ISL7184xSEH

Output Capacitance Considerations

Abstract

The ISL7184xSEH's output capacitance for the off channels does not follow a simple capacitance model. It presents a much more complex behavior that results in an anomalous current spike during an output transition. If the source impedance for the active channel is high enough, this added current can distort the output waveform. It is important to note that this phenomena does not affect DC leakage currents.

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Related Literature

For a full list of related documents, visit our website:

- ISL71840SEH, ISL71841SEH device pages

1. Anomalous Transient Current Signature

The anomalous current is exacerbated by three conditions: output voltage, temperature, and the output slew rate. For output voltage, the current spike may appear as the channel voltage transitions through 3V to 9V. For temperature, the higher the temperature, the larger the current is. For the output slew rate, the faster the slew rate, the larger the current spike. Figure 1 shows the normal (expected) behavior at 25°C versus Figure 3 at +125°C. Bench testing also showed that switching the output from below ground to some positive voltage ensured that the current spike would occur as shown in Figure 2. The test circuit used to generate Figures 1 and 2 was configured to drive the output of the multiplexer in a disabled condition with a voltage source through a 1kΩ resistor. The voltage drop across the resistor was used to measure the current going into the output.

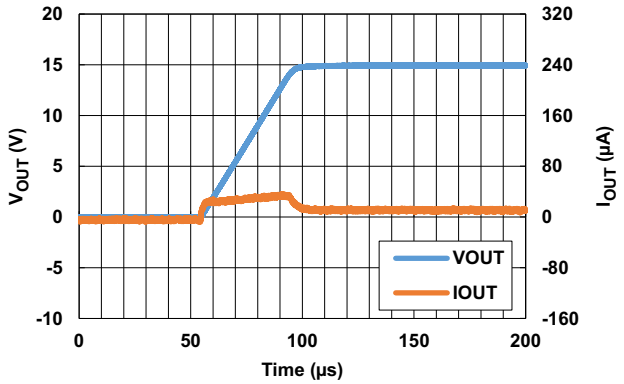

Figure 1. Normal Operation (0V to 15V on V_{OUT}) at 25°C

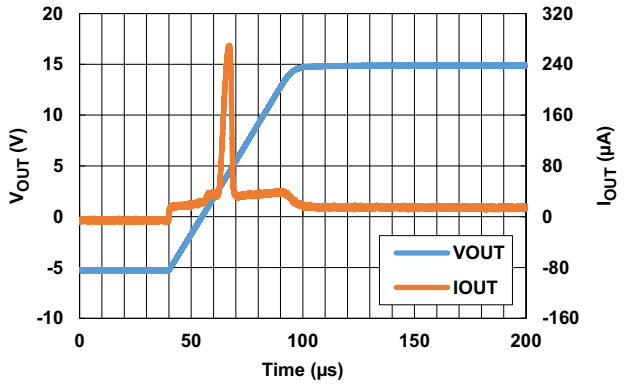

Figure 2. Anomalous Current Spike (-5V to 15V) at 25°C

When the temperature is increased to 125°C, the current spike appears regardless of how low the output voltage gets (as shown in Figures 3 and 4).

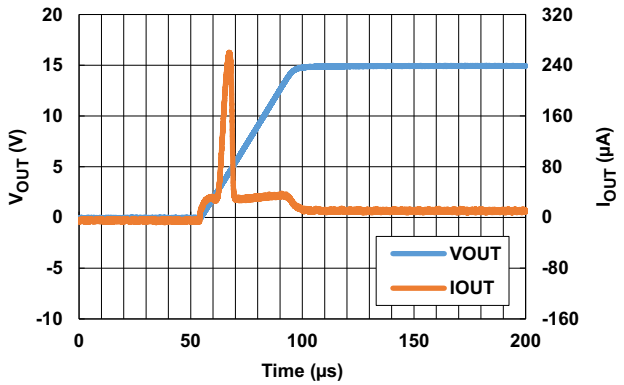

Figure 3. Anomalous Current Spike (0V to 15V on V_{OUT}) at 125°C

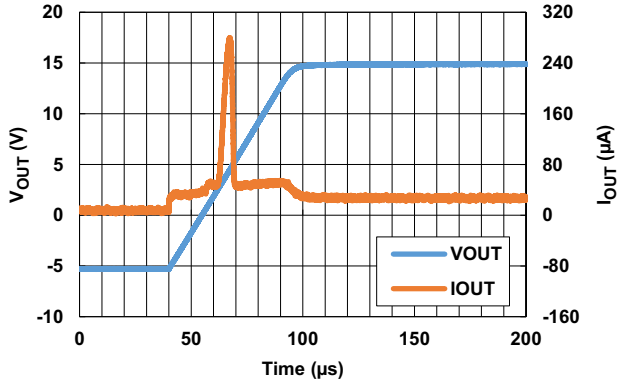

Figure 4. Anomalous Current Spike (-5V to 15V) at 125°C

As expected, the amount of current increases with increasing slew rate. The peak current versus output slew rate was plotted for both the ISL71840SEH and the ISL71841SEH. The peak current from Figure 5 on page 3 shows how much current needs to be sourced from the selected multiplexer input for a given output slew rate to ensure the output waveform is not distorted.

Figure 5 shows that the peak output current is higher for the ISL71841SEH compared to the ISL71840SEH. This is due to the increased number of inactive channels present on the ISL71841SEH. When paralleling multiple multiplexers to increase channel density, the increased current can present a significant load to the active channel.

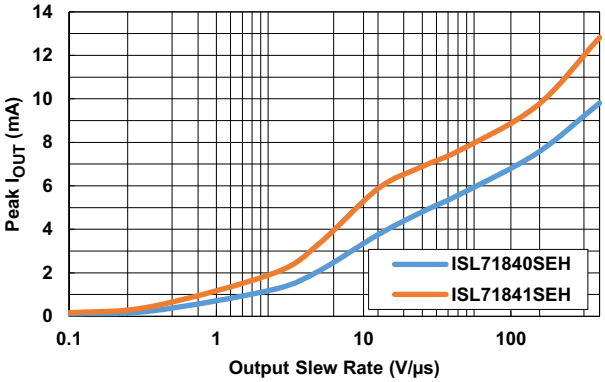

Figure 5. Anomalous Current Spike vs Output Slew Rate at 125°C

2. ISL7184xSEH vs HS-1840xRH and ISL7183xSEH

The ISL7184xSEH was a pin-for-pin replacement for the HS-1840xRH so it is good to see how it reacts under the same conditions. We considered the 0.36V/µs output ramp rate case at 125°C.

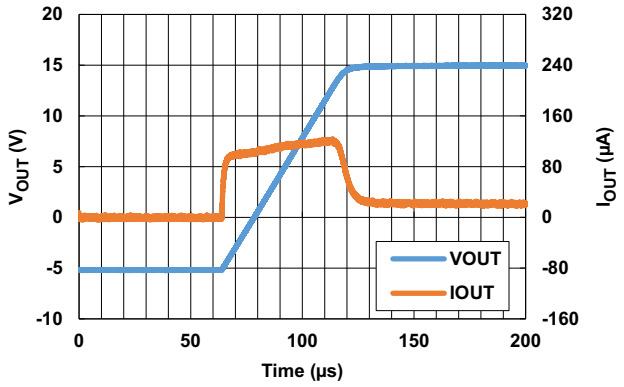

Figure 6. HS-1840xRH Behavior at 125°C

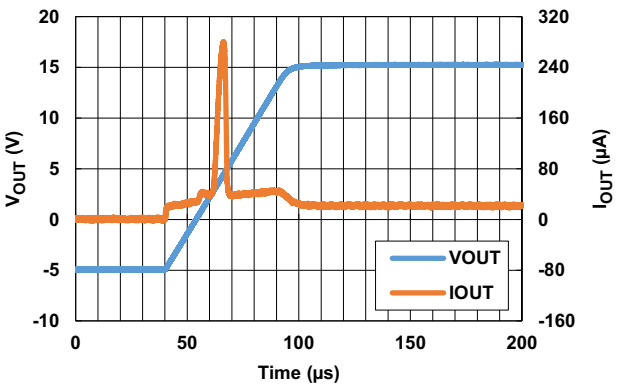

Figure 7. ISL71840SEH Behavior at 125°C

As it can be seen the plateau on I_{OUT} exists for both the HS-1840xRH and the ISL7184xSEH and is due to the inherent output capacitance of the multiplexer. For the HS-1840xRH, the current into the output is constant and in line with a simple capacitance model.

The ISL71830SEH and ISL71831SEH were tested for this anomalous current phenomena and were found to be free of it as well.

3. Assessing Peak Current in the ISL7184xSEH

Normalizing the data in Figure 5 for the ISL71840SEH on a per channel basis we get Figure 8. As the peak currents on a per channel basis are higher on the ISL71840SEH, they can be used as a worst case scenario for the ISL71841SEH.

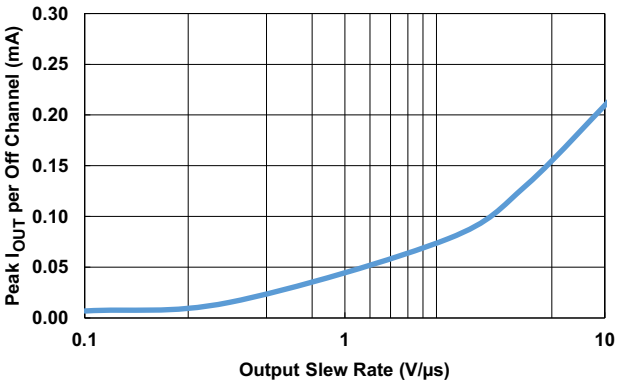

Figure 8. Normalized Peak I_{OUT} per Channel (125°C)

Multiplying the peak current in Figure 8 by the number of off channels connected to the output in a system provides the anomalous current seen during an output transition. Imposing this current against the source impedance of the selected channel allows determination of whether the transient distortion is seen on V_{OUT}. An example of this distortion can be seen in Figure 9 where the temperature is increased from +25°C (no distortion) to +125°C (with distortion).

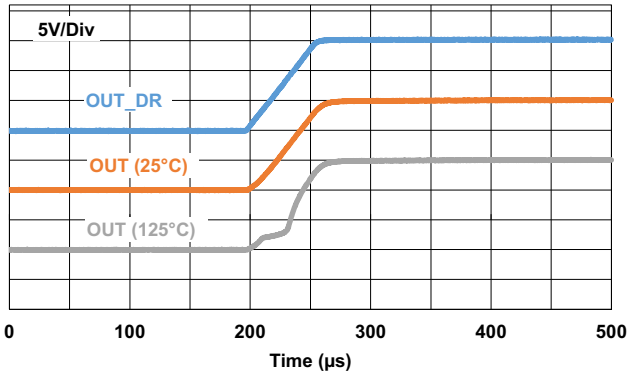

Figure 9. Transient Distortion

4. Summary and Conclusion

If the source impedance of the selected channel is high enough, the anomalous current can result in the output waveform being distorted. The distortion caused by the anomalous current needs to be accounted for during system design and can be quantified using Figure 8. This distortion is a transient phenomenon and does not affect DC performance.

5. Revision History

Rev.	Date	Description
1.00	Dec.6.19	Initial release

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