

Background

QuickSwitch devices from Quality Semiconductor, originally designed for high-performance digital bus applications, can be used in small signal analog applications. Following is a discussion of crosstalk, off-isolation, and insertion loss, parameters critical to the performance of analog systems. The characterization data of these parameters from the QuickSwitch devices is included.

Crosstalk, Off-isolation, and Insertion Loss Defined

Crosstalk and off-isolation are parameters that measure the noise that couples from a switching signal to an unused channel. Crosstalk is the amount of cross-coupling from an analog input channel to another analog channel that occurs at a specific frequency. Off-isolation is the amount of coupling from input to output of a disabled channel.

Insertion loss is the attenuation of the output signal from the respective input signal. Insertion loss varies widely with load, so it is important that the load conditions be clearly defined. Insertion loss over a range of frequencies is the frequency response of the device.

Crosstalk and off-isolation are expressed in dB as $20\log_{10}(V_{IN}/V_{OUT})$. Insertion loss is expressed in dB as $20\log_{10}(V_{IN}/V_{OUT})$.

Crosstalk and Off-isolation

Crosstalk and off-isolation are critically dependent on circuit layout. The test setup, described later, was not optimized for this type of data. The results, therefore, are probably 10dB to 20dB less than what the QuickSwitch device is capable of.

The device used for the data measurement was the QS3L384 from Quality Semiconductor. The crosstalk of the QuickSwitch device tested was measured to be -66dB at 50MHz. Typical analog switches measure in the -60 to -80dB range.

Off-isolation of the QuickSwitch device was also measured to be -66dB at 50MHz. Typical analog switches measure in the -60 to -80dB range. The off-isolation and crosstalk measurements are the same because of the QuickSwitch device layout. The QS3L384 shares its design with the QS3L383, the bus swap QuickSwitch device, thus the swapping transistors are still present in the silicon, though not actively in use.

Insertion Loss

Insertion loss for the QuickSwitch device as with any analog switch is dependent on the circuit in which it is employed. In a 75Ω circuit at 80MHz, a typical video environment, the 3dB point of the QuickSwitch device is not reached until V_{IN} is greater than 3.0V.

Break Frequency

The frequency at which the insertion loss crosses the 3dB point is the break frequency. For this reason the break frequency is also referred to as the f3dB. The f3dB can be calculated from the equation $f_{3dB} = 1/2RC$, where R is the resistance of the circuit (R_{ON} and R_L in parallel) and C is the capacitance of the circuit (C_{DS} and C_L in parallel). R_L and C_L are the external load elements, R_{ON} is the on resistance and C_{DS} is the parasitic capacitance between the drain and the source of the switching element. It is clear from the chart below that C_L has the biggest effect on the break frequency.

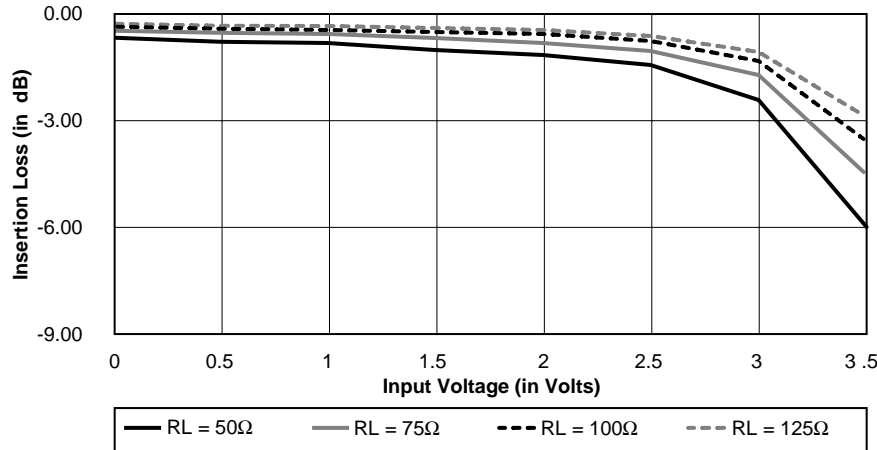


Figure 1. QuickSwitch Insertion Loss @ 80MHz

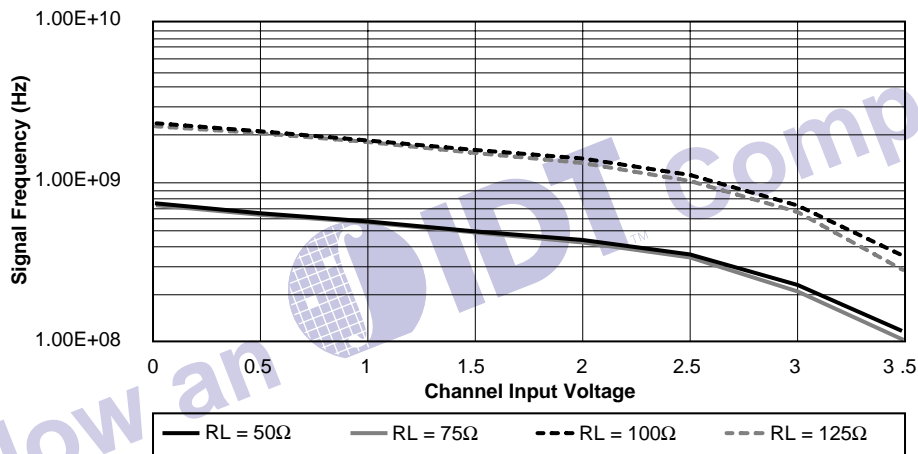


Figure 2. Back Frequency of QuickSwitch Channels

Setup

The device used for the characterization was a QS3L384P soldered directly to a ground plane, no socketing was used. The DIP package was chosen for evaluation to allow for capacitor and resistor components to be soldered to the pins without having to resort to a custom board as would have been necessary with the SOIC or QSOP package. All unused signal lines were tied to ground. The V_{CC} line was decoupled to the ground plane using a $0.1\mu\text{F}$ and a $0.01\mu\text{F}$ capacitor. The same value decoupling capacitors were also placed between the power supply ground lead and the ground plane. The pins being tested were terminated to the ground plane using 75 resistors. All components used were surface mount to reduce the effects of inductance.

The pulse generator used was a Wavetek model 3000 signal generator with a maximum frequency of 520MHz. All measurements were taken with an HP54110D digitizing oscilloscope with a bandwidth of 1GHz. Since the linearity of the QuickSwitch device channel is quite good from 0 to 2.0V, the input signal magnitude was chosen to be approximately 2V rather than 0.7V, a typical video signal, to give more accurate data.

Measurements for crosstalk were taken at pin A0, while measurements for off-isolation were taken at pin A1.

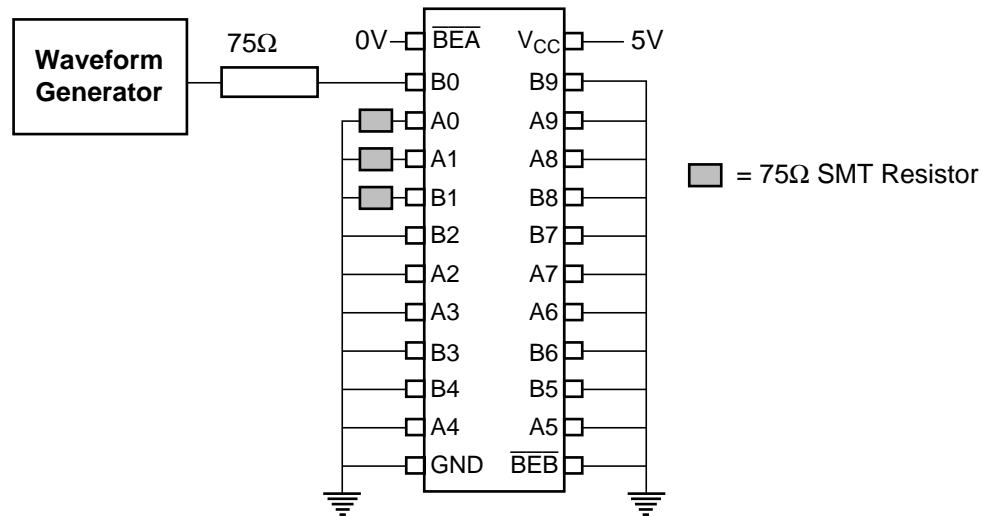


Figure 3. Test Jig

Conclusion

The crosstalk and off-isolation characteristics provide much immunity from unwanted noise and the frequency response, insertion loss over frequency, is most affected by system load. The QuickSwitch

devices from Quality Semiconductor provide good noise margin and insertion loss characteristics for use in many small signal analog applications such as VGA adapters.

Figure 4. 24-Pin TSSOP/QSOP Universal Footprint