

PS4157N

Negative Voltage SPDT Switch

Features

- Operating Voltage Range: $V_{EE} = -12\text{ V to }-4\text{ V}$
- Switch Signal Voltage Range: $V_{IS} = V_{EE}\text{ to GND}$
- Positive Control Signal Voltage: $V_{IN} = 0\text{ to }3.3\text{ V}$
- Low ON Resistance: $R_{ON} \leq 5\ \Omega$ when $V_{EE} = -10\text{ V}$
- Extended Industrial Temperature Range: $-55^\circ\text{C to }125^\circ\text{C}$
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. "Green" Device (Note 3)
- For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](#) or your local Diodes representative.
<https://www.diodes.com/quality/product-definitions/>
- Packaging (Pb-free and Green):
 - 6-pin Small Compact SC70

Description

The DIODES™ PS4157N is a bidirectional, single-channel, single-pole double-throw (SPDT) analog switch. The device can pass analog and digital negative voltages that may vary across the full power-supply range (from V_{EE} to GND).

Applications

- 5G NR AAU

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

DIODES is a trademark of Diodes Incorporated in the United States and other countries.

The Diodes logo is a registered trademark of Diodes Incorporated in the United States and other countries.

Pin Configuration

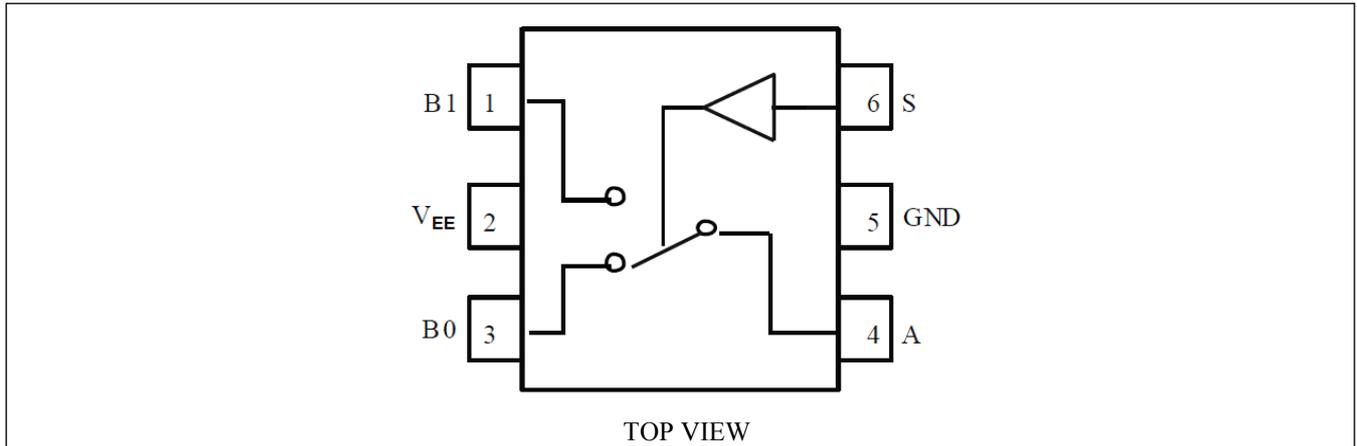


Figure 1. 6-lead SC70

Pin Description

Pin#	Pin Name	Description
1	B1	Data Port (NO)
2	V _{EE}	Negative Voltage Power Supply
3	B0	Data Port (NC)
4	A	Data Port (COM)
5	GND	Ground
6	S	Select Pin

Logic Function Table

Select Pin (S)	Function
0	B0 Connected to A
1	B1 Connected to A

Maximum Ratings

Supply Voltage, V_{EE}	-13 V to +0.5 V
Switch Input / Output Voltage, V_{IS}	$V_{EE} - 0.5$ V to +0.5 V
Select Input Voltage, V_{IN}	-0.5 V to +3.6 V
Switch Input / Output Diode Current, I_{IOK}	±50 mA
Select Input Diode Current, I_{IK}	-50 mA
Power Dissipation, P_D	60 mW
Lead Temperature, T_L	260 °C
Junction Temperature, T_J	150 °C
Storage Temperature, T_S	-65 °C to +150 °C
Thermal Resistance, θ_{JA}	400 °C/W
Latch-up	±300 mA
ESD (HBM)	3 kV
ESD (MM)	150 V

Note:

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Recommended Operating Conditions

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{EE}	Supply Voltage	-	-12	-	-4	V
V_{IN}	Select Input Voltage	-	0	-	3.3	V
V_{IS}	Switch Input / Output Voltage	-	V_{EE}	-	0	V
T_A	Operating Temperature	-	-55	25	125	°C
tr, tf	Select Input Rise and Fall Time ⁽¹⁾	-	0	-	100	ns/V

1. Select input must be held HIGH or LOW; it must not be made to float.

DC Electrical Characteristics

(Voltage referenced to GND; $T_A = -55$ °C to 125 °C; unless otherwise specified. Typical characteristics are T_A at 25 °C.)

Parameter	Description	Condition	Min.	Typ.	Max.	Units
Power Supply						
I_{DD}	Quiescent Supply Current	$V_{IN} = 0$ V or 3.3 V, $V_{IS} = V_{EE}$ or 0 V, -10 V $\leq V_{EE} \leq -4$ V	-	25	80	μA
Analog Switch						
R_{ON}	Maximum ON Resistance ⁽¹⁾⁽²⁾	$V_{IN} = V_{IL}$ or V_{IH} , $V_{IS} = V_{EE}$ to 0 V, $I_{LOAD} \leq 10$ mA				Ω
		$V_{EE} = -12$ V	-	2.6	4.5	
		$V_{EE} = -10$ V	-	3.0	5	
		$V_{EE} = -8$ V	-	3.5	5.8	
		$V_{EE} = -6$ V	-	4.5	7.5	
R_{FLAT}	ON Resistance Flatness ⁽²⁾	$V_{IN} = V_{IL}$ or V_{IH} , $V_{IS} = V_{EE}$ to 0 V, $I_{LOAD} \leq 10$ mA				Ω
		$V_{EE} = -12$ V	-	0.4	-	
		$V_{EE} = -10$ V	-	1.2	-	
		$V_{EE} = -8$ V	-	1.7	-	
		$V_{EE} = -6$ V	-	2.5	-	
		$V_{IN} = V_{IL}$ or V_{IH} , $V_{IS} = V_{EE}$ to 0V,	-	6	-	

Parameter	Description	Condition	Min.	Typ.	Max.	Units
		$I_{LOAD} \leq 5 \text{ mA}$, $V_{EE} = -4 \text{ V}$				
ΔR_{ON}	ON Resistance Mismatch Between Channels ⁽²⁾⁽³⁾	$V_{EE} = -12\text{V}$, $I_A = -10 \text{ mA}$, $V_{Bn} = -8.4\text{V}$	-	0.2	-	Ω
		$V_{EE} = -10\text{V}$, $I_A = -10\text{mA}$, $V_{Bn} = -7\text{V}$		0.2		
		$V_{EE} = -8 \text{ V}$, $I_A = -10 \text{ mA}$, $V_{Bn} = -5.6\text{V}$	-	0.25	-	
		$V_{EE} = -6\text{V}$, $I_A = -10\text{mA}$, $V_{Bn} = -4.2\text{V}$	-	0.25	-	
		$V_{EE} = -4\text{V}$, $I_A = -5\text{mA}$, $V_{Bn} = -2.8\text{V}$	-	0.3	-	
$I_{Bn(OFF)}$	B_0 or B_1 OFF Leakage Current	$V_{IN} = V_{IL}$ or V_{IH} , $V_{Bn} = 0\text{V}$, $V_A = V_{EE}$ to 0V , $V_{EE} = -10\text{V}$	-	± 1.0	± 20	μA
$I_{A(ON)}$	A On Leakage Current	$V_{IN} = V_{IL}$ or V_{IH} , $V_{EE} = -10\text{V}$ $V_A = 0\text{V}$ or V_{EE} , $V_{B0} = 0\text{V}$ or V_{EE} with V_{B1} floating, or $V_{B1} = 0\text{V}$ to V_{EE} with V_{B0} floating	-	± 2.0	± 20	μA
Select Input						
V_{IH}	High-Level Input Voltage	$V_{EE} = -12\text{V}$	1.8	-	3.3	V
		$V_{EE} = -10\text{V}$	1.6	-	3.3	
		$V_{EE} = -8\text{V}$	1.35	-	3.3	
		$V_{EE} = -6\text{V}$	1.2	-	3.3	
		$V_{EE} = -4\text{V}$	1.0	-	3.3	
V_{IL}	Low-Level Input Voltage	$V_{EE} = -12\text{V}$	0	-	0.8	V
		$V_{EE} = -10\text{V}$	0	-	0.7	
		$V_{EE} = -8\text{V}$	0	-	0.6	
		$V_{EE} = -6\text{V}$	0	-	0.5	
		$V_{EE} = -4\text{V}$	0	-	0.4	
I_{IN}	Input Leakage Current	$V_{IN} = 0\text{V}$ or 3.3V , $V_{EE} = -10 \text{ V}$	-	± 0.2	± 50	μA
		$V_{IN} = 0\text{V}$ or 3.3V , $V_{EE} = -10 \text{ V}$, T_A at 25°C			± 0.5	

Note:

- $R_{ON} = (\Delta V_{ON}) / I_{LOAD}$. ΔV_{ON} = Voltage drop between A and Bn pins
- Parameters is characterized but not tested in production.
- $\Delta R_{ON} = R_{ONMAX} - R_{ONMIN}$ is measured at same V_{EE} , T_A , V_{IS} and I_{LOAD} .

AC Electrical Characteristics

 (Voltage referenced to GND; $T_A = -55^\circ\text{C}$ to 125°C ; unless otherwise specified. Typical characteristics are T_A at 25°C .)

Parameter	Description	Condition	Min.	Typ.	Max.	Units
t_{PHL}, t_{PLH}	Propagation Delay, Bus to Bus (A to B _n) ⁽¹⁾	$C_L = 100 \text{ pF}$, $-12\text{V} \leq V_{EE} \leq -4\text{V}$ (Figure 2, 3)	-	-	2	ns
t_{PZL}, t_{PZH}	Switch Enable Time Turn-On Time (A to B _n)	$C_L = 100 \text{ pF}$ (Figure 2, 3)				ns
		$V_{EE} = -12\text{V}$	-	-	220	
		$V_{EE} = -10\text{V}$	-	-	175	
		$V_{EE} = -8\text{V}$	-	-	165	
		$V_{EE} = -6\text{V}$	-	-	165	
t_{PLZ}, t_{PHZ}	Switch Disable Time Turn-Off Time (A to B _n)	$C_L = 100 \text{ pF}$ (Figure 2,3)				ns
		$V_{EE} = -12\text{V}$	-	-	225	
		$V_{EE} = -10\text{V}$	-	-	155	
		$V_{EE} = -8\text{V}$	-	-	150	

Parameter	Description	Condition	Min.	Typ.	Max.	Units
		$V_{EE} = -6V$	-	-	120	
		$V_{EE} = -4V$	-	-	145	
t_B	Switch Break Time	$R_L = 50 \Omega, C_L = 100 \text{ pF}, V_{IS} = -2.5V$ (Figure 4)				
		$V_{EE} = -12V$	5		60	ns
		$V_{EE} = -10V$	5		60	
		$V_{EE} = -8V$	7		75	
		$V_{EE} = -6V$	10		90	
		$V_{EE} = -4V$	20		135	
t_{POR}	Power ON Reset Time	$-12 V \leq V_{EE} \leq -4V$	-	-	20	μs
Q	Charge Injection ⁽¹⁾	$C_L = 1 \text{ nF}, V_{GEN} = 0V, R_{GEN} = 0 \Omega$ (Figure 5)				
		$V_{EE} = -12V$	-	170	-	pC
		$V_{EE} = -10V$	-	120	-	
		$V_{EE} = -8V$	-	95	-	
		$V_{EE} = -6V$	-	55	-	
		$V_{EE} = -4V$	-	40	-	
BW	-3 dB Bandwidth	$R_L = 50 \Omega, -12V \leq V_{EE} \leq -4V$ (Figure 10)	-	200	-	MHz
QIRR	Off-Isolation ⁽²⁾	$R_L = 50 \Omega, f = 10 \text{ MHz}, -12V \leq V_{EE} \leq -4V$ (Figure 6)	-	-33	-	dB
Xtalk	Crosstalk	$R_L = 50 \Omega, f = 10 \text{ MHz}, -12V \leq V_{EE} \leq -4V$ (Figure 7)	-	-42	-	dB

Note:

- Guaranteed by design but not tested.
- Off Isolation = $20 \text{ Log}_{10} [V_A / V_{B_n}]$

Capacitance ⁽¹⁾

 (Typical characteristics are $T_A = 25^\circ C$)

Parameter	Description	Condition	Min.	Typ.	Max.	Units
C_{IN}	Input Capacitance, Select Input	$V_{EE} = -12 V, f = 1 \text{ MHz}$	-	6	-	pF
C_{IOB_OFF}	B-Port OFF Capacitance	$V_{EE} = -10 V, f = 1 \text{ MHz}$ (Figure 8)	-	45	-	
C_{IOA_ON}	A-Port Capacitance when Switch is Enabled	$V_{EE} = -10 V, f = 1 \text{ MHz}$ (Figure 9)	-	100	-	

Note:

- Capacitance is characterized but not tested in production

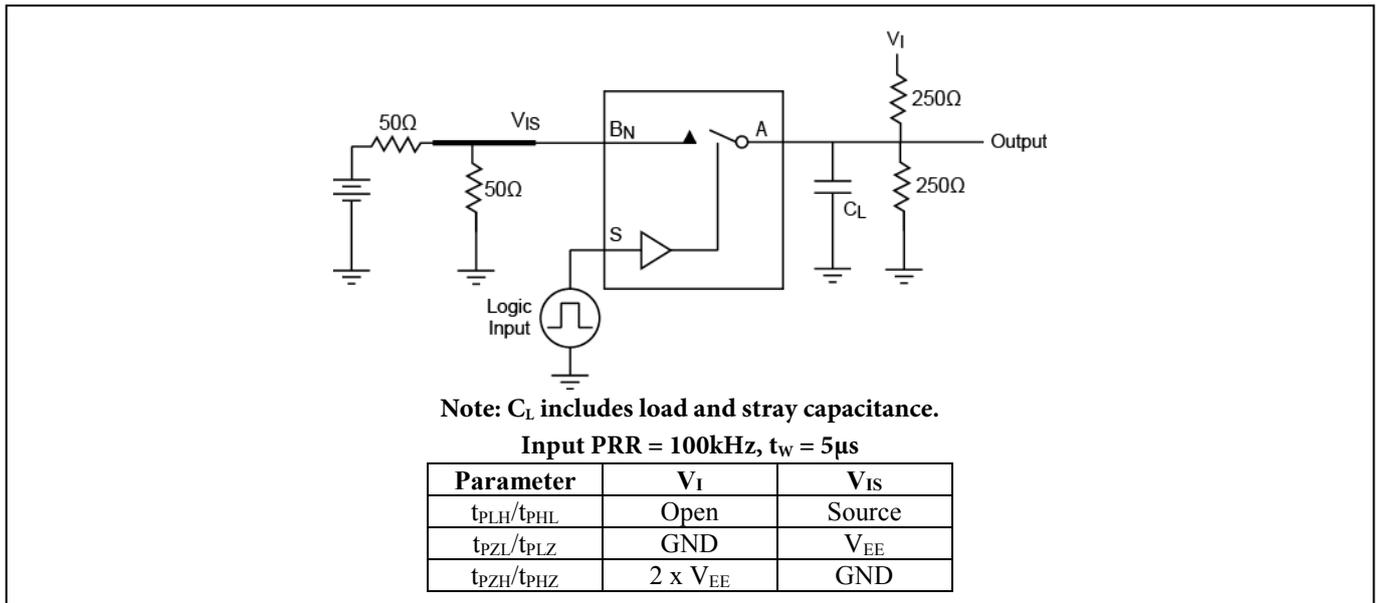


Figure 2. AC Test Circuit

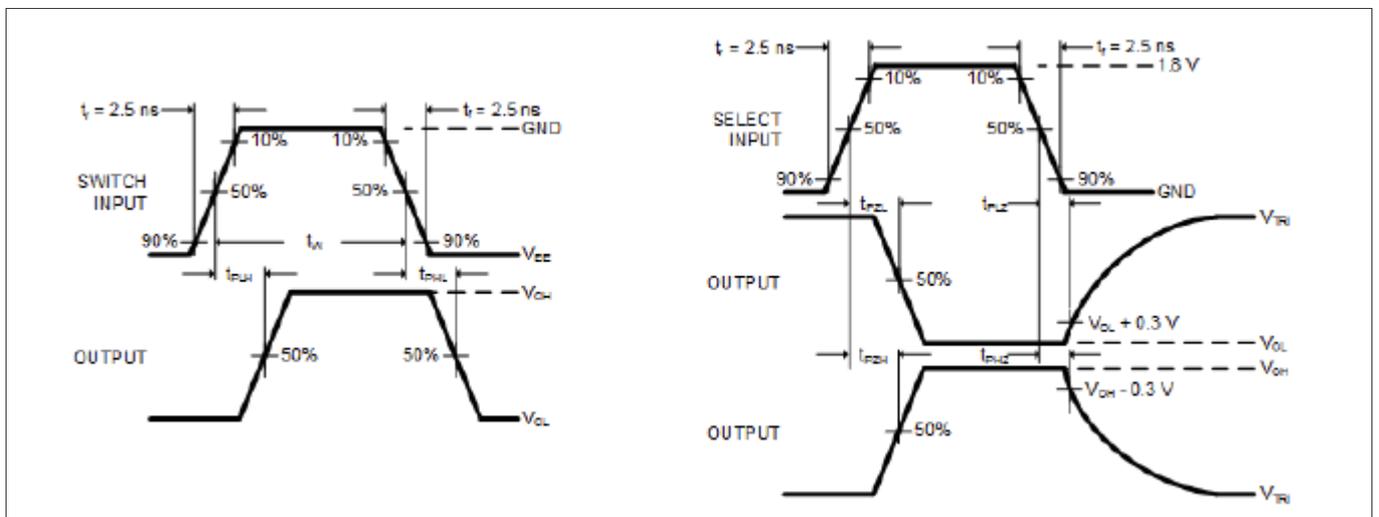


Figure 3. AC Test Waveforms

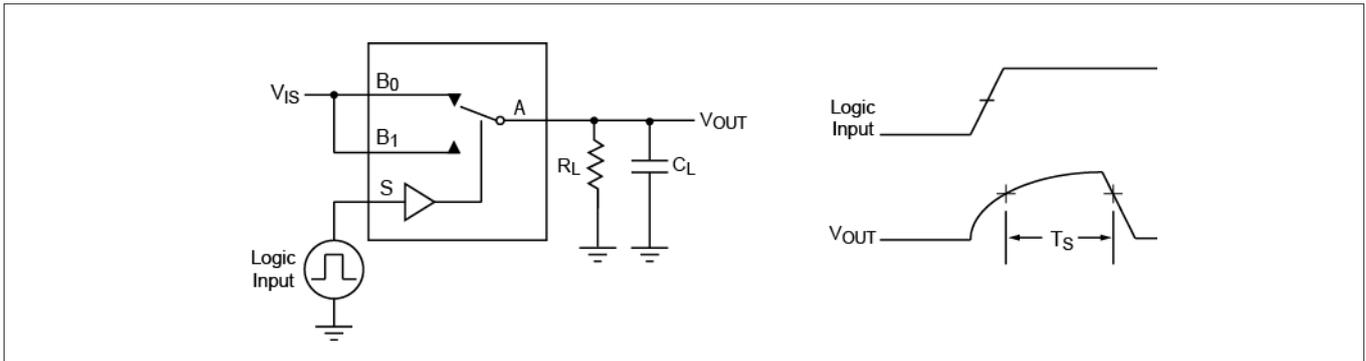


Figure 4. Switch Break Interval Timing

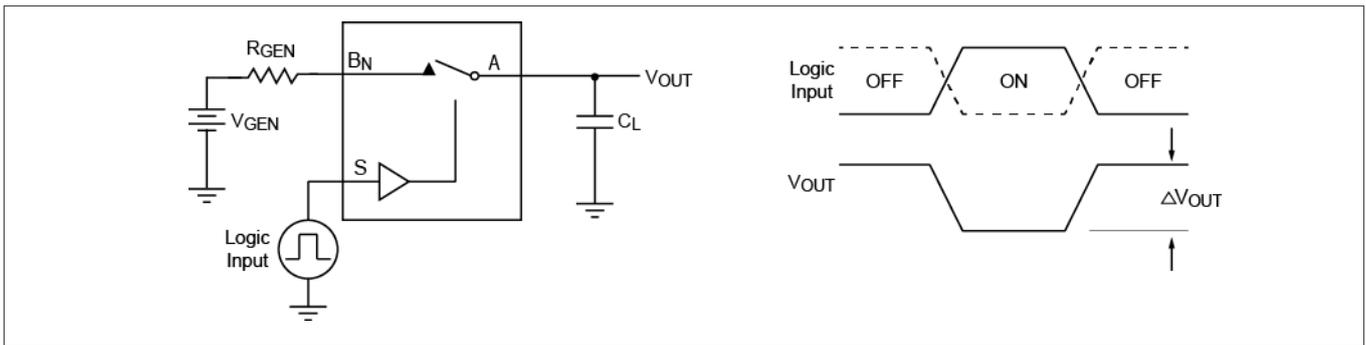


Figure 5. Charge Injection Test

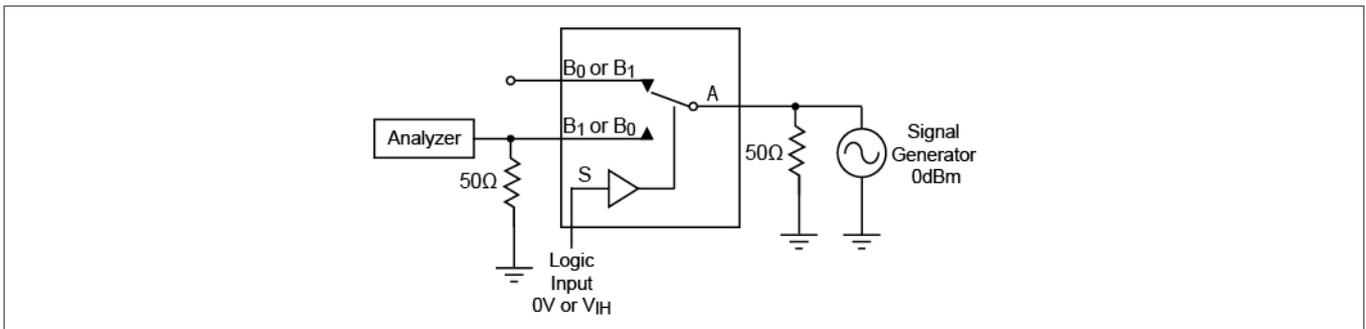


Figure 6. Off Isolation

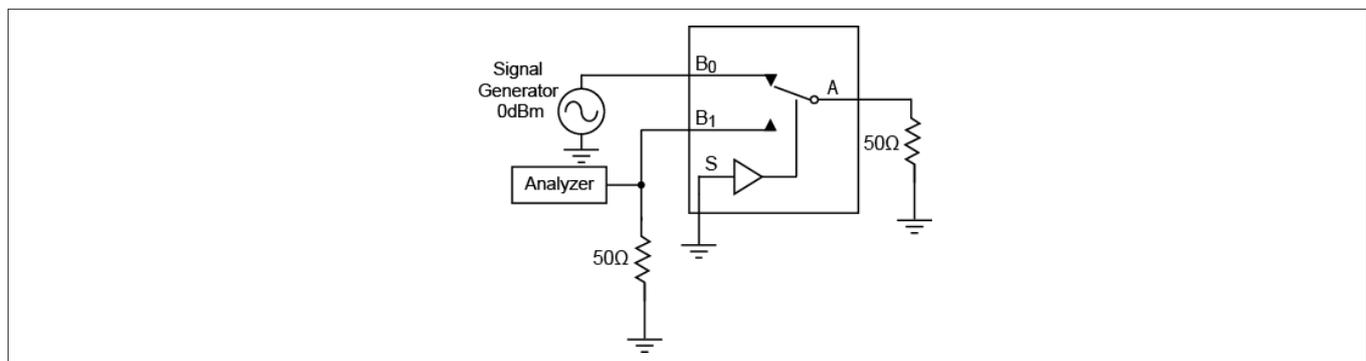


Figure 7. Crosstalk

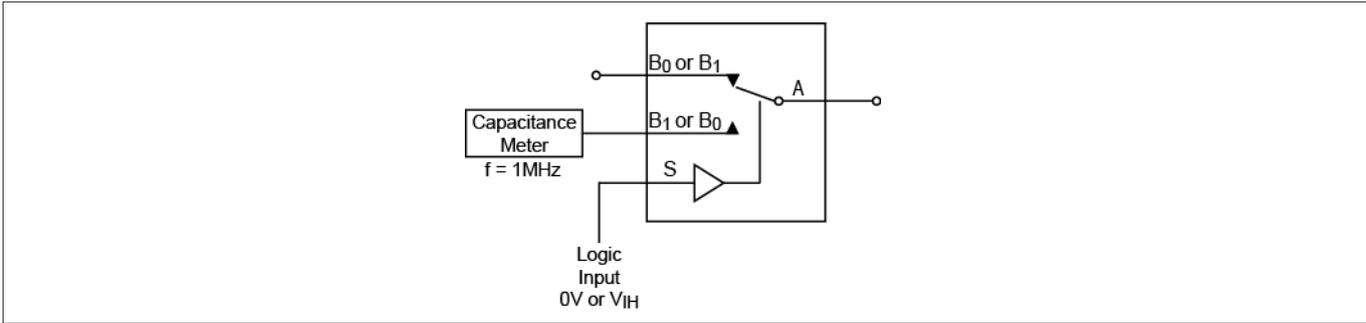


Figure 8. Channel Off Capacitance

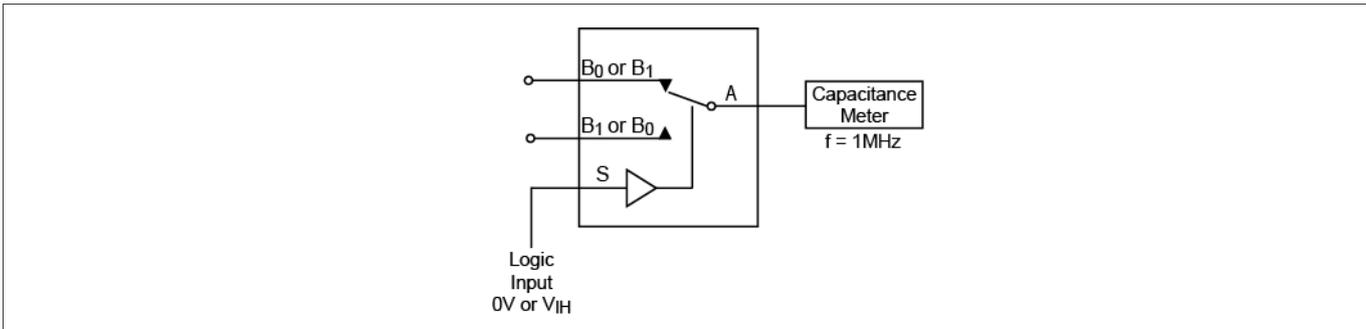


Figure 9. Channel On Capacitance

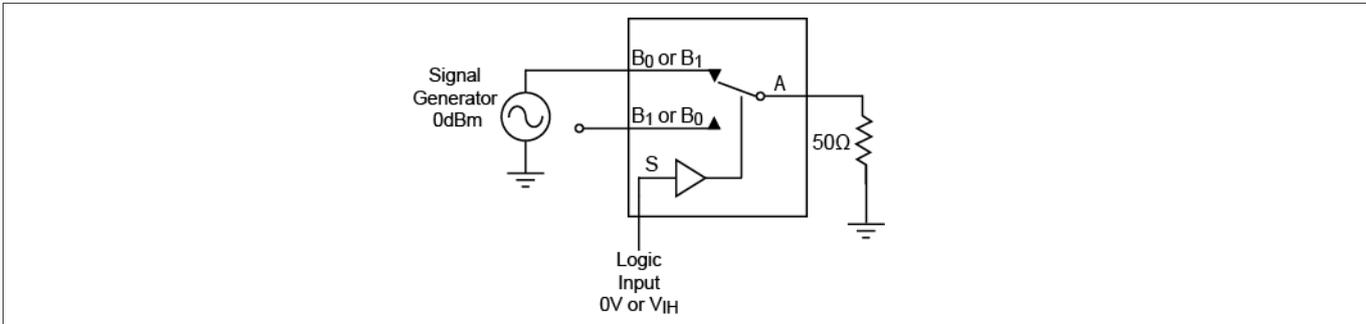


Figure 10. Bandwidth

Part Marking

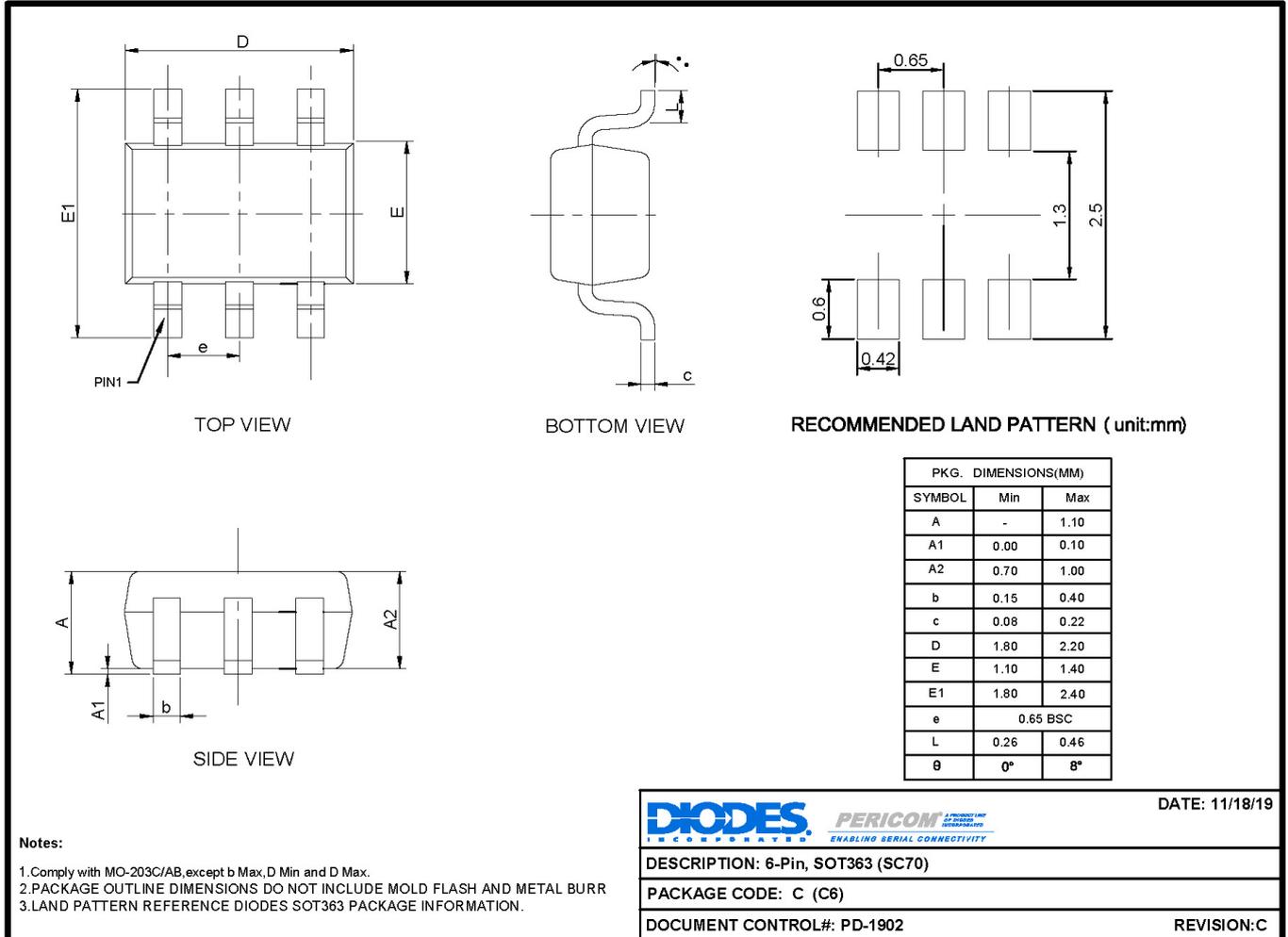
xQ = PS4157NCE



Y: Date Code (Year)
W: Date Code (Workweek)

Packaging Mechanical

C-6 (SC70)



19-1160

For latest package info.

please check: <http://www.diodes.com/design/support/packaging/pericom-packaging/packaging-mechanicals-and-thermal-characteristics/>

Ordering Information

Part Number	Package Code	Package Description
PS4157NCEX	C	6-Pin, SOT363 (SC70)

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. E = Pb-free and Green
5. X suffix = Tape/Reel

IMPORTANT NOTICE

1. DIODES INCORPORATED AND ITS SUBSIDIARIES (“DIODES”) MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).
2. The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes products. Diodes products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of the Diodes products for their intended applications, (c) ensuring their applications, which incorporate Diodes products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.
3. Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes’ websites, harmless against all damages and liabilities.
4. Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes’ website) under this document.
5. Diodes products are provided subject to Diodes’ Standard Terms and Conditions of Sale (<https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/>) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.
6. Diodes products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.
7. While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes.
8. Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.

Copyright © 2022 Diodes Incorporated

www.diodes.com