

CT453 Evaluation Board User Guide

DESCRIPTION

The Allegro CTD453 evaluation board showcases the industry-leading advantages of contactless current sensing using the CT453 differential-magnetic-field sensor from Allegro MicroSystems. This document provides a description of the evaluation board circuit and gives representative measurements of gain and linearity error.

The CT453, based on Allegro XtremeSense™ tunnel magnetoresistance (TMR) technology, features a full-bridge configuration comprising four TMR elements with active CMOS circuitry that enables high-bandwidth, high-accuracy current measurements and achieves a total output error of less than $\pm 1.0\%$ FS over voltage and temperature.

The CTD453 is a four-layer PCB equipped to perform contactless current sensing for two ranges: using PCB traces for $< 75 A_{PK}$ current and using a busbar for $300 A_{NOMINAL}$ current.

FEATURES

- Total Error: $\pm 0.5\%$ FS (Typ.)
- Available Field Ranges:

Ordering Part Number	Field Range
CTD453-06U	+6 mT
CTD453-06B	± 6 mT
CTD453-12U	+12 mT
CTD453-12B	± 12 mT
CTD453-24U	+24 mT
CTD453-20B	± 24 mT

- Built-in Galvanic Isolation
- Low-Noise Performance
- $V_{OUT} - V_{REF}$ Error: $\pm 1.0\%$ FS (Max.)
- High-Bandwidth: 1 MHz
- Fast Response Time: ~ 300 ns
- Immunity to Common-Mode Fields

EVALUATION BOARD CONTENTS

- CTD453 Evaluation Board

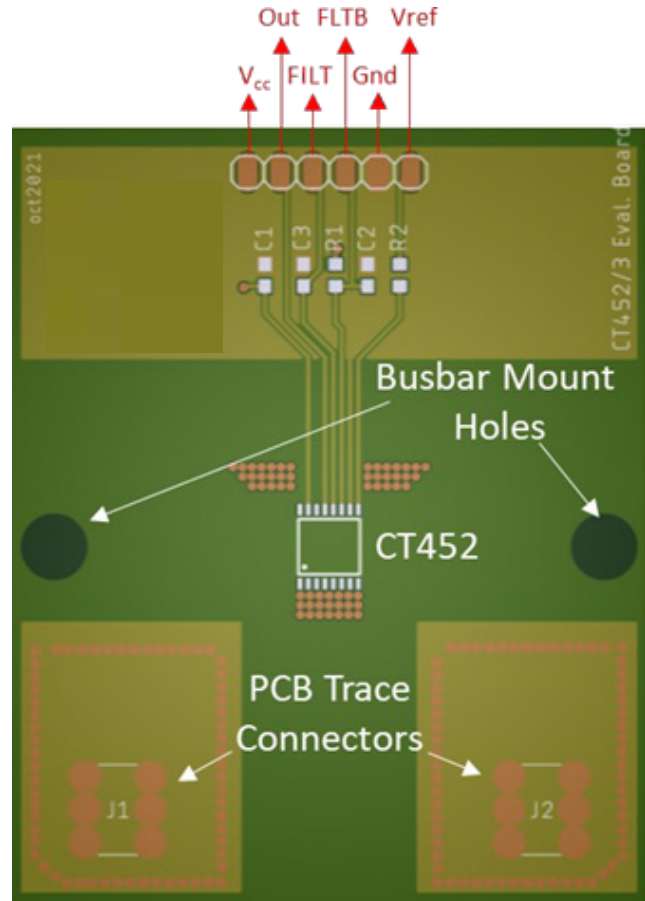


Figure 1: CTD453 Evaluation Board

Table of Contents

Description	1
Features	1
Evaluation Board Contents	1
Using the Evaluation Board	2
Introduction	2
PCB Current Sensing	2
Busbar Current Sensing	4
Materials	5
Application Support	5
Revision History	6

USING THE EVALUATION BOARD

Introduction

The CTD453, shown in Figure 1, is powered by applying a 3.3 V bias voltage between the VCC and GND pins. The analog output voltage of the sensor is accessed through the OUT pin. The VREF and FLT pins on the PCB provide access to the VREF and FLT pins on the integrated circuit (IC).

PCB Current Sensing (Steady-State Current < 75 A_{PK})

In this mode, the current is measured by passing it through the PCB traces using the screw connectors. The top layer of the evaluation board is used to place the CT453 IC and input/output (I/O) traces needed to connect to the CT453. The remaining three layers of the PCB are used to carry the current being measured. The maximum current that can be passed through the evaluation board is guided by the thermal limitations of the PCB layers.

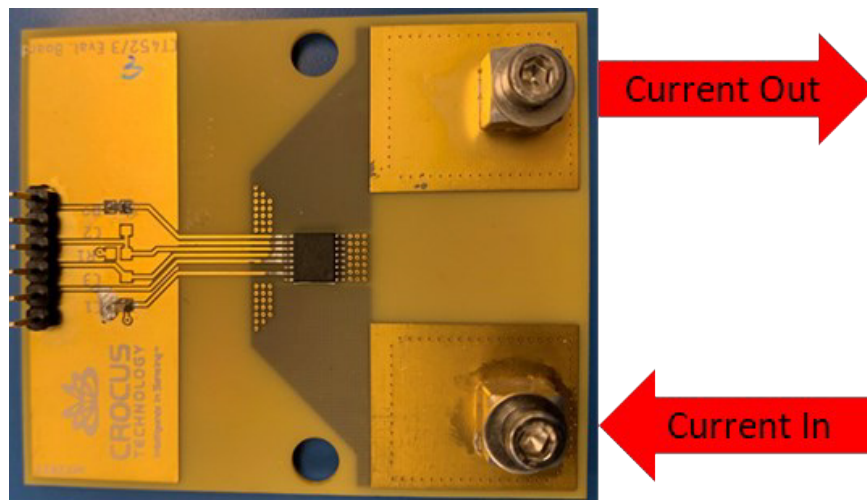


Figure 2: CTD453 PCB-Based Current Sensing

The positive direction of current flow through the PCB is shown in Figure 2. The analog output of the sensor and the <1% total error over full temperature range is showcased in Figure 3.

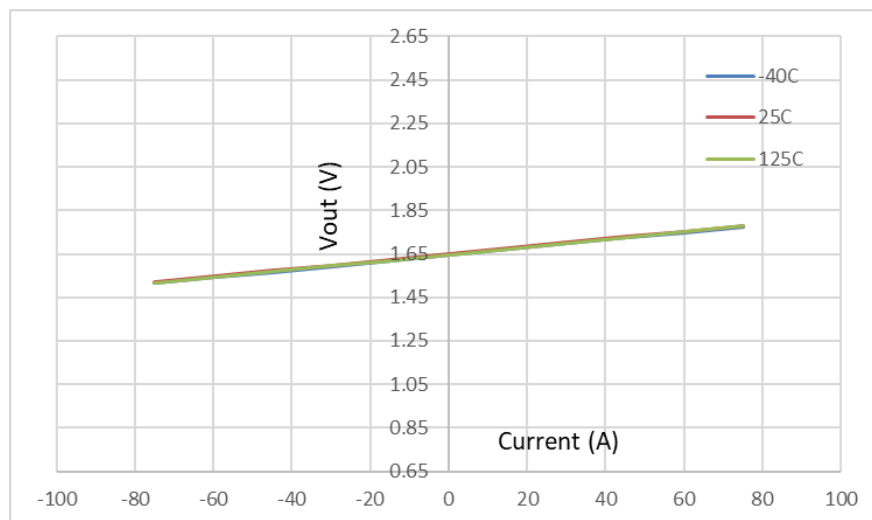


Figure 3: Excellent Linearity and Temperature Performance for CTD453

In addition to excellent linearity and temperature performance, the CT453 has extremely low noise. The input-referred noise density is shown in Figure 4, and it can be observed that the noise spectrum has a very pronounced 1/f roll-off with a typical integrated noise less than 1 mV rms from DC to 100 kHz. The integrated noise is an order of magnitude lower than the noise from any competing contactless sensor in the market.

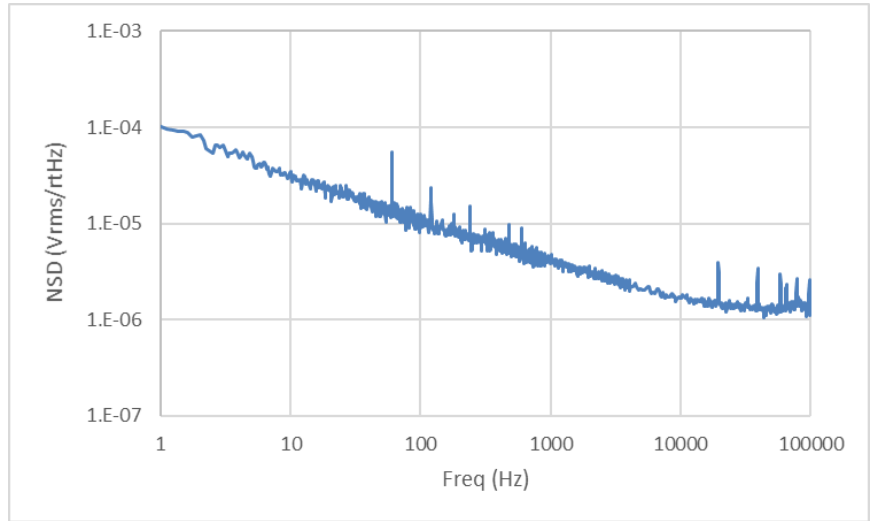


Figure 4: Noise Density of the CTD453

Busbar Current Sensing

The busbar supplied with the CTD453 should be used to measure larger currents. The busbar is made of copper, and three slits are placed in the busbar to generate a differential magnetic field. The CTD453 in this configuration is illustrated in Figure 5. For this evaluation, the busbar is installed 1.5 mm away from the surface of the PCB. In this configuration, the busbar can carry steady-state current of 300 A with a peak current of ~900 A.

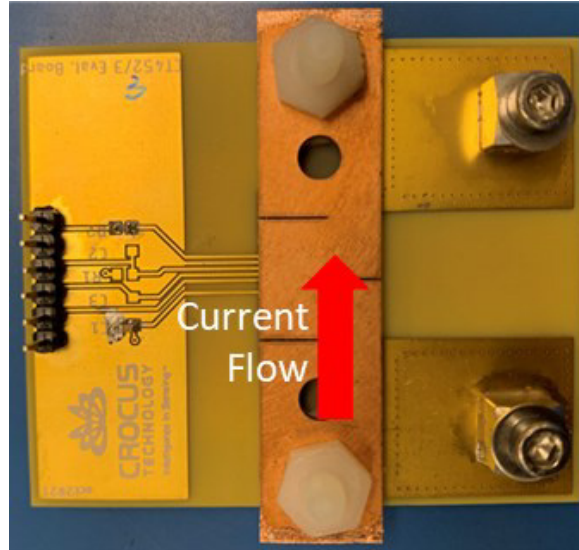


Figure 5: CTD453 with Busbar

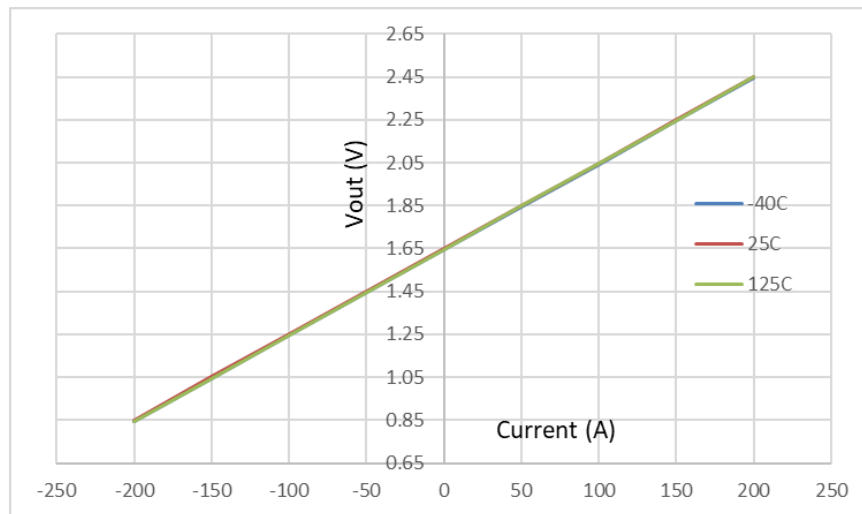


Figure 6: Tri-Temperature Performance of CTD453 with Busbar

MATERIALS

The CTD453 evaluation board includes:

- 2× Screw connectors
- 1× CT453 current sensor
- 1× 100 pF SMD capacitor (optional)
- 1× 1 μ F SMD capacitor
- 1× 5 pF SMD capacitor
- Multiple male header connectors for biasing and measurements
- Nylon washers and custom busbar

APPLICATION SUPPORT

For samples or applications support contact, go to <https://www.allegromicro.com/en/about-allegro/contact-us/technical-assistance> and navigate to the appropriate region.

Revision History

Number	Date	Description
1	November 30, 2023	Document rebrand and minor editorial corrections.

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