Application Report
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Why Users Should Consider Upgrading Their LMV324, LMV358, and LMV321 Devices

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ABSTRACT

This app note provides guidance as to why a designer should consider upgrading their designs from legacy LMV324, LMV358, and LMV321 (LMV) devices to the modern LMV324A, LMV358A, and LMV321A (LMVA) device family, which are more robust and can be used as a drop-in replacement for LMV devices. LMVA devices also have overall better performance while staying within same design budget. While the legacy LMV devices are fabricated by multiple semiconductor manufacturers and found in many designs, the devices are not necessarily interchangeable across manufacturers. For example, some devices not produced by Texas Instruments have higher current when used in comparator mode. Also, some LMV devices, including those produced by Texas Instruments, may exhibit phase reversal when common-mode recommended voltage range violations occur. TI's modern LMVA devices do not have phase reversal and can be used in comparator mode, which yields a more robust design.

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1 Phase Reversal

When the input common mode is in the recommended operating range, the output is the correct phase for all devices tested. When both inputs are above the common-mode range, LMV devices from multiple manufacturers have input stages where the transistors are in cutoff, so the output tries to either go to VOH (positive supply rail) or VOL (negative supply rail). In normal (negative feedback) operation, VOL-going samples clamp the output to keep input at the maximum common-mode voltage, the point where inversion stops. LMVA devices do not exhibit phase reversal and provide the desired output voltage.

Figure 1 is sample data for maximum input common mode range with supply voltage set to 5 V. If the input common-mode voltage exceeds the chart value, the input stage goes into cut off. Therefore, the output is no longer controlled by the input voltage.

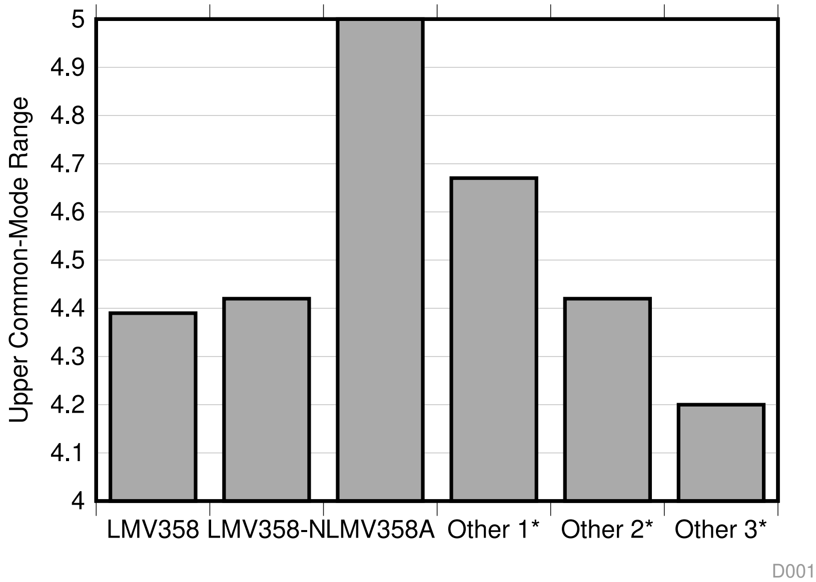

Figure 1. Maximum Input Common-Mode Range (Supply is 5 V)

For a negative input voltage on either input, LMV devices from multiple manufacturers, including Texas Instruments, exhibited phase reversal. The output voltage went to the incorrect supply rail for at least one of the inputs. LMVA samples tested did not invert with current up to -10mA. Avoiding negative voltages altogether is the preferred design practice.

However, good design practice limits the maximum input current to -1mA. Figure 2 and Figure 3 show the output voltage for a unity gain buffer application where negative input current flows due to a negative input voltage. Ideally, the output must be low. Output voltage going high indicates phase reversal.

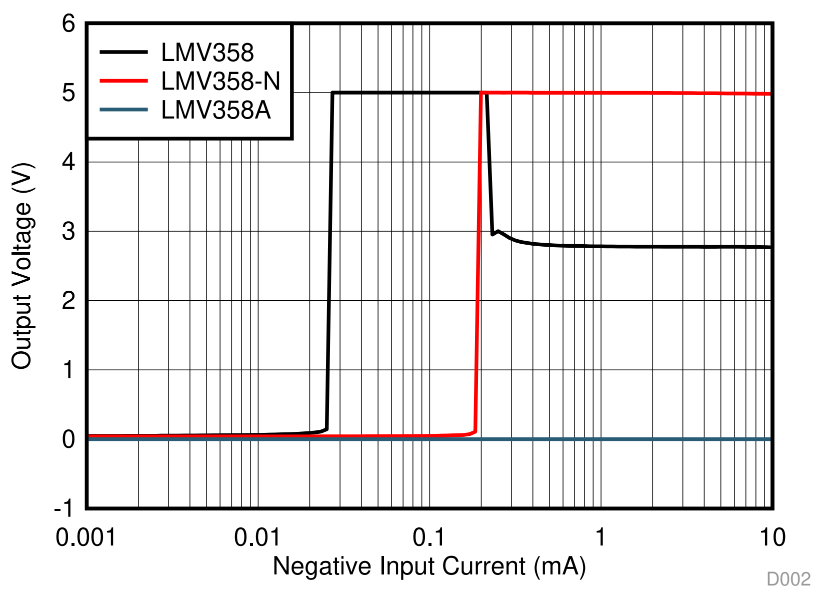

Figure 2. Output Voltage Versus Negative Input Current (Non-Inverting Input) for Texas Instruments' Samples

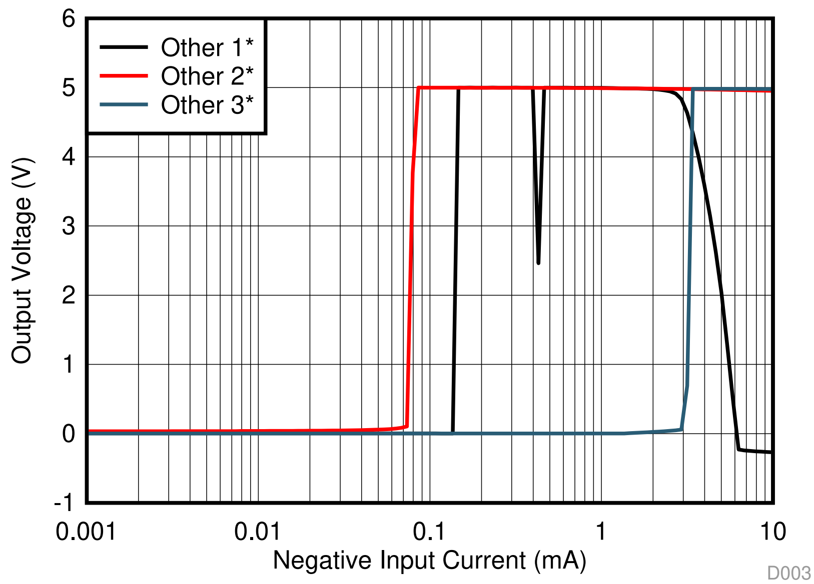

Figure 3. Output Voltage Versus Negative Input Current (Non-Inverting Input) for *Other Manufacturers' Samples

2 Better Performance Within Design Budget

As of the publication of this document, LMVA device specifications are better and 1 ku web pricing is lower. This quick comparison link has up-to-date 1 ku product page pricing.

The comparison highlights the improvements in input offset error and quiescent current. There is also significant improvement in common mode rejection (13 dB higher) and power supply rejection (28 dB higher). Slew rate is also increased by 70%.

In general, op amps must not be used as comparators. However, these general purpose op amps are often used as comparators in some applications. Comparator applications spend most of the time in VOL or VOH output state. Some LMV devices tested had an elevated quiescent current when the output was VOL or VOH. Texas Instruments LMV and LMVA products do not have increased quiescent current when the output is VOL or VOH. Also important for comparator usage is overload recovery time; this parameter is analogous to propagation delay in a dedicated comparator. Overload recovery for LMVA is typically 0.9 us. After overload recovery time, slew rate controls the output rise and fall times.

Figure 4 and Figure 5 show changes in supply current and quiescent current when the output is driven into VOL and VOH states. Greater changes in VOL or VOH are charted in Figure 4 and Figure 5.

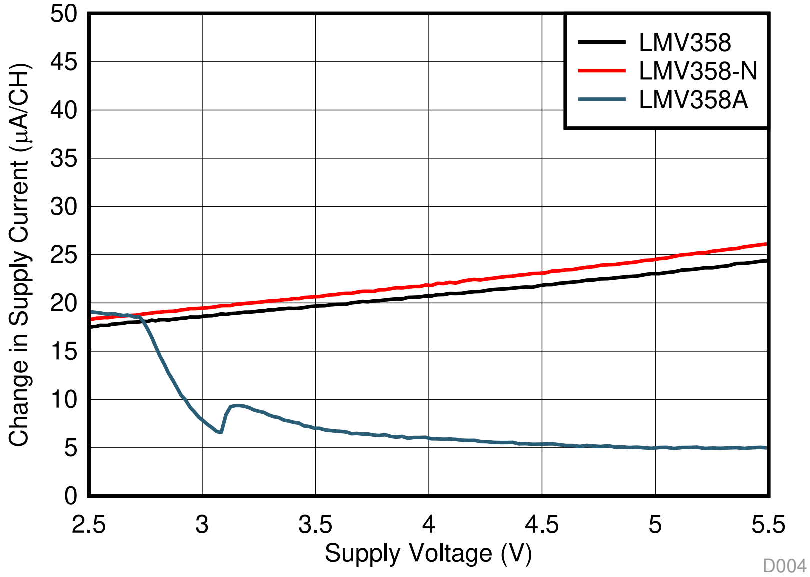

Figure 4. Change in Supply Current for Output in VOL and VOH state Versus Supply Voltage for Texas Instruments' Samples

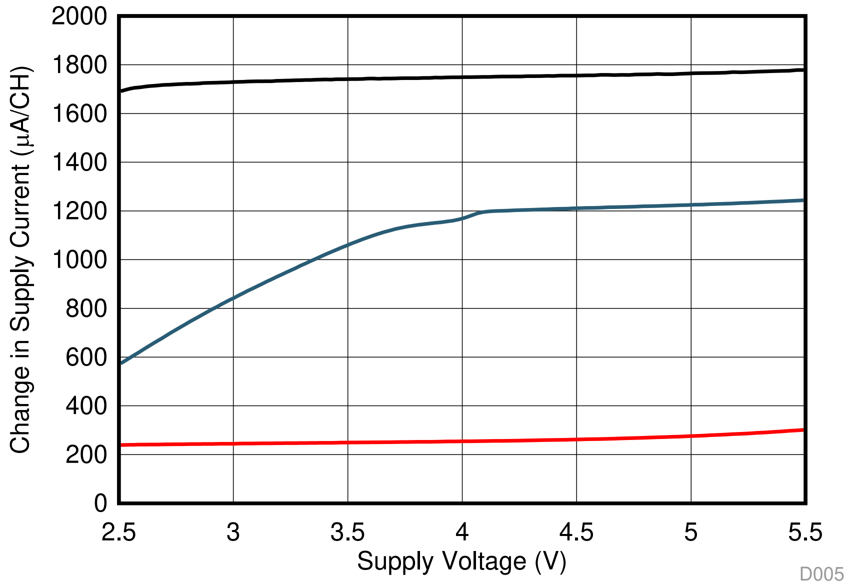

Figure 5. Change in Supply Current for Output in VOL and VOH State Versus Supply Voltage for *Other Manufacturers' Samples

3 Summary

This document has outlined a number of reasons why designers should consider upgrading their designs from legacy LMV324, LMV358, and LMV321 (LMV) devices to the modern LMV324A, LMV358A, and LMV321A (LMVA) device families. They yield better performance (comparator mode, no phase reversal) without sacrificing design budget.

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