Application Report

SBOT014A–December 2013–Revised July 2015

TLC2272 and TLC2272-Q1 EMI Immunity Performance

ABSTRACT

This application report describes of the EMI immunity performance of the TLC2272 and TLC2272-Q1 family of operational amplifier devices.

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1 EMI Rejection Ratio (EMIRR)

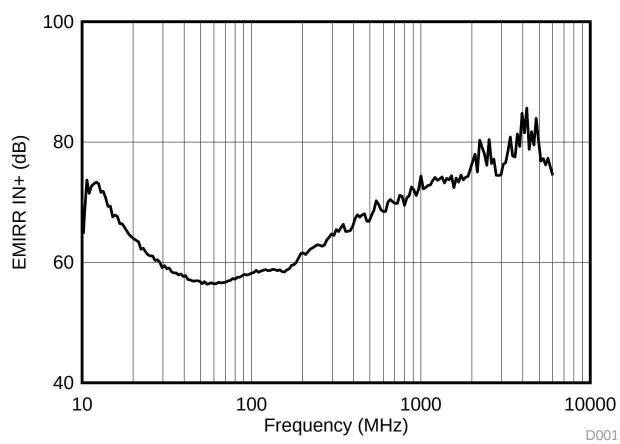
The electromagnetic interference (EMI) rejection ratio, or EMIRR, describes the EMI immunity of operational amplifiers. An adverse effect that is common to many operational amplifiers is a change in the offset voltage as a result of RF signal rectification. An operational amplifier that is more efficient at rejecting this change in offset as a result of EMI has a higher EMIRR and is quantified by a decibel value.

Measuring EMIRR can be performed in many ways, but this report provides the EMIRR IN+, which specifically describes the EMIRR performance when the RF signal is applied to the noninverting input pin of the operational amplifier. In general, only the noninverting input is tested for EMIRR for the following three reasons:

1. Operational amplifier input pins are known to be the most sensitive to EMI, and typically rectify RF signals better than the supply or output pins.
2. The noninverting and inverting operational amplifier inputs have symmetrical physical layouts and exhibit nearly matching EMIRR performance.
3. EMIRR is easier to measure on noninverting pins than on other pins because the noninverting input terminal can be isolated on a printed circuit board (PCB). This isolation allows the RF signal to be applied directly to the noninverting input terminal with no complex interactions from other components or connecting PCB traces.

A more formal discussion of the EMIRR IN+ definition and test method is provided in application report SBOA128, *EMI Rejection Ratio of Operational Amplifiers*, available for download at www.ti.com.

The EMIRR IN+ of the TLC2272 and TLC2272-Q1 is plotted versus frequency as shown in Figure 1. If available, any dual and quad operational amplifier device versions have nearly similar EMIRR IN+ performance. The TLC2272 and TLC2272-Q1 unity-gain bandwidth is 2.2 MHz. EMIRR performance below this frequency denotes interfering signals that fall within the operational amplifier bandwidth.



P_{RF} = –10 dBm V_{SUPPLY} = ±12 V

Figure 1. TLC2272 and TLC2272-Q1 EMIRR IN+ vs Frequency

Table 1 shows the EMIRR IN+ values for the TLC2272 and TLC2272-Q1 at particular frequencies commonly encountered in real-world applications. Applications listed in Table 1 may be centered on or operated near the particular frequency shown. This information may be of special interest to designers working with these types of applications, or working in other fields likely to encounter RF interference from broad sources, such as the industrial, scientific, and medical (ISM) radio band.

Table 1. TLC2272 and TLC2272-Q1 EMIRR IN+ for Frequencies of Interest

FREQUENCY	APPLICATION/ALLOCATION	EMIRR IN+
400 MHz	Mobile radio, mobile satellite/space operation, weather, radar, UHF	66.0 dB
900 MHz	GSM, radio com/nav./GPS (to 1.6 GHz), ISM, aeronautical mobile, UHF	72.1 dB
1.8 GHz	GSM, mobile personal comm. broadband, satellite, L-band	73.7 dB
2.4 GHz	802.11b/g/n, Bluetooth™, mobile personal comm., ISM, amateur radio/satellite, S-band	78.0 dB
3.6 GHz	Radiolocation, aero comm./nav., satellite, mobile, S-band	77.5 dB
5.0 GHz	802.11a/n, aero comm./nav., mobile comm., space/satellite operation, C-band	80.2 dB

2 EMIRR IN+ Test Configuration

Figure 2 shows the circuit configuration for testing the EMIRR IN+. An RF source is connected to the operational amplifier noninverting input terminal using a transmission line. The op amp is configured in a unity gain buffer topology with the output connected to a low-pass filter (LPF) and a digital multimeter (DMM). Note that a large impedance mismatch at the operational amplifier input causes a voltage reflection; however, this effect is characterized and accounted for when determining the EMIRR IN+. The resulting dc offset voltage is sampled and measured by the multimeter. The LPF isolates the multimeter from residual RF signals that may interfere with multimeter accuracy. Refer to SBOA128 for more details.

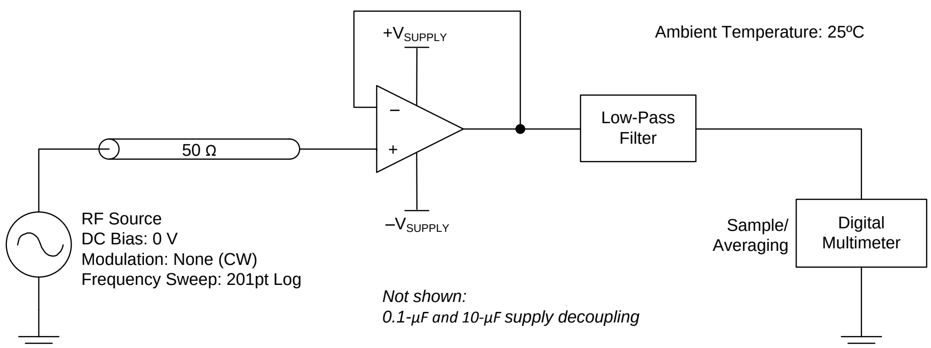


Figure 2. EMIRR IN+ Test Configuration Schematic

3 References

1. Chris Hall and Thomas Kuehl, *EMI Rejection Ratio of Operational Amplifiers*, application report SBOA128, Texas Instruments, August 2011.
2. Gerrit de Wagt and Arie van Staveren, *A Specification for EMI Hardened Operational Amplifiers*, application report SNOA497, Texas Instruments, January 2010.

For additional device information, go to the device product folders on www.ti.com:

- TLC2272, www.ti.com/product/TLC2272
- TLC2272-Q1, www.ti.com/product/TLC2272-Q1
- TLC2272A, www.ti.com/product/TLC2272A
- TLC2272A-Q1, www.ti.com/product/TLC2272A-Q1
- TLC2272AM, www.ti.com/product/TLC2272AM
- TLC2272M, www.ti.com/product/TLC2272M
- TLC2274, www.ti.com/product/TLC2274
- TLC2274-Q1, www.ti.com/product/TLC2274-Q1
- TLC2274A-Q1, www.ti.com/product/TLC2274A-Q1
- TLE2144A, www.ti.com/product/TLE2144A
- TLC2274AM, www.ti.com/product/TLC2274AM
- TLC2274M, www.ti.com/product/TLC2274M

Revision History

Changes from Original (December 2013) to A Revision	**Page**
• Added the automotive versions of the TLC2272 family of devices to the document	2
• Changed the unity-gain bandwidth from 5.8 to 2.2 MHz	2

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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