

# design Switches And Multiplexers

# FAQs

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## FREQUENTLY ASKED QUESTIONS

### What's new in analog switches and multiplexers?

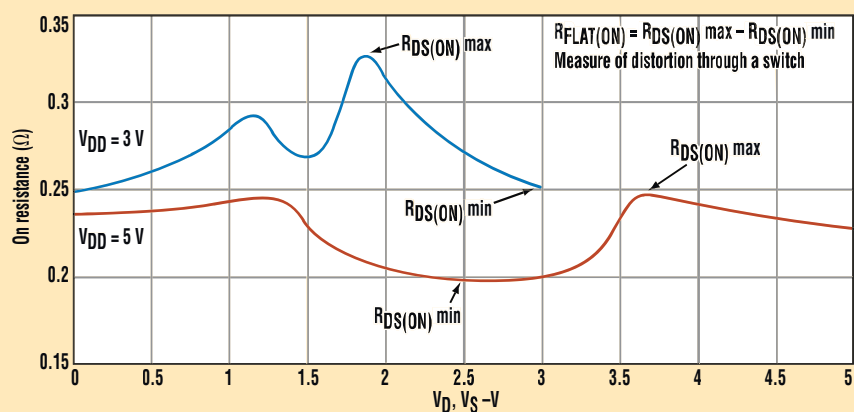
These chips are extending their reach from industrial and instrumentation equipment and communications infrastructure to consumer gear like AV receivers and cell phones, which need bandwidth and signal-amplitude flexibility. Component video needs larger switch arrays than composite video, but the configurations are much the same. Cell-phone audio requires simple single-pole single-throw (SPST) and single-pole double-throw (SPDT) switches for microphones, speakers and auxiliary outputs, and multimedia functions that add more switching complexity.

### What are some key specs?

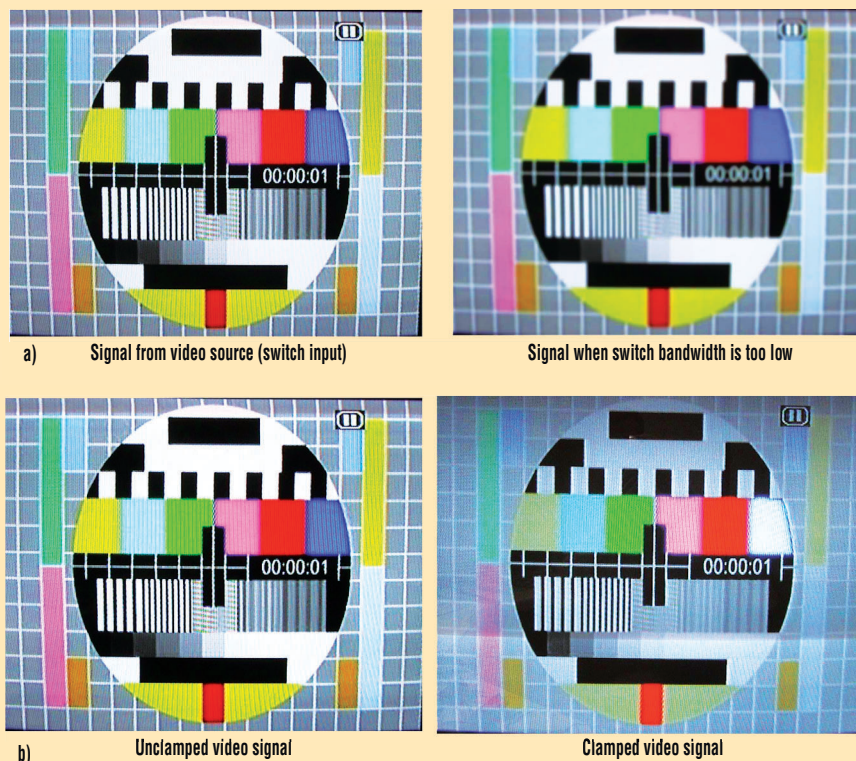
On resistance ( $R_{DS(ON)}$ ) is critical for both video and audio, not only because of insertion loss, but also because it can vary with signal voltage, distorting the transfer characteristic and creating harmonic distortion and intermodulation products. In addition, the parasitic input and output capacitances associated with the MOS switch limit bandwidth. Also, there's the allowable input signal range. Power consumption and the physical size of the package are significant factors as well.

### Are critical specs different for video and audio?

While video loads are all 75  $\Omega$ , audio loads vary from 600- $\Omega$  twisted-pair down to 4- $\Omega$  speakers or earphones. Also, the on resistance has a greater effect when the device is working into low load



1.  $R_{FLAT(ON)}$  is a measure of distortion through a MOSFET switch.



2. Bandwidth limiting shows up in softened edges and an inability to resolve closely spaced vertical lines (a). Clamping degrades dynamic range in the black-and-white signal and color saturation in the color signal (b).

impedances. And, the currents that the switches must handle are higher when driving speakers and headphones from a power amplifier than when driving higher impedance loads at line levels.

### How much can on resistance vary, and how much variation is acceptable?

On resistance for CMOS analog switches varies (*Fig. 1*). The data sheet spec of interest,  $R_{\text{FLAT(ON)}}$ , is measured across an input range of 0 V to  $V_{\text{DD}}$ . A good CMOS audio switch may exhibit a guaranteed maximum on resistance of about 0.6  $\Omega$ . (The variation in on resistance between the N-channel and the P-channel MOSFETs will be about 0.08  $\Omega$ ).  $R_{\text{FLAT(ON)}}$  will be below 0.2  $\Omega$  (max). (These values are for 25°C, but actual characteristics should be close to those values at temperature extremes.)

### What about bandwidth?

The parasitic input and output capacitances of the MOS switch and on resistance limit bandwidth. When feeding video to an oversampling data converter, the required bandwidth varies from a few tens of megahertz for low video resolutions up to a few hundred megahertz for higher-resolution digital TV modes. Figure 2a shows the effects of insufficient bandwidth on a video signal.

### What about signal range?

While the nominal amplitude for a video signal is 1 V p-p, actual signal amplitude can be as low as 0.7 V and as high as 2.5 V. Any switch must have an analog signal range large enough so that all signals are passed without distortion. If the amplitude of the video signals applied to the switch exceeds its signal range spec, the switch will clamp the signal, resulting in distortion (*Fig. 2b*).

### And the control interface?

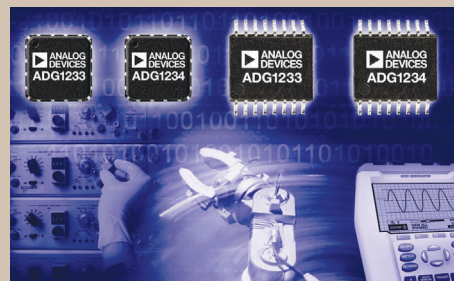
Generally, some form of parallel interface is used for simple switch and multiplexer configurations. Large multiplexers and crosspoints normally use serial buses. For most video switching, I<sup>2</sup>C is an industry standard due to its simplicity, flexibility, and ease of use.

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# ANALOG DEVICES product Q&As

## ADI Switches And Multiplexers Support Performance, Power And Footprint Requirements In Consumer And Industrial Designs

Analog Devices' switch and multiplexer products are used in a wide and growing range of applications. In support of the increased performance, low power, and reduced footprint needs of industrial design engineers, ADI iCMOS™ technology has enabled the introduction of high-performance  $\pm 15/12$ -V switch and multiplexer solutions.



### Industry's Lowest Capacitance and Charge Injection

The ADG1208/ADG1209 are monolithic analog multiplexers that deliver the industry's lowest off capacitance of 1.5 pF and lowest charge injection of <1 pC for high-end data-acquisition applications. The ADG1233 and ADG1234 are triple/quad SPDT  $\pm 15/12$ -V switches delivering 1.5-pF off capacitance and <1-pC charge injection.

### Industry's Best $R_{\text{ON}}$ Performance

The ADG1408/ADG1409 monolithic CMOS analog multiplexers offer the industry's industry's best  $R_{\text{ON}}$  performance of just 5  $\Omega$  max over the full signal range, which is 95% lower than competing solutions.

### Best-In-Class Crosstalk and Isolation Performance in Crosspoint Switch

A wide range of applications including AV switching in TV, CCTV, and automotive infotainment will benefit from the flexibility and uncompromised performance of the ADG2128. It features single-supply operation up to +12 V dc, dual-supply operation up to  $\pm 5$  V, 79-dB crosstalk, 66-dB isolation, low  $R_{\text{ON}}$  of 40  $\Omega$  max, and a 5-mm  $\times$  5-mm 32-LFCSP.

### Wide-Bandwidth Switches for High-Definition Video Applications

The ADG79xA family includes wide-bandwidth, bidirectional, low-power switches and multiplexers specifically designed for high-definition video applications. They feature wide bandwidth of 190 to 325 MHz, -75-dB crosstalk, -60-dB isolation, low  $R_{\text{ON}}$  of 5  $\Omega$ , I<sup>2</sup>C interface, and one or two optional general-purpose outputs in a 4-mm  $\times$  4-mm 24-LFCSP.

For more information on ADI switch and multiplexer solutions, visit [www.analog.com/switchFAQ](http://www.analog.com/switchFAQ).

