

Utilizing AMC3311 to Power AMC23C11 for Isolated Sensing and Fault Detection



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Introduction

Fault-detection is essential in applications including [motor drives](#), [servo drives](#), [onboard chargers \(OBCs\)](#), [string inverters](#), and [micro inverters](#). Separating the high voltage domain and the low voltage domain across an isolation barrier allows the system to operate at different common-mode voltages. The high voltage domain performs a function while the low voltage domain controls equipment. This prevents both electrical damage to the low voltage circuitry and harm to users. Detecting faults such as overvoltage is required when operating at high common-mode voltages. This document highlights how the AMC3311 can offer high-side supply current from HLDO_OUT to power the high voltage domain of the AMC23C11 isolated comparator for a compact fault detection design.

The AMC3311 is a precision, reinforced, isolated amplifier. This device has a 0-2 V input voltage range, which is an option for precision isolated DC voltage measurements that drive the control loop. This device features an integrated DC/DC converter that supports high-side supply current for auxiliary circuitry of 4 mA. This allows for single-supply operation from the low-side to high-side of the device for both the feedback measurement of the AMC3311 and the overvoltage fault detection of the AMC23C11. The AMC23C11 is a fast response, reinforced, isolated comparator. The device can be used for rapid overcurrent or overvoltage sensing with an adjustable trip threshold. The device requires a high-side supply current of 2.7 mA. The AMC3311 is the first isolated amplifier with an integrated DC/DC converter to enable the two devices to work as a pair for applications that require a precision isolated amplifier for control functions and a fast-acting comparator for overcurrent or overvoltage protection.

AMC3311 used to power AMC23C11

The AMC3311 offers an isolated power supply capable of providing up to 4 mA through the HLDO_OUT pin for connected components that require a high-side supply. This feature directly allows the use of higher performance isolated comparators such as the AMC23C11.

The available supply current from the AMC3311 allows a wider range of companion devices to be used with the isolated amplifier. [Figure 1](#) shows an example schematic of how to use the AMC3311 to power the high side of the AMC23C11. In the schematic, HLDO_OUT at pin five on the AMC3311 shows a trace that extends to VDD1 at pin one of the AMC23C11. The isolated comparator compares the input voltage to the reference voltage at pin three. The device pulls down the open-drain output if the input voltage exceeds the threshold established as the reference voltage. The threshold voltage can be adjusted by modifying the value of the reference resistor in relation to the internal 100- μ A current source.

Additionally, the AMC23C11 has a 1.4-V margin overhead voltage. The threshold voltage cannot be higher than the difference of the 3.2-V input and 1.4-V margin (1.8 V.) A resistor is placed between REF and GND1 to define the trip voltage as 1.07 V. As a result, this overhead requirement limits the threshold voltage on the isolated comparator to be lower than the true cutoff voltage seen on the amplifier. For example, when the true cutoff voltage is 2.14 V on the amplifier, the isolated comparator cannot monitor the voltage because the voltage exceeds the bounds set by the margin overhead voltage. As a result, RSNS is separated into two equal resistors (RSNS1 and RSNS2) to define the cutoff voltage to be proportionately half of the voltage that the AMC3311 requires. Instead, the AMC23C11 reads 1.07 V as the reference voltage.

[Figure 2](#) shows an example of a PCB layout example that routes the devices in combination.

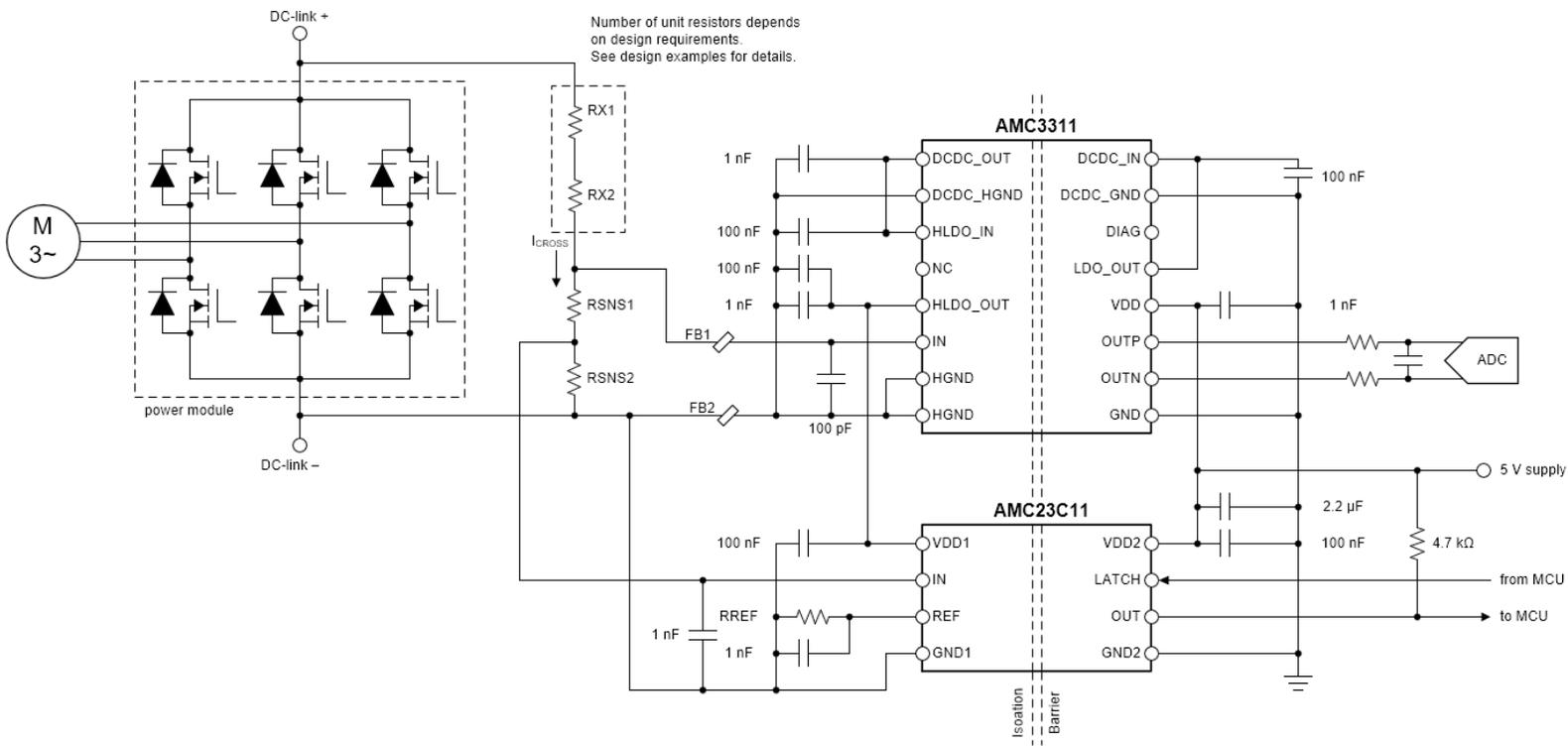


Figure 1. AMC3311 and AMC23C11 Schematic

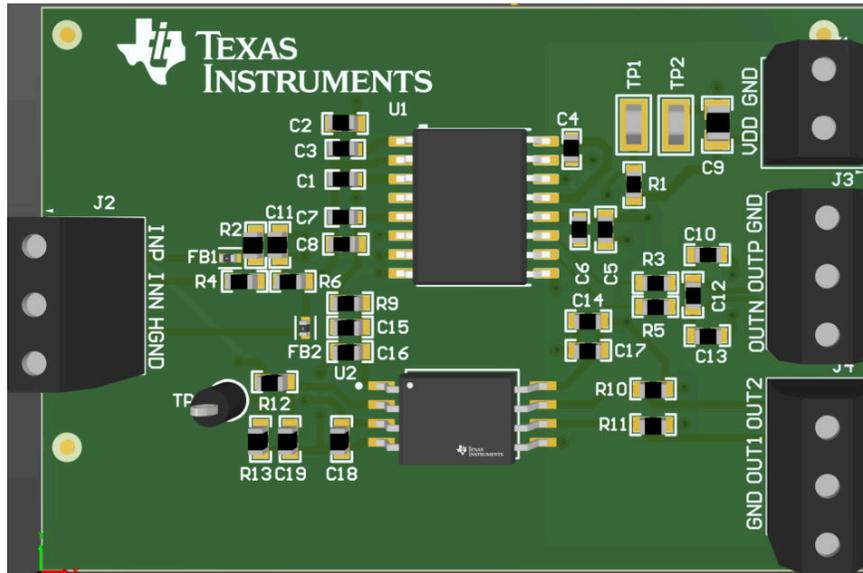


Figure 2. AMC3311 and AMC23C11 PCB Layout

AMC23C11 used for overvoltage detection

Figure 3 and Figure 4 show the overvoltage response times in the AMC3311 and the AMC23C11, respectively. Using a 3.2-V power supply, the input signal (CH4) shows the voltage rise above the 1.07 V overvoltage threshold.

The response time on the AMC3311, VOUTP (CH2), and VOUTN channels (CH1) is 2.906 μ s, while the response time on the AMC23C11, OUT (CH3), is 314.015 ns. The amplifier takes greater than nine times the length the isolated comparator takes to detect overvoltage. This time delay can be too long for low latency applications. To supplement the AMC3311 amplifier, the isolated comparator can be used to prevent an overvoltage, as the comparator quickly detects voltages higher than the set threshold. This notifies the controller to shut down all affected electronics, which offers increased safety and reliability in high voltage applications.

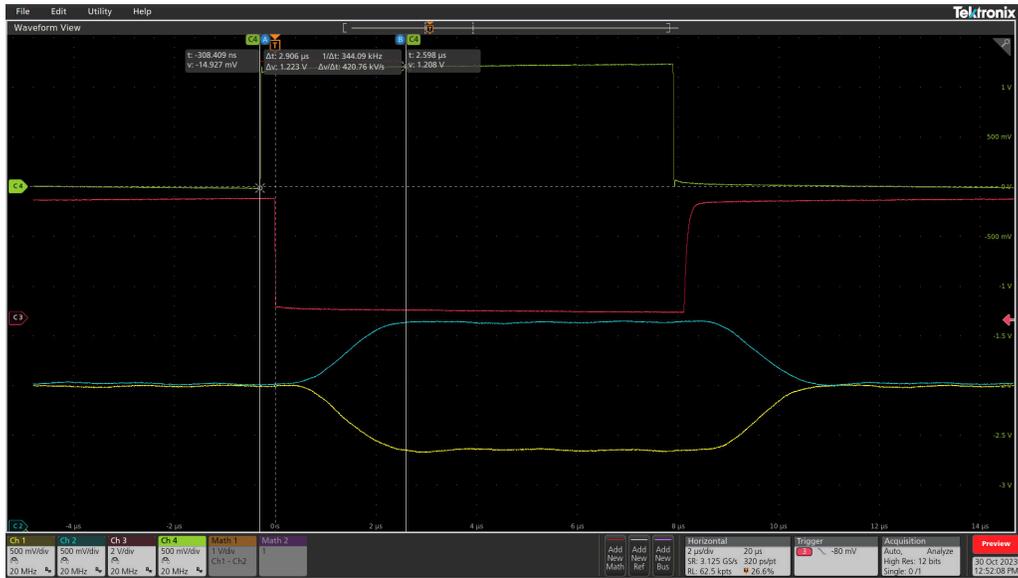


Figure 3. AMC3311 Overvoltage Response Timing Waveform

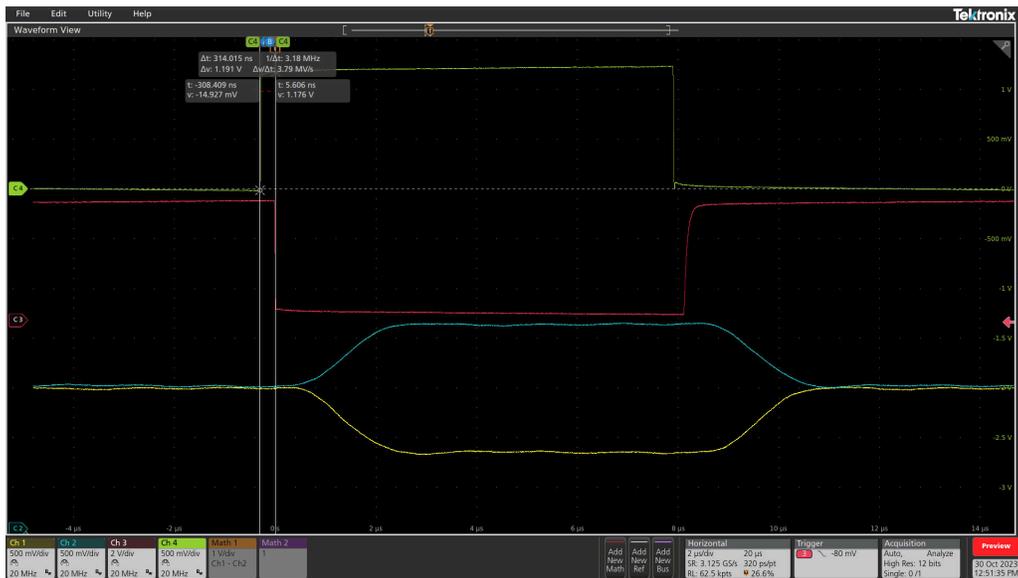


Figure 4. AMC23C11 Overvoltage Response Timing Waveform

Conclusion

The AMC3311 is an isolated amplifier with a high-side current supply that can be leveraged to power auxiliary sensing circuits. The device can power external devices up to 4 mA on the high-side, and is compatible with high-speed isolated comparators such as the AMC23C11. This comparator offers the advantage of a significantly faster response time to enable overvoltage protection. Using the AMC3311 and AMC23C11 together can be a useful option for voltage and current sensing applications.

Additional Resources

- Texas Instruments, [Precision labs series: Introduction to isolation](#), video series.
- Texas Instruments, [AMC3311-Q1 Automotive, Precision, 2-V Input, Reinforced Isolated Amplifier With Integrated DC/DC Converter](#), data sheet.
- Texas Instruments, [AMC23C11 Fast Response, Reinforced Isolated Comparator With Adjustable Threshold and Latch Function](#), data sheet.
- Texas Instruments, [Isolation Glossary](#)
- Texas Instruments, [Isolated Amplifier Voltage Sensing Excel Calculator](#), design resource.

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