



#### FEATURES

- $\pm 2$  V to  $\pm 6$  V dual-supply operation
- 2 V to 12 V single-supply operation
- Temperature range:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- $<0.2$  nA leakage currents
- 52  $\Omega$  on resistance over full signal range
- Rail-to-rail switching operation
- 16-lead LFCSP and TSSOP packages
- Typical power consumption:  $<0.1$   $\mu\text{W}$
- TTL-/CMOS-compatible inputs
- Package upgrades to 74HC4053 and MAX4053/MAX4583

#### APPLICATIONS

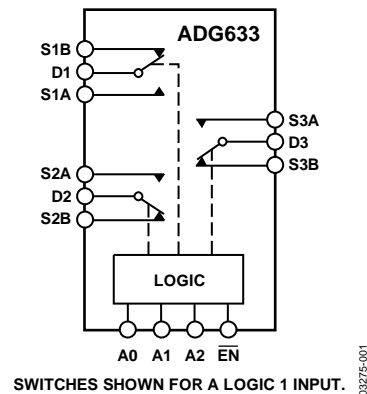
- Automatic test equipment
- Data acquisition systems
- Battery-powered systems
- Communications systems
- Audio and video signal routing
- Relay replacement
- Sample-and-hold systems
- Industrial control systems

#### GENERAL DESCRIPTION

The **ADG633** is a low voltage CMOS device comprising three independently selectable single-pole, double-throw (SPDT) switches. The device is fully specified for  $\pm 5$  V, +5 V, and +3 V supplies. The **ADG633** switches are turned on with a logic low (or high) on the appropriate control input. Each switch conducts equally well in both directions when on and has an input signal range that extends to the supplies. An  $\overline{\text{EN}}$  input is used to enable or disable the device. When the device is disabled, all channels are switched off.

The **ADG633** is designed on an enhanced process that provides lower power dissipation, yet is capable of high switching speeds. Low power consumption and an operating supply range of 2 V to 12 V make the **ADG633** ideal for battery-powered, portable instruments. All channels exhibit break-before-make switching action, preventing momentary shorting when switching channels.

#### FUNCTIONAL BLOCK DIAGRAM



SWITCHES SHOWN FOR A LOGIC 1 INPUT.

Figure 1.

All digital inputs have 0.8 V to 2.4 V logic thresholds, ensuring TTL/CMOS logic compatibility when using single +5 V or dual  $\pm 5$  V supplies.

The **ADG633** is available in a small, 16-lead TSSOP package and a 16-lead, 4 mm  $\times$  4 mm LFCSP package.

#### PRODUCT HIGHLIGHTS

1. Single- and dual-supply operation. The **ADG633** offers high performance and is fully specified and guaranteed with  $\pm 5$  V, +5 V, and +3 V supply rails.
2. Temperature range:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .
3. Guaranteed break-before-make switching action.
4. Low power consumption, typically  $<0.1$   $\mu\text{W}$ .
5. Small, 16-lead TSSOP and 16-lead, 4 mm  $\times$  4 mm LFCSP packages.

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## REVISION HISTORY

### 2/2017—Rev. A to Rev. B

Deleted B Version .....	Throughout
Changes to Features Section, Applications Section, and Product Highlights Section .....	1
Added Note 2 to Table 1; Renumbered Sequentially .....	3
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Changes to Figure 3 and Table 6.....	7
Updated Outline Dimensions .....	14
Changes to Ordering Guide .....	14

### 11/2009—Rev. 0 to Rev. A

Changes to Table 4.....	6
Added Table 5; Renumbered Sequentially .....	7
Changes to Table 6.....	7
Update Outline Dimensions .....	14
Changes to Ordering Guide .....	14

### 2/2003—Revision 0: Initial Version

## SPECIFICATIONS

## DUAL-SUPPLY OPERATION

$V_{DD} = +5\text{ V}$ ,  $V_{SS} = -5\text{ V}$ ,  $GND = 0\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ , unless otherwise noted.

Table 1.

Parameter	+25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
<b>ANALOG SWITCH</b>					
Analog Signal Range			$V_{SS}$ to $V_{DD}$	V	$V_{DD} = +4.5\text{ V}$ , $V_{SS} = -4.5\text{ V}$
On Resistance, $R_{ON}$	52			$\Omega$ typ	$V_S = \pm 4.5\text{ V}$ , $I_S = 1\text{ mA}$ ; see Figure 20
	75	90	100	$\Omega$ max	$V_S = \pm 4.5\text{ V}$ , $I_S = 1\text{ mA}$ ; see Figure 20
On-Resistance Match Between Channels, $\Delta R_{ON}$	0.8			$\Omega$ typ	$V_S = +3.5\text{ V}$ , $I_S = 1\text{ mA}$
	1.3	1.8	2	$\Omega$ max	$V_S = +3.5\text{ V}$ , $I_S = 1\text{ mA}$
On-Resistance Flatness, $R_{FLAT(ON)}$	9			$\Omega$ typ	$V_{DD} = +5\text{ V}$ , $V_{SS} = -5\text{ V}$ , $V_S = \pm 3\text{ V}$ , $I_S = 1\text{ mA}$
	12	13	14	$\Omega$ max	$V_{DD} = +5\text{ V}$ , $V_{SS} = -5\text{ V}$ , $V_S = \pm 3\text{ V}$ , $I_S = 1\text{ mA}$
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_{S(OFF)}$	$\pm 0.005$			nA typ	$V_{DD} = +5.5\text{ V}$ , $V_{SS} = -5.5\text{ V}$
	$\pm 0.2$		$\pm 5$	nA max	$V_D = \pm 4.5\text{ V}$ , $V_S = \mp 4.5\text{ V}$ ; see Figure 21
Drain Off Leakage, $I_{D(OFF)}$	$\pm 0.005$			nA typ	$V_D = \pm 4.5\text{ V}$ , $V_S = \mp 4.5\text{ V}$ ; see Figure 21
	$\pm 0.2$		$\pm 5$	nA max	$V_D = \pm 4.5\text{ V}$ , $V_S = \mp 4.5\text{ V}$ ; see Figure 22
Channel On Leakage, $I_{D(ON)}$ , $I_{S(ON)}$	$\pm 0.005$			nA typ	$V_D = V_S = \pm 4.5\text{ V}$ ; see Figure 23
	$\pm 0.2$		$\pm 5$	nA max	$V_D = V_S = \pm 4.5\text{ V}$ ; see Figure 23
<b>DIGITAL INPUTS</b>					
Input High Voltage, $V_{INH}$			2.4	V min	
Input Low Voltage, $V_{INL}$			0.8	V max	
Input Current, $I_{INL}$ or $I_{INH}$	0.005			$\mu\text{A}$ typ	$V_{IN} = V_{INL}$ or $V_{INH}$
			$\pm 1$	$\mu\text{A}$ max	$V_{IN} = V_{INL}$ or $V_{INH}$
Digital Input Capacitance, $C_{IN}$	2			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
$t_{TRANSITION}$	60			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_S = 3\text{ V}$ ; see Figure 24
	90	110	130	ns max	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_S = 3\text{ V}$ ; see Figure 24
$t_{ON}(\overline{EN})$	70			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_S = 3\text{ V}$ ; see Figure 26
	95	120	135	ns max	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_S = 3\text{ V}$ ; see Figure 26
$t_{OFF}(\overline{EN})$	25			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_S = 3\text{ V}$ ; see Figure 26
	40	45	50	ns max	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_S = 3\text{ V}$ ; see Figure 26
Break-Before-Make Time Delay, $t_{BBM}$	40			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_{S1} = V_{S2} = 3\text{ V}$ ; see Figure 25
			10	ns min	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_{S1} = V_{S2} = 3\text{ V}$ ; see Figure 25
Charge Injection	2			pC typ	$V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 27
	4			pC max	$V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 27
Off Isolation	-90			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 28
Total Harmonic Distortion, THD + N	0.025			% typ	$R_L = 600\ \Omega$ , $2\text{ V p-p}$ , $f = 20\text{ Hz}$ to $20\text{ kHz}$
Channel-to-Channel Crosstalk	-90			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 30
-3 dB Bandwidth	580			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 29
$C_{S(OFF)}$	4			pF typ	$f = 1\text{ MHz}$
$C_{D(OFF)}$	7			pF typ	$f = 1\text{ MHz}$
$C_{D(ON)}$ , $C_{S(ON)}$	12			pF typ	$f = 1\text{ MHz}$
<b>POWER REQUIREMENTS<sup>2</sup></b>					
$I_{DD}$	0.01			$\mu\text{A}$ typ	$V_{DD} = +5.5\text{ V}$ , $V_{SS} = -5.5\text{ V}$
			1	$\mu\text{A}$ max	Digital inputs = 0 V or 5.5 V
$I_{SS}$	0.01			$\mu\text{A}$ typ	Digital inputs = 0 V or 5.5 V
			1	$\mu\text{A}$ max	Digital inputs = 0 V or 5.5 V

<sup>1</sup> Guaranteed by design; not subject to production test.

<sup>2</sup> The device is fully specified at a  $\pm 5\text{ V}$  dual supply and at 5 V and 3.3 V single supplies. It is possible to operate the ADG633 with unbalanced supplies or at other voltage supplies ( $\pm 2\text{ V}$  to  $\pm 6\text{ V}$ , and  $2\text{ V}$  to  $12\text{ V}$ ); however, the switch characteristics change. These changes include, but are not limited to: analog signal range, on resistance, leakage,  $V_{INL}$ ,  $V_{INH}$ , and switching times. The optimal power-up sequence for the device is: ground,  $V_{DD}$ ,  $V_{SS}$ , and then the digital inputs, before applying the analog input signal.

## SINGLE-SUPPLY OPERATION

$V_{DD} = 5\text{ V}$ ,  $V_{SS} = 0\text{ V}$ ,  $GND = 0\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ , unless otherwise noted.

Table 2.

Parameter	+25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
<b>ANALOG SWITCH</b>					
Analogue Signal Range			0 to $V_{DD}$	V	$V_{DD} = 4.5\text{ V}$ , $V_{SS} = 0\text{ V}$
On Resistance, $R_{ON}$	85	160	200	$\Omega$ typ $\Omega$ max	$V_S = 0\text{ V}$ to $4.5\text{ V}$ , $I_S = 1\text{ mA}$ ; see Figure 20
On-Resistance Match Between Channels, $\Delta R_{ON}$	4.5			$\Omega$ typ	$V_S = 0\text{ V}$ to $4.5\text{ V}$ , $I_S = 1\text{ mA}$ ; see Figure 20
On-Resistance Flatness, $R_{FLAT(ON)}$	8	9	10	$\Omega$ max	$V_S = +3.5\text{ V}$ , $I_S = 1\text{ mA}$
	13	14	16	$\Omega$ typ	$V_{DD} = 5\text{ V}$ , $V_{SS} = 0\text{ V}$ , $V_S = 1.5\text{ V}$ to $4\text{ V}$ , $I_S = 1\text{ mA}$
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_{S(OFF)}$	$\pm 0.005$			nA typ	$V_{DD} = 5.5\text{ V}$
	$\pm 0.2$		$\pm 5$	nA max	$V_S = 1\text{ V}/4.5\text{ V}$ , $V_D = 4.5\text{ V}/1\text{ V}$ ; see Figure 21
Drain Off Leakage, $I_{D(OFF)}$	$\pm 0.005$			nA typ	$V_S = 1\text{ V}/4.5\text{ V}$ , $V_D = 4.5\text{ V}/1\text{ V}$ ; see Figure 21
	$\pm 0.2$		$\pm 5$	nA max	$V_S = 1\text{ V}/4.5\text{ V}$ , $V_D = 4.5\text{ V}/1\text{ V}$ ; see Figure 22
Channel On Leakage, $I_{D(ON)}$ , $I_{S(ON)}$	$\pm 0.005$			nA typ	$V_S = V_D = 1\text{ V}$ or $4.5\text{ V}$ ; see Figure 23
	$\pm 0.2$		$\pm 5$	nA max	$V_S = V_D = 1\text{ V}$ or $4.5\text{ V}$ ; see Figure 23
<b>DIGITAL INPUTS</b>					
Input High Voltage, $V_{INH}$			2.4	V min	
Input Low Voltage, $V_{INL}$			0.8	V max	
Input Current, $I_{INL}$ or $I_{INH}$	0.005			$\mu\text{A}$ typ	$V_{IN} = V_{INL}$ or $V_{INH}$
			$\pm 1$	$\mu\text{A}$ max	$V_{IN} = V_{INL}$ or $V_{INH}$
Digital Input Capacitance, $C_{IN}$	2			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
$t_{TRANSITION}$	100			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_S = 3\text{ V}$ ; see Figure 24
	150	190	220	ns max	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_S = 3\text{ V}$ ; see Figure 24
$t_{ON}(\overline{EN})$	100			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_S = 3\text{ V}$ ; see Figure 26
	150	190	220	ns max	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_S = 3\text{ V}$ ; see Figure 26
$t_{OFF}(\overline{EN})$	25			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_S = 3\text{ V}$ ; see Figure 26
	35	45	50	ns max	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_S = 3\text{ V}$ ; see Figure 26
Break-Before-Make Time Delay, $t_{BBM}$	90			ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_{S1} = V_{S2} = 3\text{ V}$ ; see Figure 25
			10	ns min	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ , $V_{S1} = V_{S2} = 3\text{ V}$ ; see Figure 25
Charge Injection	0.5			pC typ	$V_S = 2.5\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 27
	1			pC max	$V_S = 2.5\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; see Figure 27
Off Isolation	-90			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 28
Channel-to-Channel Crosstalk	-90			dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; see Figure 30
-3 dB Bandwidth	520			MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ ; see Figure 29
$C_{S(OFF)}$	5			pF typ	$f = 1\text{ MHz}$
$C_{D(OFF)}$	8			pF typ	$f = 1\text{ MHz}$
$C_{D(ON)}$ , $C_{S(ON)}$	12			pF typ	$f = 1\text{ MHz}$
<b>POWER REQUIREMENTS<sup>2</sup></b>					
$I_{DD}$	0.01			$\mu\text{A}$ typ	$V_{DD} = 5.5\text{ V}$
			1	$\mu\text{A}$ max	Digital inputs = 0 V or 5.5 V

<sup>1</sup> Guaranteed by design; not subject to production test.

<sup>2</sup> The device is fully specified at a  $\pm 5\text{ V}$  dual supply and at 5 V and 3.3 V single supplies. It is possible to operate the ADG633 with unbalanced supplies or at other voltage supplies ( $\pm 2\text{ V}$  to  $\pm 6\text{ V}$ , and 2 V to 12 V); however, the switch characteristics change. These changes include, but are not limited to: analog signal range, on resistance, leakage,  $V_{INL}$ ,  $V_{INH}$ , and switching times. The optimal power-up sequence for the device is: ground,  $V_{DD}$ ,  $V_{SS}$ , and then the digital inputs, before applying the analog input signal.

$V_{DD} = 2.7 \text{ V to } 3.6 \text{ V}$ ,  $V_{SS} = 0 \text{ V}$ ,  $GND = 0 \text{ V}$ ,  $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ , unless otherwise noted.

Table 3.

Parameter	+25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
<b>ANALOG SWITCH</b>					
Analog Signal Range			0 to $V_{DD}$	V	$V_{DD} = 2.7 \text{ V}$ , $V_{SS} = 0 \text{ V}$
On Resistance, $R_{ON}$	185			$\Omega$ typ	$V_S = 0 \text{ V to } 2.7 \text{ V}$ , $I_S = 0.1 \text{ mA}$ ; see Figure 20
	300	350	400	$\Omega$ max	$V_S = 0 \text{ V to } 2.7 \text{ V}$ , $I_S = 0.1 \text{ mA}$ ; see Figure 20
On-Resistance Match Between Channels, $\Delta R_{ON}$	2			$\Omega$ typ	$V_S = +1.5 \text{ V}$ , $I_S = 0.1 \text{ mA}$
	4.5	6	7	$\Omega$ max	$V_S = +1.5 \text{ V}$ , $I_S = 0.1 \text{ mA}$
<b>LEAKAGE CURRENTS</b>					
Source Off Leakage, $I_{S(OFF)}$	$\pm 0.005$			nA typ	$V_{DD} = 3.3 \text{ V}$ $V_S = 1 \text{ V/3 V}$ , $V_D = 3 \text{ V/1 V}$ ; see Figure 21
	$\pm 0.2$		$\pm 5$	nA max	$V_S = 1 \text{ V/3 V}$ , $V_D = 3 \text{ V/1 V}$ ; see Figure 21
Drain Off Leakage, $I_{D(OFF)}$	$\pm 0.005$			nA typ	$V_S = 1 \text{ V/3 V}$ , $V_D = 3 \text{ V/1 V}$ ; see Figure 22
	$\pm 0.2$		$\pm 5$	nA max	$V_S = 1 \text{ V/3 V}$ , $V_D = 3 \text{ V/1 V}$ ; see Figure 22
Channel On Leakage, $I_{D(ON)}$ , $I_{S(ON)}$	$\pm 0.005$			nA typ	$V_S = V_D = 1 \text{ V or } 3 \text{ V}$ ; see Figure 23
	$\pm 0.2$		$\pm 5$	nA max	$V_S = V_D = 1 \text{ V or } 3 \text{ V}$ ; see Figure 23
<b>DIGITAL INPUTS</b>					
Input High Voltage, $V_{INH}$			2.0	V min	
Input Low Voltage, $V_{INL}$			0.5	V max	
Input Current, $I_{INL}$ or $I_{INH}$	0.005			$\mu\text{A}$ typ	$V_{IN} = V_{INL}$ or $V_{INH}$
			$\pm 1$	$\mu\text{A}$ max	$V_{IN} = V_{INL}$ or $V_{INH}$
Digital Input Capacitance, $C_{IN}$	2			pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>					
$t_{TRANSITION}$	170			ns typ	$R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ , $V_S = 1.5 \text{ V}$ ; see Figure 24
	300	370	400	ns max	$R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ , $V_S = 1.5 \text{ V}$ ; see Figure 24
$t_{ON}(\overline{EN})$	200			ns typ	$R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ , $V_S = 1.5 \text{ V}$ ; see Figure 26
	310	380	420	ns max	$R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ , $V_S = 1.5 \text{ V}$ ; see Figure 26
$t_{OFF}(\overline{EN})$	30			ns typ	$R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ , $V_S = 1.5 \text{ V}$ ; see Figure 26
	40	55	75	ns max	$R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ , $V_S = 1.5 \text{ V}$ ; see Figure 26
Break-Before-Make Time Delay, $t_{BBM}$	180			ns typ	$R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ , $V_{S1} = V_{S2} = 1.5 \text{ V}$ ; see Figure 25
			10	ns min	$R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ , $V_{S1} = V_{S2} = 1.5 \text{ V}$ ; see Figure 25
Charge Injection	1			pC typ	$V_S = 1.5 \text{ V}$ , $R_S = 0 \Omega$ , $C_L = 1 \text{ nF}$ ; see Figure 27
	2			pC max	$V_S = 1.5 \text{ V}$ , $R_S = 0 \Omega$ , $C_L = 1 \text{ nF}$ ; see Figure 27
Off Isolation	-90			dB typ	$R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ , $f = 1 \text{ MHz}$ ; see Figure 28
Channel-to-Channel Crosstalk	-90			dB typ	$R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ , $f = 1 \text{ MHz}$ ; see Figure 30
-3 dB Bandwidth	500			MHz typ	$R_L = 50 \Omega$ , $C_L = 5 \text{ pF}$ ; see Figure 29
$C_{S(OFF)}$	5			pF typ	$f = 1 \text{ MHz}$
$C_{D(OFF)}$	8			pF typ	$f = 1 \text{ MHz}$
$C_{D(ON)}$ , $C_{S(ON)}$	12			pF typ	$f = 1 \text{ MHz}$
<b>POWER REQUIREMENTS<sup>2</sup></b>					
$I_{DD}$	0.01			$\mu\text{A}$ typ	$V_{DD} = 3.3 \text{ V}$ Digital inputs = 0 V or 3.3 V
			1	$\mu\text{A}$ max	Digital inputs = 0 V or 3.3 V

<sup>1</sup> Guaranteed by design; not subject to production test.

<sup>2</sup> The device is fully specified at a  $\pm 5 \text{ V}$  dual supply and at 5 V and 3.3 V single supplies. It is possible to operate the ADG633 with unbalanced supplies or at other voltage supplies ( $\pm 2 \text{ V to } \pm 6 \text{ V}$ , and 2 V to 12 V); however, the switch characteristics change. These changes include, but are not limited to: analog signal range, on resistance, leakage,  $V_{INL}$ ,  $V_{INH}$ , and switching times. The optimal power-up sequence for the device is: ground,  $V_{DD}$ ,  $V_{SS}$ , and then the digital inputs, before applying the analog input signal.

## ABSOLUTE MAXIMUM RATINGS

$T_A = 25^\circ\text{C}$ , unless otherwise noted.

Table 4.

Parameter	Rating
$V_{DD}$ to $V_{SS}$ <sup>1</sup>	13 V
$V_{DD}$ to GND	-0.3 V to +13 V
$V_{SS}$ to GND	+0.3 V to -6.5 V
Analog Inputs <sup>2</sup>	$V_{SS} - 0.3\text{ V}$ to $V_{DD} + 0.3\text{ V}$
Digital Inputs <sup>2</sup>	GND - 0.3 V to $V_{DD} + 0.3\text{ V}$ or 10 mA, whichever occurs first
Peak Current, S or D	40 mA (pulsed at 1 ms, 10% duty cycle maximum)
Continuous Current, S or D	20 mA
Operating Temperature Range	-40°C to +125°C
Storage Temperature Range	-65°C to +150°C
Junction Temperature	150°C
$\theta_{JA}$ Thermal Impedance	
16-Lead TSSOP	150.4°C/W
16-Lead LFCSF, 4-Layer Board	70°C/W
Lead Soldering	
Lead Temperature, Soldering (10 sec)	300°C
IR Reflow, Peak Temperature (<20 sec)	220°C
(Pb-Free) Soldering	
Reflow, Peak Temperature	260(+0/-5)°C
Time at Peak Temperature	20 sec to 40 sec
ESD	4 kV

<sup>1</sup> The device is fully specified at a  $\pm 5\text{ V}$  dual supply and at 5 V and 3.3 V single supplies. It is possible to operate the ADG633 with unbalanced supplies or at other voltage supplies ( $\pm 2\text{ V}$  to  $\pm 6\text{ V}$ , and 2 V to 12 V); however, the switch characteristics change. These changes include, but are not limited to: analog signal range, on resistance, leakage,  $V_{INL}$ ,  $V_{INH}$ , and switching times. The optimal power-up sequence for the device is: ground,  $V_{DD}$ ,  $V_{SS}$ , and then the digital inputs, before applying the analog input signal.

<sup>2</sup> Overvoltages at AX, EN, S, or D are clamped by internal diodes. Limit current to the maximum ratings given.

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

Only one absolute maximum rating can be applied at any one time.

### ESD CAUTION



**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

# PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

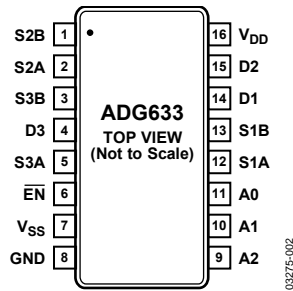
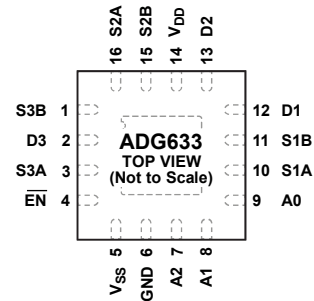


Figure 2. 16-Lead TSSOP Pin Configuration



NOTES  
 1. THE EXPOSED PADDLE CAN BE LEFT FLOATING OR BE TIED TO V<sub>DD</sub>, V<sub>SS</sub>, OR GND.

Figure 3. 16-Lead LFCSP Pin Configuration

Table 5. Pin Function Descriptions

Pin No.		Mnemonic	Description
TSSOP	LFCSP		
1	15	S2B	Source Terminal of Multiplexer 2. Can be an input or output.
2	16	S2A	Source Terminal of Multiplexer 2. Can be an input or output.
3	1	S3B	Source Terminal of Multiplexer 3. Can be an input or output.
4	2	D3	Drain Terminal of Multiplexer 3. Can be an input or output.
5	3	S3A	Source Terminal of Multiplexer 3. Can be an input or output.
6	4	EN	Digital Control Input. Disables all multiplexers when set high.
7	5	V <sub>SS</sub>	Most Negative Power Supply Terminal. Tie this pin to GND when using the device with single-supply voltages.
8	6	GND	Ground (0 V) Reference.
9	7	A2	Digital Control Input.
10	8	A1	Digital Control Input.
11	9	A0	Digital Control Input.
12	10	S1A	Source Terminal of Multiplexer 1. Can be an input or output.
13	11	S1B	Source Terminal of Multiplexer 1. Can be an input or output.
14	12	D1	Drain Terminal of Multiplexer 1. Can be an input or output.
15	13	D2	Drain Terminal of Multiplexer 2. Can be an input or output.
16	14	V <sub>DD</sub>	Most Positive Power Supply Terminal.
Not applicable	EP	EP	Exposed Paddle. The exposed paddle can be left floating or be tied to V <sub>DD</sub> , V <sub>SS</sub> , or GND.

Table 6. ADG633 Truth Table

A2	A1	A0	EN	Switch Condition					
				Switch S1A/D1	Switch S1B/D1	Switch S2A/D2	Switch S2B/D2	Switch S3A/D3	Switch S3B/D3
X <sup>1</sup>	X <sup>1</sup>	X <sup>1</sup>	1	Off	Off	Off	Off	Off	Off
0	0	0	0	On	Off	On	Off	On	Off
0	0	1	0	Off	On	On	Off	On	Off
0	1	0	0	On	Off	Off	On	On	Off
0	1	1	0	Off	On	Off	On	On	Off
1	0	0	0	On	Off	On	Off	Off	On
1	0	1	0	Off	On	On	Off	Off	On
1	1	0	0	On	Off	Off	On	Off	On
1	1	1	0	Off	On	Off	On	Off	On

<sup>1</sup> X means the logic state does not matter; it can be either 0 or 1.

TYPICAL PERFORMANCE CHARACTERISTICS

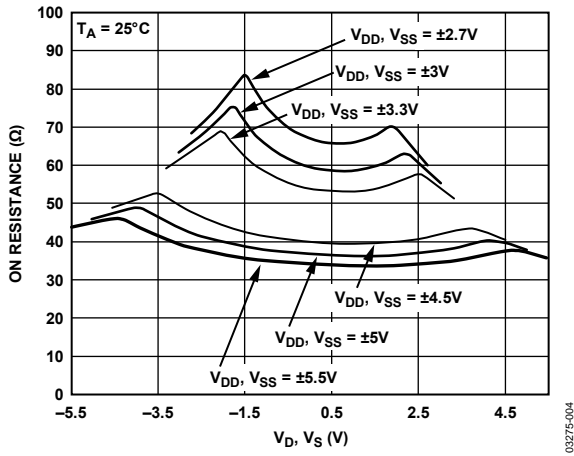


Figure 4. On Resistance vs.  $V_D (V_S)$ , Dual Supplies

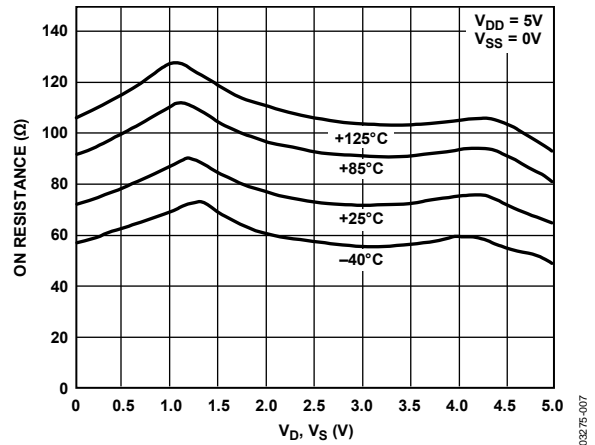


Figure 7. On Resistance vs.  $V_D (V_S)$  for Various Temperatures, Single Supply

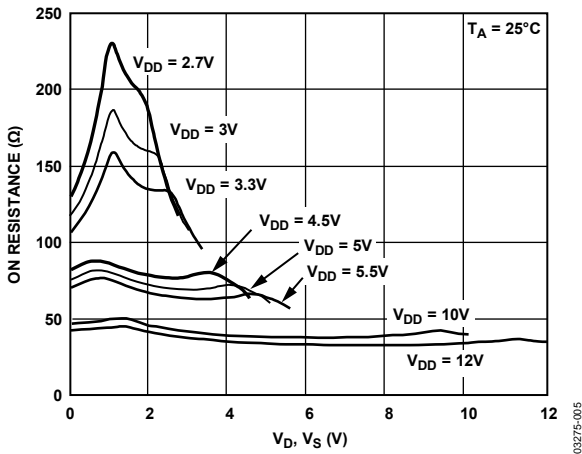


Figure 5. On Resistance vs.  $V_D (V_S)$ , Single Supply

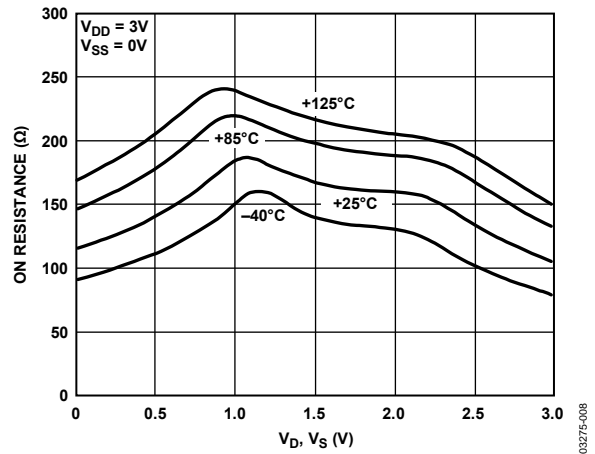


Figure 8. On Resistance vs.  $V_D (V_S)$  for Various Temperatures, Single Supply

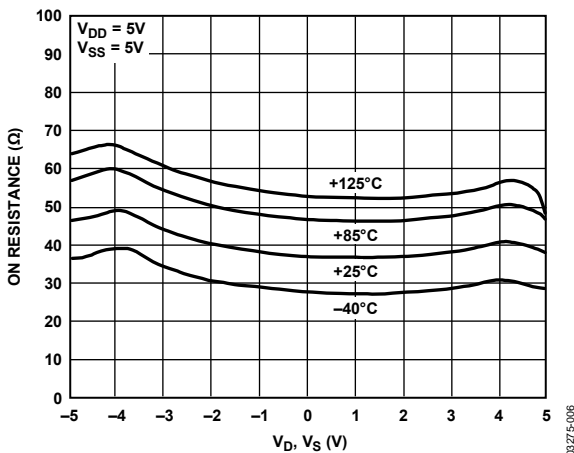


Figure 6. On Resistance vs.  $V_D (V_S)$  for Various Temperatures, Dual Supplies

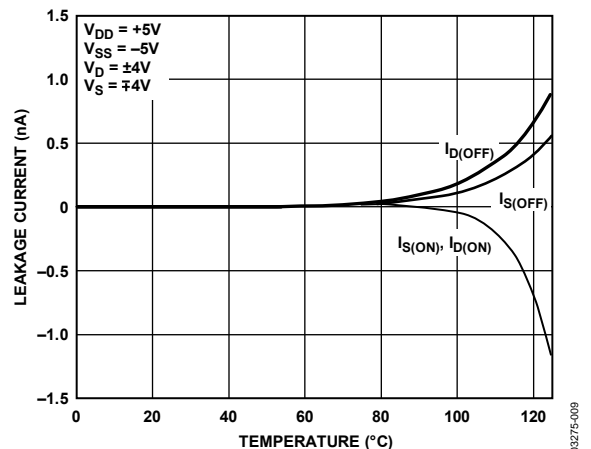


Figure 9. Leakage Current vs. Temperature, Dual Supplies



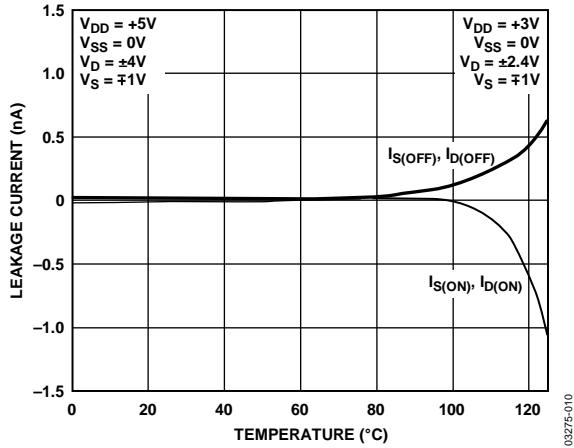


Figure 10. Leakage Current vs. Temperature, Single Supply

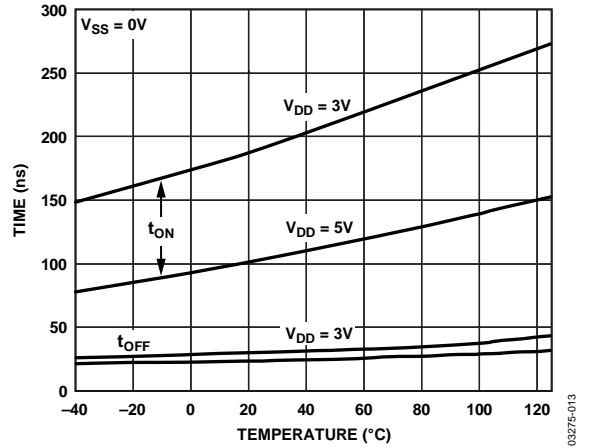


Figure 13.  $t_{ON}/t_{OFF}$  Times vs. Temperature, Single Supply

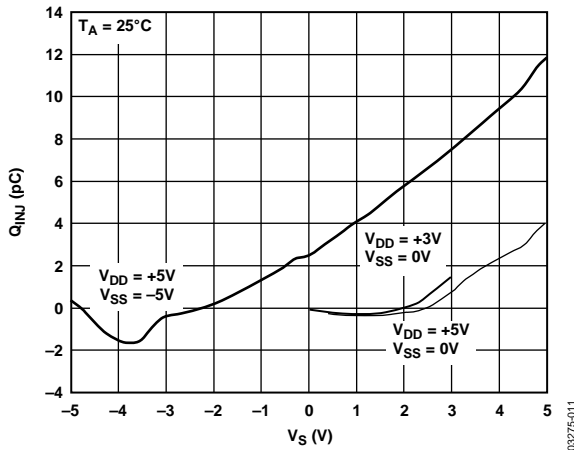


Figure 11. Charge Injection vs. Source Voltage

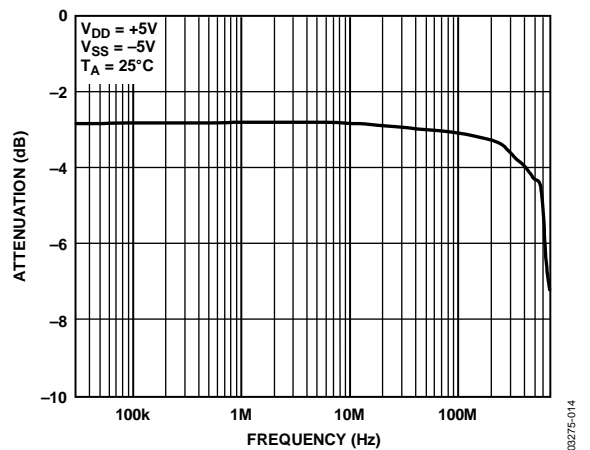


Figure 14. On Response vs. Frequency

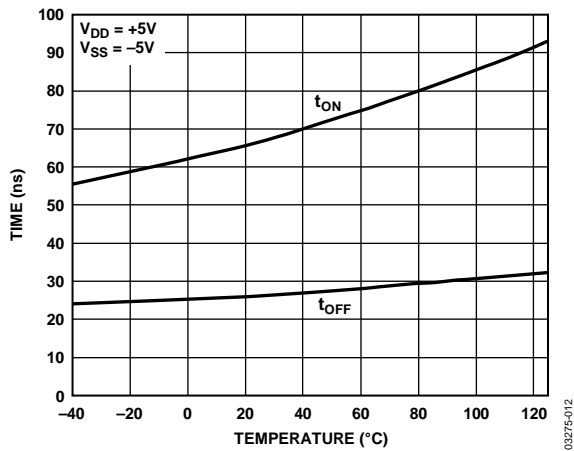


Figure 12.  $t_{ON}/t_{OFF}$  Times vs. Temperature, Dual Supplies

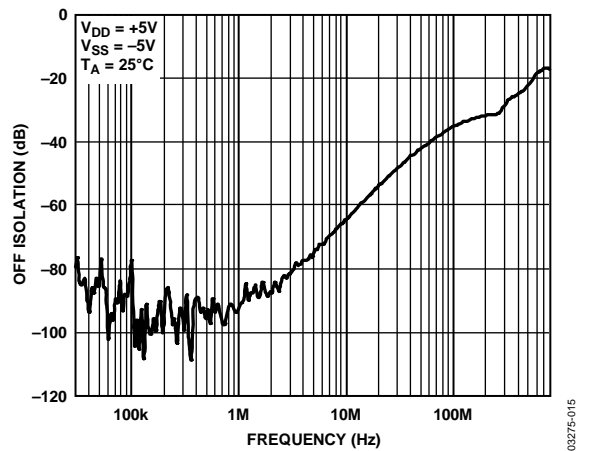


Figure 15. Off Isolation vs. Frequency

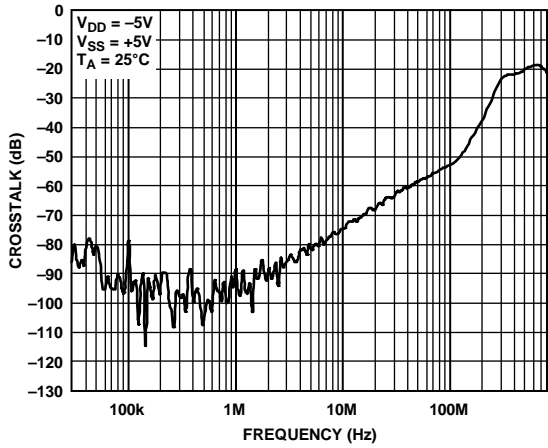


Figure 16. Crosstalk vs. Frequency

03275-016

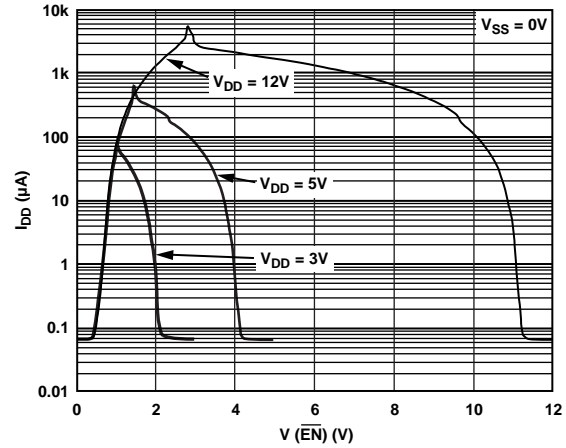


Figure 18.  $V_{DD}$  Current vs. Logic Level

03275-018

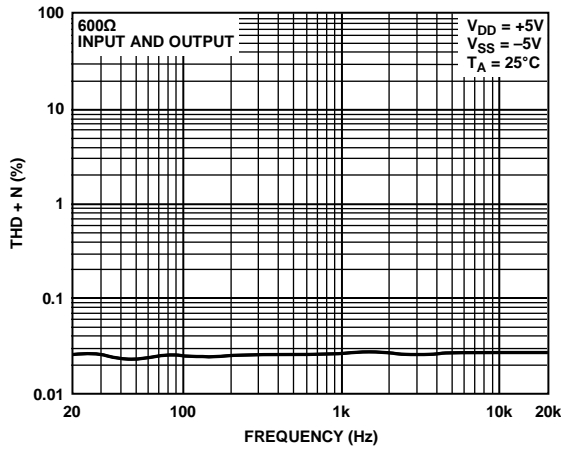


Figure 17. THD + Noise vs. Frequency

03275-017

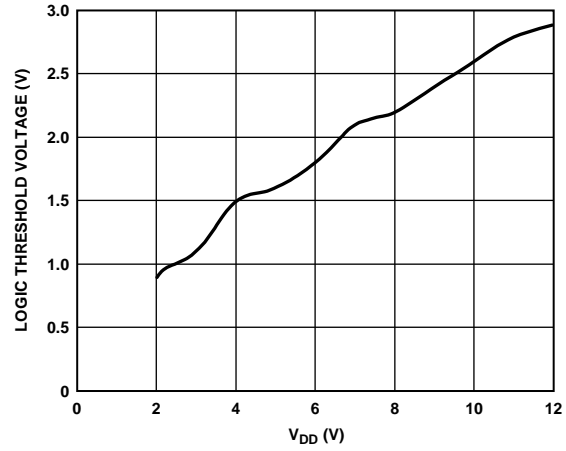


Figure 19. Logic Threshold Voltage vs.  $V_{DD}$

03275-019

## TERMINOLOGY

$V_{DD}$

Most positive power supply potential.

$V_{SS}$

Most negative power supply potential.

$I_{DD}$

Positive supply current.

$I_{SS}$

Negative supply current.

**GND**

Ground (0 V) reference.

**S**

Source terminal. Can be an input or output.

**D**

Drain terminal. Can be an input or output.

$A_x$

Logic control input.

$\overline{EN}$

Active low digital input. When  $\overline{EN}$  is high, the device is disabled and all switches are off. When  $\overline{EN}$  is low, the  $A_x$  logic inputs determine the on switches.

$V_D, V_S$

Analog voltage on Terminal D and Terminal S.

$R_{ON}$

Ohmic resistance between Terminal D and Terminal S.

$\Delta R_{ON}$

On-resistance match between any two channels, that is,  $R_{ONMAX} - R_{ONMIN}$ .

$R_{FLAT(ON)}$

Flatness is defined as the difference between the maximum and minimum value of on resistance as measured over the specified analog signal range.

$I_{S(OFF)}$

Source leakage current with the switch off.

$I_{D(OFF)}$

Drain leakage current with the switch off.

$I_{D(ON)}, I_{S(ON)}$

Channel leakage current with the switch on.

$V_{INL}$

Maximum input voltage for Logic 0.

$V_{INH}$

Minimum input voltage for Logic 1.

$I_{INL}, I_{INH}$

Input current of the digital input.

$C_{S(OFF)}$

Off switch source capacitance. Measured with reference to ground.

$C_{D(OFF)}$

Off switch drain capacitance. Measured with reference to ground.

$C_{D(ON)}, C_{S(ON)}$

On switch capacitance. Measured with reference to ground.

$C_{IN}$

Digital input capacitance.

$t_{ON}(\overline{EN})$

Delay between applying the digital control input and the output switching on (see Figure 26).

$t_{OFF}(\overline{EN})$

Delay between applying the digital control input and the output switching off (see Figure 26).

$t_{BBM}$

On time, measured between 80% points of both switches when switching from one address state to another.

### Charge Injection

A measure of the glitch impulse transferred from the digital input to the analog output during switching.

### Off Isolation

A measure of unwanted signal coupling through an off switch.

### Crosstalk

A measure of unwanted signal that is coupled through from one channel to another as a result of parasitic capacitance.

### Bandwidth

The frequency at which the output is attenuated by 3 dB.

### On Response

The frequency response of the on switch.

### Insertion Loss

The loss due to the on resistance of the switch.

TEST CIRCUITS

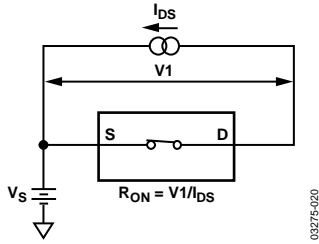


Figure 20. On Resistance

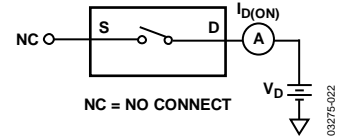


Figure 22. Drain Off Leakage

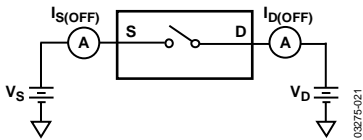


Figure 21. Source Off Leakage

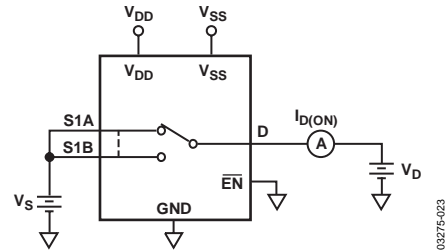


Figure 23. Channel On Leakage

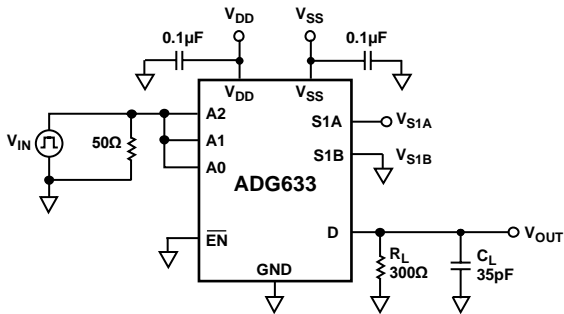
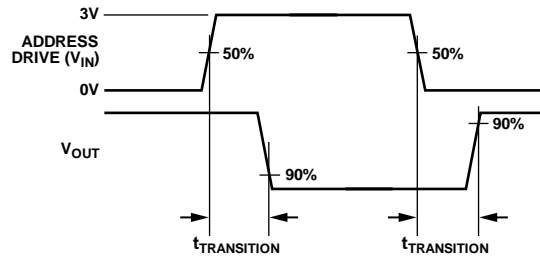


Figure 24. Transition Time,  $t_{TRANSITION}$



03275-024

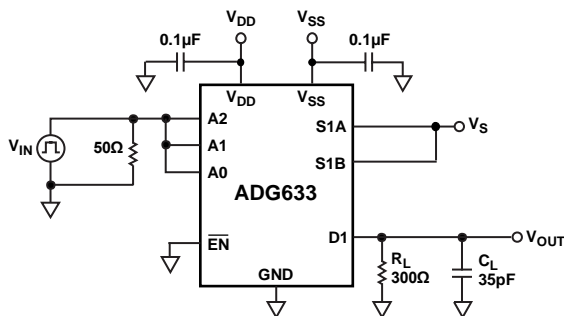
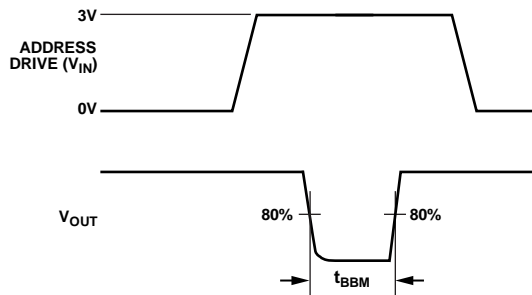


Figure 25. Break-Before-Make Delay,  $t_{BBM}$



03275-025

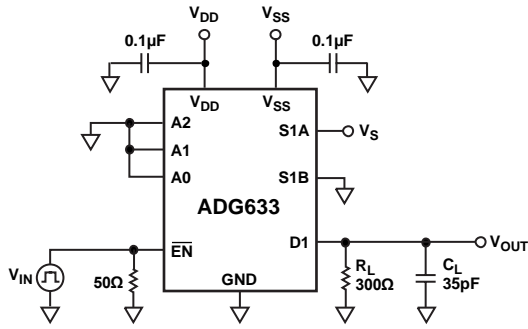
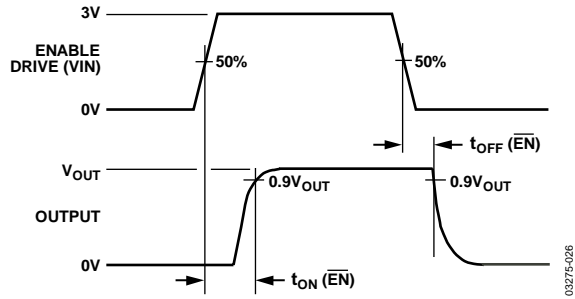


Figure 26. Enable Delay,  $t_{ON}(\overline{EN})$ ,  $t_{OFF}(\overline{EN})$



03275-026

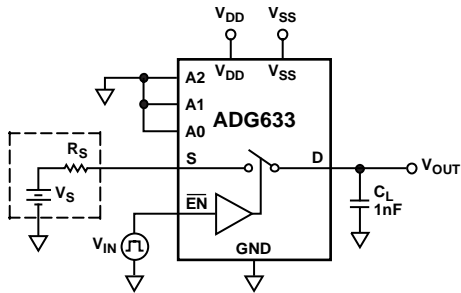
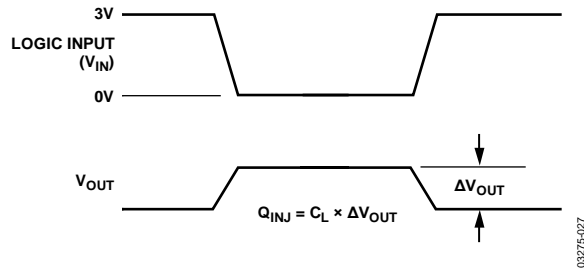


Figure 27. Charge Injection



03275-027

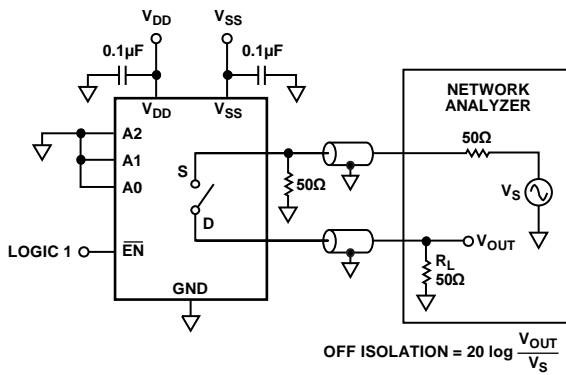


Figure 28. Off Isolation

$$\text{OFF ISOLATION} = 20 \log \frac{V_{OUT}}{V_S}$$

03275-028

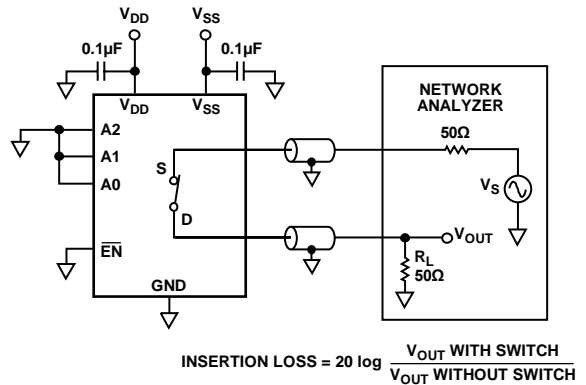


Figure 29. Bandwidth

$$\text{INSERTION LOSS} = 20 \log \frac{V_{OUT} \text{ WITH SWITCH}}{V_{OUT} \text{ WITHOUT SWITCH}}$$

03275-029

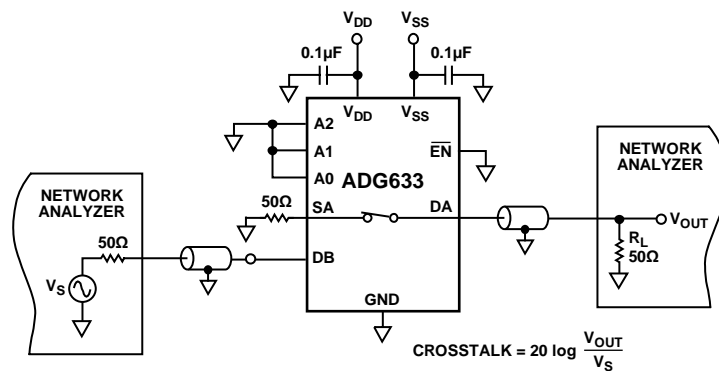
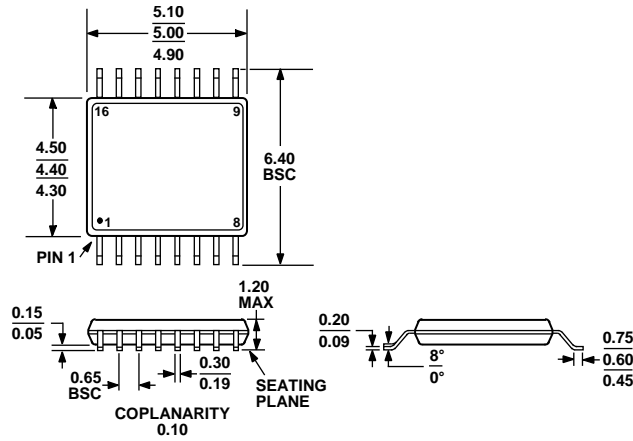


Figure 30. Channel-to-Channel Crosstalk

$$\text{CROSSTALK} = 20 \log \frac{V_{OUT}}{V_S}$$

03275-030

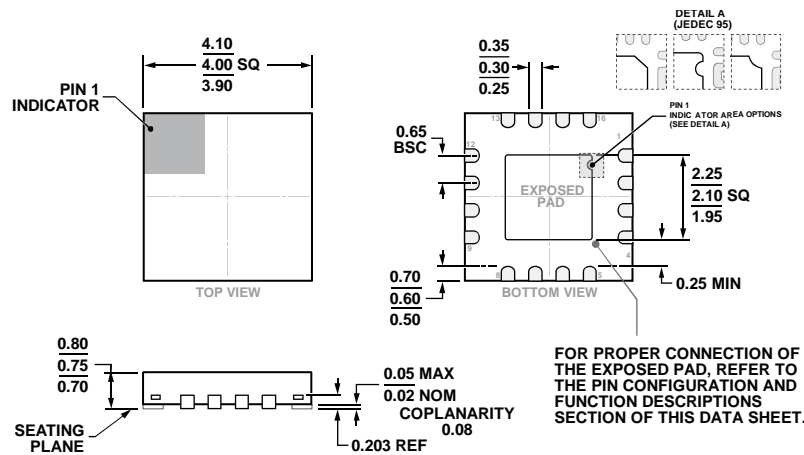
OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AB

Figure 31. 16-Lead Thin Shrink Small Outline Package [TSSOP] (RU-16)

Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-220-WGGC.

Figure 32. 16-Lead Frame Chip Scale Package [LF CSP]

4 mm x 4 mm Body and 0.75 mm Package Height (CP-16-23)

Dimensions shown in millimeters

ORDERING GUIDE

Model <sup>1</sup>	Temperature Range	Package Description	Package Option
ADG633YRU	-40°C to +125°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	RU-16
ADG633YRU-REEL7	-40°C to +125°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	RU-16
ADG633YRUZ	-40°C to +125°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	RU-16
ADG633YRUZ-REEL7	-40°C to +125°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	RU-16
ADG633YCPZ	-40°C to +85°C	16-Lead Lead Frame Chip Scale Package [LF CSP]	CP-16-23
ADG633YCPZ-REEL7	-40°C to +85°C	16-Lead Lead Frame Chip Scale Package [LF CSP]	CP-16-23

<sup>1</sup> Z = RoHS Compliant Part.

**NOTES**

**NOTES**



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