

### Features

- Low Voltage Operation (1.8 V to 3.3 V)
- Low On-Resistance -  $r_{ON}$ : 1.8  $\Omega$  at 2.7 V
- Low Charge Injection
- Low Voltage Logic Compatible
- DFN-6 Package or SC70-6 Package

### Benefits

- Reduced Power Consumption
- Simple Logic Interface
- High Accuracy
- Reduce Board Space
- Guaranteed 2 V Operation

### Applications

- Cellular Phones
- Communication Systems
- Portable Test Equipment
- Battery Operated Systems
- Sample and Hold Circuits
- ADC and DAC Applications
- USB 1.1 Interfaces

### Description

The PA2011 is a low on-resistance, single-pole double-throw monolithic CMOS analog switch. It is designed for low voltage applications with guaranteed operation at 2 V.

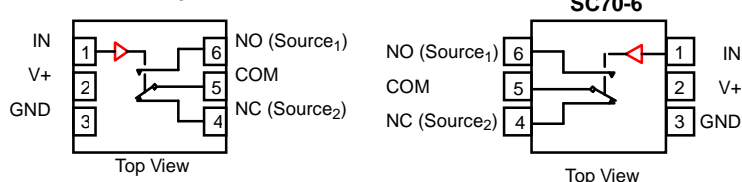
The PA2011 is ideal for portable and battery powered equipment, requiring high performance and efficient use of board space. In addition to the low on-resistance (1.8  $\Omega$  at 2.7 V), charge injection is less than 10 pC over the entire analog range.

The switch conducts equally well in both directions when on, and blocks up to the power supply level when off.

Break-before-make is guaranteed.

The PA2011 is mounted in a 1.6 x 1.6 mm DFN-6 or SC70-6 lead package, reducing board spacing by approximately 40 %

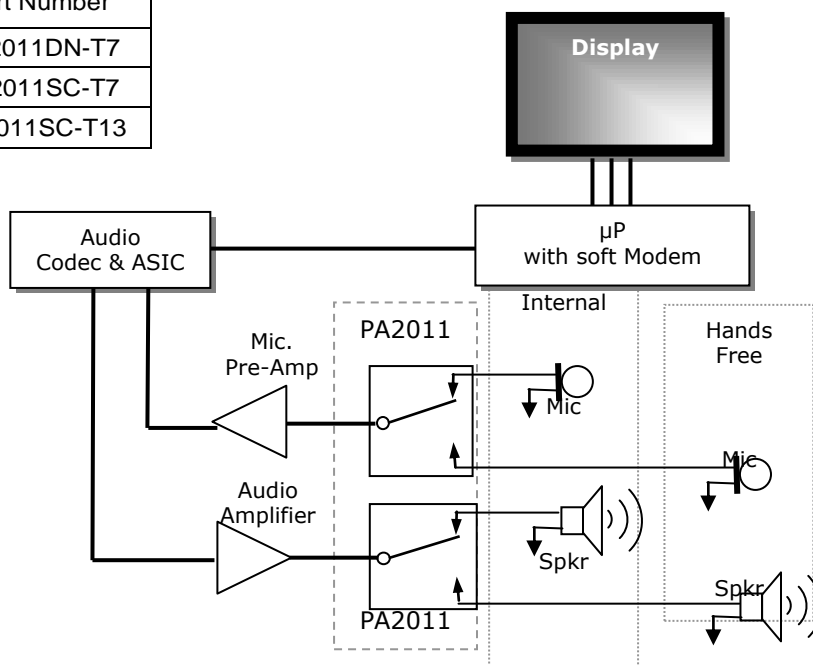
### Pin Configuration



Truth Table		
Logic	NC	NO
0	ON	OFF
1	OFF	ON

Ordering information		
Temp. Range	Package	Part Number
-40 to 85 °C	DFN-6	PA2011DN-T7
	SC70-6	PA2011SC-T7
	SC70-6	PA2011SC-T13

### Typical Application



Absolute Maximum Ratings $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted		
Parameter	Limit	Unit
Reference V+ to Ground	-0.3 to 4.2	V
IN, COM, NC, NO <sup>1</sup>	-0.3 to (V <sub>CC</sub> + 0.3V)	
Continuous Current (NO,NC,COM pins)	±150	mA
Peak Current (Pulsed at 1mS, 10% duty cycle)	±300	
Storage Temperature	-65 to +150	°C
Power Dissipation	172	mW

## Notes

1. Signals on NC, NO, or COM or IN exceeding V+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings

**Specifications V+ = 2.0V** Test Conditions unless otherwise specified: V+ = 2.0 V, V<sub>IN</sub> = 0.4 V or 1.6 V

Parameter	Symbol	Test Conditions	Temp	Min	Typ	Max	Unit
<b>Analog Switch</b>							
Analog Signal Range	V <sub>NO</sub> , V <sub>NC</sub> , V <sub>COM</sub>		Full	0.0		V <sub>CC</sub>	V
On-Resistance	R <sub>ON</sub>	V <sub>CC</sub> = 2.0V, V <sub>COM</sub> = 0.2V- 0.9V I <sub>NO</sub> , I <sub>NC</sub> = 20mA,	Room Full		3.5	5.5 5.5	Ω
Switch Off Leakage Current	I <sub>OFF(NO)</sub> or I <sub>OFF(NC)</sub>	V+ = 2.2 V, V <sub>NO</sub> , V <sub>NC</sub> = 0.5 V/1.5 V, V <sub>COM</sub> = 1.5 V/0.5 V	Room Full	-1 -10		-1 -10	nA
	I <sub>COM(OFF)</sub>	V+ = 2.2 V, V <sub>NO</sub> , V <sub>NC</sub> = 0.5 V/1.5 V, V <sub>COM</sub> = 1.5 V/0.5 V	Room Full	-1 -10		-1 -10	
Channel On Leakage Current	I <sub>COM(ON)</sub>	V+ = 2.2 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 0.5 V/1.5 V	Room Full	-1 -10		-1 -10	
<b>Digital Control</b>							
Input High Voltage	V <sub>INH</sub>		Full	1.5			VnA
Input Low Voltage	V <sub>INL</sub>		Full			0.4	
Input Capacitance	C <sub>in</sub>		Full		4		pF
Input Current	I <sub>INL</sub> or I <sub>INH</sub>	V <sub>IN</sub> = 0 or V+	Full	1		1	μA
<b>Dynamic Characteristics</b>							
Turn On Time	t <sub>ON</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 1.5 V, R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	Room Full		75	110 113	nS
Turn Off Time	t <sub>OFF</sub>		Room Full		37	71 76	
Break Before Make Time	t <sub>BBM</sub>		Room Full		37		
Charge Injection	Q <sub>INJ</sub>		Room		7		pC
Off Isolation	OIRR		Room		-62		dB
Crosstalk	X <sub>TALK</sub>		Room		-69		
NO, NC OFF Capacitance	C <sub>NO(off)</sub> C <sub>NC(off)</sub>		Room		29		pF
Channel On Capacitance	C <sub>ON</sub>		Room		85		
<b>Power Supply</b>							
Positive Supply Range	V+	V <sub>IN</sub> = 0 or V+		1.8		3.3	V
Negative Supply Current	I+				0.01		1.0

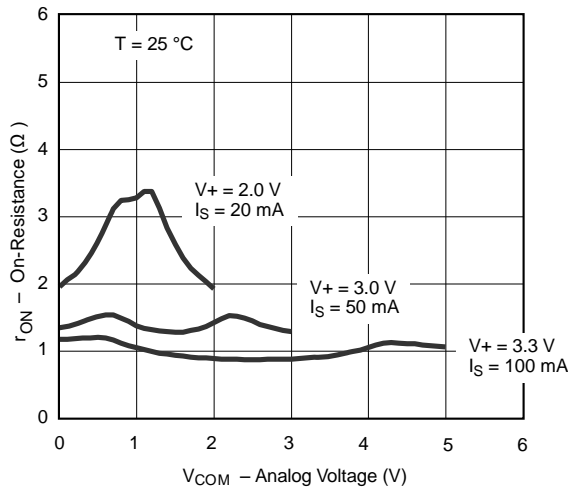
**Specifications V+ = 3.0V** Test Conditions unless otherwise specified:  $V+ = 3.0V \pm 10\%$ ,  $V_{IN} = 0.4V$  or  $2.0V$ 

Parameter	Symbol	Test Conditions	Temp	Min	Typ	Max	Unit
<b>Analog Switch</b>							
Analog Signal Range	$V_{NO}, V_{NC}, V_{COM}$		Full	0.0		$V_{CC}$	V
On-Resistance	$R_{ON}$	$V_{CC} = 2.7V, V_{COM} = 0.9V - 1.5V$ $I_{NO}, I_{NC} = 50mA,$	Room Full		1.8	2.7 2.9	$\Omega$
$R_{ON}$ Matching	$\Delta R_{ON}$					0.2	
$R_{ON}$ Flatness	$R_{ON(FLAT)}$				0.2	0.5	
Switch Off Leakage Current	$I_{OFF(NO)}$ or $I_{OFF(NC)}$	$V+ = 3.3V,$ $V_{NO}, V_{NC} = 1.0V/3.0V, V_{COM} = 3.0V/1.0V$	Room Full	-1 -10		-1 -10	nA
	$I_{COM(OFF)}$		Room Full	-1 -10		-1 -10	
Channel On Leakage Current	$I_{COM(ON)}$	$V+ = 3.3V, V_{NO}, V_{NC} = V_{COM} = 1.0V/3.0V$	Room Full	-1 -10		-1 -10	
<b>Digital Control</b>							
Input High Voltage	$V_{INH}$		Full	1.5			VnA
Input Low Voltage	$V_{INL}$		Full			0.4	
Input Capacitance	$C_{in}$		Full		4		pF
Input Current	$I_{INL}$ or $I_{INH}$	$V_{IN} = 0$ or $V+$	Full	1		1	$\mu A$
<b>Dynamic Characteristics</b>							
Turn On Time	$t_{ON}$	$V_{NO}$ or $V_{NC} = 2.0V, R_L = 300\Omega, C_L = 35pF$	Room Full		45	75 77	nS
Turn Off Time	$t_{OFF}$		Room Full		29	59 62	
Break Before Make Time	$t_{BBM}$		Room Full		16		
Charge Injection	$Q_{INJ}$	$C_L = 1nF, V_{GEN} = 0V, R_{GEN} = 0\Omega$	Room		2		pC
Off Isolation	OIRR	$R_L = 50\Omega, C_L = 5pF, f = 1MHz$	Room		-62		dB
Crosstalk	$X_{TALK}$		Room		-69		
NO, NC OFF Capacitance	$C_{NO(off)}$ $C_{NC(off)}$	$V_{IN} = 0$ or $V+, f = 1MHz$	Room		28		pF
Channel On Capacitance	$C_{ON}$		Room		84		
<b>Power Supply</b>							
Positive Supply Range	$V+$	$V_{IN} = 0$ or $V+$		1.8		3.3	V
Negative Supply Current	$I+$				0.01		1.0

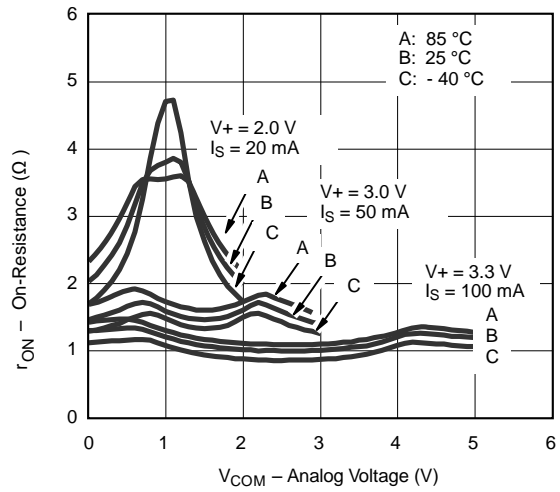
**Notes:**

1. Room = 25 °C, Full = as determined by the operating suffix.
2. Typical values are for design aid only, not guaranteed nor subject to production testing.
3. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
4. Guarantee by design, not subjected to production test.
5.  $V_{IN}$  = input voltage to perform proper function.
6. Guaranteed by 5 V leakage testing, not production tested.

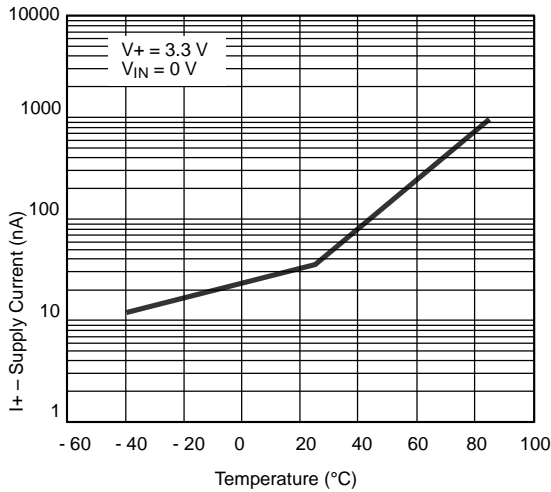
Typical Characteristics T<sub>A</sub> = 25 °C, unless otherwise noted



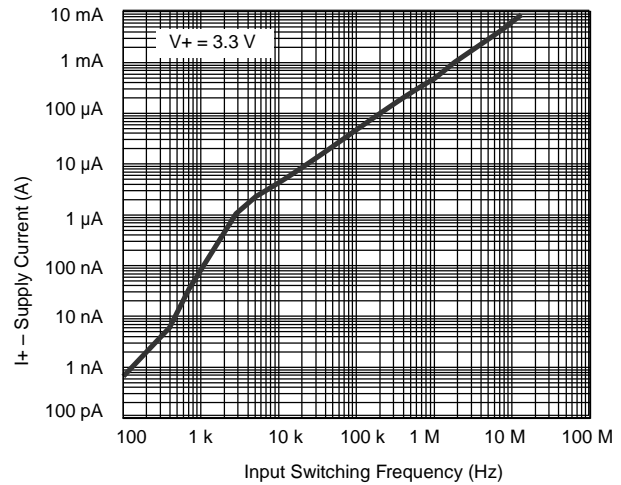
**r<sub>ON</sub> vs. V<sub>COM</sub> and Supply Voltage**



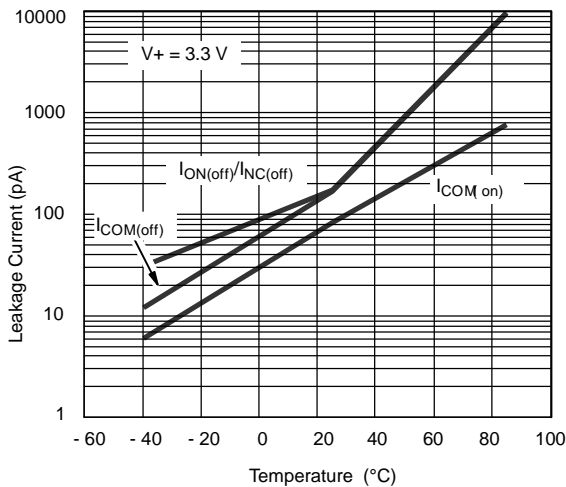
**r<sub>ON</sub> vs. Analog Voltage and Temperature**



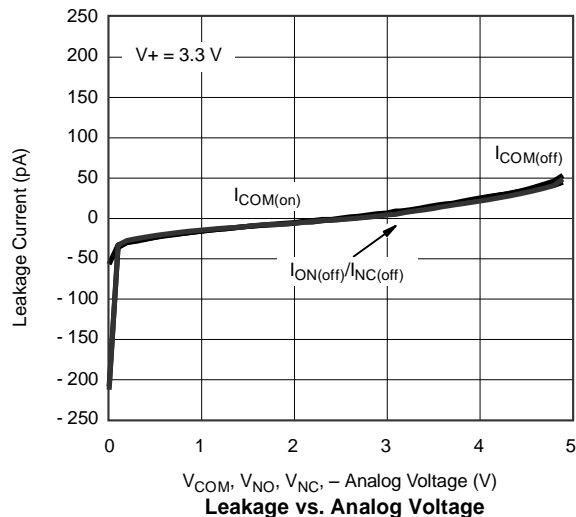
**Supply Current vs. Temperature**



**Supply Current vs. Input Switching Frequency**

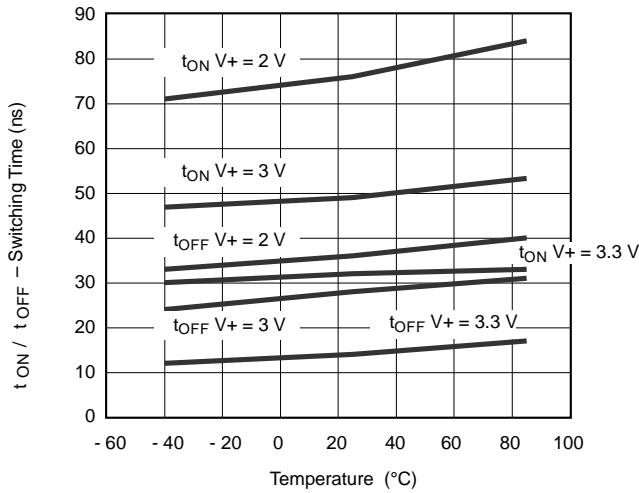


**Leakage Current vs. Temperature**

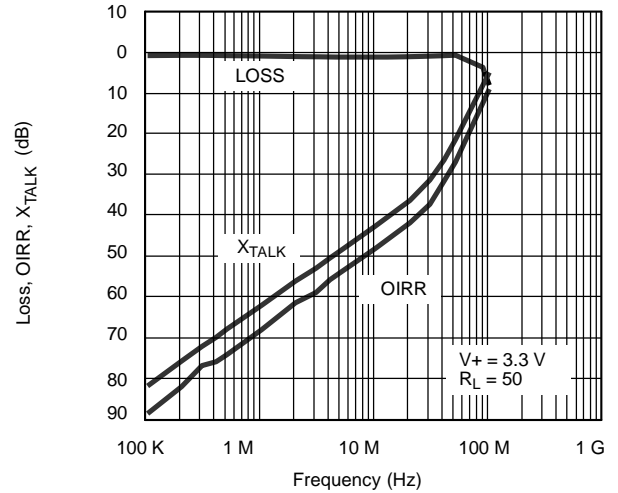


**Leakage vs. Analog Voltage**

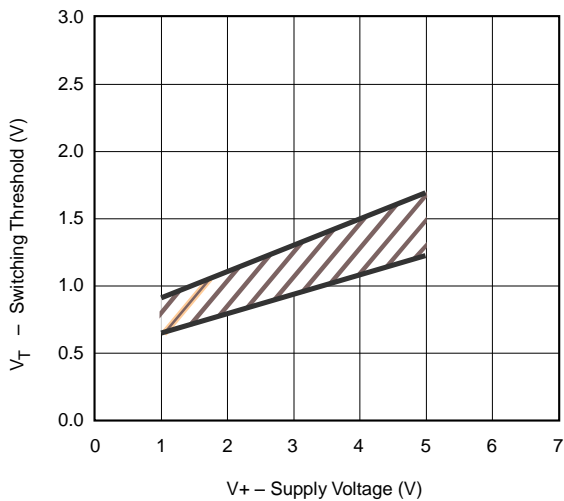
Typical Characteristics T<sub>A</sub> = 25 °C, unless otherwise noted



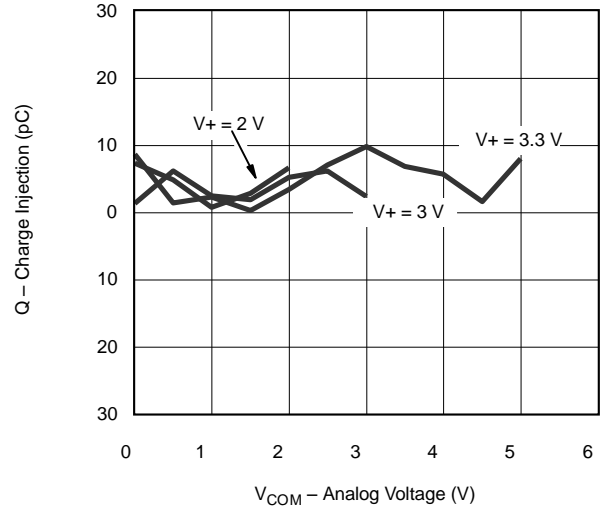
**Switching Time vs. Temperature and Supply Voltage**



**Insertion Loss, Off-Isolation, Crosstalk vs. Frequency**

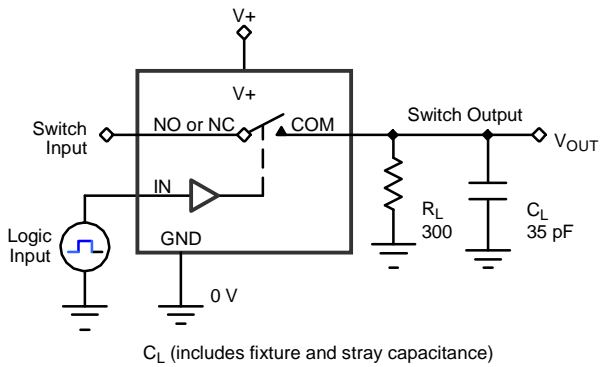


**Switching Threshold vs. Supply Voltage**



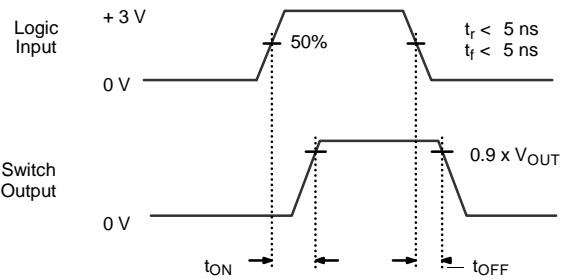
**Charge Injection vs. Analog Voltage**

Test Circuits



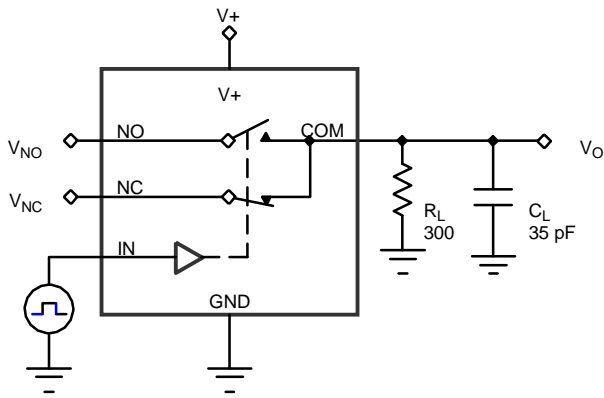
C<sub>L</sub> (includes fixture and stray capacitance)

$$V_{OUT} = V_{COM} \left( \frac{R_L}{R_L + R_{ON}} \right)$$



Logic "1" = Switch On  
Logic input waveforms inverted for switches that have the opposite logic sense.

Figure 1. Switching Time



C<sub>L</sub> (includes fixture and stray capacitance)

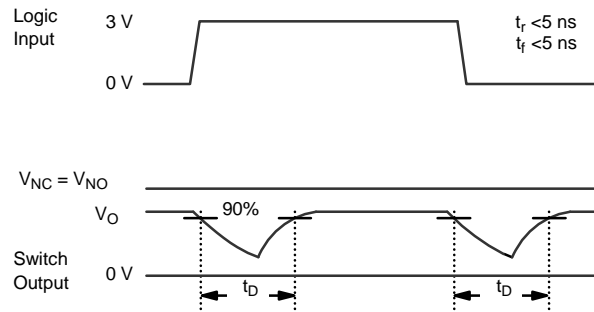
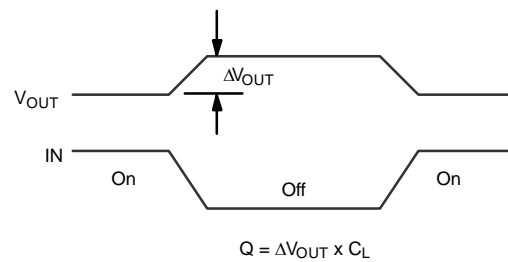
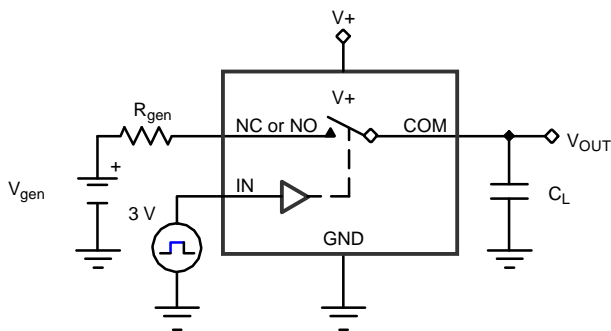


Figure 2. Break-Before-Make Interval



IN depends on switch configuration: input polarity determined by sense of switch.

Figure 3. Charge Injection

Test Circuits

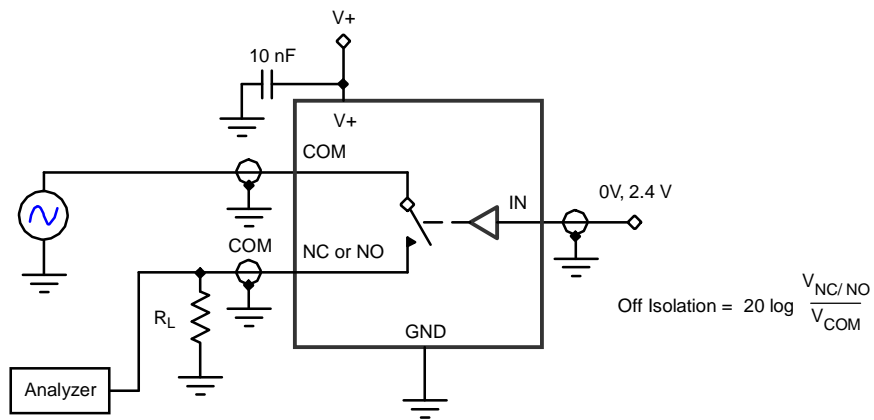


Figure 4. Off-Isolation

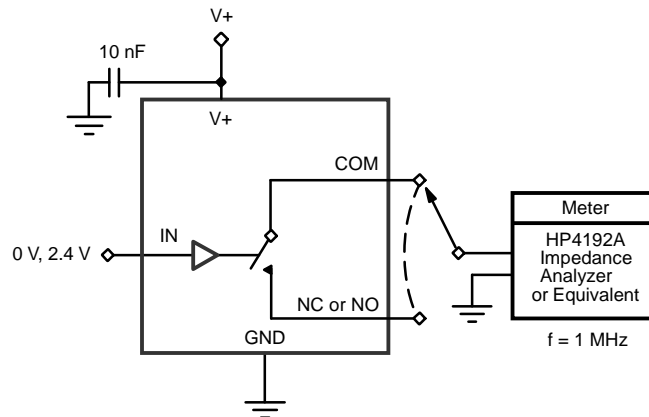
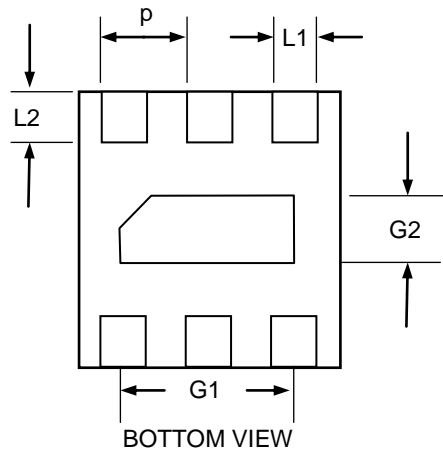
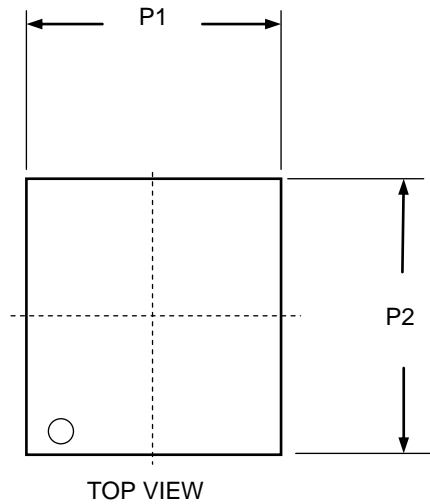
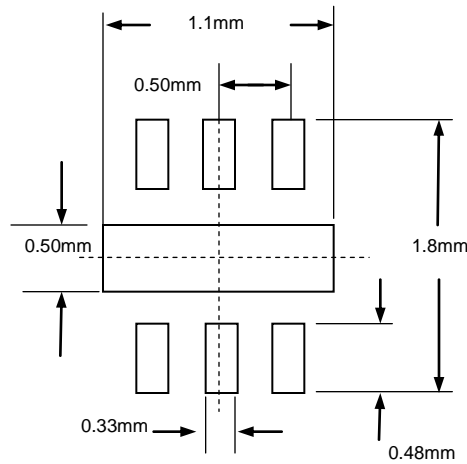
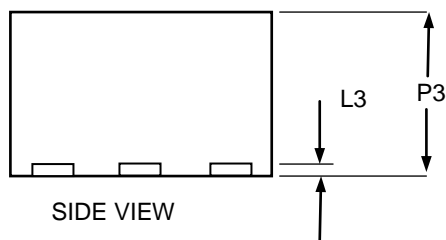


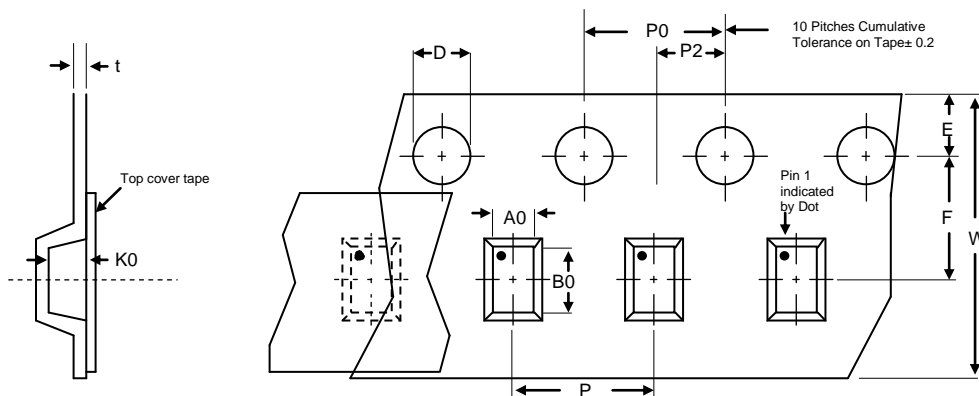
Figure 5. Channel Off/On Capacitance

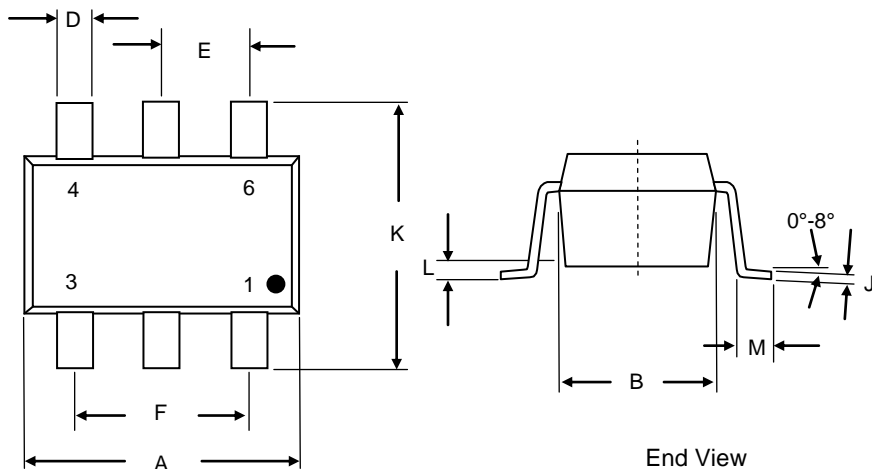
**Package Outline and Dimensions DFN-6**


Dim	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
P1	1.5	1.7	0.060	0.066
P2	1.5	1.7	0.060	0.066
P3	0.45	0.65	0.018	0.026
L1	0.23	0.27	0.009	0.012
L2	0.20	0.30	0.008	0.012
L3	0.01	0.09	0.001	0.003
P	0.50	0.50	0.020	0.020
G1	0.90	1.10	0.035	0.043
G2	0.38	0.43	0.013	0.017


**Tape and Reel Specifications (Dimensions in mm)**

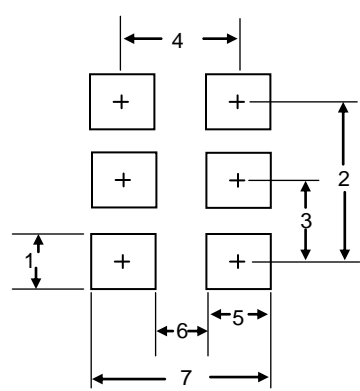
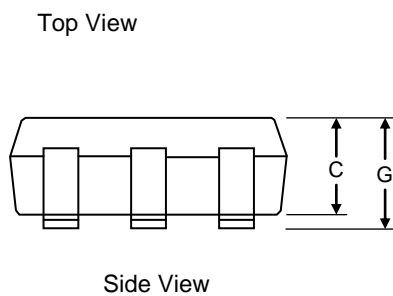
Reel Dia	A0	B0	K0	D	E	F	W	P0	P2	P	t-max
178 (7")	1.80±0.10	1.80±0.10	0.80±0.10	1.50±0.10	1.75±0.10	3.50±0.05	8.00±0.30	4.00±0.10	2.00±0.05	4.00±0.10	0.25



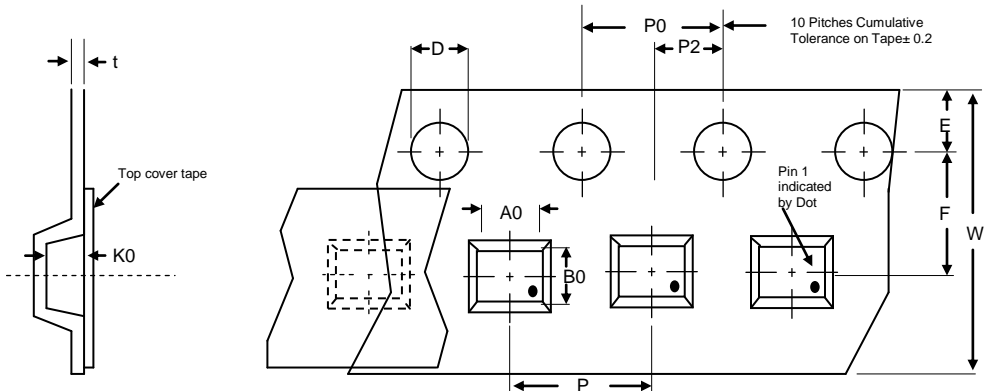
**Package Outline and Dimensions SC70-6 Lead**


Dim	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.90	2.15	0.074	0.084
B	1.15	1.35	0.045	0.055
C	0.80	1.00	0.031	0.040
D	0.15	0.30	0.006	0.012
E	0.65 BSC		0.0255 BSC	
F	1.30 BSC		0.0512 BSC	
G	0.80	1.10	0.031	0.043
J	0.08	0.25	0.003	0.010
K	2.00	2.20	0.078	0.086
L	0	0.10	0	0.004
M	0.26	0.46	0.010	0.018

LAND PATTERN		
1	0.50	0.020
2	1.30	0.051
3	0.65	0.026
4	1.72	0.068
5	0.60	0.024
6	1.11	0.044
7	2.33	0.092


**Recommended Land Pattern**
**Tape and Reel Specifications (Dimensions in mm)**

Reel Dia	A0	B0	K0	D	E	F	W	P0	P2	P	t-max
178 (7")	2.25±0.10	2.34±0.10	1.22±0.10	1.50±0.10	1.75±0.10	3.50±0.05	8.00±0.30	4.00±0.10	2.00±0.05	4.00±0.10	0.25


**Life Support Policy**

PROTEK ANALOG'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF PROTEK DEVICES.