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Two New Analog Switches Set Standards for Space Efficiency

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APPLICATION NOTE

INTRODUCTION

Analog switches that provide analog and digital switching to circuit designers, have been around for more than 30 years. One of the most popular switches has been the 4053, a triple Single-Pole Double-Throw (SPDT) switch in a 16-pin package. The most aggressive common package for this device is the TSSOP-16 which occupies 32 mm² of board space or 10.5 mm² per switch.

The hand-held wireless phenomenon is driving the need to get more functionality into even smaller spaces. In response, ON Semiconductor released more than 30 single-gate switches that supply exactly the right bit of logic just where it is needed. These products were released in industry standard SC88A/SOT-353 packages which occupy just over 4 mm². These devices are all five leads and provide standard logic functions. An example is the MC74VHC1G66, a Single-Pole, Single-Throw (SPST) analog switch.

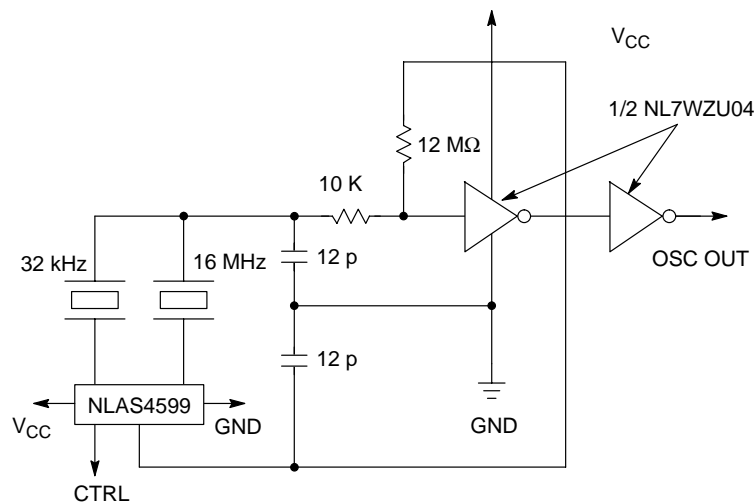
The NLAS4599

The new NLAS4599 device is a single SPDT switch, one-third the size of the venerable 4053, contained in an aggressive 0.6 μ CMOS technology. It provides voltage

breakdown greater than 7.0 V, low R_{on}, and excellent high frequency response. The NLAS4599 sets a new standard in space efficiency. It occupies 4. mm² and provides the same functionality as one-third of a 4053. Compared to the 4053, the NLAS4599 is 2.5 times more space efficient. This is a real boon to designers, who need to put as much functionality as possible into every square inch.

Examples

1. Design a crystal-controlled oscillator that functions at 32 KHz for minimum power consumption and 16 MHz for performance in a battery-operated environment. The new NL27WZU04 provides two unbuffered gates in a single 4 mm² package. One gate is an oscillator; the second gate is a buffer. The NLAS4599 is used to switch crystals. A single control line (assumed to come from a microcontroller) controls the frequency. When the unit is near idle, the clock is 32 KHz and the microcontroller/DSP functions at minimum power consumption. When speed (performance) is required, the clock switches to 16 MHz.



This circuit provides dual clock rates under microprocessor control and occupies minimal board space.

Figure 1. Dual Frequency Oscillator

2. Switch between two audio signals in a single phone, one from a digital baseband detector, the other from an analog baseband detector, to drive the final audio output to an ear piece. In this example, it is assumed that a multifunctional cell phone has both an analog detector and a digital detector, one of which must be selected to drive the final audio output to the ear piece. The NLAS4599 selects the digital or analog detector output, presenting very low impedance to the driver amplifier for the selected device and very high impedance to the deselected device.

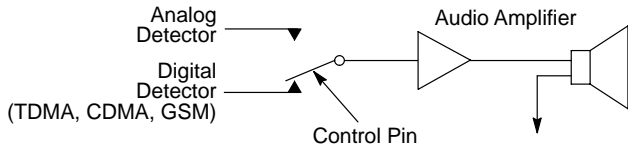


Figure 2. Switching Between Two Audio Signals

These two examples show how the NLAS4599 can be used to select from two outputs, such as crystals and digital, or analog signals under microprocessor control. The NLAS4599 will stop or pass any signal between GND and V_{CC}, either digital or analog, and preserve its voltage level. The device is usable beyond 100 MHz, since the 3 dB point is beyond 150 MHz.

The NLAS44599

ON Semiconductor has designed a new device in even smaller spaces with more functionality. The device is placed in a new package type, being made available and accepted by JEDEC, called the Fine Pitch Quad Flat No Lead package (QFN). The specification falls under JEDEC MO-220, dated January 2000. It calls for packages whose body sizes range from 3 x 3 mm to 8 x 8 mm. The lead count goes from 4 to 56. The thickness (height off the board) is a maximum of 1 mm.

ON Semiconductor put a new device, called the NLAS44599, in a 3 x 3 package. The new device consists of 16 leads with a 0.5 mm pitch. Since the package is “no lead,” there are no co-planarity issues and no solder bumps. The user simply applies solder paste to the circuit board, places the QFN, and uses IR re-flow soldering to complete the mounting.

With this concept, we were able to put the equivalent of four of the NLAS4599 SPDT devices into a 9 mm² package. Compared to the 4053 in TSSOP, this device is more than four times as space efficient. With 16 pins, we were able to construct two independent DPDT switches. These devices are inherently bilateral. Signals can flow in either direction and, once turned on, these devices offer almost zero propagation delay.

See Figure 3 for an example of how to switch LVDS signals.

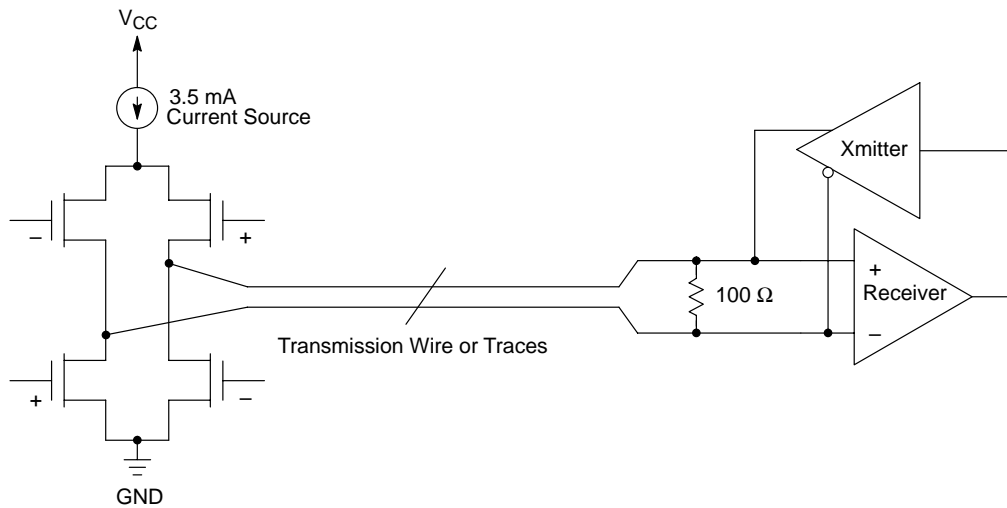


Figure 3. Low Voltage Differential Signaling

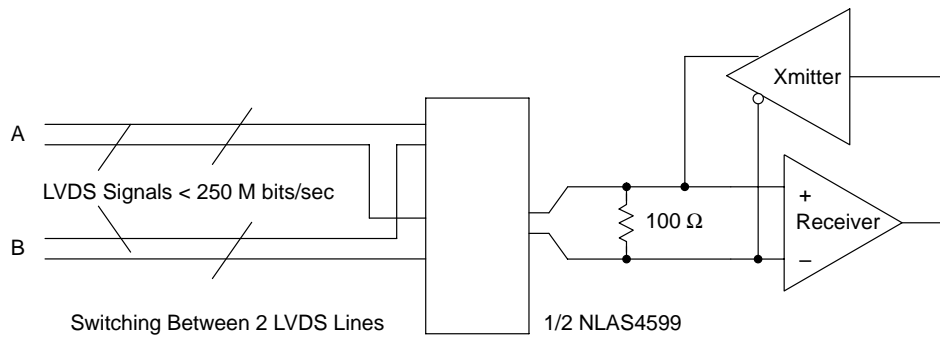


Figure 4. Switching Between Two LVDS Lines

Low Voltage Differential Signaling


Low Voltage Differential Signaling (LVDS) is becoming a very popular scheme for point-to-point transfer of signals up to 200 MHz and for distances less than 25 meters. The LVDS signals fall under EIA-644 specifications. The LVDS signal sits at a dc. level of about 1.25 volts and is guaranteed to fall between 100 mV and 750 mV of differential swing. Since the NLAS44599 provides very small insertion loss, owing to frequency roll-off or series resistance attenuation, it makes an ideal switch for differential pairs. The NLAS44599 consists of two independent DPST switches; therefore, it only takes one of this device to select between two LVDS signals going to a single transceiver.

Figure 4 shows one-half of the mm^2 device used to switch between two differential pairs. No biasing is required since the LVDS specification calls for the signal to be at

roughly 1.25 V, well within the requirement of the NLAS44599. The other half of the device may be used to provide similar or entirely different switching functions. Other differential signals such as Ethernet signals on a Category 5 wire, ECL signals within the frequency range of this device, and professional audio signals (600 Ω balanced) may be switched in a similar manner.

Summary

On Semiconductor is bringing new, extremely space-efficient analog switches to the marketplace. These devices will be used creatively by our customers to solve difficult problems, in small spaces. Both new products, the NLAS4599 and the NLAS44599, represent step functions in space efficiency and functionality over existing solutions.

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