

0.5 Ω CMOS, 1.65 V TO 3.6 V, Dual SPDT/2:1 MUX

Data Sheet ADG836

FEATURES

0.5 Ω typical on resistance 0.8 Ω maximum on resistance at 125°C 1.65 V to 3.6 V operation Automotive temperature range: -40°C to +125°C High current carrying capability: 300 mA continuous Rail-to-rail switching operation Fast-switching times <20 ns Typical power consumption (<0.1 μ W)

APPLICATIONS

Cellular phones
PDAs
MP3 players
Power routing
Battery-powered systems
PCMCIA cards
Modems
Audio and video signal routing
Communication systems

GENERAL DESCRIPTION

The ADG836 is a low voltage complementary metal-oxide semiconductor (CMOS) device containing two independently selectable single-pole, double-throw (SPDT) switches. This device offers an ultralow on resistance of less than 0.8 Ω over the full temperature range. The ADG836 is fully specified for 3.3 V, 2.5 V, and 1.8 V supply operation.

Each switch conducts equally well in both directions when on, and has an input signal range that extends to the supplies. The ADG836 exhibits break-before-make switching action.

The ADG836 is available in a 10-lead MSOP and in a 3 mm \times 3 mm 12-lead LFCSP.

FUNCTIONAL BLOCK DIAGRAM

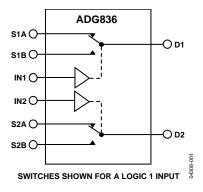


Figure 1.

PRODUCT HIGHLIGHTS

- 1. $< 0.8 \Omega$ over full temperature range of -40° C to $+125^{\circ}$ C.
- 2. Single 1.65 V to 3.6 V operation.
- 3. Compatible with 1.8 V CMOS logic.
- 4. High current handling capability (300 mA continuous current at 3.3 V).
- 5. Low total harmonic distortion plus noise (THD + N) (0.02% typical).
- 6. $3 \text{ mm} \times 3 \text{ mm}$ LFCSP and 10-lead MSOP.

ADG836* PRODUCT PAGE QUICK LINKS

Last Content Update: 06/30/2017

COMPARABLE PARTS -

View a parametric search of comparable parts.

EVALUATION KITS

 Evaluation Board for 10-Lead MSOP Devices in the Switches and Multiplexers Portfolio

DOCUMENTATION

Data Sheet

- ADG836: 0.5 Ω CMOS, 1.65 V TO 3.6 V, Dual SPDT/2:1 MUX Data Sheet

User Guides

 UG-1037: Evaluation Board for 10-Lead MSOP Devices in the Switches and Multiplexers Portfolio

REFERENCE MATERIALS -

Product Selection Guide

• Switches and Multiplexers Product Selection Guide

Technical Articles

- CMOS Switches Offer High Performance in Low Power, Wideband Applications
- Data-acquisition system uses fault protection
- Enhanced Multiplexing for MEMS Optical Cross Connects
- Temperature monitor measures three thermal zones

DESIGN RESOURCES 🖵

- · ADG836 Material Declaration
- PCN-PDN Information
- · Quality And Reliability
- Symbols and Footprints

DISCUSSIONS 🖳

View all ADG836 EngineerZone Discussions.

SAMPLE AND BUY 🖳

Visit the product page to see pricing options.

TECHNICAL SUPPORT

Submit a technical question or find your regional support number.

DOCUMENT FEEDBACK 🖳

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6/2016—Rev. A to Rev. B
6/2016—Rev. A to Rev. B Changed CP-12-1 to CP-12-4 Throughout
6/2016—Rev. A to Rev. B Changed CP-12-1 to CP-12-4 Throughout Changes to Figure 3 and Table 6
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SPECIFICATIONS

 V_{DD} = 2.7 V to 3.6 V, GND = 0 V, unless otherwise noted. The temperature range for the Y version is -40° C to $+125^{\circ}$ C.

Table 1.

Parameter	+25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
ANALOG SWITCH					
Analog Signal Range			0 V to V _{DD}	٧	
On Resistance (R _{ON})	0.5			Ωtyp	$V_{DD} = 2.7 \text{ V, } V_S = 0 \text{ V to } V_{DD}, I_S = 100 \text{ mA};$ Figure 19
	0.65	0.75	0.8	Ω max	
On-Resistance Match Between	0.04			Ωtyp	$V_{DD} = 2.7 \text{ V}, V_S = 0.65 \text{ V}, I_S = 100 \text{ mA}$
Channels (ΔR _{ON})		0.075	0.08	Ω max	
On-Resistance Flatness (R _{FLAT (ON)})	0.1			Ωtyp	$V_{DD} = 2.7 \text{ V, } V_S = 0 \text{ V to } V_{DD}$
		0.15	0.16	Ω max	$I_S = 100 \text{ mA}$
LEAKAGE CURRENTS					$V_{DD} = 3.6 \text{ V}$
Source Off Leakage I _s (OFF)	±0.2			nA typ	$V_S = 0.6 \text{ V}/3.3 \text{ V}, V_D = 3.3 \text{ V}/0.6 \text{ V};$ Figure 20
Channel On Leakage ID, Is (ON)	±0.2			nA typ	$V_S = V_D = 0.6 \text{ V or } 3.3 \text{ V; Figure } 21$
DIGITAL INPUTS					
Input High Voltage, V _{INH}			2	V min	
Input Low Voltage, V _{INL}			0.8	V max	
Input Current					
lint or linh	0.005			μA typ	$V_{IN} = V_{INL}$ or V_{INH}
			±0.1	μA max	
C _{IN} , Digital Input Capacitance	4			pF typ	
DYNAMIC CHARACTERISTICS ¹					
ton	21			ns typ	$R_L = 50 \Omega$, $C_L = 35 pF$
	26	28	29	ns max	V _s = 1.5 V/0 V; Figure 22
toff	4			ns typ	$R_L = 50 \Omega$, $C_L = 35 pF$
	7	8	9	ns max	V _s = 1.5 V; Figure 22
Break-Before-Make Time Delay (t _{BBM})	17			ns typ	$R_L = 50 \Omega$, $C_L = 35 pF$
			5	ns min	$V_{S1} = V_{S2} = 1.5 \text{ V}$; Figure 23
Charge Injection	40			pC typ	$V_S = 1.5 \text{ V, } R_S = 0 \Omega, C_L = 1 \text{ nF; Figure 24}$
Off Isolation	-67			dB typ	$R_L = 50 \Omega$, $C_L = 5 pF$, $f = 100 kHz$; Figure 25
Channel-to-Channel Crosstalk	-90			dB typ	S1A to S2A/S1B to S2B, $R_L = 50 \Omega$, $C_L = 5 pF$, $f = 100 kHz$; Figure 28
	-67			dB typ	S1A to S1B/S2A to S2B, $R_L = 50 \Omega$, $C_L = 5 pF$, $f = 100 kHz$; Figure 27
Total Harmonic Distortion Plus Noise (THD + N)	0.02			%	$R_L = 32 \Omega$, $f = 20 Hz$ to 20 kHz, $V_S = 2 V p-p$
Insertion Loss	-0.05			dB typ	$R_L = 50 \Omega$, $C_L = 5 pF$; Figure 26
–3 dB Bandwidth	57			MHz typ	$R_L = 50 \Omega$, $C_L = 5 pF$; Figure 26
C _s (OFF)	25			pF typ	
C_D, C_S (ON)	75			pF typ	
POWER REQUIREMENTS				1	V _{DD} = 3.6 V
IDD	0.003			μA typ	Digital inputs = 0 V or 3.6 V
		1	4	μA max	

 $^{^{\}rm 1}$ Guaranteed by design, not subject to production test.

 V_{DD} = 2.5 V \pm 0.2 V, GND = 0 V, unless otherwise noted. The temperature range for the Y version is -40° C to $+125^{\circ}$ C.

Table 2.

Parameter	+25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
ANALOG SWITCH					
Analog Signal Range			$0V$ to V_{DD}	V	
On Resistance (RoN)	0.65			Ω typ	$V_{DD} = 2.3 \text{ V}, V_S = 0 \text{ V to } V_{DD}, I_S = 100 \text{ mA}; Figure 19$
	0.72	0.8	0.88	Ω max	
On-Resistance Match Between	0.04			Ω typ	$V_{DD} = 2.3 \text{ V}, V_S = 0.7 \text{ V}, I_S = 100 \text{ mA}$
Channels (ΔR _{ON})		0.08	0.085	Ω max	
On-Resistance Flatness (R _{FLAT (ON)})	0.16			Ω typ	$V_{DD} = 2.3 \text{ V}, V_S = 0 \text{ V to } V_{DD}, I_S = 100 \text{ mA}$
		0.23	0.24	Ω max	
LEAKAGE CURRENTS					$V_{DD} = 2.7 \text{ V}$
Source Off Leakage I _s (OFF)	±0.2			nA typ	$V_S = 0.6 \text{ V}/2.4 \text{ V}, V_D = 2.4 \text{ V}/0.6 \text{ V}$; Figure 20
Channel On Leakage ID, Is (ON)	±0.2			nA typ	$V_S = V_D = 0.6 \text{ V or } 2.4 \text{ V}$; Figure 21
DIGITAL INPUTS					
Input High Voltage, VINH			1.7	V min	
Input Low Voltage, V _{INL}			0.7	V max	
Input Current					
linl or linh	0.005			μA typ	$V_{IN} = V_{INL}$ or V_{INH}
			±0.1	μA max	
C _{IN} , Digital Input Capacitance	4			pF typ	
DYNAMIC CHARACTERISTICS ¹					
ton	23			ns typ	$R_L = 50 \Omega$, $C_L = 35 pF$
	29	30	31	ns max	$V_5 = 1.5 \text{ V/0 V}$; Figure 22
t _{OFF}	5			ns typ	$R_L = 50 \Omega$, $C_L = 35 pF$
	7	8	9	ns max	$V_{S} = 1.5 \text{ V}$; Figure 22
Break-before-Make Time Delay (t _{BBM})	17			ns typ	$R_L = 50 \Omega$, $C_L = 35 pF$
			5	ns min	$V_{51} = V_{52} = 1.5 \text{ V}$; Figure 23
Charge Injection	30			pC typ	$V_S = 1.25 \text{ V}$, $R_S = 0 \Omega$, $C_L = 1 \text{ nF}$; Figure 24
Off Isolation	-67			dB typ	$R_L = 50 \Omega$, $C_L = 5 pF$, $f = 100 kHz$; Figure 25
Channel-to-Channel Crosstalk	-90			dB typ	S1A to S2A/S1B to S2B, $R_L = 50~\Omega$, $C_L = 5~pF$,
					f = 100 kHz; Figure 28
	-67			dB typ	S1A to S1B/S2A to S2B, $R_L = 50 \Omega$, $C_L = 5 pF$, $f = 100 kHz$; Figure 27
Total Harmonic Distortion Plus Noise (THD + N)	0.022			%	$R_L = 32 \Omega$, $f = 20 \text{ Hz}$ to 20 kHz , $V_S = 1.5 \text{ V p-p}$
Insertion Loss	-0.06			dB typ	$R_L = 50 \Omega$, $C_L = 5 pF$; Figure 26
–3 dB Bandwidth	57			MHz typ	$R_L = 50 \Omega$, $C_L = 5 pF$; Figure 26
C _s (OFF)	25			pF typ	· -
C _D , C _s (ON)	75			pF typ	
POWER REQUIREMENTS					$V_{DD} = 2.7 \text{ V}$
I_{DD}	0.003			μA typ	Digital inputs = 0 V or 2.7 V
		1	4	μA max	

 $^{^{\}mbox{\tiny 1}}$ Guaranteed by design, not subject to production test.

 V_{DD} = 1.65 V \pm 1.95 V, GND = 0 V, unless otherwise noted. The temperature range for the Y version is -40° C to $+125^{\circ}$ C.

Table 3.

Parameter	+25°C	-40°C to +85°C	-40°C to +125°C	Unit	Test Conditions/Comments
ANALOG SWITCH					
Analog Signal Range			0 V to V _{DD}	V	
On Resistance (R _{ON})	1			Ωtyp	$V_{DD} = 1.8 \text{ V}, V_S = 0 \text{ V to } V_{DD}, I_S = 100 \text{ mA};$ Figure 19
	1.4	2.2	2.2	Ω max	
	2	4	4	Ω max	$V_{DD} = 1.65 \text{ V}, V_S = 0 \text{ V to } V_{DD}, I_S = 100 \text{ mA};$ Figure 19
On-Resistance Match Between Channels (ΔR_{ON})	0.1			Ωtyp	$V_{DD} = 1.65 \text{ V}, V_S = 0.7 \text{ V}, I_S = 100 \text{ mA}$
LEAKAGE CURRENTS					V _{DD} = 1.95 V
Source Off Leakage Is (OFF)	±0.2			nA typ	$V_S = 0.6 \text{ V}/1.65 \text{ V}, V_D = 1.65 \text{ V}/0.6 \text{ V};$ Figure 20
Channel On Leakage ID, IS (ON)	±0.2			nA typ	$V_S = V_D = 0.6 \text{ V or } 1.65 \text{ V; Figure } 21$
DIGITAL INPUTS					
Input High Voltage, V _{INH}			0.65 V _{DD}	V min	
Input Low Voltage, V _{INL}			0.35 V _{DD}	V max	
Input Current					
linl or linh	0.005			μA typ	$V_{IN} = V_{INL} \text{ or } V_{INH}$
			±0.1	μA max	
C _{IN} , Digital Input Capacitance	4			pF typ	
DYNAMIC CHARACTERISTICS ¹					
t _{ON}	28			ns typ	$R_L = 50 \Omega, C_L = 35 pF$
	37	38	39	ns max	V _s = 1.5 V/0 V; Figure 22
t _{OFF}	7			ns typ	$R_L = 50 \Omega, C_L = 35 pF$
	9	10	11	ns max	V _s = 1.5 V; Figure 22
Break-Before-Make Time Delay (t _{BBM})	21			ns typ	$R_L = 50 \Omega, C_L = 35 pF$
			5	ns min	$V_{S1} = V_{S2} = 1 \text{ V}$; Figure 23
Charge Injection	20			pC typ	$V_S = 1 \text{ V, } R_S = 0 \text{ V, } C_L = 1 \text{ nF; Figure 24}$
Off Isolation	-67			dB typ	$R_L = 50 \Omega$, $C_L = 5 pF$, $f = 100 kHz$; Figure 25
Channel-to-Channel Crosstalk	-90			dB typ	S1A to S2A/S1B to S2B; $R_L = 50 \Omega$, $C_L = 5 \text{ pF}$, $f = 100 \text{ kHz}$; Figure 28
	-67			dB typ	S1A to S1B/S2A to S2B; $R_L = 50 \Omega$, $C_L = 5 pF$, $f = 100 kHz$; Figure 27
Total Harmonic Distortion (THD)	0.14			%	$R_L = 32 \Omega$, $f = 20 \text{ Hz to } 20 \text{ kHz}$, $V_S = 1.2 \text{ V p-p}$
Insertion Loss	-0.08			dB typ	$R_L = 50 \Omega$, $C_L = 5 pF$; Figure 26
–3 dB Bandwidth	57			MHz typ	$R_L = 50 \Omega$, $C_L = 5 pF$; Figure 26
C _s (OFF)	25			pF typ	
C _D , C _s (ON)	75			pF typ	
POWER REQUIREMENTS					V _{DD} = 1.95 V
IDD	0.003			μA typ	Digital inputs = 0 V or 1.95 V
		1.0	4	μA max	,

 $^{^{\}mbox{\tiny 1}}$ Guaranteed by design, not subject to production test.

ABSOLUTE MAXIMUM RATINGS

 $T_A = 25$ °C, unless otherwise noted.

Table 4.

Table 4.			
Parameter	Rating		
V _{DD} to GND	-0.3 V to +4.6 V		
Analog Inputs ¹	$-0.3 \text{ V to V}_{DD} + 0.3 \text{ V}$		
Digital Inputs ¹	−0.3 V to 4.6 V or 10 mA, whichever occurs first		
Peak Current, S or D			
3.3 V Operation	500 mA		
2.5 V Operation	460 mA		
1.8 V Operation	420 mA (pulsed at 1ms, 10% duty cycle max)		
Continuous Current, S or D			
3.3 V Operation	300 mA		
2.5 V Operation	275 mA		
1.8 V Operation	250 mA		
Operating Temperature Range			
Automotive (Y Version)	-40°C to +125°C		
Storage Temperature Range	−65°C to +150°C		
Junction Temperature	150°C		
Thermal Impedance			
MSOP			
Θ_{JA}	206°C/W		
θ_{JC}	44°C/W		
LFCSP			
θ_{JA} (3-Layer Board)	61.1°C/W		
IR Reflow, Peak Temperature <20 sec	235°C		

 $^{^{\}rm 1}$ Overvoltages at IN, S, or D are clamped by internal diodes. Current should be limited 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 may be applied at any one time.

Table 5. Truth Table

Logic	Switch A	Switch B
0	Off	On
1	On	Off

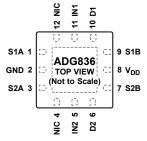
ESD CAUTION



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





- 1. NIC = NO INTERNAL CONNECTION.
 2. IT IS RECOMMENDED THAT THE EXPOSED PAD BE THERMALLY CONNECTED TO A COPPER PLANE FOR ENHANCED THERMAL PERFORMANCE. THE EXPOSED PAD SHOULD BE GROUNDED AS WELL.

Figure 2. 10-Lead MSOP Pin Configuration (RM-10)

Figure 3. 12-Lead LFCSP Pin Configuration (CP-12-4)

Table 6. Pin Function Descriptions

Pin No).			
MSOP	LFCSP	Mnemonic	Description	
1, 5	11,5	IN1, IN2	Logic Control Inputs.	
2, 4, 7, 9	1, 3, 7, 9	S1A, S2A, S2B, S1B	Source Terminals. Can be inputs or outputs.	
3	2	GND	Ground (0 V) Reference.	
6, 10	6, 10	D2, D1	Drain Terminals. Can be inputs or outputs.	
8	8	V _{DD}	Most Positive Power Supply Potential.	
Not applicable	4, 12	NIC	No Internal Connection.	
Not applicable	0	EPAD	Exposed Pad. It is recommended that the exposed pad be thermally connected to a copper plane for enhanced thermal performance. The exposed pad should be grounded as well.	

TYPICAL PERFORMANCE CHARACTERISTICS

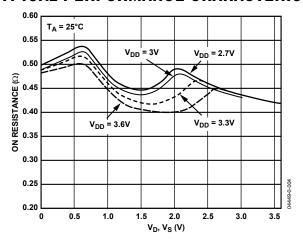


Figure 4. On Resistance vs. V_D (V_S), $V_{DD} = 2.7 \text{ V to } 3.6 \text{ V}$

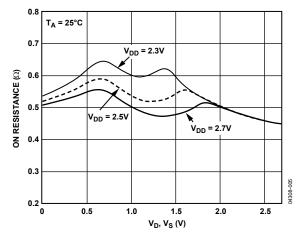


Figure 5. On Resistance vs. V_D (V_S), $V_{DD} = 2.5 \text{ V to } 0.2 \text{ V}$

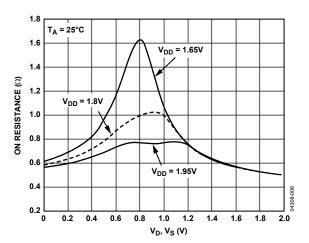


Figure 6. On Resistance vs. V_D (V_S), $V_{DD}=1.8\pm3.6$

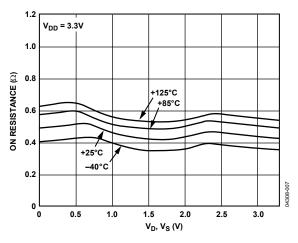


Figure 7. On Resistance vs. V_D (V_S) for Different Temperatures, 3.3 V

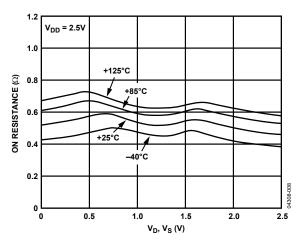


Figure 8. On Resistance vs. V_D (V_S) for Different Temperatures, 2.5 V

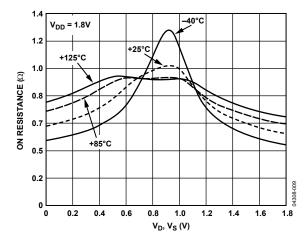


Figure 9. On Resistance vs. V_D (V_S) for Different Temperatures, 1.8 V

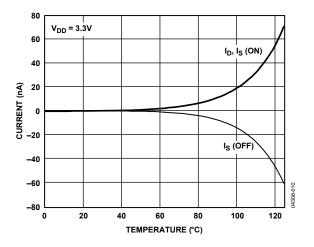


Figure 10. Leakage Current vs. Temperature, 3.3 V

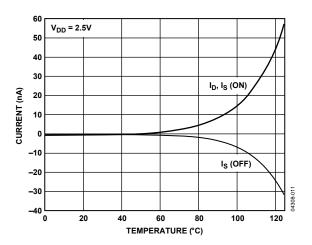


Figure 11. Leakage Current vs. Temperature, 2.5 V

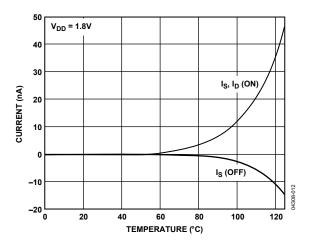


Figure 12. Leakage Current vs. Temperature, 1.8 V

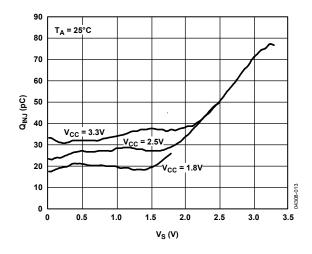


Figure 13. Charge Injection vs. Source Voltage

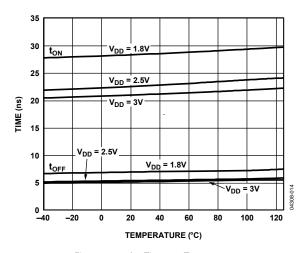


Figure 14. ton/toff Times vs. Temperature

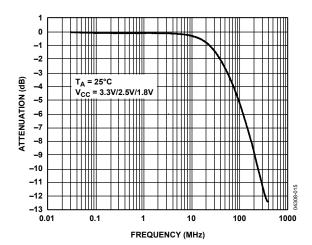


Figure 15. Bandwidth

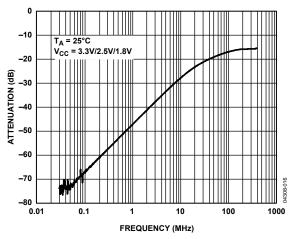


Figure 16. Off Isolation vs. Frequency

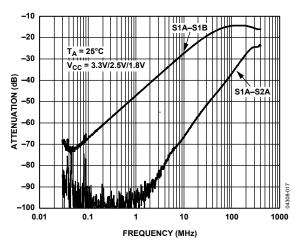


Figure 17. Crosstalk vs. Frequency

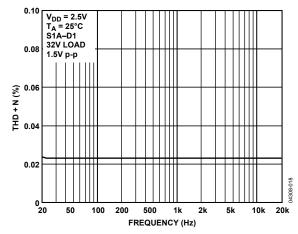
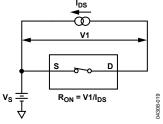
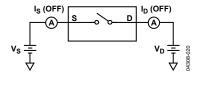


Figure 18. THD + N

TEST CIRCUITS





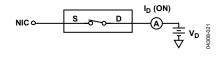


Figure 19. On Resistance

Figure 20. Off Leakage

Figure 21. On Leakage

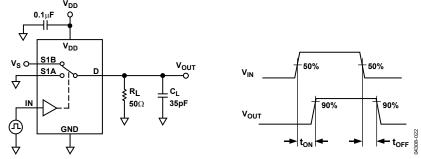


Figure 22. Switching Times, t_{ON}, t_{OFF}

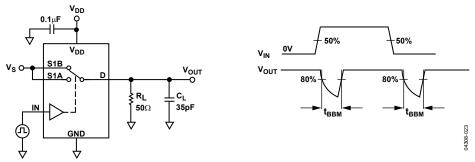


Figure 23. Break-Before-Make Time Delay, t_{BBM}

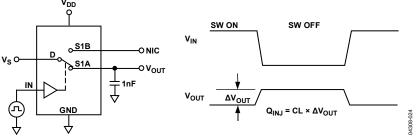


Figure 24. Charge Injection

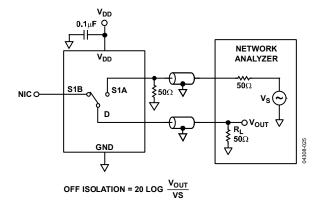


Figure 25. Off Isolation

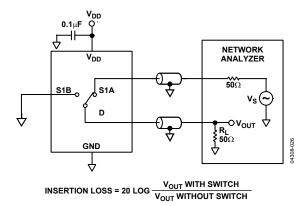


Figure 26. Bandwidth

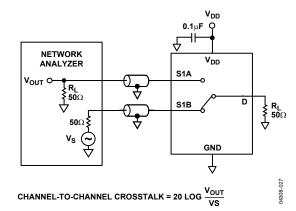


Figure 27. Channel-to-Channel Crosstalk (S1A to S1B)

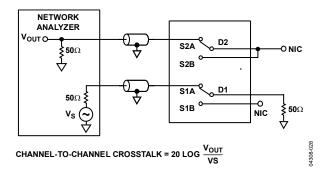


Figure 28. Channel-to-Channel Crosstalk (S1A to S2A)

TERMINOLOGY

 I_{DD}

Positive supply current.

 $V_D(V_S)$

Analog voltage on Terminal D and Terminal S.

Ron

Ohmic resistance between Terminal D and Terminal S.

RELAT (ON)

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

 ΔR_{ON}

On-resistance match between any two channels.

Is (OFF)

Source leakage current with the switch off.

I_D (OFF)

Drain leakage current with the switch off.

ID, Is (ON)

Channel leakage current with the switch on.

 V_{INL}

Maximum input voltage for Logic 0.

 $V_{\text{INH}} \\$

Minimum input voltage for Logic 1.

 $I_{INL}(I_{INH})$

Input current of the digital input.

Cs (OFF)

Off switch source capacitance. Measured with reference to ground.

C_D (OFF)

Off switch drain capacitance. Measured with reference to ground.

C_D, C_s (ON)

On switch capacitance. Measured with reference to ground.

CIN

Digital input capacitance.

ton

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

toff

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

 t_{BBM}

On or off time measured between the 80% points of both switches when switching from one to another.

Charge Injection

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

Off Isolation

A measure of unwanted signal coupling through an off switch.

Crosstalk

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

-3 dB 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.

Total Harmonic Distortion Plus Noise (THD + N)

The ratio of the harmonics amplitude plus the noise of a signal to the fundamental.

OUTLINE DIMENSIONS

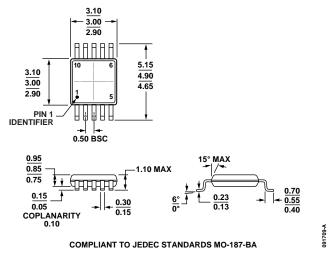


Figure 29. 10-Lead Mini Small Outline Package [MSOP] (RM-10) Dimensions shown in millimeters

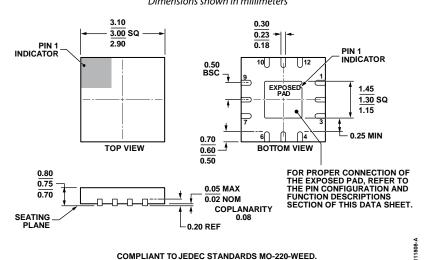


Figure 30. 12-Lead Lead Frame Chip Scale Package [LFCSP] 3 mm x 3 mm Body and 0.75 mm Package Height (CP-12-4) Dimensions shown in millimeters

ORDERING GUIDE

Model ¹	Temperature Range	Package Description	Package Option	Branding ²
ADG836YRM	−40°C to +125°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	S9A
ADG836YRMZ	-40°C to +125°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	S05
ADG836YRMZ-REEL	-40°C to +125°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	S05
ADG836YRMZ-REEL7	-40°C to +125°C	10-Lead Mini Small Outline Package [MSOP]	RM-10	S05
ADG836YCPZ-REEL7	−40°C to +125°C	12-Lead Lead Frame Chip Scale Package [LFCSP]	CP-12-4	S05

¹ Z = RoHS Compliant Part.

² Branding on this package is limited to three characters due to space constraints.

NOTES

NOTES

