

## 3V to 16V SPDT/SPST CMOS ANALOG SWITCHES

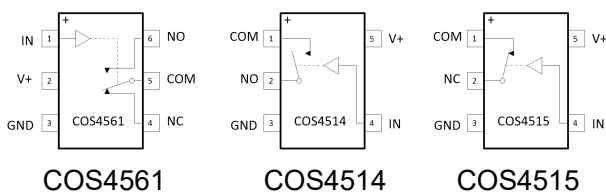
### Features

- 3V to 16V Single-Supply Operation
- Low ON-State Resistance:
  - 2.8Ω with 16V Supply
  - 3.6Ω with 12V Supply
  - 11Ω with 5V Supply
- Low Leakage Currents
  - 1 nA Off-Leakage at 25°C
  - 1 nA On-Leakage at 25°C
- Fast Switching Speed
  - t<sub>ON</sub>=70ns, t<sub>OFF</sub>=50ns (12V Supply)
- Break-Before-Make Operation
- Rail-to-Rail Operation
- TTL/CMOS Logic Compatible
- Small Packaging:
  - SOT23-6 (COS4561)
  - SOT23-5 (COS4514/4515)

### General Description

The COS4561 is a single-pole/double-throw (SPDT) CMOS analog switch. The COS4514 and COS4515 are single pole / single throw (SPST) CMOS analog switches. They have very low switch ON-state resistance. The COS4514 is normally open (NO). The COS4515 is normally closed (NC).

These CMOS switches can operate continuously with a single supply between 3V and 16V. Each switch can handle rail-to-rail analog signals. The OFF/ON-Leakage current maximum is only 1nA at 25°C or 10nA at 85°C. The digital inputs have 0.8V to 2.4V logic thresholds, ensuring TTL/CMOS logic compatibility when using a +5V supply.



Pin Diagram

### Applications

- Power routing applications
- Audio and video signal switching
- Precision automatic test equipment
- Relay replacement
- Automotive applications
- Sample and hold systems
- Telecom signal switching
- Battery power systems

Rev1.1

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## 1. Pin Configuration and Functions

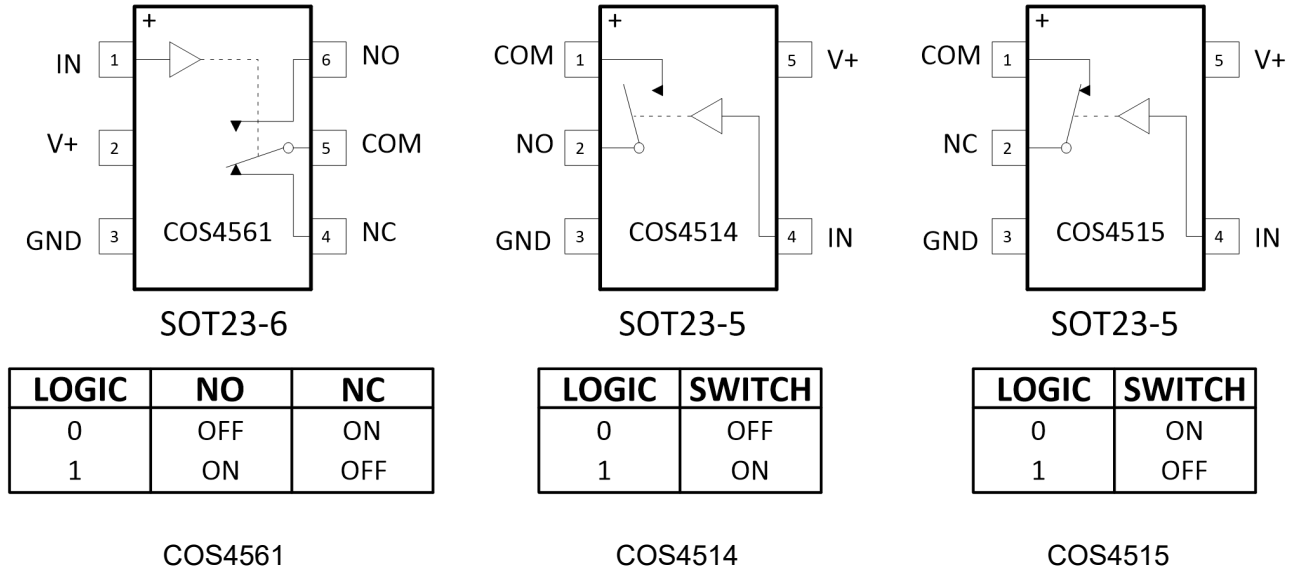


Figure 1 Pin Diagram

### Pin Description

PIN			NAME	FUNCTION
COS4561	COS4514	COS4515		
1	4	4	IN	Digital Control Input
2	5	5	V+	Supply Voltage
3	3	3	GND	Ground
4	-	2	NC	Normally Closed Terminal
5	1	1	COM	Common Terminal
6	2	-	NO	Normally Open Terminal

## 2. Ordering Information

Order Number	Package	Package Option	Marking Information
COS4561TR	SOT23-6	Tape and Reel, 3000	C4561
COS4514TR	SOT23-5	Tape and Reel, 3000	C4514
COS4515TR	SOT23-5	Tape and Reel, 3000	C4515

### 3. Product Specification

#### 3.1 Absolute Maximum Ratings <sup>(1)</sup>

Parameter	Min	Max	Unit
Supply voltage range (V <sub>+</sub> )	-0.3	17	V
Analog voltage range (V <sub>NC</sub> , V <sub>NO</sub> , V <sub>COM</sub> )	-0.3	V <sub>+</sub> + 0.3	V
Continuous current into any terminal		±20	mA
Peak current into any terminal		±30	mA
Continuous power dissipation		560	mW
Operating junction temperature	-40	+125	°C
Storage temperature	-55	+150	°C

(1) Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

#### 3.2 Thermal Data

Parameter	Rating	Unit
Package Thermal Resistance, R <sub>θJA</sub> (Junction-to-ambient)	190 (SOT23-5/6)	°C/W

#### 3.3 Recommended Operating Conditions

Parameter	Rating	Unit
DC Supply Voltage	3.0V ~ 16V	V
Operating ambient temperature	-40 to +85	°C

### 3.4 Electrical Characteristics for 5-V Supply

(Typical values are tested at  $T_A=25\text{ }^\circ\text{C}$ ,  $V_+=4.5\text{V}$  to  $5.5\text{V}$ ,  $V_{INH}=2.4\text{V}$ ,  $V_{INL}=0.8$ , unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>Analog Switch</b>						
Analog signal range	$V_{COM}, V_{NO}, V_{NC}$		0		$V_+$	V
On-state resistance	$R_{ON}$	$V_+ = 4.5\text{V}, V_{COM}=3.5\text{V}, I_{COM}=1\text{mA}$		11	28	$\Omega$
OFF leakage current (NO, NC)	$I_{NO(OFF)}, I_{NC(OFF)}$	$V_+ = 5.5\text{V}, V_{COM}=1\text{V}, V_{NO}$ or $V_{NC}=4.5\text{V}$			1	nA
OFF leakage current (COM)	$I_{COM(OFF)}$	$V_+ = 5.5\text{V}, V_{COM}=1\text{V}, V_{NO}$ or $V_{NC}=4.5\text{V}$			1	nA
ON leakage current (COM)	$I_{COM(ON)}$	$V_+ = 5.5\text{V}, V_{COM}=4.5\text{V}, V_{NO}$ or $V_{NC}=4.5\text{V}$			1	nA
<b>Digital Control Input (IN)</b>						
Input logic high	$V_{IH}$		2.4		$V_+$	V
Input logic low	$V_{IL}$		0		0.8	V
Input leakage current	$I_{IH}, I_{IL}$	$V_{IN} = 0$ or $V_+$			0.01	$\mu\text{A}$
<b>Switch Dynamic Characteristics</b>						
Turn-on time	$t_{ON}$	$V_{NO}$ or $V_{NC}=3\text{V}, R_L=300\Omega, C_L = 35\text{pF}$ , Figure 1		75	130	ns
Turn-off time	$t_{OFF}$	$V_{NO}$ or $V_{NC}=3\text{V}, R_L=300\Omega, C_L = 35\text{pF}$ , Figure 1		45	70	ns
Break-Before-Make Delay (COS4561 only)	$t_{BBM}$	$V_{NO}$ or $V_{NC}=3\text{V}, R_L=300\Omega, C_L = 35\text{pF}$ , Figure 2	5	40		ns
Charge Injection	Q	$V_{GEN} = 2\text{V}, R_{GEN}=0, C_L = 1.0\text{nF}$ , Figure 3		-40		pC
NO or NC Off Capacitance	$C_{OFF}$	$V_{NC}=V_{NO} = 0, f = 1\text{MHz}$ ,		15		pF
COM Off-Capacitance (COS4514/COS4515 only)	$C_{COM}$	$V_{COM} = 0, f = 1\text{MHz}$ ,		65		pF
COM On-Capacitance	$C_{COM}$	$V_{COM} = V_{NO}, V_{NC} = 0, f = 1\text{MHz}$ ,		65		pF
Off-Isolation	$V_{ISO}$	$R_L = 50\Omega, C_L = 15\text{pF}, V_{NC} = 1V_{RMS}, f = 100\text{kHz}$		-85		dB
Bandwidth	BW	$R_L = 50\Omega, C_L = 15\text{pF}, V_{NC} = 1V_{RMS}, f = 100\text{kHz}$		600		MHz
<b>Power Supply</b>						
$V_+$ supply current	$I_+$	$V_{IN} = 0$ or $V_+$			0.01	$\mu\text{A}$

### 3.5 Electrical Characteristics for 12-V Supply

(Typical values are tested at  $T_A=25\text{ }^\circ\text{C}$ ,  $V_+=11.4\text{V}$  to  $12.6\text{V}$ ,  $V_{\text{INH}}=3\text{V}$ ,  $V_{\text{INL}}=0.8$ , unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>Analog Switch</b>						
Analog signal range	$V_{\text{COM}}$ , $V_{\text{NO}}$ , $V_{\text{NC}}$		0		$V_+$	V
On-state resistance	$R_{\text{ON}}$	$V_+ = 11.4\text{V}$ , $V_{\text{COM}}=10\text{V}$ , $I_{\text{COM}}=1\text{mA}$		3.6	6	$\Omega$
On-state resistance flatness	$R_{\text{ON}}$	$V_+ = 11.4\text{V}$ , $I_{\text{COM}}=1\text{mA}$ $V_{\text{COM}}=2\text{V}, 5\text{V}, 10\text{V}$		1.5	3	$\Omega$
OFF leakage current (NO, NC)	$I_{\text{NO(OFF)}}$ , $I_{\text{NC(OFF)}}$	$V_+ = 12.6\text{V}$ , $V_{\text{COM}}=1\text{V}$ , $V_{\text{NO}}$ or $V_{\text{NC}}=10\text{V}$			1	nA
OFF leakage current (COM)	$I_{\text{COM(OFF)}}$	$V_+ = 12.6\text{V}$ , $V_{\text{COM}}=1\text{V}$ , $V_{\text{NO}}$ or $V_{\text{NC}}=10\text{V}$			1	nA
ON leakage current (COM)	$I_{\text{COM(ON)}}$	$V_+ = 12.6\text{V}$ , $V_{\text{COM}}=10\text{V}$ , $V_{\text{NO}}$ or $V_{\text{NC}}=10\text{V}$			1	nA
<b>Digital Control Input (IN)</b>						
Input logic high	$V_{\text{IH}}$		2.4		$V_+$	V
Input logic low	$V_{\text{IL}}$		0		0.8	V
Input leakage current	$I_{\text{IH}}$ , $I_{\text{IL}}$	$V_{\text{IN}} = 0$ or $V_+$			0.01	$\mu\text{A}$
<b>Switch Dynamic Characteristics</b>						
Turn-on time	$t_{\text{ON}}$	$V_{\text{NO}}$ or $V_{\text{NC}}=10\text{V}$ , $R_{\text{L}}=300\Omega$ , $C_{\text{L}} = 35\text{pF}$ , Figure 1		70	130	ns
Turn-off time	$t_{\text{OFF}}$	$V_{\text{NO}}$ or $V_{\text{NC}}=10\text{V}$ , $R_{\text{L}}=300\Omega$ , $C_{\text{L}} = 35\text{pF}$ , Figure 1		50	75	ns
Break-Before-Make Delay (COS4561 only)	$t_{\text{BBM}}$	$V_{\text{NO}}$ or $V_{\text{NC}}=10\text{V}$ , $R_{\text{L}}=300\Omega$ , $C_{\text{L}} = 35\text{pF}$ , Figure 2	5	40		ns
Charge Injection	Q	$V_{\text{GEN}} = 5\text{V}$ , $R_{\text{GEN}}=0$ , $C_{\text{L}} = 1.0\text{nF}$ , Figure 3		-110		pC
NO or NC off capacitance	$C_{\text{OFF}}$	$V_{\text{NC}}=V_{\text{NO}} = 0$ , $f = 1\text{MHz}$ ,		15		pF
COM off-capacitance (COS4514/COS4515 only)	$C_{\text{COM}}$	$V_{\text{COM}} = 0$ , $f = 1\text{MHz}$ ,		65		pF
COM On-Capacitance	$C_{\text{COM}}$	$V_{\text{COM}} = V_{\text{NO}}$ , $V_{\text{NC}} = 0$ , $f = 1\text{MHz}$ ,		65		pF
Off-Isolation	$V_{\text{ISO}}$	$R_{\text{L}} = 50\Omega$ , $C_{\text{L}} = 15\text{pF}$ , $V_{\text{NC}} = 1V_{\text{RMS}}$ , $f = 100\text{kHz}$		-85		dB
Bandwidth	BW	$R_{\text{L}} = 50\Omega$ , $C_{\text{L}} = 15\text{pF}$ , $V_{\text{NC}} = 1V_{\text{RMS}}$ , $f = 100\text{kHz}$		900		MHz
<b>Power Supply</b>						
$V_+$ supply current	$I_+$	$V_{\text{IN}} = 0$ or $V_+$			0.01	$\mu\text{A}$

### 4. Test Circuits and Timing Diagrams

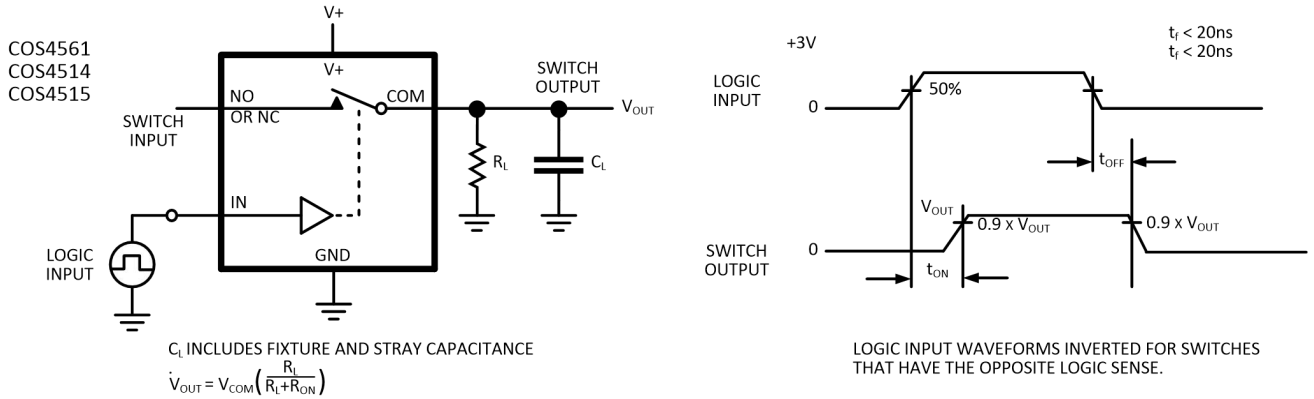


Figure 1. Switching Time

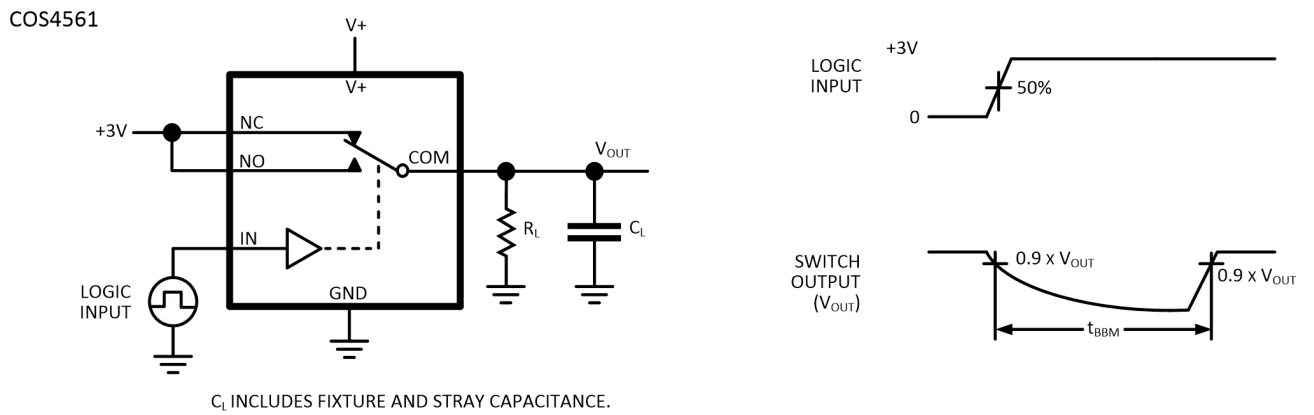


Figure 2. Break-Before-Make Interval

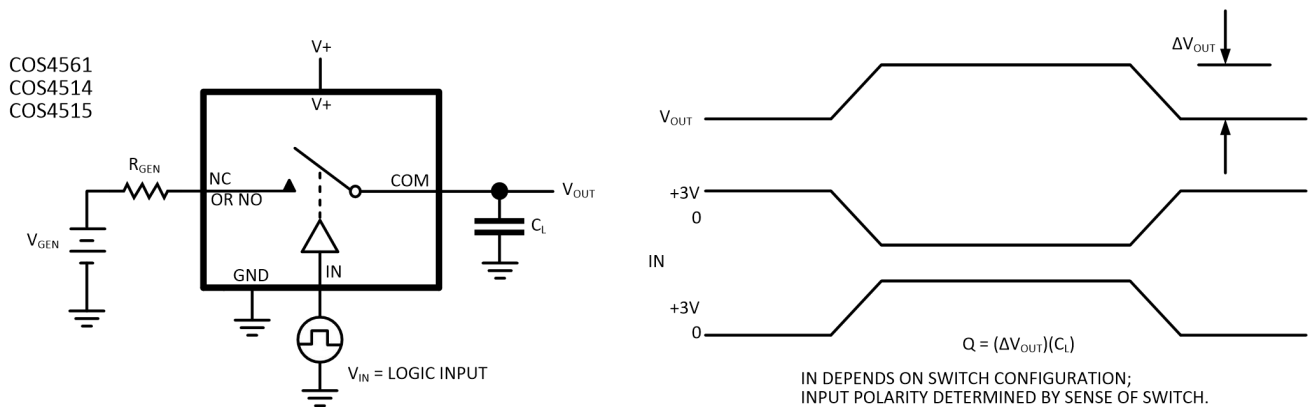
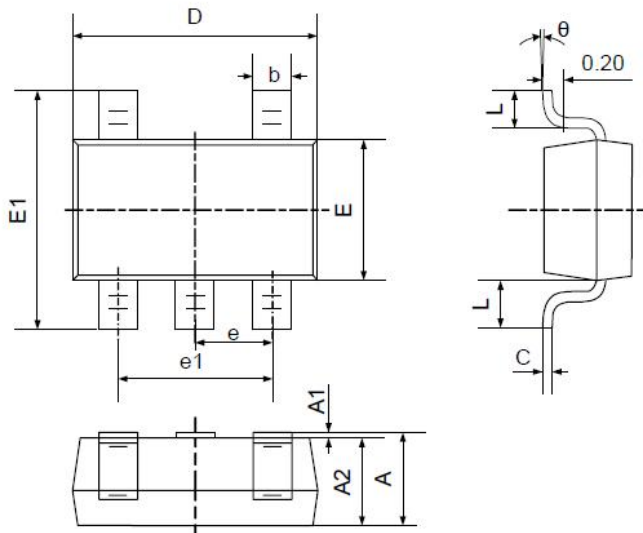


Figure 3. Charge Injection

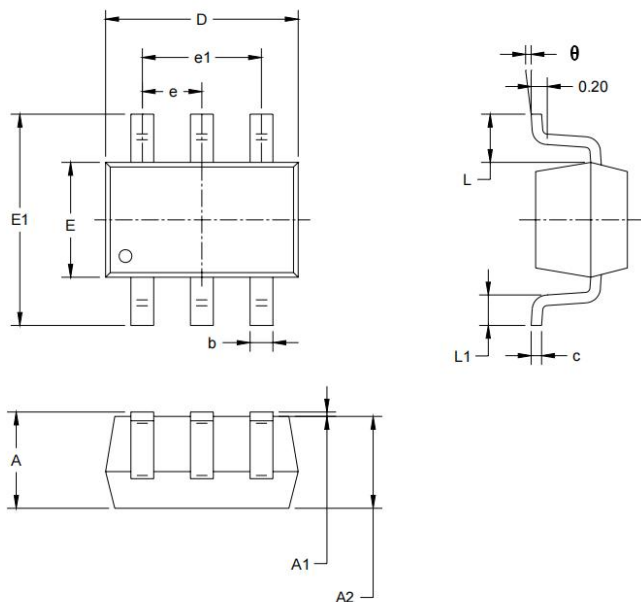
## 5. Package Information

### 5.1 SOT23-5 (Package Outline Dimensions)



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	0.400	0.012	0.016
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	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
$\theta$	0°	8°	0°	8°

### 5.2 SOT23-6 (Package Outline Dimensions)



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	0.400	0.012	0.016
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	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
$\theta$	0°	8°	0°	8°