HOLT INTEGRATED CIRCUITS INC.

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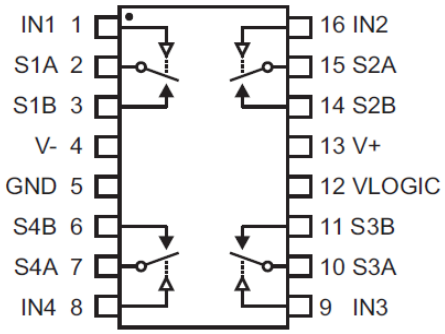
AN-177

HI-8190/HI-8191/HI-8192 Analog Switch Application Note

Introduction

This application note provides examples using Holt's analog switches in ARINC 429 and general purpose applications. Occasionally, there is a need in an ARINC 429 design to switch between two or more ARINC 429 Line Driver outputs onto a common output bus. The analog switches are also suitable for most general purpose analog switching applications. The HI-8190, HI-8191 and HI-8192 are quad analog CMOS switches fabricated with Silicon-on-Insulator (SOI) technology for latch-up free operation.

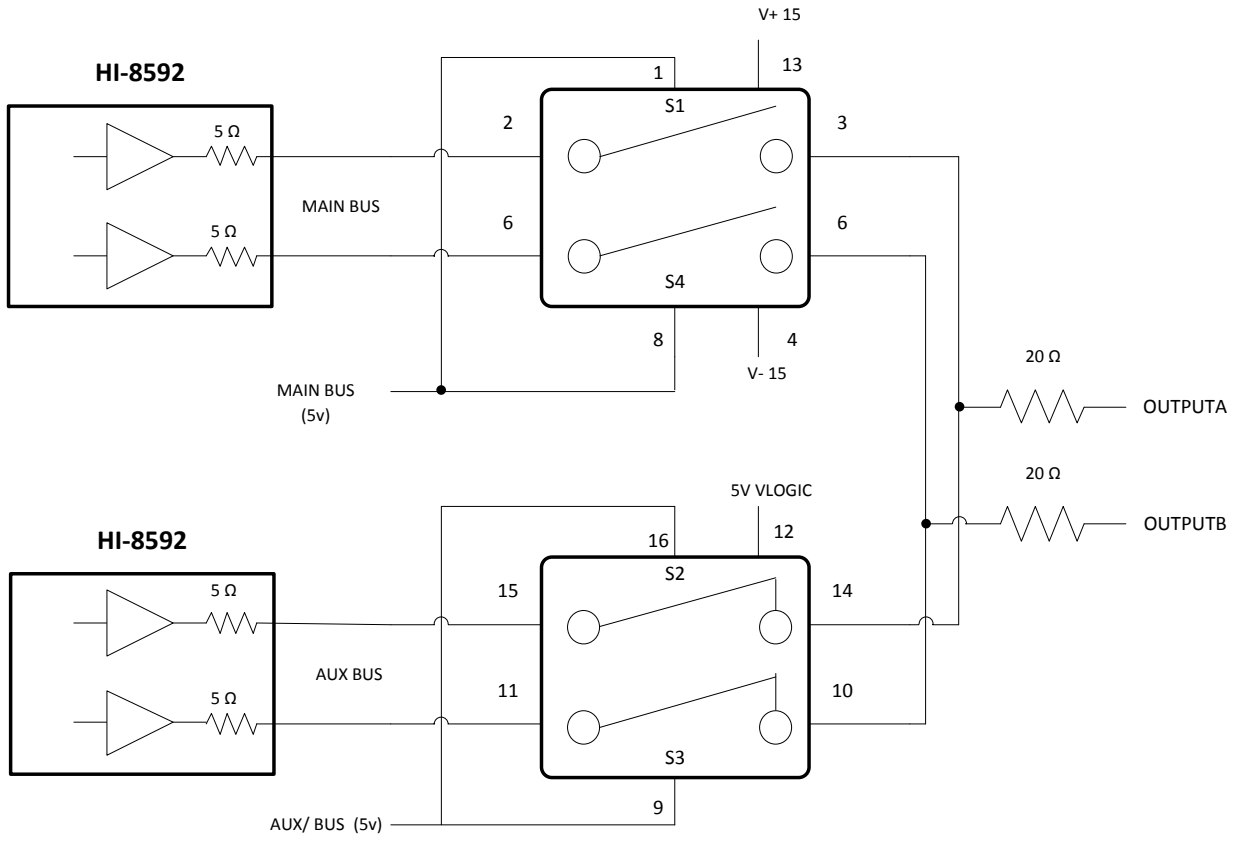
All the analog switches exhibit very low supply current on the VLOGIC, V+ and V- pins. Three versions are available, featuring different combinations of normally open (NO) and normally closed (NC) operation shown in the table below.



PRODUCT	IN1	Switch 1	IN2	Switch 2	IN3	Switch 3	IN4	Switch 4
HI-8190	0 1	Open Closed	0 1	Open Closed	0 1	Open Closed	0 1	Open Closed
HI-8191	0 1	Closed Open	0 1	Closed Open	0 1	Closed Open	0 1	Closed Open
HI-8192	0 1	Open Closed	0 1	Closed Open	0 1	Closed Open	0 1	Open Closed

ARINC 429 Application using the HI-8592 Line Driver

This application shows how the HI-8190 analog switch multiplexes two ARINC 429 transmitter outputs onto a common output bus. A typical need to do this is to add system redundancy or to allow a path for test equipment.

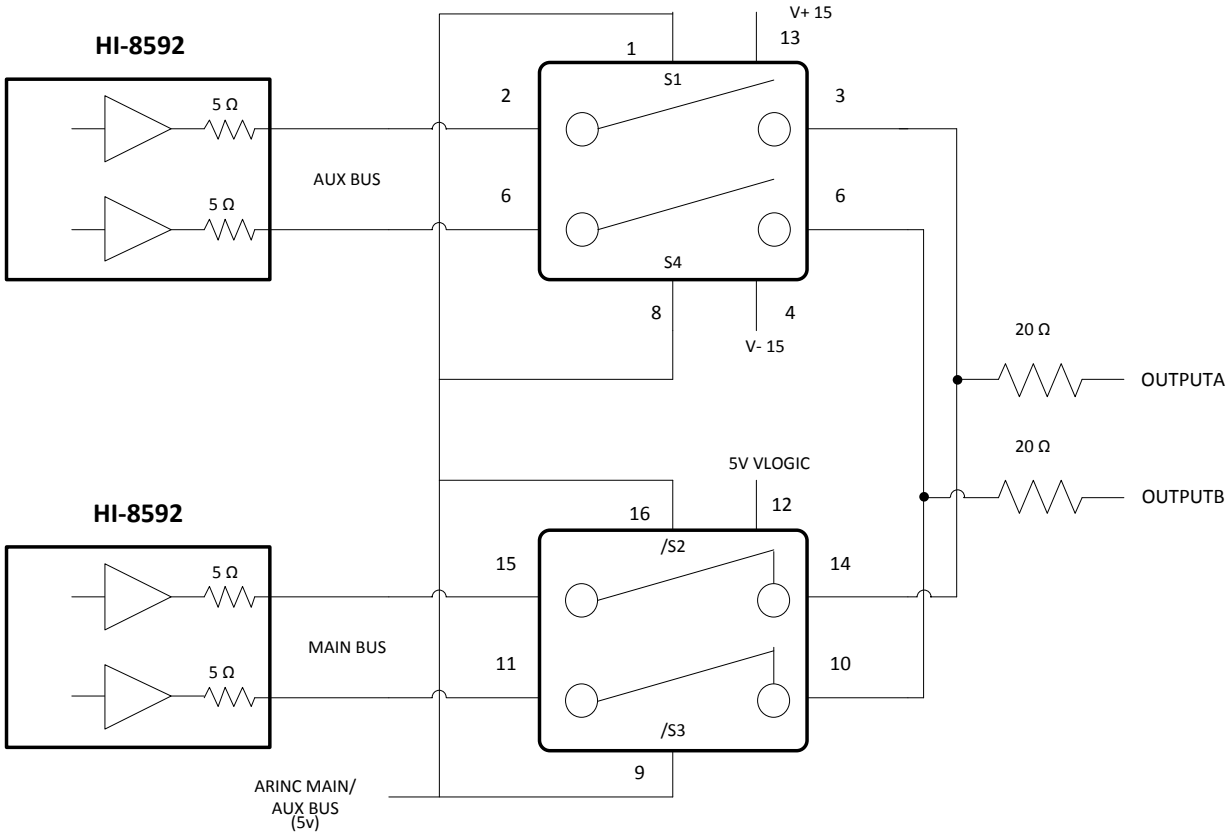


ARINC 429 specifies a 75(+/-5) ohms output impedance for the differential output, which is accomplished by each output having 37.5 ohms. The HI-8596 and most other Holt Line Drivers normally provide two types of output drive. The TXAOUT/TXBOUT outputs have an integrated 37.5 ohms resistance which can drive the ARINC bus directly. The AMPA/AMPB outputs have 5 ohms output resistance, typically used when implementing a lightning protection scheme using external components. The lightning protection components make up the remaining resistance to maintain 37.5 ohms. See the Holt AN-300 and AN-301 application notes for lightning protection schemes.

When the analog switch is powered using nominal VLOGIC, V+ and V- power supply voltages of (5V, +15V and -15V), the ROn resistance is optimal. When using an analog switch on the output of a ARINC Line Driver, the 5 ohm outputs should be used; this 5 ohms and the ROn resistance of the switch should be considered when determining the series resistor value needed to maintain 37.5 ohms. The ROn resistance values shown in the graph in the data sheet for the three ARINC voltage levels -5, 0 and +5 volts are approximately 11.8, 15 or 14 ohms. We will use 13 ohms for the switch ROn resistance value.

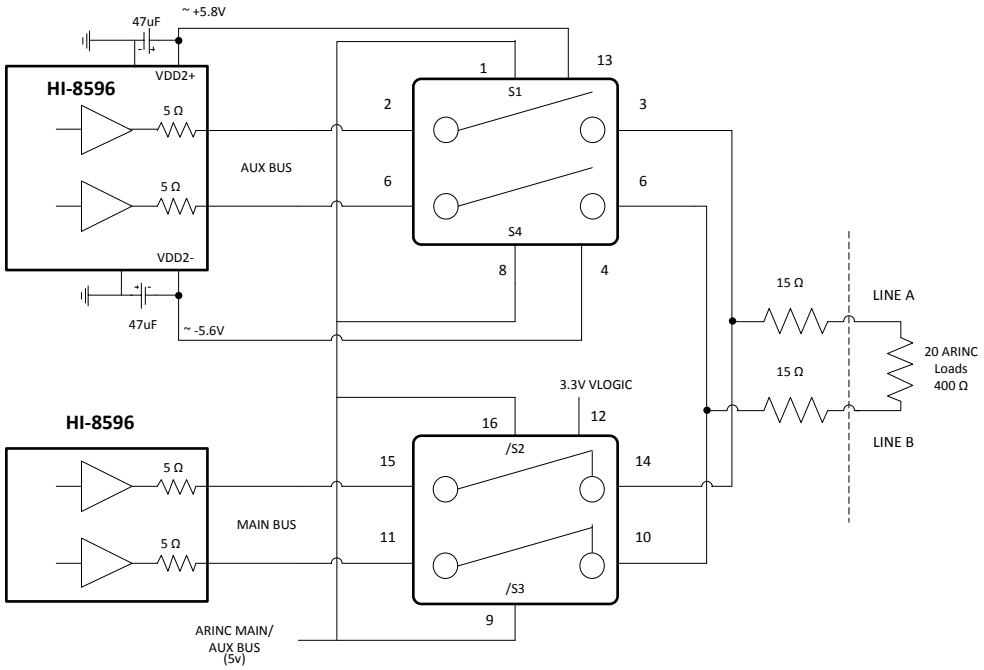
To achieve 37.5 ohms utilizing the built-in 5 ohms of the line driver and 13 ohms for the ROn resistance we need an external 19.5 ohm resistor. Since ARINC specifies the output impedance to be 75 +/- 5 ohms, choosing a 20 ohm resistor is suitable.

In some applications, the HI-8192 is a better choice, providing two NO switches and two NC switches in a single IC package. The previous diagram is now simplified with one control signal.



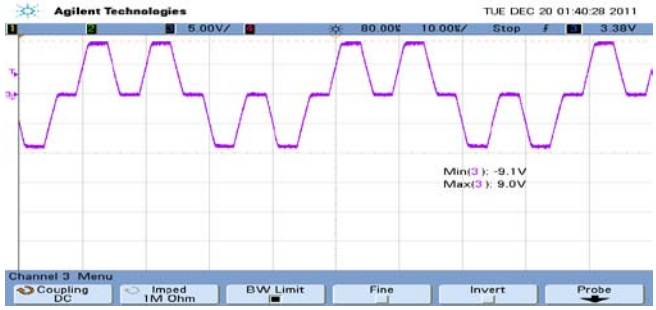
ARINC 429 Application using the HI-8596 Single-Rail 3.3V Line Driver

This configuration demonstrates switching between two ARINC Line Driver outputs with the HI-8596 DC-DC converter sharing power with the analog switch. This eliminates the need for additional +/- 15V power supplies. The analog switch input current on the V- and V+ pins is minimal (500nA) so this has nearly no loading affect on the DC-DC converter voltages on the Line Driver IC. The RON resistance of the switch is slightly higher in this case due to the lower voltages on V+, V- and VLOGIC so the output series resistor is decreased to 15 ohms to compensate, while still maintaining a 37.5 ohms output.



The scope plot below shows the HI-8596 and HI-8192 output waveform across LINE A and LINE B with VDD&VLOGIC at 3.30V. With twenty receiver loads, the minimum resistance is 400 ohms per the ARINC 429 specification (2.2.4.2). ARINC 429 (2.2.3.2) specifies the normal differential voltage at the receiver as follows.

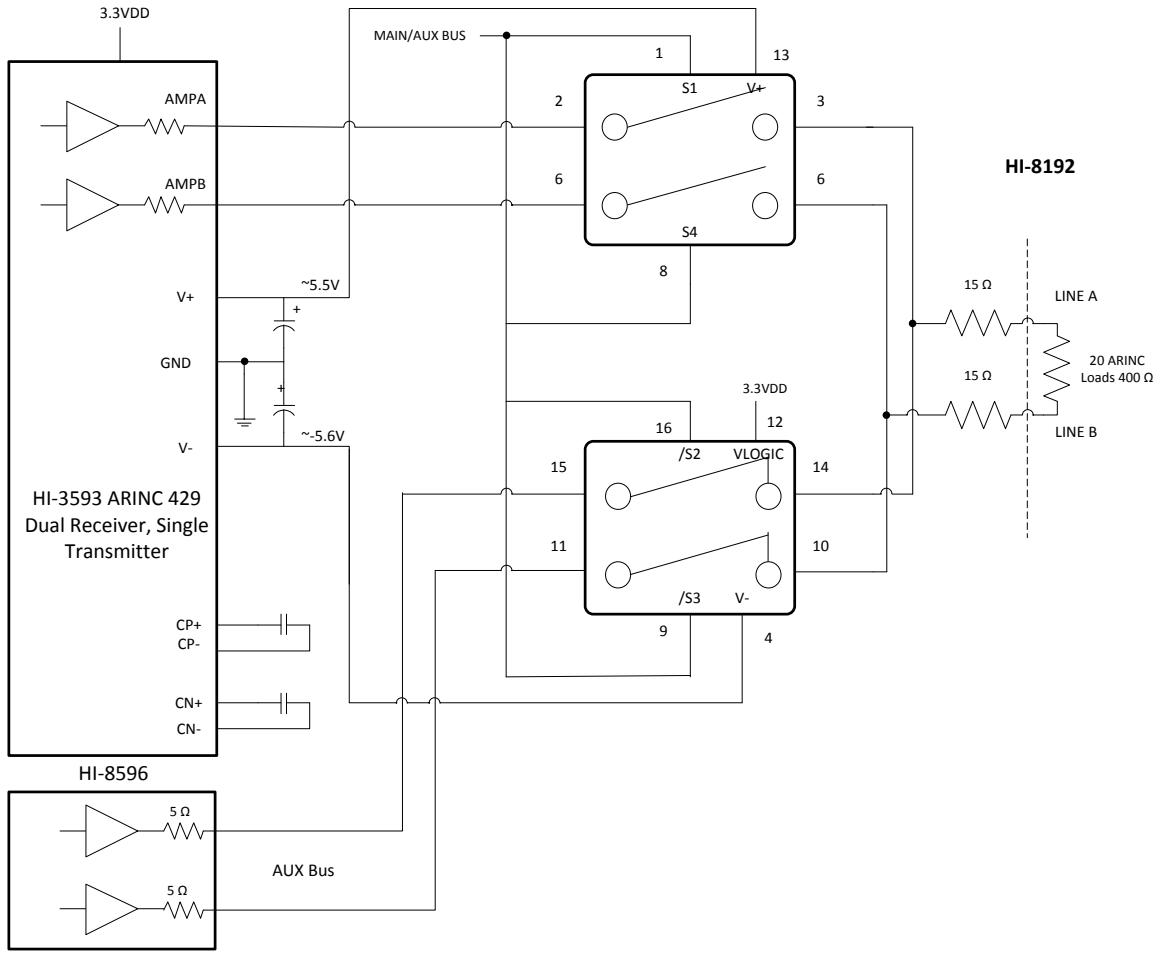
HI = +7.25V to 11V
NULL = +.5V to -.5V
LO = -7.25V to -11V.



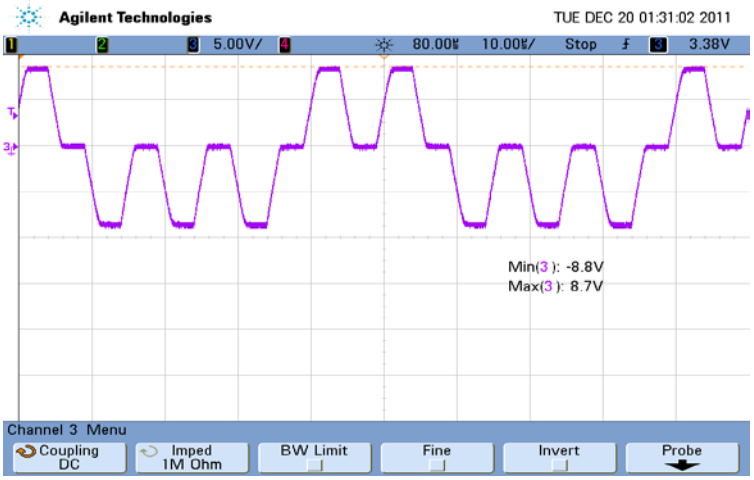
With VDD/VLOGIC at 3.3V the line voltages are 9.0 and 9.1 volts as shown in the plot. With VDD/VLOGIC reduced to 3.0V, the differential line voltages only drops to 8.7/8.8 volts (not shown).

ARINC 429 Application using the HI-3593 and HI-8596

This configuration demonstrates switching between a HI-3593 output and an auxiliary bus driven by a HI-8596 line driver. The HI-3593 DC-DC converter shares the V+/V- power with the HI-8192. The ROn resistance of the switch is slightly higher here due to the lower voltages on V+, V- and VLOGIC, so 15 ohms output resistors are used here.



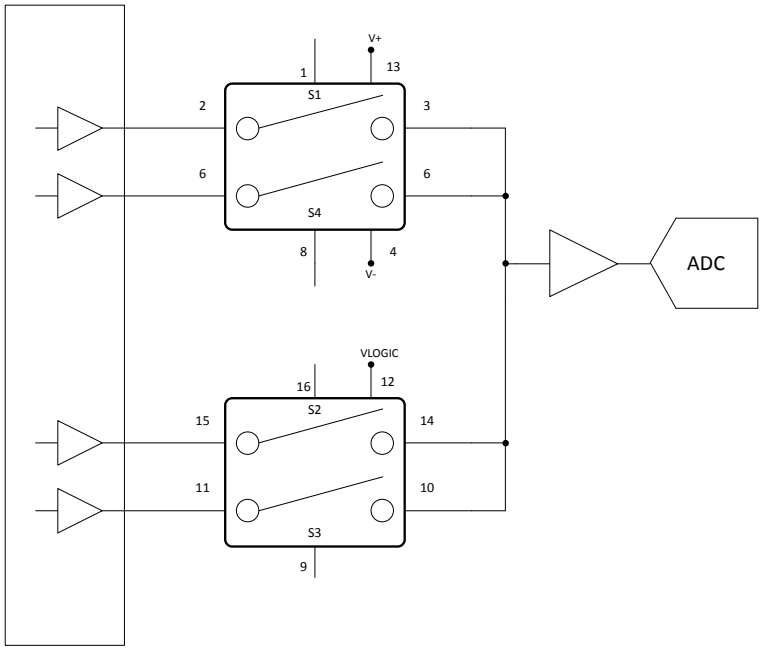
The scope plot shows the HI-3593 and HI-8192 output waveform across LINE A and LINE B with VDD&VLOGIC at 3.30V at full load. With VDD&VLOGIC reduced to 3.0V, the differential LINE voltages only dropped to 8.7/8.6 volts (not shown).

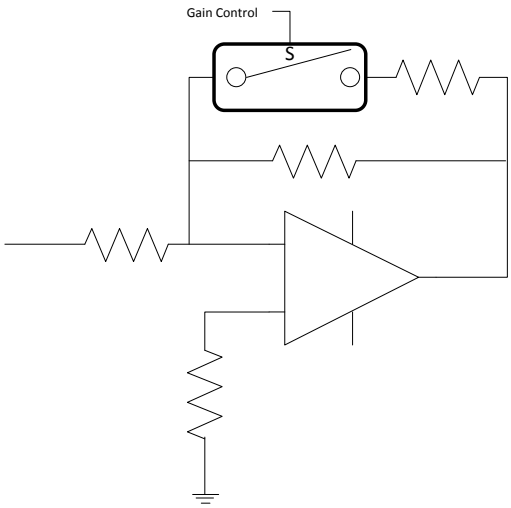


When using the HI-8190 family with the nominal power supply voltages on VLOGIC(5V), V+(15) and V-(-15V) a 20 ohm matching output resistor should be used. This assumes a 5 ohm line driver output.

General Purpose Applications

The Holt analog switches are well suited for general purpose analog signal switching. For example, they can be used to multiplex multiple sensor inputs to a common amplifier block preceding an ADC, or to switch other components in or out of a circuit to alter the gain or filtering response of an amplifier or filter block. Typical examples are shown below.





Summary

This application note demonstrates how to use the Holt analog switches in ARINC 429 bus switching and in general purpose applications.

REVISION HISTORY

P/N	Rev	Date	Description of Change
AN-177	NEW	01/31/12	Initial Release