AS1741, AS1742, AS1743

DataSheet

High-Speed, Low-Voltage, Single-Supply, 0.8Ω, Dual SPST Analog Switches

1 General Description

The AS1741/AS1742/AS1743 are high-speed, low-voltage, dual single-pole/single-throw (SPST) analog switches.

Fast switching speeds, low ON-resistance, and low power-consumption make these devices ideal for single-cell battery powered applications.

These highly-reliable devices operate from a single +1.6 to +3.6V supply, and are differentiated by the type and number of switches as listed in Table 1.

Table 1. Standard Products

Model	Switch Types
AS1741	Two Normally Open (NO) Switches
AS1742	Two Normally Closed (NC) Switches
AS1743	One NO Switch and One NC Switch

The AS1743 supports break-before-make switching.

With very low ON-resistance (R_{ON}), R_{ON} matching, and R_{ON} flatness, the devices can accurately switch signals for sample and hold circuits, digital filters, and op-amp gain switching networks.

The AS1741/AS1742/AS1743 digital logic input is 1.8V CMOS-compatible when using a single +3V supply, and all devices can handle Rail-to-Rail signals.

The devices are available in an 8-pin MSOP package and an 8-pin SOT23 package.

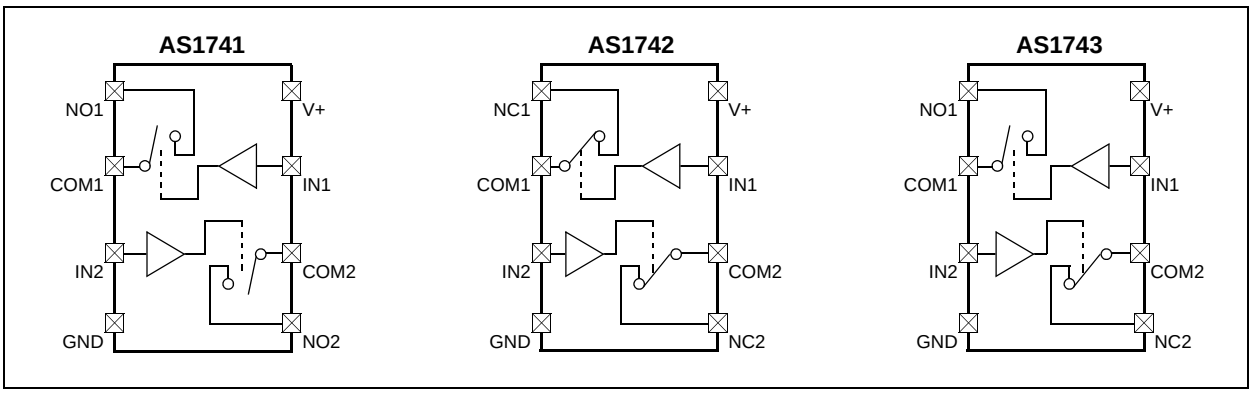
2 Key Features

- ON-Resistance:
  - 0.8Ω (+3V supply)
  - 2.5Ω (+1.8V supply)
- R_{ON} Matching: 0.08Ω (+3V supply)
- R_{ON} Flatness: 0.18Ω (+3V supply)
- Supply Voltage Range: +1.6 to +3.6V
- Switching Action: t_{ON} = 22ns, t_{OFF} = 14ns
- Current-Handling: 250mA Continuous
- Break-Before-Make Switching (AS1743)
- Rail-to-Rail Signal Handling
- 1.8V CMOS Logic Compatible (+3V supply)
- Total Harmonic Distortion: 0.03%
- Operating Temperature Range: -40 to +85ºC
- Package Types:
  - 8-pin MSOP
  - 8-pin SOT23

3 Applications

The devices are ideal for use in power routing systems, cordless and mobile phones, MP3 players, CD and DVD players, PDAs, handheld computers, digital cameras, hard drives, and any other application where high-speed signal switching is required.

Figure 1. MSOP Block Diagrams



4 Absolute Maximum Ratings

Stresses beyond those listed in Table 2 may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in Section 5 Electrical Characteristics on page 3 is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 2. Absolute Maximum Ratings

Parameter	Min	Max	Units	Comments
V+, IN*x* to GND	-0.3	+5	V	
COM*x*, NO*x*, NC*x* to GND †	-0.3	V+ + 0.3	V	
COM*x*, NO*x*, NC*x* Continuous Current	-250	+250	mA	
COM*x*, NO*x*, NC*x* Peak Current	-350	+350	mA	Pulsed at 1ms 10% duty cycle
Continuous Power Dissipation (T_{AMB} = +70ºC)		362	mW	Derate at 4.5mW/ºC above +70ºC
Electro-Static Discharge		2500	V	*HBM Mil-Std883E 3015.7* methods
Latch Up Immunity IN1, IN2		150	mA	Norm: *JEDEC 17*
Latch Up Immunity all other Pins		250	mA	
Operating Temperature Range	-40	+85	ºC	
Junction Temperature		+150	ºC	
Storage Temperature Range	-65	+150	ºC	
Package Body Temperature		+260	ºC	The reflow peak soldering temperature (body temperature) specified is in accordance with *IPC/JEDEC J-STD-020C "Moisture/Reflow Sensitivity Classification for Non-Hermetic Solid State Surface Mount Devices"*

† Signals on pins COM1, COM2, NO1, NO2, NC1, or NC2 that exceed V+ or GND are clamped by internal diodes. Limit forward-diode current to the maximum current rating.

5 Electrical Characteristics

Table 3. Power Supply Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V+	Power Supply Range		1.6		3.6	V
I+	Positive Supply Current	V+ = 3.6V, V_{INx} = 0 or V+, all channels on or off		0.01	1	µA

V+ = +2.7 to +3.6V, V_{IH} = +1.4V, V_{IL} = +0.5V, T_{AMB} = T_{MIN} to T_{MAX} (unless otherwise specified). Typ values @ V+ = +3.0V, T_{AMB} = +25ºC.

Table 4. +3V Supply Electrical Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Analog Switch							
V_{COMx}, V_{NOx}, V_{NCx}	Analog Signal Range			0		V+	V
R_{ON}	ON-Resistance	V+ = 2.7V, I_{COMx} = 100mA, V_{NOx} or V_{NCx} = 1.5V	T_{AMB} = +25ºC		0.35	0.8	Ω
			T_{AMB} = T_{MIN} to T_{MAX}			0.9	
ΔR_{ON}	ON-Resistance Match Between Channels [1]	V+ = 2.7V, I_{COMx} = 100mA, V_{NOx} or V_{NCx} = 1.5V	T_{AMB} = +25ºC		0.02	0.08	Ω
			T_{AMB} = T_{MIN} to T_{MAX}			0.09	
$R_{FLAT(ON)}$	ON-Resistance Flatness [2]	V+ = 2.7V, I_{COMx} = 100mA, V_{NOx} or V_{NCx} = 1, 1.5, or 2V	T_{AMB} = +25ºC		0.02	0.18	Ω
			T_{AMB} = T_{MIN} to T_{MAX}			0.20	
$I_{NOx(OFF)}$, $I_{NCx(OFF)}$	NO*x* or NC*x* Off-Leakage Current	V+ = 3.3V, V_{COMx} = 0.3 or 3.0V, V_{NOx} or V_{NCx} = 3.0 or 0.3V	T_{AMB} = +25ºC	-1		1	nA
			T_{AMB} = T_{MIN} to T_{MAX}	-5		5	
$I_{COMx(OFF)}$	COM*x* Off-Leakage Current	V+ = 3.3V, V_{COMx} = 0.3 or 3.0V, V_{NOx} or V_{NCx} = 3.0, 0.3V	T_{AMB} = +25ºC	-1		1	nA
			T_{AMB} = T_{MIN} to T_{MAX}	-5		5	
$I_{COMx(ON)}$	COM*x* On-Leakage Current	V+ = 3.3V, V_{COMx} = 3.0 or 0.3V, $_{NOx}$ or V_{NCx} = 3.0 or 0.3V	T_{AMB} = +25ºC	-2		2	nA
			T_{AMB} = T_{MIN} to T_{MAX}	-10		10	
Switch Dynamic Characteristics							
t_{ON}	Turn On Time [3]	V_{NOx} or V_{NCx} = 1.5V, R_{LOAD} = 50Ω, C_{LOAD} = 35pF, Figures 12, 13	T_{AMB} = +25ºC		13	22	ns
			T_{AMB} = T_{MIN} to T_{MAX}			24	
t_{OFF}	Turn Off Time [3]	V_{NOx} or V_{NCx} = 1.5V, R_{LOAD} = 50Ω, C_{LOAD} = 35pF, Figures 12, 13	T_{AMB} = +25ºC		7	14	ns
			T_{AMB} = T_{MIN} to T_{MAX}			15	
t_{BBM}	Break Before Make [3]	V_{NOx} or V_{NCx} = 1.5V, R_{LOAD} = 50Ω, C_{LOAD} = 35p, Figure 14 (AS1743)	T_{AMB} = +25ºC		6		ns
			T_{AMB} = T_{MIN} to T_{MAX}	1			
Q	Charge Injection	V_{GEN} = 3.3V, R_{GEN} = 0, C_{LOAD} = 1.0nF, Figure 15	8-pin MSOP		6		pC
			8-pin SOT23		5		
C_{OFF}	NO*x*, NC*x* Off-Capacitance	f = 1MHz, Figure 16			35		pF
$C_{COMx(OFF)}$	COM*x* Off-Capacitance	f = 1MHz, Figure 16			35		pF
$C_{COMx(ON)}$	COM*x* On-Capacitance	f = 1MHz, Figure 16			35		pF
BW	-3dB On-Channel Bandwidth	Signal = 0, R_{IN} = R_{OUT} = 50Ω, C_{LOAD} = 5pF, Figure 17			130		MHz
V_{ISO}	Off-Isolation [4]	f = 1MHz, V_{COMx} = 1V_{RMS}, R_{LOAD} = 50Ω, C_{LOAD} = 5pF, Figure 17			-55		dB
	Crosstalk [5]	f = 1MHz, V_{COMx} = 1V_{RMS}, R_{LOAD} = 50Ω, C_{LOAD} = 5pF, Figure 17			-100		dB
THD	Total Harmonic Distortion	f = 20Hz to 20kHz, V_{COMx} = 2Vp-p, R_{LOAD} = 32Ω			0.03		%

Table 4. +3V Supply Electrical Characteristics (Continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Logic Input						
V_{IH}	Input Logic High		1.4			V
V_{IL}	Input Logic Low				0.5	V
I_{IN}	Input Leakage Current	V_{INx} = 0 or V+	-1000	0.1	1000	nA

V+ = *+1.8V,* V_{IH} = *+1.0V,* V_{IL} = *0.4V,* T_{AMB} = *T_{MIN} to T_{MAX} (unless otherwise specified). Typ values @* T_{AMB} = *+25ºC.*

Table 5. +1.8V Supply Electrical Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Analog Switch							
V_{COMx}, V_{NOx}, V_{NCx}	Analog Signal Range			0		V+	V
R_{ON}	ON-Resistance	I_{COMx} = 10mA, V_{NOx} or V_{NCx} = 0.9V	T_{AMB} = +25ºC		0.9	2.5	Ω
			T_{AMB} = T_{MIN} to T_{MAX}			3	
$I_{NOx(OFF)}$, $I_{NCx(OFF)}$	NO*x* or NC*x* Off-Leakage Current	V_{COMx} = 0.3 or 1.5V, V_{NOx} or V_{NCx} = 1.5 or 0.3V	T_{AMB} = +25ºC	-1		1	nA
			T_{AMB} = T_{MIN} to T_{MAX}	-5		5	
$I_{COMx(OFF)}$	COM*x* Off-Leakage Current	V_{COMx} = 0.3 or 1.5V, V_{NOx} or V_{NCx} = 1.5 or 0.3V	T_{AMB} = +25ºC	-1		1	nA
			T_{AMB} = T_{MIN} to T_{MAX}	-5		5	
$I_{COMx(ON)}$	COM*x* On-Leakage Current	V_{COMx} = 0.3 or 1.5V, V_{NOx} or V_{NCx} = 0.3 or 1.5V	T_{AMB} = +25ºC	-2		2	nA
			T_{AMB} = T_{MIN} to T_{MAX}	-10		10	
Switch Dynamic Characteristics							
t_{ON}	Turn On Time [3]	V_{NOx} or V_{NCx} = 1.5V, R_{LOAD} = 50Ω, C_{LOAD} = 35pF, Figures 12, 13	T_{AMB} = +25ºC		21	30	ns
			T_{AMB} = T_{MIN} to T_{MAX}			35	
t_{OFF}	Turn Off Time [3]	V_{NOx} or V_{NCx} = 1.5V, R_{LOAD} = 50Ω, C_{LOAD} = 35pF, Figures 12, 13	T_{AMB} = +25ºC		12	20	ns
			T_{AMB} = T_{MIN} to T_{MAX}			25	
t_{BBM}	Break-Before-Make [3]	V_{NOx} or V_{NCx} = 1.5V, R_{LOAD} = 50Ω, C_{LOAD} = 35p, Figure 14, (AS1743)	T_{AMB} = +25ºC		8		ns
			T_{AMB} = T_{MIN} to T_{MAX}	1			
Q	Charge Injection	V_{GEN} = 1.8V, R_{GEN} = 0, C_{LOAD} = 1.0nF, Figure 15	8-pin MSOP		6		pC
			8-pin SOT23		2.5		
V_{ISO}	Off-Isolation [4]	f = 1MHz, V_{COMx} = 1V_{RMS}, R_{LOAD} = 50Ω, C_{LOAD} = 5pF, Figure 17			-50		dB
	Crosstalk [5]	f = 1MHz, V_{COMx} = 1V_{RMS}, R_{LOAD} = 50Ω, C_{LOAD} = 5pF, Figure 17			-100		dB
Logic Input							
V_{IH}	Input Logic High			1			V
V_{IL}	Input Logic Low					0.4	V
I_{IN}	Input Leakage Current	V_{INx} = 0 or V+		-1000	0.1	1000	nA

1. $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$.
2. Flatness is defined as the difference between the maximum and the minimum value of ON-resistance as measured over the specified analog signal ranges.
3. Guaranteed by design.
4. Off-Isolation = 20log10(V_{COMx}/V_{NOx}), V_{COMx} = output, V_{NOx} = input to off switch.
5. Between two switches.

6 Typical Operating Characteristics

Figure 2. Charge Injection vs. Output Voltage; SOT23

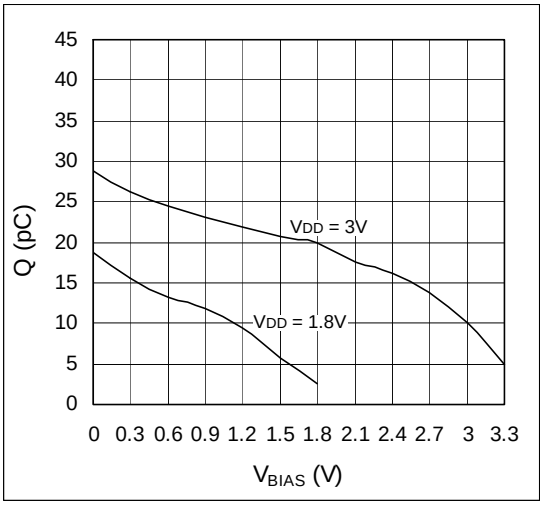


Figure 3. Charge Injection vs. Output Voltage; MSOP

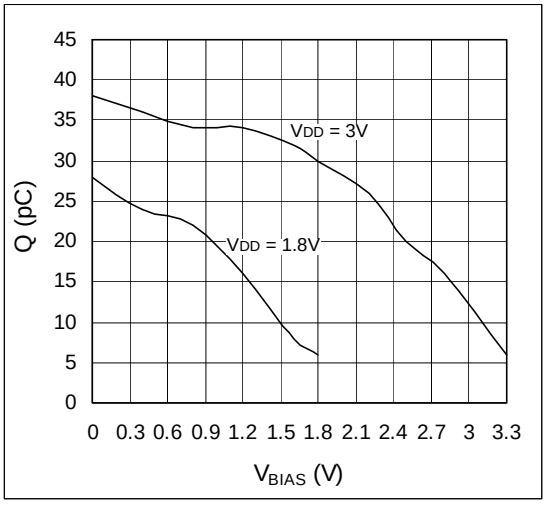


Figure 4. RON vs. VCOM and Temperature; VDD = 2.7V

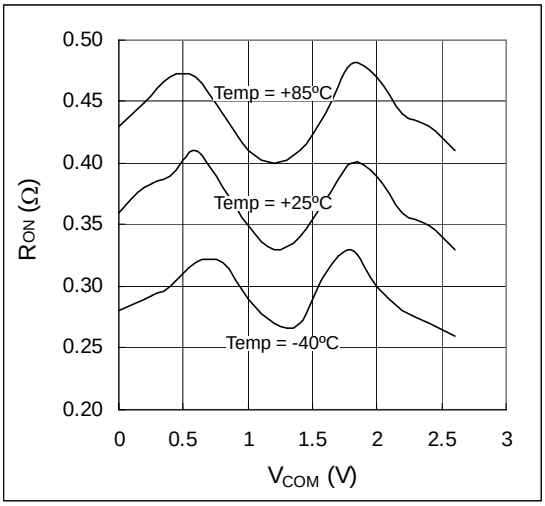


Figure 5. RON vs. VCOM

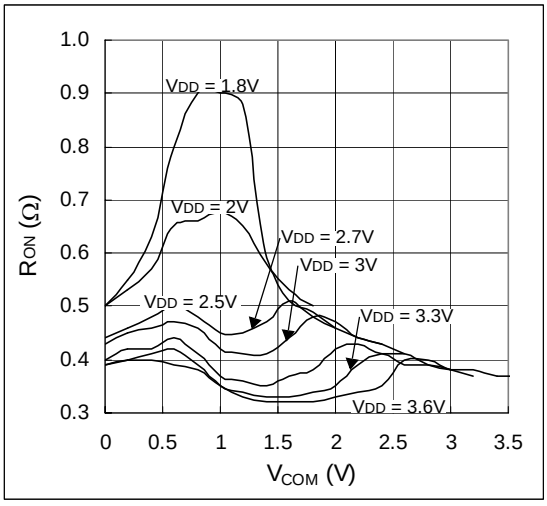


Figure 6. tON/tOFF vs. Supply Voltage

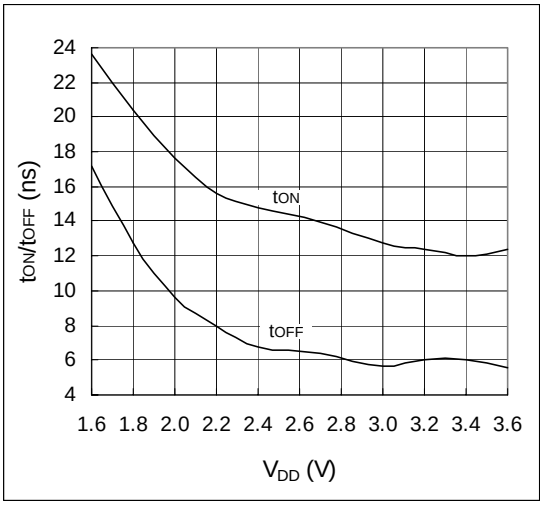


Figure 7. tON/tOFF vs. Temperature

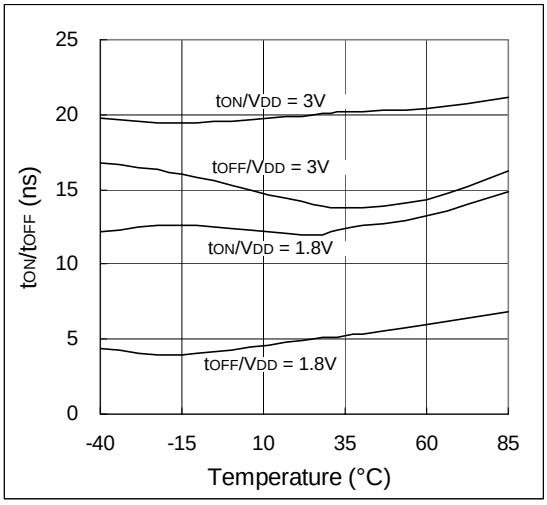


Figure 8. THD vs. Frequency; R_{LOAD} = 32Ω, V_{DD} = 3V

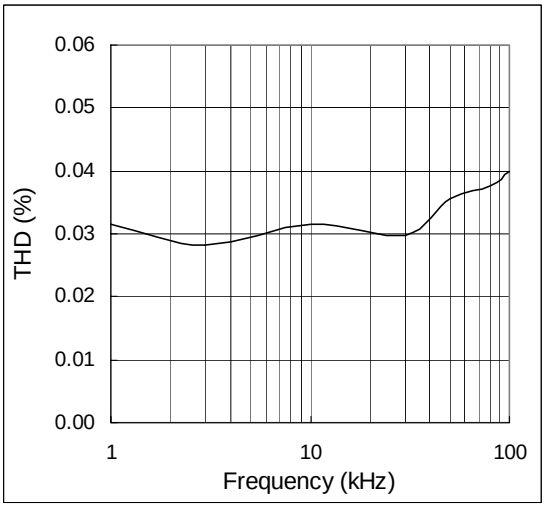
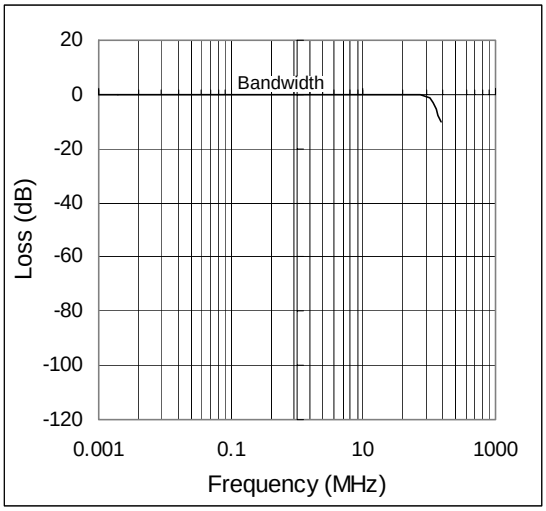


Figure 9. Frequency Response



7 Pinout

Pin Assignments

Figure 10. MSOP Pin Assignments (Top View)

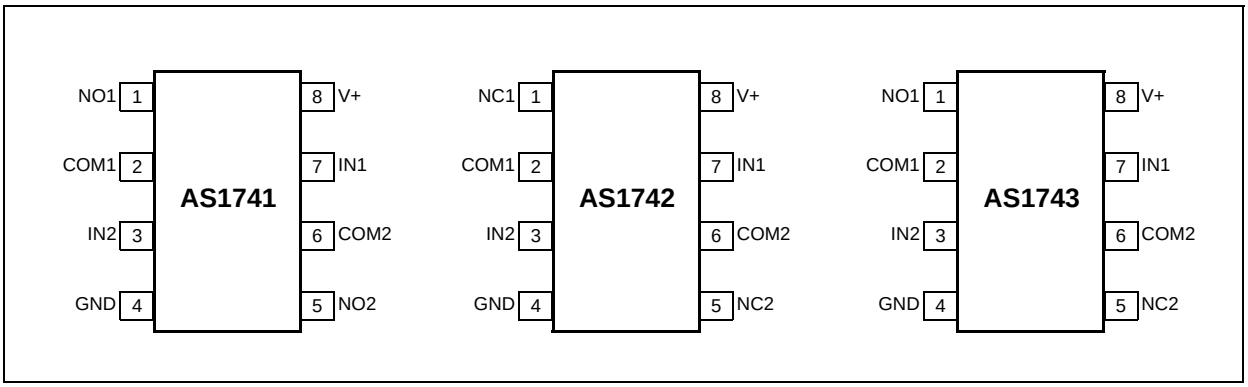
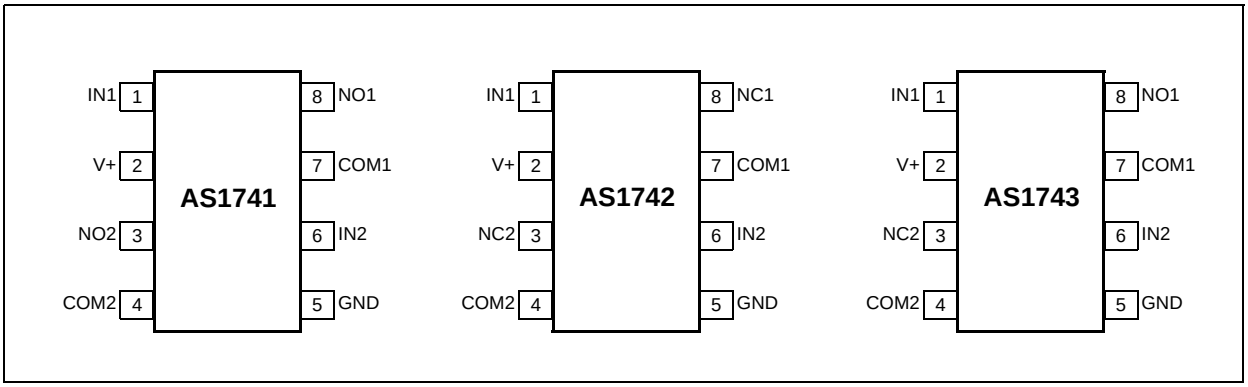


Figure 11. SOT23 Pin Assignments (Top View)



Pin Descriptions

Table 6. Pin Descriptions

Pin Number	Pin Name	Description
See Figure 10 and Figure 11	COM1	**Analog Switch 1 Common**
	COM2	**Analog Switch 2 Common**
	GND	**Ground**
	IN1	**Analog Switch 1 Logic Control Input**
	IN2	**Analog Switch 2 Logic Control Input**
	NC1	**Analog Switch 1 Normally Closed Terminal**
	NC2	**Analog Switch 2 Normally Closed Terminal**
	NO1	**Analog Switch 1 Normally Open Terminal**
	NO2	**Analog Switch 2 Normally Open Terminal**
	V+	**Input Supply Voltage**. +1.6 to +3.6V

8 Detailed Description

The AS1741/AS1742/AS1743 are low ON-resistance, low-voltage, dual analog SPST switches that operate from a single +1.6 to +3.6V supply.

CMOS process technology allows switching of analog signals that are within the supply voltage range (GND to V+).

ON Resistance

When powered from a +3V supply, the AS1741/AS1742/AS1743 low (0.8Ω, max) ON-resistance allows high-speed, continuous signals to be switched in a variety of applications. All devices have very low R_{ON} flatness (0.18Ω, max) so they can meet or exceed the low-distortion audio requirements of modern portable audio devices.

Bi-Directional Switching

Pins NO*x*, NC*x*, and COM*x* are bi-directional and can be used as inputs or outputs.

Analog Signal Levels

Analog signals ranging over the entire supply voltage range (V+ to GND) can be passed with very little change in ON-resistance (see Typical Operating Characteristics on page 5).

Logic Inputs

The AS1741/AS1742/AS1743 logic inputs can be driven up to +3.6V regardless of the supply voltage value. For example, with a +1.8V supply, IN*x* may be driven low to GND and high to +3.6V. This allows the devices to interface with +3V systems using a supply of less than 3V.

9 Application Information

Power Supply Sequencing

Proper power-supply sequencing is critical for proper switch operation. The power supplies should be started up in the following sequence:

1. V+
2. NO*x*, NC*x*, COM*x*

Note: Operation beyond the absolute maximum ratings (see page 2) may permanently damage the devices.

Power Supply Bypass

Power supply connections to the devices must maintain a low impedance to ground. This can be done using a bypass capacitor, which will also improve noise margin and prevent switching noise propagation from the V+ supply to other components.

A 0.1µF bypass capacitor, connected from V+ to GND (see Figure 17 on page 11), is adequate for most applications.

Logic Inputs

Driving IN*x* Rail-to-Rail will help minimize power consumption.

Layout Considerations

High-speed switches require proper layout and design procedures for optimum performance.

- Short, wide traces should be used to reduce stray inductance and capacitance.
- Bypass capacitors should be as close to the device as possible.
- Large ground planes should be used wherever possible.

Timing Diagrams and Test Setups

Figure 12. AS1741/AS1743 Test Circuit and Timing Diagram

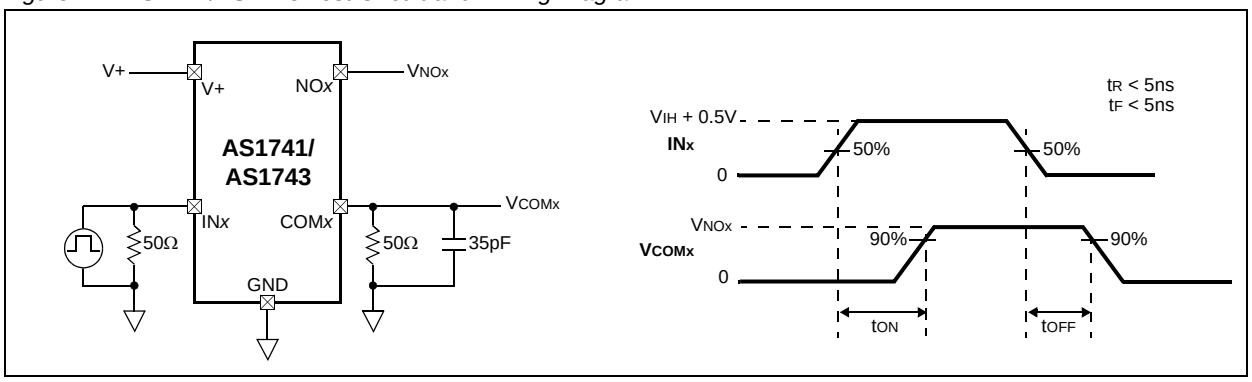


Figure 13. AS1742/AS1743 Test Circuit and Timing Diagram

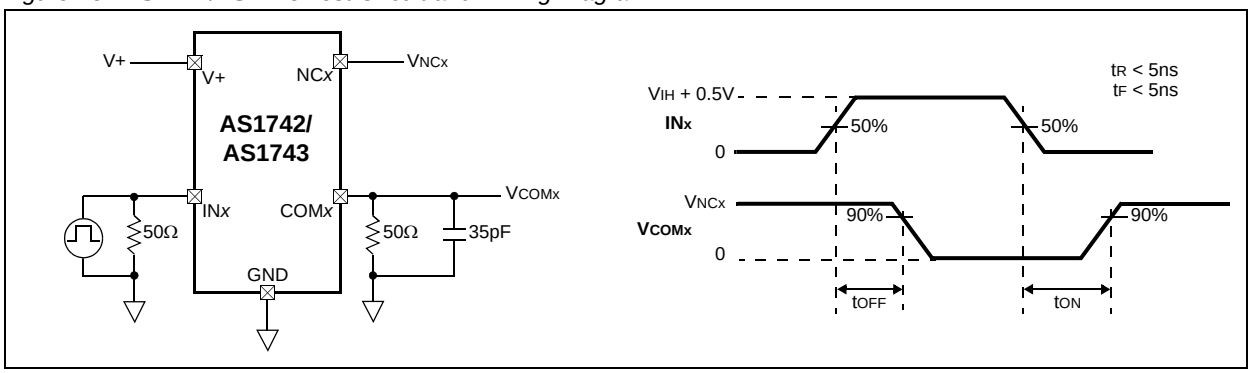


Figure 14. AS1743 Test Circuit and Timing Diagram

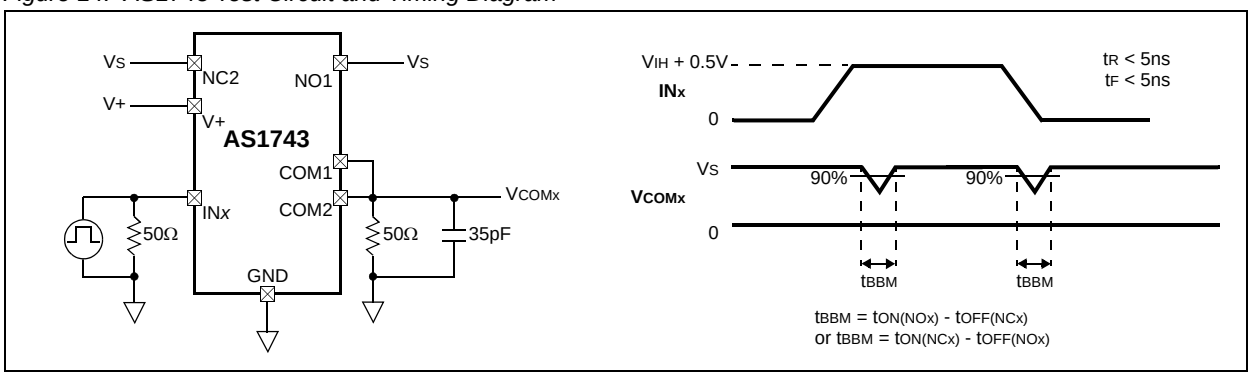


Figure 15. Charge Injection

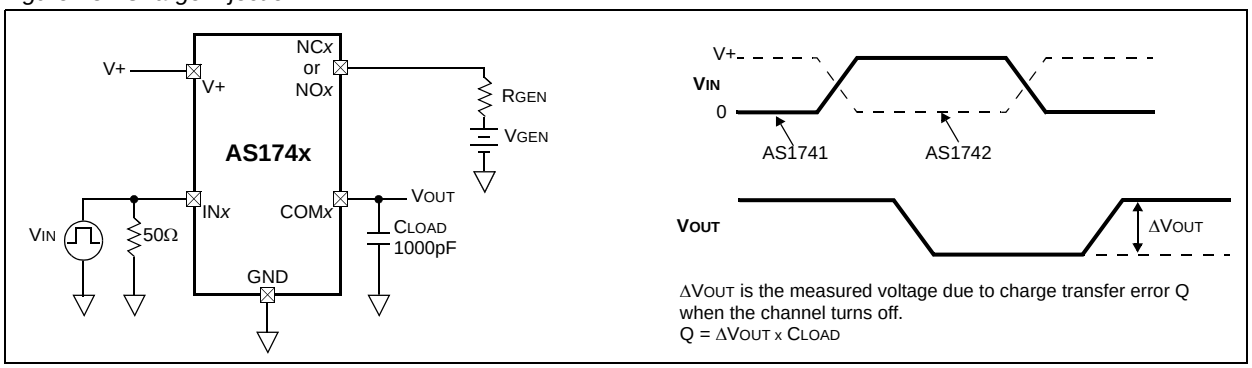


Figure 16. NOx, NCx, and COMx Capacitance

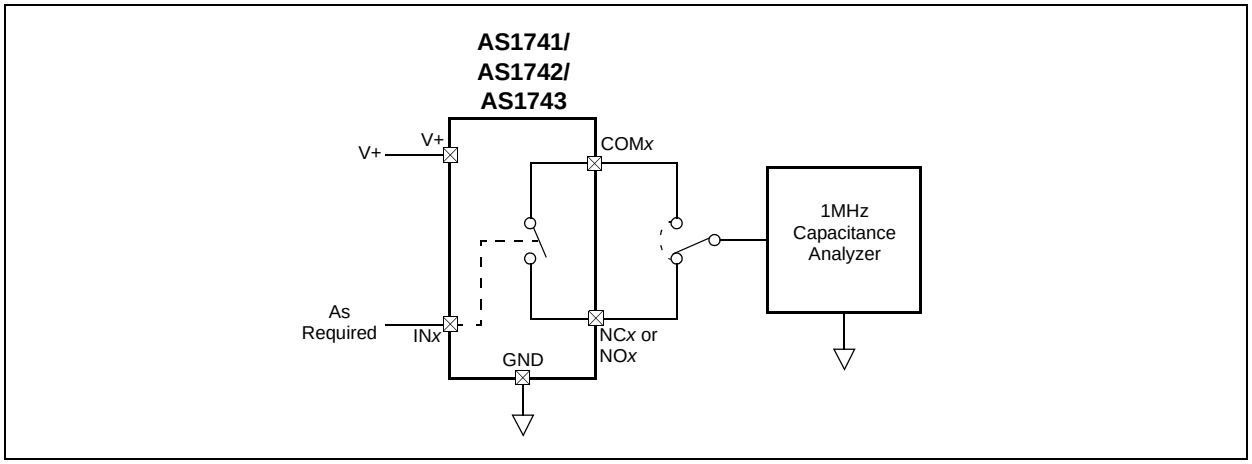
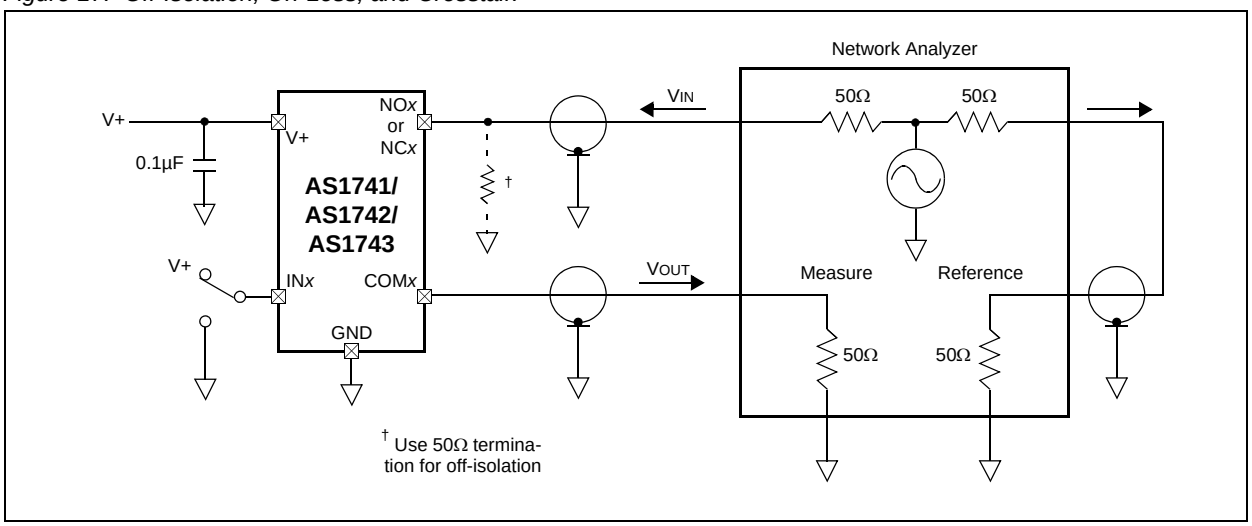


Figure 17. Off-Isolation, On-Loss, and Crosstalk



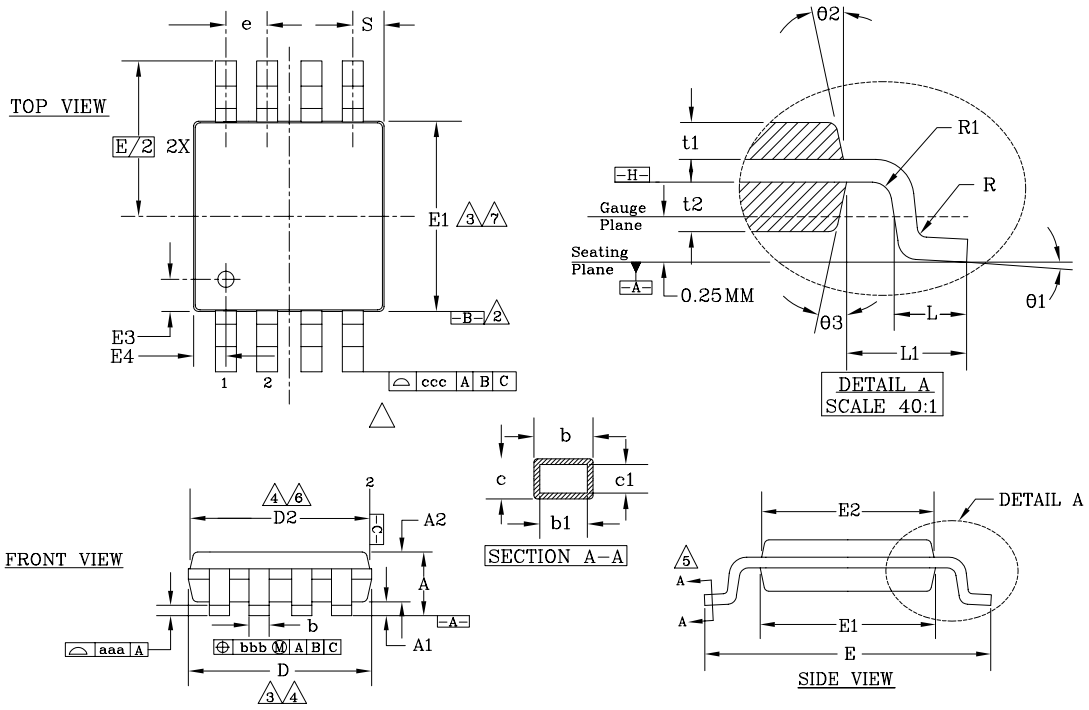
Notes:

1. Measurements are standardized against short-circuit at socket terminals.
2. Off-isolation is measured between COM*x* and the off NC*x*/NO*x* terminal of each switch. Off-isolation = 20log(V_{OUT}/V_{IN}).
3. Signal direction through the switch is reversed; worst values are recorded.

10 Package Drawings and Markings

The devices are available in an 8-pin MSOP package and an 8-pin SOT23 package.

Figure 18. 8-pin MSOP Package

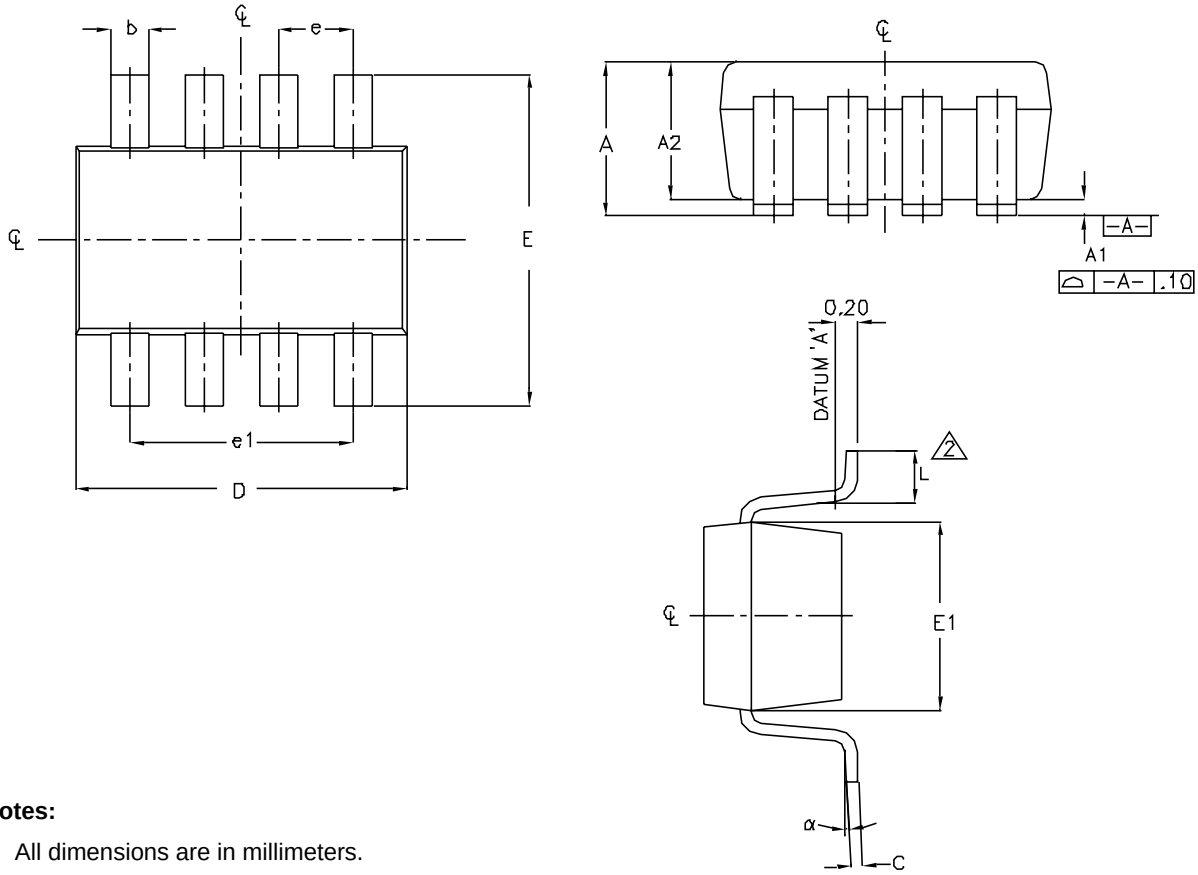


Notes:

1. All dimensions are in millimeters, angles in degrees, unless otherwise specified.
2. Datums B and C to be determined at datum plane H.
3. Dimensions D and E1 are to be determined at datum plane H.
4. Dimensions D2 and E2 are for top package; dimensions D and E1 are for bottom package.
5. Cross section A-A to be determined at 0.13 to 0.25mm from lead tip.
6. Dimensions D and D2 do not include mold flash, protrusion, or gate burrs.
7. Dimensions E1 and E2 do not include interlead flash or protrusion.

Symbol	Typ	±Tol	Symbol	Typ	±Tol
A	1.10	Max	b	0.33	+0.07/-0.08
A1	0.10	±0.05	b1	0.30	±0.05
A2	0.86	±0.08	c	0.18	±0.05
D	3.00	±0.10	c1	0.15	+0.03/-0.02
D2	2.95	±0.10	θ1	3.0º	±3.0º
E	4.90	±0.15	θ2	12.0º	±3º
E1	3.00	±0.10	θ3	12.0º	±3º
E2	2.95	±0.10	L	0.55	±0.15
E3	0.51	±0.13	L1	0.95BSC	-
E4	0.51	±0.13	aaa	0.10	-
R	0.15	+0.15/-0.08	bbb	0.08	-
R1	0.15	+0.15/-0.08	ccc	0.25	-
t1	0.31	±0.08	e	0.65 BSC	-
t2	0.41	±0.08	S	0.525 BSC	-

Figure 19. 8-pin SOT23 Package



Notes:

1. All dimensions are in millimeters.
2. Foot length measured at intercept point between datum A and lead surface.
3. Package outline exclusive of mold flash and metal burr.
4. Package outline inclusive of solder plating.
5. Complies with *EIAJ SC74* (6-lead version).
6. PKGST0005 (Rev B) refer to SOT23 8-lead SOT23-D-2019 (Rev C) package outline.

Symbol	Min	Max
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.22	0.38
C	0.09	0.20
D	2.80	3.10
E	2.60	3.00
E1	1.50	1.75
L	0.35	0.55
e	0.65REF	
e1	1.95REf	
α	0º	10º

11 Ordering Information

The devices are available as the standard products shown in Table 7.

Table 7. Ordering Information

Model	Markings	Description	Delivery Form	Package
AS1741G		Dual SPST Switch	Tube	8-pin MSOP
AS1741G-T		Dual SPST Switch	Tape and Reel	8-pin MSOP
AS1741H-T †	ASJL	Dual SPST Switch	Tape and Reel	8-pin SOT23
AS1742G		Dual SPST Switch	Tube	8-pin MSOP
AS1742G-T		Dual SPST Switch	Tape and Reel	8-pin MSOP
AS1742H-T	ASJK	Dual SPST Switch	Tape and Reel	8-pin SOT23
AS1743G		Dual SPST Switch	Tube	8-pin MSOP
AS1743G-T		Dual SPST Switch	Tape and Reel	8-pin MSOP
AS1743H-T †	ASJM	Dual SPST Switch	Tape and Reel	8-pin SOT23

† Available upon request

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