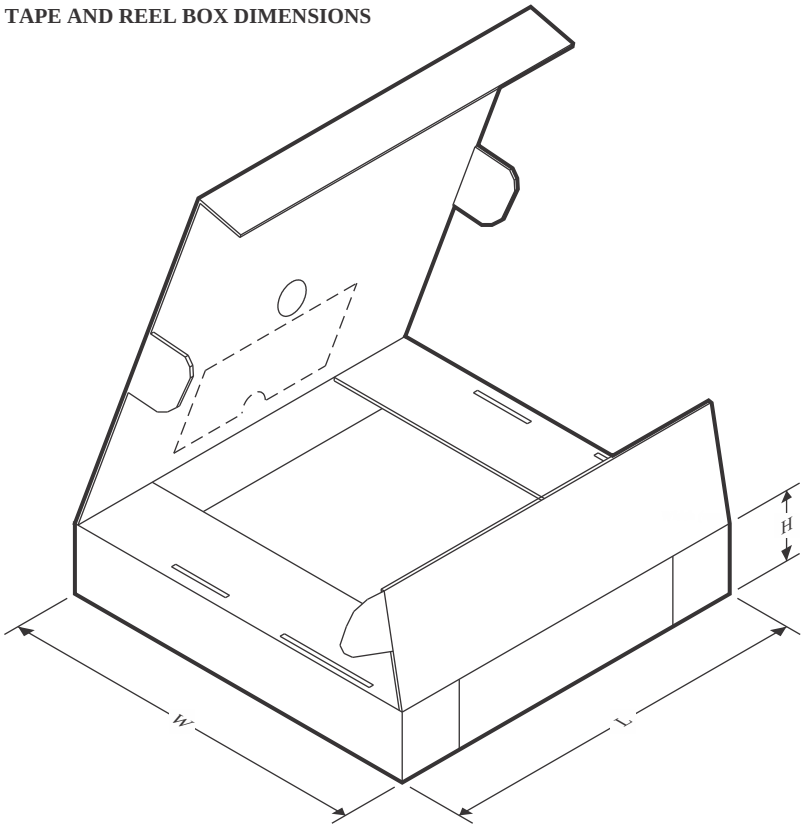
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN74HC4852QPWRQ1	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

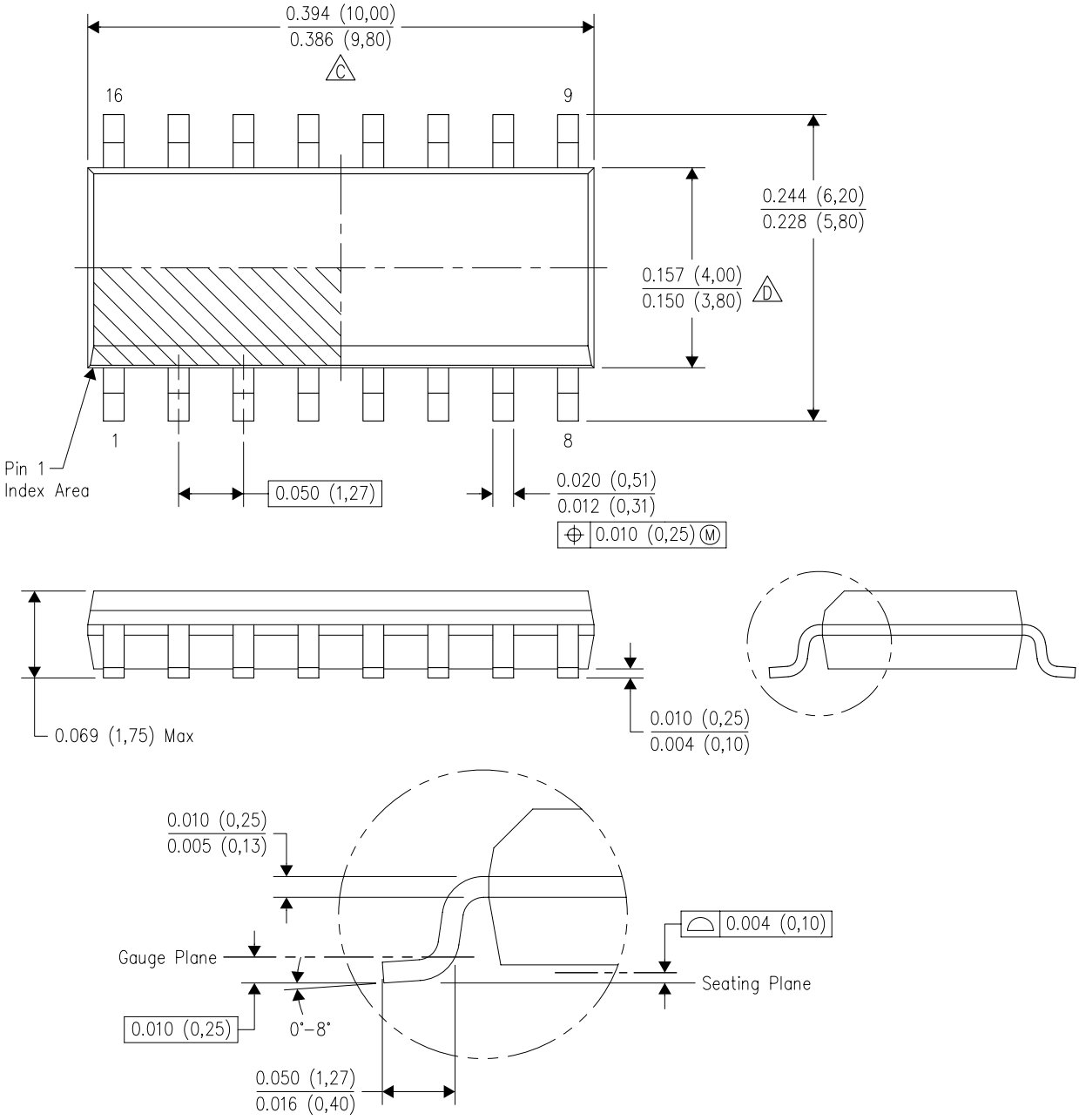
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74HC4852QPWRQ1	TSSOP	PW	16	2000	356.0	356.0	35.0

D (R–PDSO–G16) PLASTIC SMALL OUTLINE



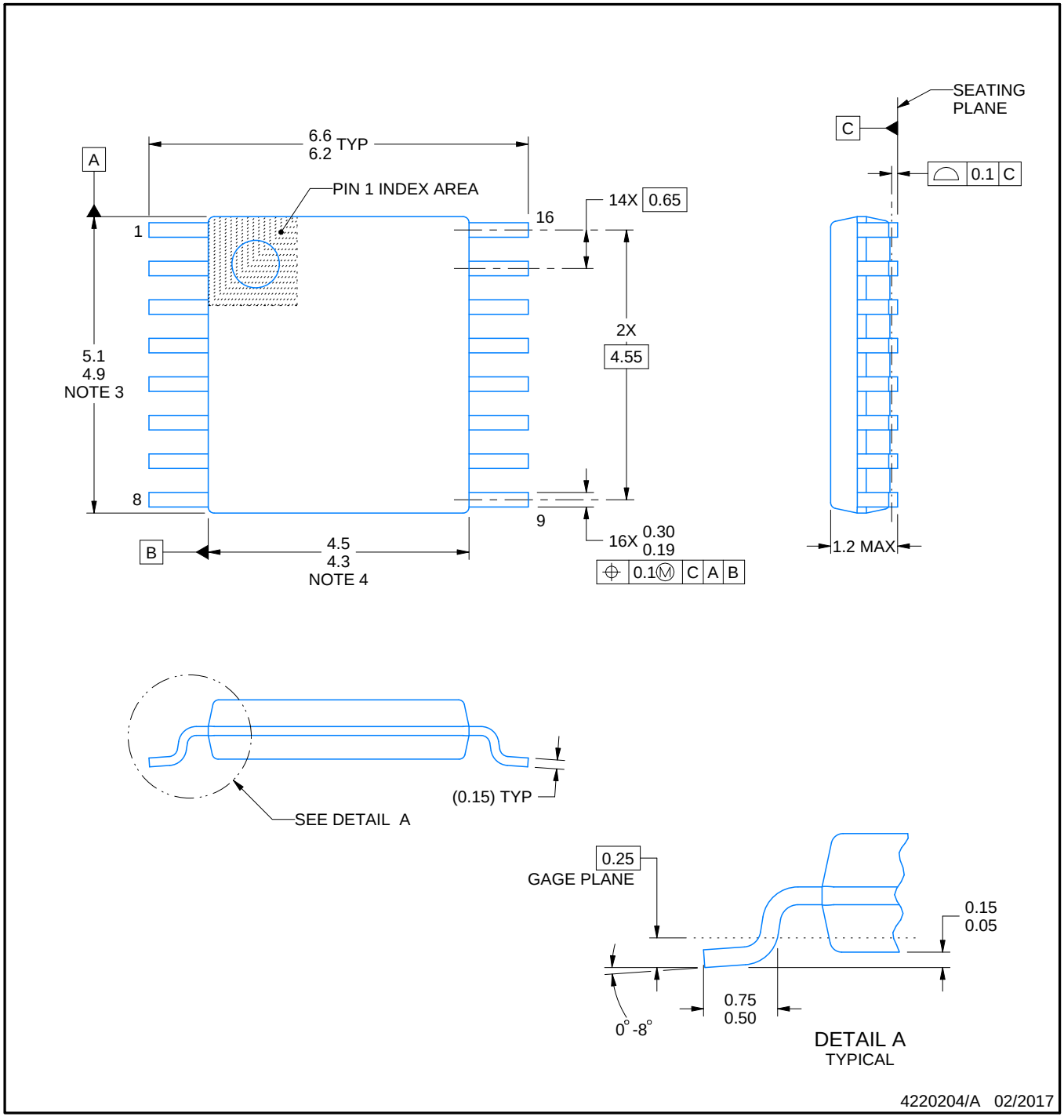
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead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

PACKAGE OUTLINE

PW0016A

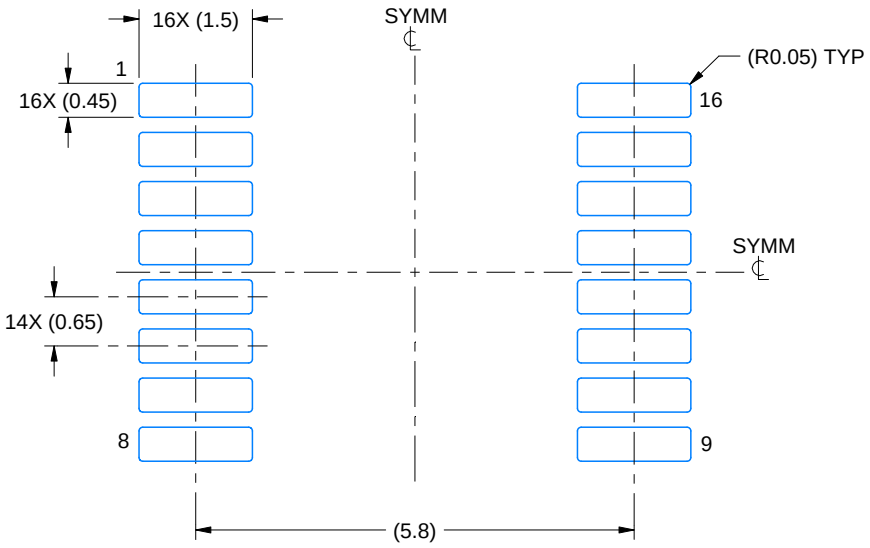
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

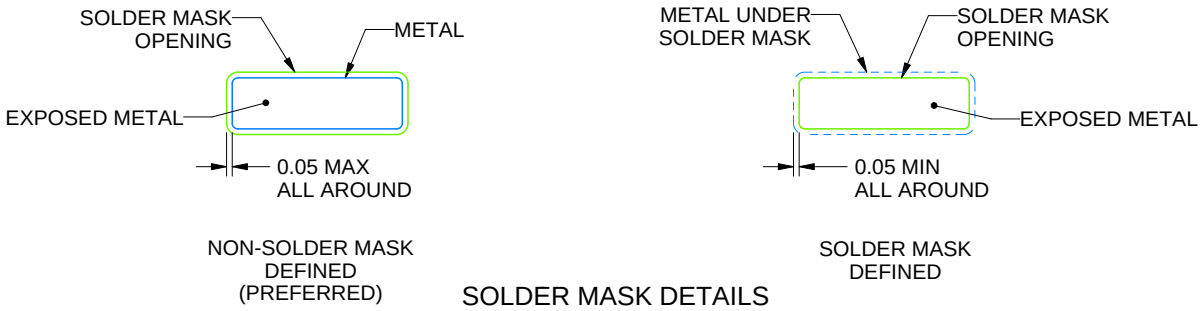


NOTES:

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

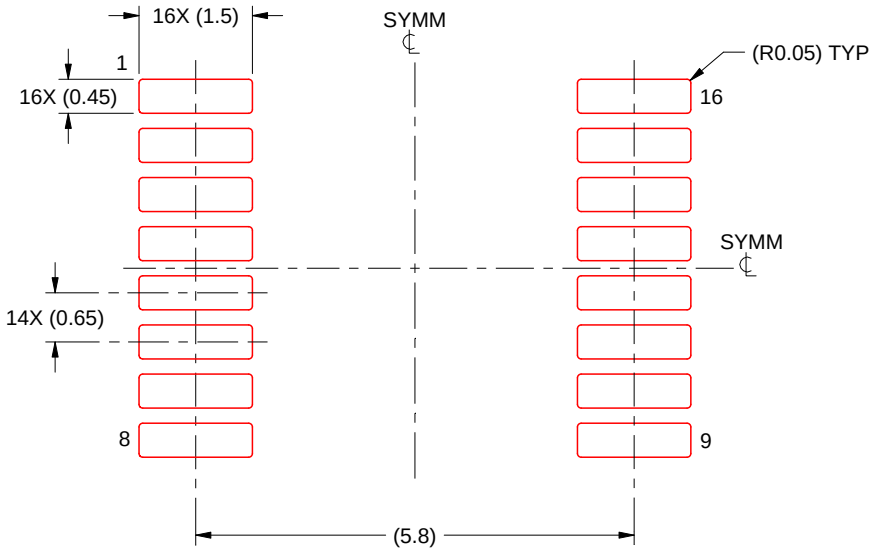


SOLDER MASK DETAILS

4220204/A 02/2017

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

4220204/A 02/2017

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.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265