## Data Sheet

## FEATURES

## $0.5 \Omega$ typical on resistance <br> $0.8 \Omega$ maximum on resistance at $125^{\circ} \mathrm{C}$

1.65 V to 3.6 V operation

Automotive temperature range: $-\mathbf{4 0 ^ { \circ }} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
High current carrying capability: $\mathbf{3 0 0} \mathbf{m A}$ continuous
Rail-to-rail switching operation
Fast-switching times <20 ns
Typical power consumption (<0.1 $\boldsymbol{\mu W}$ )

## 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 $0.8 \Omega$ over the full temperature range. The ADG836 is fully specified for $3.3 \mathrm{~V}, 2.5 \mathrm{~V}$, 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 $3 \mathrm{~mm} \times$ 3 mm 12-lead LFCSP.

FUNCTIONAL BLOCK DIAGRAM


Figure 1.

## PRODUCT HIGHLIGHTS

1. $<0.8 \Omega$ over full temperature range of $-40^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$.
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. $3 \mathrm{~mm} \times 3 \mathrm{~mm}$ LFCSP and 10 -lead MSOP.

Rev. C

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8/2003-Revision 0: Initial Version

## SPECIFICATIONS

$\mathrm{V}_{\mathrm{DD}}=2.7 \mathrm{~V}$ to $3.6 \mathrm{~V}, \mathrm{GND}=0 \mathrm{~V}$, unless otherwise noted. The temperature range for the Y version is $-40^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$.
Table 1.


[^0]
## ADG836

$\mathrm{V}_{\mathrm{DD}}=2.5 \mathrm{~V} \pm 0.2 \mathrm{~V}, \mathrm{GND}=0 \mathrm{~V}$, unless otherwise noted. The temperature range for the Y version is $-40^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$.
Table 2.


[^1]$\mathrm{V}_{\mathrm{DD}}=1.65 \mathrm{~V} \pm 1.95 \mathrm{~V}, \mathrm{GND}=0 \mathrm{~V}$, unless otherwise noted. The temperature range for the Y version is $-40^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$.
Table 3.


[^2]
## ABSOLUTE MAXIMUM RATINGS

$\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$, unless otherwise noted.
Table 4.

| Parameter | Rating |
| :--- | :--- |
| V $_{\text {DD }}$ to GND | -0.3 V to +4.6 V |
| Analog Inputs ${ }^{1}$ | -0.3 V to VDD +0.3 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 1 ms, |
| Continuous Current, S or D | $10 \%$ duty cycle max) |
| 3.3 V Operation | 300 mA |
| 2.5 V Operation | 275 mA |
| 1.8 V Operation | 250 mA |
| Operating Temperature Range |  |
| Automotive (Y Version) | $-40^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ |
| Storage Temperature Range | $-65^{\circ} \mathrm{C}$ to $+150^{\circ} \mathrm{C}$ |
| Junction Temperature | $150^{\circ} \mathrm{C}$ |
| Thermal Impedance |  |
| MSOP |  |
| $\theta_{\mathrm{JA}}$ | $206^{\circ} \mathrm{C} / \mathrm{W}$ |
| $\theta_{\mathrm{JC}}$ | $44^{\circ} \mathrm{C} / \mathrm{W}$ |
| LFCSP | $61.1^{\circ} \mathrm{C} / \mathrm{W}$ |
| $\theta_{\mathrm{JA}}$ (3-Layer Board) | $235^{\circ} \mathrm{C}$ |
| IR Reflow, Peak Temperature $<20 \mathrm{sec}$ |  |

${ }^{1}$ 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. <br> Charged devices and circuit boards can discharge <br> without detection. Although this product features <br> patented or proprietary protection circuitry, damage <br> may occur on devices subjected to high energy ESD. <br> Therefore, proper ESD precautions should be taken to <br> avoid performance degradation or loss of functionality. |
| :--- | :--- |

## PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

| IN1 1 | - | 10 D1 |
| :---: | :---: | :---: |
| S1A 2 | ADG836 | 9 S 1 B |
| GND 3 | TOP VIEW | $8 \mathrm{~V}_{\mathrm{DD}}$ |
| S2A 4 | (Not to Scale) | 7 S 2 B |
| IN2 5 |  | 6 D 2 |



NOTES

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.

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 | VDD | 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 <br> plane for enhanced thermal performance. The exposed pad should be grounded as well. |

## TYPICAL PERFORMANCE CHARACTERISTICS



Figure 4. On Resistance vs. $V_{D}\left(V_{S}\right), V_{D D}=2.7 \mathrm{~V}$ to 3.6 V


Figure 5. On Resistance vs. $V_{D}\left(V_{S}\right), V_{D D}=2.5 \mathrm{~V}$ to 0.2 V


Figure 6. On Resistance vs. $V_{D}\left(V_{S}\right), V_{D D}=1.8 \pm 3.6$


Figure 7. On Resistance vs. $V_{D}\left(V_{s}\right)$ for Different Temperatures, 3.3 V


Figure 8. On Resistance vs. $V_{D}\left(V_{s}\right)$ for Different Temperatures, 2.5 V


Figure 9. On Resistance vs. $V_{D}\left(V_{S}\right)$ 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. $t_{o n} / t_{\text {off }}$ Times vs. Temperature


Figure 15. Bandwidth


Figure 16. Off Isolation vs. Frequency


Figure 17. Crosstalk vs. Frequency


Figure 18. THD $+N$

## TEST CIRCUITS



Figure 22. Switching Times, ton, toff


Figure 23. Break-Before-Make Time Delay, $t_{\text {BB }}$


Figure 24. Charge Injection


OFF ISOLATION $=20$ LOG $\frac{\mathrm{V}_{\mathrm{OUT}}}{\mathrm{VS}}$

Figure 25. Off Isolation


INSERTION LOSS $=20$ LOG $\frac{v_{\text {OUT }} \text { WITH SWITCH }}{v_{\text {OUT WITHOUT SWITCH }}}$
Figure 26. Bandwidth


CHANNEL-TO-CHANNEL CROSSTALK $=20$ LOG $\frac{\mathrm{v}_{\text {OUT }}}{\mathrm{VS}}$

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


CHANNEL-TO-CHANNEL CROSSTALK $=20$ LOG $\frac{\mathrm{V}_{\text {OUT }}}{\mathrm{VS}}$

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

## TERMINOLOGY

## IdD

Positive supply current.

## $V_{D}$ (Vs)

Analog voltage on Terminal D and Terminal S.

## Ron

Ohmic resistance between Terminal D and Terminal S.
$\mathrm{R}_{\text {flat (on) }}$
Flatness is defined as the difference between the maximum and minimum value of on resistance as measured over the specified analog signal range.

## $\Delta \mathbf{R o N}_{\text {on }}$

On-resistance match between any two channels.

## $I_{s}$ (OFF)

Source leakage current with the switch off.
$\mathrm{I}_{\mathrm{D}}$ (OFF)
Drain leakage current with the switch off.
$\mathrm{I}_{\mathrm{D}}, \mathrm{I}_{\mathrm{s}}(\mathbf{O N})$
Channel leakage current with the switch on.
$V_{\text {INL }}$
Maximum input voltage for Logic 0 .
$V_{\text {INH }}$
Minimum input voltage for Logic 1.
$\mathbf{I}_{\text {INL }}\left(\mathbf{I}_{\text {INH }}\right)$
Input current of the digital input.
$\mathrm{C}_{\mathrm{s}}$ (OFF)
Off switch source capacitance. Measured with reference to ground.
$\mathrm{C}_{\mathrm{D}}$ (OFF)
Off switch drain capacitance. Measured with reference to ground.

## $\mathrm{C}_{\mathrm{D}}, \mathrm{Cs}_{\mathrm{s}}(\mathrm{ON})$

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.
$\boldsymbol{t}_{\text {Bвм }}$
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



COMPLIANT TO JEDEC STANDARDS MO-187-BA
Figure 29. 10-Lead Mini Small Outline Package [MSOP] (RM-10)
Dimensions shown in millimeters


COMPLIANT TO JEDEC STANDARDS MO-220-WEED-1
Figure 30. 12-Lead Lead Frame Chip Scale Package [LFCSP]
$3 \mathrm{~mm} \times 3 \mathrm{~mm}$ 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 | $-40^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 10-Lead Mini Small Outline Package [MSOP] | RM-10 | S9A |
| ADG836YRMZ | $-40^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 10-Lead Mini Small Outline Package [MSOP] | RM-10 | S05 |
| ADG836YRMZ-REEL | $-40^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 10-Lead Mini Small Outline Package [MSOP] | RM-10 | S05 |
| ADG836YRMZ-REEL7 | $-40^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 10-Lead Mini Small Outline Package [MSOP] | RM-10 | S05 |
| ADG836YCPZ-REEL7 | $-40^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 12-Lead Lead Frame Chip Scale Package [LFCSP] | $\mathrm{CP}-12-4$ | S05 |

[^3]Data Sheet

NOTES

## NOTES


[^0]:    ${ }^{1}$ Guaranteed by design, not subject to production test

[^1]:    ${ }^{1}$ Guaranteed by design, not subject to production test.

[^2]:    ${ }^{1}$ Guaranteed by design, not subject to production test.

[^3]:    ${ }^{1} Z=$ RoHS Compliant Part.
    ${ }^{2}$ Branding on this package is limited to three characters due to space constraints.

