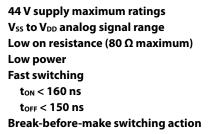


LC²MOS 8-/16-Channel High Performance Analog Multiplexers

ADG406/ADG407/ADG426

FEATURES

FUNCTIONAL BLOCK DIAGRAMS

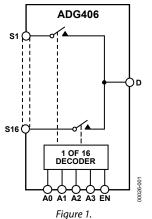


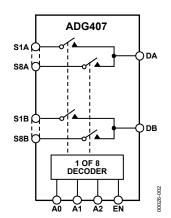
APPLICATIONS

Audio and video routing Automatic test equipment Data acquisition systems Battery powered systems Sample hold systems Communication systems Avionics

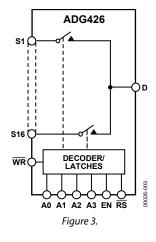
PRODUCT HIGHLIGHTS

- 1. Extended Signal Range.
- The ADG406/ADG407/ADG426 are fabricated on an enhanced LC²MOS process giving an increased signal range which extends to the supply rails.
- 3. Low Power Dissipation.
- 4. Low R_{on}.
- 5. Single/Dual Supply Operation.
- 6. Single Supply Operation.
- For applications where the analog signal is unipolar, the ADG406/ADG407/ADG426 can be operated from a single rail power supply. The parts are fully specified with a single +12 V power supply and remain functional with single supplies as low as +5 V.









Rev. B

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 One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.

 Tel: 781.329.4700
 www.analog.com

 Fax: 781.461.3113
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REVISION HISTORY

5/10—Rev. A to Rev. B	
Changes to Ordering Guide	20

6/09—Rev. 0 to Rev. A

Updated Format	Universal
Removed T Grade	Universal
Added Table 4	9
Added Table 6	
Added Table 8	
Updated Outline Dimensions	
Changes to Ordering Guide	

4/94—Revision 0: Initial Version

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GENERAL DESCRIPTION

The ADG406, ADG407, and ADG426 are monolithic CMOS analog multiplexers. The ADG406 and ADG426 switch one of sixteen inputs to a common output as determined by the 4-bit binary address lines: A0, A1, A2, and A3. The ADG426 has on-chip address and control latches that facilitate microprocessor interfacing. The ADG407 switches one of eight differential inputs to a common differential output as determined by the 3-bit binary address lines A0, A1 and A2. An EN input on all devices is used to enable or disable the device. When disabled, all channels are switched off. The ADG406/ADG407/ADG426 are designed on an enhanced LC²MOS process that provides low power dissipation yet gives high switching speed and low on resistance. These features make the parts suitable for high speed data acquisition systems and audio signal switching. Low power dissipation makes the parts suitable for battery powered systems. Each channel conducts equally well in both directions when on and has an input signal range which extends to the supplies. In the off condition, signal levels up to the supplies are blocked. All channels exhibit breakbefore-make switching action preventing momentary shorting when switching channels. Inherent in the design is low charge injection for minimum transients when switching the digital inputs.

SPECIFICATIONS

DUAL SUPPLY

 V_{DD} = +15 V \pm 10%, V_{SS} = –15 V \pm 10%, GND = 0 V, unless otherwise noted.

Table 1.

Parameter ¹	+25°C	–40°C to +85°C	Unit	Test Conditions/Comments
ANALOG SWITCH				
Analog Signal Range		Vss to VDD	V	
Ron	50		Ωtyp	$V_D = \pm 10 \text{ V}, \text{ I}_S = -1 \text{ mA}$
	80	125	Ωmax	$V_{DD} = +13.5 \text{ V}, V_{SS} = -13.5 \text{ V}$
Ron Match	4		Ωtyp	$V_D = 0 V$, $I_S = -1 mA$
LEAKAGE CURRENTS				$V_{DD} = +16.5 V, V_{SS} = -16.5 V$
Source Off Leakage I _s (Off)	±0.5	±20	nA max	$V_D = \pm 10 \text{ V}, V_S = \mp 10 \text{ V}$, see Figure 26
Drain Off Leakage I _D (Off)				$V_D = \pm 10 \text{ V}, V_S = \mp 10 \text{ V};$ see Figure 27
ADG406, ADG426	±1	±20	nA max	
ADG407	±1	±20	nA max	
Channel On Leakage I _D , I _S (On)				$V_S = V_D = \pm 10 V$; see Figure 28
ADG406, ADG426	±1	±20	nA max	
ADG407	±1	±20	nA max	
DIGITAL INPUTS				
Input High Voltage, V _{INH}		2.4	V min	
Input Low Voltage, V _{INL}		0.8	V max	
Input Current				
IINL OF IINH		±1	µA max	$V_{IN} = 0 \text{ or } V_{DD}$
C _{IN} , Digital Input Capacitance	8		pF typ	f = 1 MHz
DYNAMIC CHARACTERISTICS ²				
transition	120		ns typ	$R_L = 300 \Omega$, $C_L = 35 pF$; $V_1 = \pm 10 V$, $V_2 = \mp 10 V$; see Figure 29
	150	250	ns max	
Break Before Make Delay, topen	10	10	ns min	R_L = 300 $\Omega,$ C_L = 35 pF; V_S = +5 V, see Figure 30
ton (EN, WR)	120	175	ns typ	$R_L = 300 \Omega$, $C_L = 35 pF$; $V_S = 5 V$, see Figure 31
	160	225	ns max	······································
t_{OFF} (EN, \overline{RS})	110	130	ns typ	$R_L = 300 \Omega$, $C_L = 35 pF$; $V_S = 5 V$, see Figure 31
	150	180	ns max	
ADG426 Only	150	100	ins max	
t _w , Write Pulse Width		100	ns min	
ts, Address, Enable Setup Time		100	ns min	
t_{H} , Address, Enable Hold Time		10	ns min	
t _{RS} , Reset Pulse Width		100	ns min	$V_s = +5 V$
Charge Injection	8		pC typ	$V_{s} = 0 V, R_{s} = 0 \Omega, C_{L} = 1 nF;$
			F - 7F	See Figure 34
Off Isolation	-75		dB typ	$R_{L} = 1 \text{ k} \Omega, f = 100 \text{ kHz};$
				$V_{EN} = 0 V$, see Figure 35
Channel-to-Channel Crosstalk	85		dB typ	$R_L = 1 \text{ k} \Omega$, f = 100 kHz, see Figure 36
Cs (Off)	5		pF typ	f=1 MHz
C _D (Off)				f = 1 MHz
ADG406, ADG426	50		pF typ	
ADG407	25		pF typ	
C _D , C _s (On)				f = 1 MHz
ADG406, ADG426	60		pF typ	
ADG407	40		pF typ	

Parameter ¹	+25°C	–40°C to +85°C	Unit	Test Conditions/Comments
POWER REQUIREMENTS				$V_{DD} = +16.5 \text{ V}, V_{SS} = -16.5 \text{ V}$
l _{DD}		1	μA typ	$V_{IN} = 0 V, V_{EN} = 0 V$
		5	μA max	
lss		1	μA typ	
		5	μA max	
ldd	100		μA typ	$V_{IN} = 0 V, V_{EN} = 2.4 V$
	200	500	µA max	
lss		1	μA typ	
		5	µA max	

 $^{\rm 1}$ Temperature ranges is –40°C to +85°C. $^{\rm 2}$ Guaranteed by design, not subject to production test.

SINGLE SUPPLY

 V_{DD} = +12 V \pm 10%, V_{SS} = 0 V, GND = 0 V, unless otherwise noted.

Table 2.

ments
1 mA;
V/8 V; see Figure 26
V/8 V; see Figure 27
Figure 28
$V_1 = 8 V/0 V, V_2 = 0 V/8 V$; see Figure 29
$V_s = 5 V$, see Figure 30
1
V _s = 5 V, see Figure 31
1 nF; see Figure 34
see Figure 35
see Figure 36

 1 Temperature range is –40°C to +85°C. 2 Guaranteed by design, not subject to production test.

ADG426 TIMING DIAGRAMS

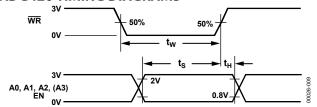


Figure 4. Timing Sequence for Latching the Switch Address and Enable Inputs

Figure 4 shows the timing sequence for latching the switch address and enable inputs. The latches are level sensitive; therefore, while \overline{WR} is held low, the latches are transparent and the switches respond to the address and enable inputs. This input data is latched on the rising edge of \overline{WR} .

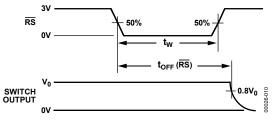


Figure 5. Reset Pulse Width and Reset Turn Off Time

Figure 5 shows the reset pulse width, t_{rs} , and the reset turn off time, t_{OFF} (\overline{RS}).

Note that all digital input signals rise and fall times are measured from 10% to 90% of 3 V; $t_R = t_F = 20$ ns.

ABSOLUTE MAXIMUM RATINGS

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

Table 3.

Parameter	Rating
V _{DD} to V _{SS}	44 V
V _{DD} to GND	–0.3 V to +25 V
Vss to GND	+0.3 V to -25 V
Analog, Digital Inputs ¹	$V_{SS} - 2 V$ to $V_{DD} + 2 V$ or 20 mA, whichever occurs first
Continuous Current, S or D	20 mA
Peak Current, S or D	40 mA
	(Pulsed at 1 ms, 10% duty cycle max)
Operating Temperature Range	
Industrial (B Version)	–40°C to +85°C
Storage Temperature Range	–65°C to +150°C
Junction Temperature	150°C
Plastic Package	
θ_{JA} , Thermal Impedance	75°C/W
Lead Temperature, Soldering (10 sec)	260°C
PLCC Package	
θ_{JA} , Thermal Impedance	80°C/W
Lead Temperature, Soldering	
Vapor Phase (60 sec)	215°C
Infrared (15 sec)	220°C
SSOP Package	
θ _{JA} , Thermal Impedance	122°C/W
Lead Temperature, Soldering	
Vapor Phase (60 sec)	215°C
Infrared (15 sec)	220°C

 1 Overvoltages at A, S, D, \overline{WR} , or \overline{RS} will be clamped by internal diodes. Current should be limited to the maximum ratings given.

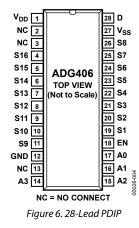
Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute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

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



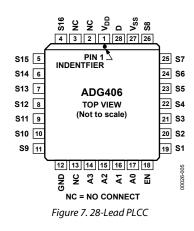


Table 4. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	V _{DD}	Most Positive Power Supply Potential.
2, 3, 13	NC	No Connect.
4 to 11	S16 to S9	Source Terminal 16 to Source Terminal 9. These pins can be inputs or outputs.
12	GND	Ground (0 V) Reference.
14 to 17	A3 to A0	Logic Control Input.
18	EN	Active High Digital Input. When this pin is low, the device is disabled and all switches are turned off. When this pin is high, the Ax logic inputs determine which switch is turned on.
19 to 26	S1 to 8	Source Terminal 1 to Source Terminal 8. These pins can be inputs or outputs.
27	Vss	Most Negative Power Supply Potential. In single-supply applications, this pin can be connected to ground.
28	D	Drain Terminal. This pin can be an input or an output.

Table 5. Truth Table (ADG406)

A3	A2	A1	A0	EN	On Switch	
Х	Х	Х	Х	0	None	
0	0	0	0	1	1	
0	0	0	1	1	2	
0	0	1	0	1	3	
0	0	1	1	1	4	
0	1	0	0	1	5	
0	1	0	1	1	6	
0	1	1	0	1	7	
0	1	1	1	1	8	
1	0	0	0	1	9	
1	0	0	1	1	10	
1	0	1	0	1	11	
1	0	1	1	1	12	
1	1	0	0	1	13	
1	1	0	1	1	14	
1	1	1	0	1	15	
1	1	1	1	1	16	

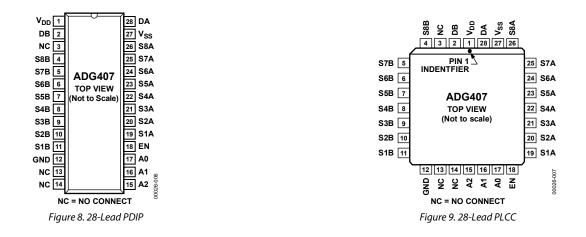


Table 6. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	V _{DD}	Most Positive Power Supply Potential.
2	DB	Drain Terminal B. This pin can be an input or an output.
3, 13, 14	NC	No Connect.
4 to 11	S8B to S1B	Source Terminal 8B to Source Terminal 1B. These pins can be inputs or outputs.
12	GND	Ground (0 V) Reference.
15 to 17	A2 to A0	Logic Control Input.
18	EN	Active High Digital Input. When this pin is low, the device is disabled and all switches are turned off. When this pin is high, the Ax logic inputs determine which switch is turned on.
19 to 26	S1A to S8A	Source Terminal 1A to Source Terminal 8A. These pins can be inputs or outputs.
27	V _{ss}	Most Negative Power Supply Potential. In single-supply applications, this pin can be connected to ground.
28	DA	Drain Terminal A. This pin can be an input or an output.

A2	A1	AO	EN	On Switch Pair	
Х	Х	Х	0	None	
0	0	0	1	1	
0	0	1	1	2	
0	1	0	1	3	
0	1	1	1	4	
1	0	0	1	5	
1	0	1	1	6	
1	1	0	1	7	
1	1	1	1	8	

Table 7. Truth Table (ADG407)

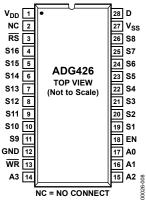


Figure 10. 28-Lead PDIP/SSOP

Table 8.	Pin	Function	Descriptions
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Pin No.	Mnemonic	Description				
1	V _{DD}	Most Positive Power Supply Potential.				
2	NC	No Connect.				
3	RS	Active Low Logic Input. When this pin is low, all switches are open, and address and enable latches registers are cleared to 0.				
4 to 11	S16 to S9	Source Terminal 16 to Source Terminal 9. These pins can be inputs or outputs.				
12	GND	Ground (0 V) Reference.				
13	WR	The rising edge of the $\overline{ ext{WR}}$ signal latches the state of the address control lines and the enable line.				
14 to 17	A3 to A0	Logic Control Input.				
18	EN	Active High Digital Input. When this pin is low, the device is disabled and all switches are turned off. When this pin is high, the Ax logic inputs determine which switch is turned on.				
19 to 26	S1 to S8	Source Terminal 1 to Source Terminal 8. These pins can be inputs or outputs.				
27	Vss	Most Negative Power Supply Potential. In single-supply applications, this pin can be connected to ground.				
28	D	Drain Terminal. This pin can be an input or an output.				

Table 9. Truth Table (ADG426)

A3	A2	A1	A0	EN	WR	RS	On switch
Х	Х	Х	Х	Х	Ţ	1	Retains previous switch condition
Х	Х	Х	х	Х	Х	0	None (address and enable latches cleared)
Х	Х	Х	Х	0	0	1	None
0	0	0	0	1	0	1	1
0	0	0	1	1	0	1	2
0	0	1	0	1	0	1	3
0	0	1	1	1	0	1	4
0	1	0	0	1	0	1	5
0	1	0	1	1	0	1	6
0	1	1	0	1	0	1	7
0	1	1	1	1	0	1	8
1	0	0	0	1	0	1	9
1	0	0	1	1	0	1	10
1	0	1	0	1	0	1	11
1	0	1	1	1	0	1	12
1	1	0	0	1	0	1	13
1	1	0	1	1	0	1	14
1	1	1	0	1	0	1	15
1	1	1	1	1	0	1	16

TYPICAL PERFORMANCE CHARACTERISTICS

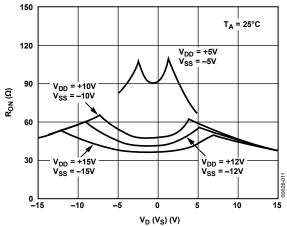


Figure 11. R_{ON} as a Function of V_D (V_S): Dual Supplies

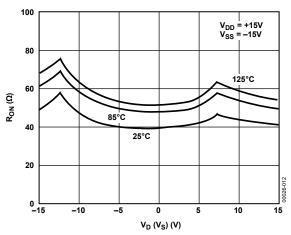


Figure 12. R_{ON} as a Function of V_D (V_S) for Different Temperatures

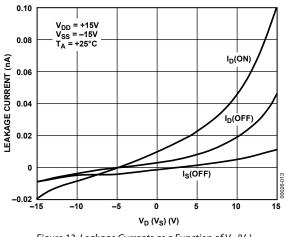


Figure 13. Leakage Currents as a Function of V_D (V_S)

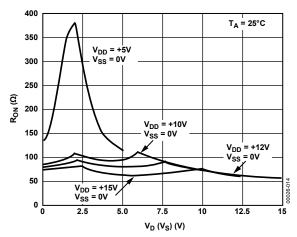
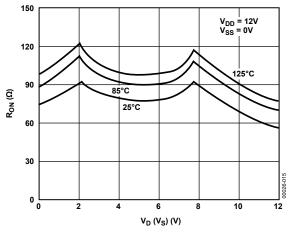


Figure 14. Ron as a Function of VD (Vs): Single Supplies



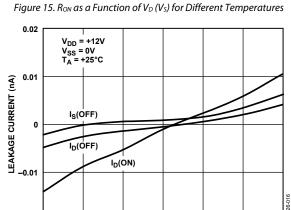


Figure 16. Leakage Currents as a Function of V_D (V_S)

6

 $V_D (V_S) (V)$

8

10

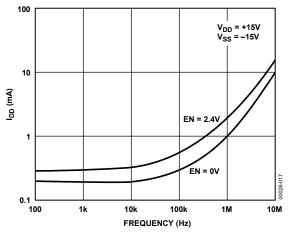
12

4

-0.02

0

2





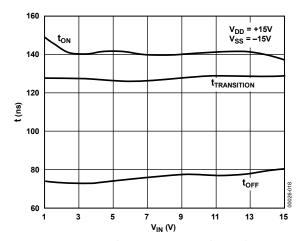
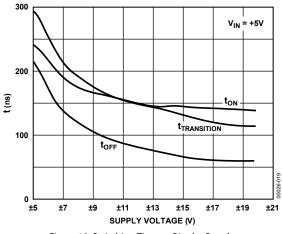


Figure 18. Switching Time vs. V_{IN} (Bipolar Supply)





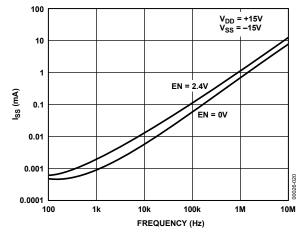


Figure 20. Negative Supply Current vs. Switching Frequency

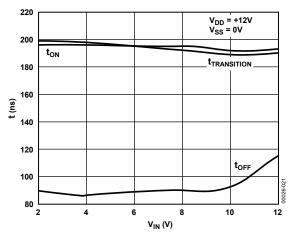


Figure 21. Switching Time vs. V_{IN} (Single Supply)

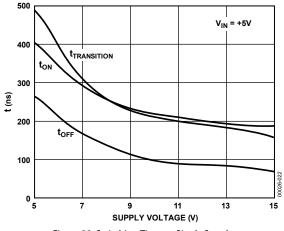
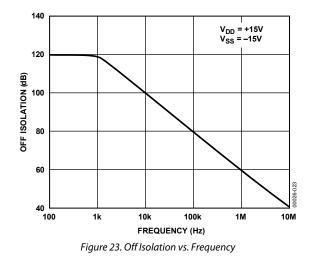
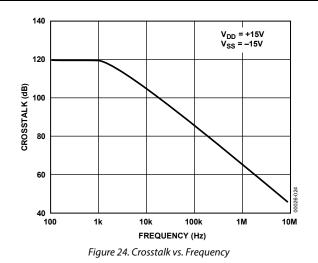
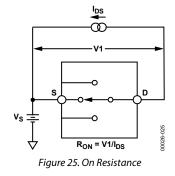


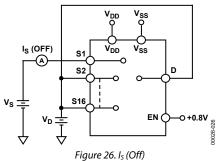
Figure 22. Switching Time vs. Single Supply

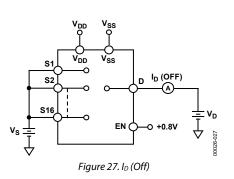


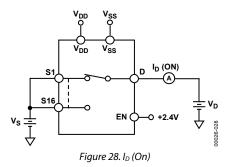


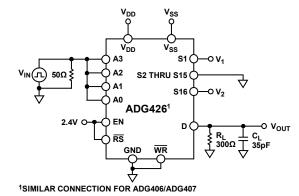
TEST CIRCUITS











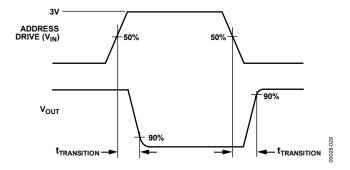


Figure 29. Switching Time of Multiplexer, t_{TRANSITION}

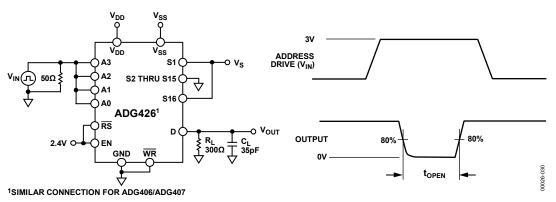
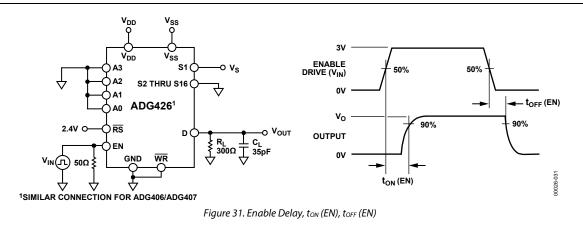


Figure 30. Break-Before-Make Delay, tOPEN



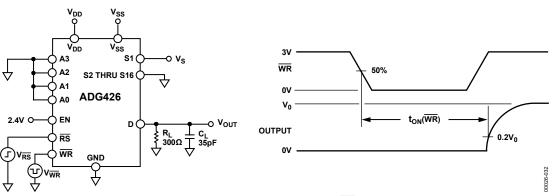


Figure 32. Write Turn-On Time, ton (WR)

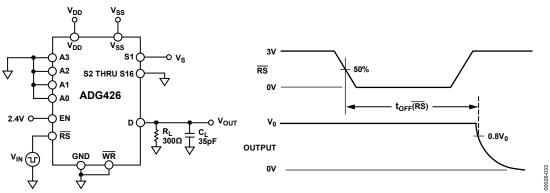
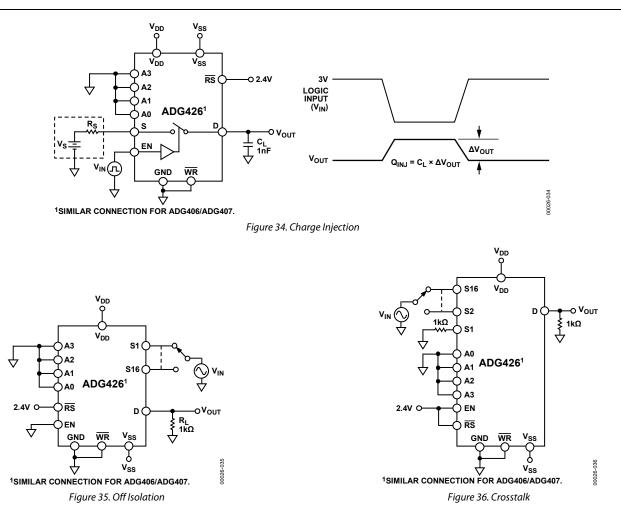


Figure 33. Reset Turn-Off Time, t_{OFF} (\overline{RS})



TERMINOLOGY

VDD

Most positive power supply potential.

Vss

Most negative power supply potential in dual supplies. In single supply applications, it may be connected to ground.

GND Ground (0 V) reference.

R_{ON} Ohmic resistance between the D and S terminals.

R_{ON} Match

Difference between the R_{ON} of any two channels.

Is (Off) Source leakage current when the switch is off.

 $I_{\rm D}$ (Off) Drain leakage current when the switch is off.

 $I_{\rm D},\,I_{\rm S}\left(On\right)$ Channel leakage current when the switch is on.

V_D (V_s) Analog voltage on Terminal D, Terminal S.

Cs (Off) Channel input capacitance for off condition.

C_D (Off) Channel output capacitance for off condition.

C_D, C_s (ON) On switch capacitance.

C_{IN} Digital input capacitance.

ton (EN)

Delay time between the 50% and 90% points of the digital input and switch on condition.

toff (EN)

Delay time between the 50% and 90% points of the digital input and switch off condition.

tTRANSITION

Delay time between the 50% and 90% points of the digital inputs and the switch on condition when switching from one address state to another.

topen

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

 \mathbf{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.

Crosstalk

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

Off Isolation A measure of unwanted signal coupling through an off channel.

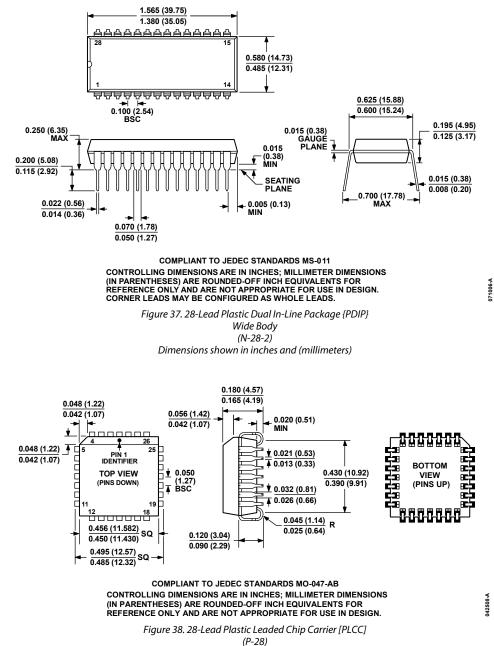
Charge Injection A measure of the glitch impulse transferred from the digital input to the analog output during switching.

IDD Positive supply current.

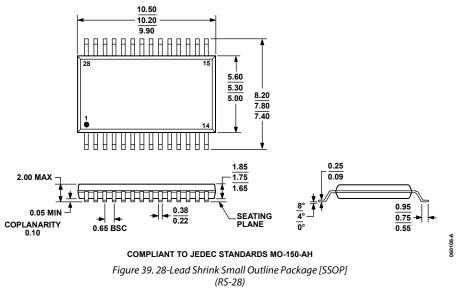
Iss

Negative supply current.

OUTLINE DIMENSIONS



Dimensions shown in inches and (millimeters)



Dimensions shown in millimeters

ORDERING GUIDE

Model ¹	Temperature Range	Package Description	Package Option ²
ADG406BN	-40°C to +85°C	28-Lead PDIP	N-28-2
ADG406BNZ	-40°C to +85°C	28-Lead PDIP	N-28-2
ADG406BP	–40°C to +85°C	28-Lead PLCC	P-28
ADG406BP-REEL	–40°C to +85°C	28-Lead PLCC	P-28
ADG406BPZ	-40°C to +85°C	28-Lead PLCC	P-28
ADG406BPZ-REEL	–40°C to +85°C	28-Lead PLCC	P-28
ADG407BN	-40°C to +85°C	28-Lead PDIP	N-28-2
ADG407BNZ	–40°C to +85°C	28-Lead PDIP	N-28-2
ADG407BP	-40°C to +85°C	28-Lead PLCC	P-28
ADG407BP-REEL	–40°C to +85°C	28-Lead PLCC	P-28
ADG407BPZ	-40°C to +85°C	28-Lead PLCC	P-28
ADG407BPZ-RL	–40°C to +85°C	28-Lead PLCC	P-28
ADG407BCHIPS	–40°C to +85°C		DIE
ADG426BN	-40°C to +85°C	28-Lead PDIP	N-28-2
ADG426BNZ	-40°C to +85°C	28-Lead PDIP	N-28-2
ADG426BRS	–40°C to +85°C	28-Lead SSOP	RS-28
ADG426BRS-REEL	–40°C to +85°C	28-Lead SSOP	RS-28
ADG426BRS-REEL7	–40°C to +85°C	28-Lead SSOP	RS-28
ADG426BRSZ	–40°C to +85°C	28-Lead SSOP	RS-28
ADG426BRSZ-REEL	–40°C to +85°C	28-Lead SSOP	RS-28

 1 Z = RoHS Compliant Part.

² N = Plastic DIP, P = Plastic Leaded Chip Carrier (PLCC), RS = Shrink Small Outline Package (SSOP).

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