CTD452

CT452 Evaluation Board User Guide

DESCRIPTION

The Allegro MicroSystems CTD452 is an evaluation board containing the CT452—XtremeSense™ tunnel magnetoresistance (TMR) integrated circuit (IC). This user guide describes the operation and use of the CTD452 evaluation board as an engineering tool for evaluating the CT452 IC performance in contactless current sensing applications.

FEATURES

- Total Error: ±0.7% FS (Typ.)
- Available Field Ranges:

Ordering Part Number	Field Range
CTD452-06U	+6 mT
CTD452-06B	±6 mT
CTD452-12U	+12 mT
CTD452-12B	±12 mT
CTD452-24U	+24 mT
CTD452-20B	±24 mT

- Built-in Galvanic Isolation
- Low-Noise Performance
- 1 MHz Operating Bandwidth
- ~300 ns Signal Response
- Immunity to Common-Mode Fields

EVALUATION BOARD CONTENTS

- CTD452 Evaluation Board

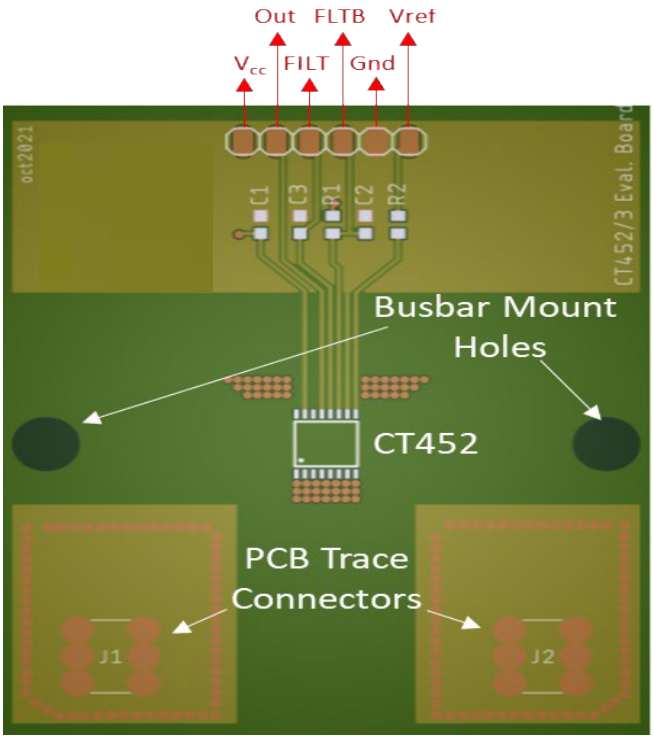

Figure 1: CT452 Evaluation Board

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USING THE EVALUATION BOARD

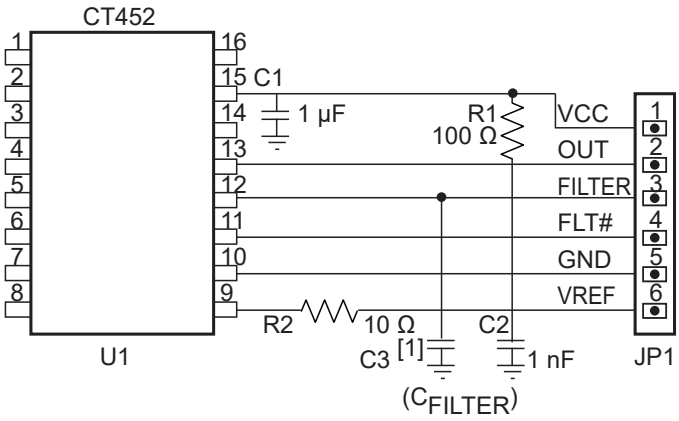
Introduction

The CT452 is a differential magnetic field sensor IC that detects a current-induced magnetic flux and outputs a voltage proportional to the AC or DC current flow. The CT452 integrates two patented XtremeSense TMR flux sense elements configured for common field rejection, high bandwidth, and high current accuracy, and immune to external magnetic field noise. It achieves a total output error of less than ±0.7% FS (typical) with a total lifetime drift of ±1.0% FS (typical).

The CTD452 is a four-layer (3 oz. copper) PCB designed to test two types of contactless current-sensing methods: with a PCB trace for <75 A_{PK} current or with a busbar for 300 $A_{NOMINAL}$ current. Both the PCB current-carrying trace and the supplied copper busbar have three slits for current steering and generating a differential magnetic field.

General Description

The CTD452 is enabled by applying a 5 V bias between the VCC and GND pins. The voltage corresponding to the detected flux is available on the OUT pin. The VREF pin provides a voltage that is half of V_{CC} while the FLTB pin provides an active low signal for an over-field or under-voltage condition. The FILT pin has a capacitor, C3, to improve noise performance. Options for C3 values are illustrated and detailed in the schematic and table shown in Figure 2. For more-detailed electrical and performance specifications, refer to the CT452 datasheet.



[1] Capacitor C3 options for the FILTER pin:

Cutoff Frequency	C_{FILTER} (pF)	Capacitor Part Number
100 kHz	91	GRM0225C1C910JA02
250 kHz	33	GRM0225C1C330JA02
500 kHz	16	GRM0225C1C160JA03
1 MHz	5	GRM0225C1C5R0CA03

Figure 2: CTD452 Evaluation Board Schematic

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PCB Current Sensing

STEADY-STATE CURRENT (< 75 A_{PK})

In this configuration, the busbar is removed, so current is measured by placing the CTD452 inline between the supply voltage and the load, as shown in Figure 3. For DC currents, the supply voltage must be connected to the CURRENT IN terminal, with the load connected to the CURRENT OUT terminal, resulting in a current flow through the PCB trace underneath the CT452 IC. The top layer of the evaluation board has the CT452 IC as well as the signal traces routed to the 6-pin header. The remaining three layers of the PCB are used to carry the in-line current. The maximum current passed through the evaluation board is limited by the thermal capability of the PCB layers.

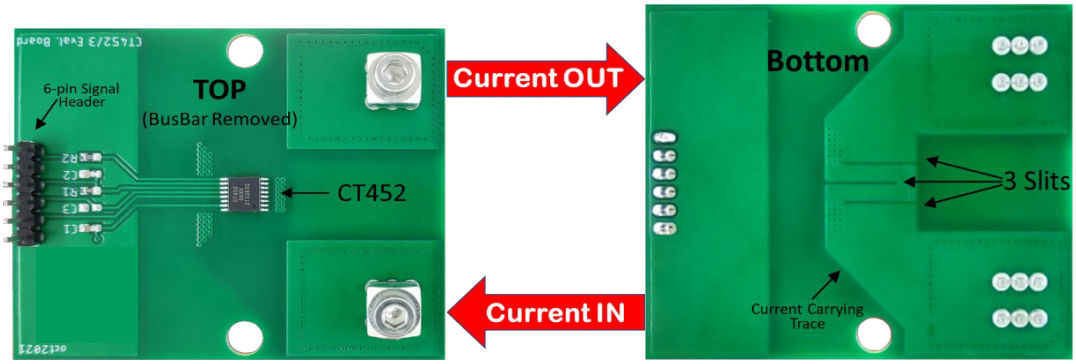

Figure 3: CTD452 PCB Current Sensing

BUSBAR CURRENT SENSING (300 $A_{NOMINAL}$)

for measuring currents in the range of 70 A to ~300 A, the custom slitted busbar is placed over the CT452, as shown in Figure 4. It can carry a steady-state current of 300 A with a peak current of ~900 A. When installing the busbar, ensure the slit orientation is the opposite of the slit orientation of the bottom PCB trace (this is due to the inversion of the magnetic flux). Take care in handling the busbar and do not over-tighten the nylon screws because this could bend the busbar. Do not use the CURRENT OUT and CURRENT IN terminals of the PCB, which must be left floating when using the busbar. Also note the DC current flow direction shown in Figure 4.

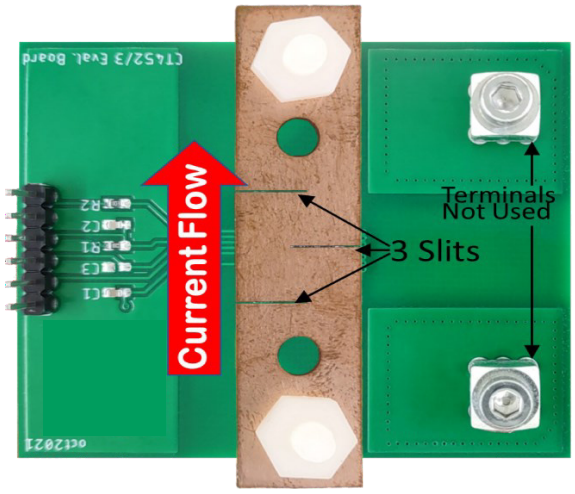

Figure 4: CTD452 with Busbar

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CT452 Sensor Alignment

The CT452 has two integrated TMR sensors for high common-mode field-rejection (CMFR) capability. Their position in the IC is one parameter that dictates the dimensions of the three slits on the current-carrying PCB trace and busbar. The position of the current-carrying conductor (whether on top or bottom of the CT452) dictates the slit orientation because magnetic-field orientation is affected. The TMR sensor position dimensions within the CT452 are shown in Figure 5.

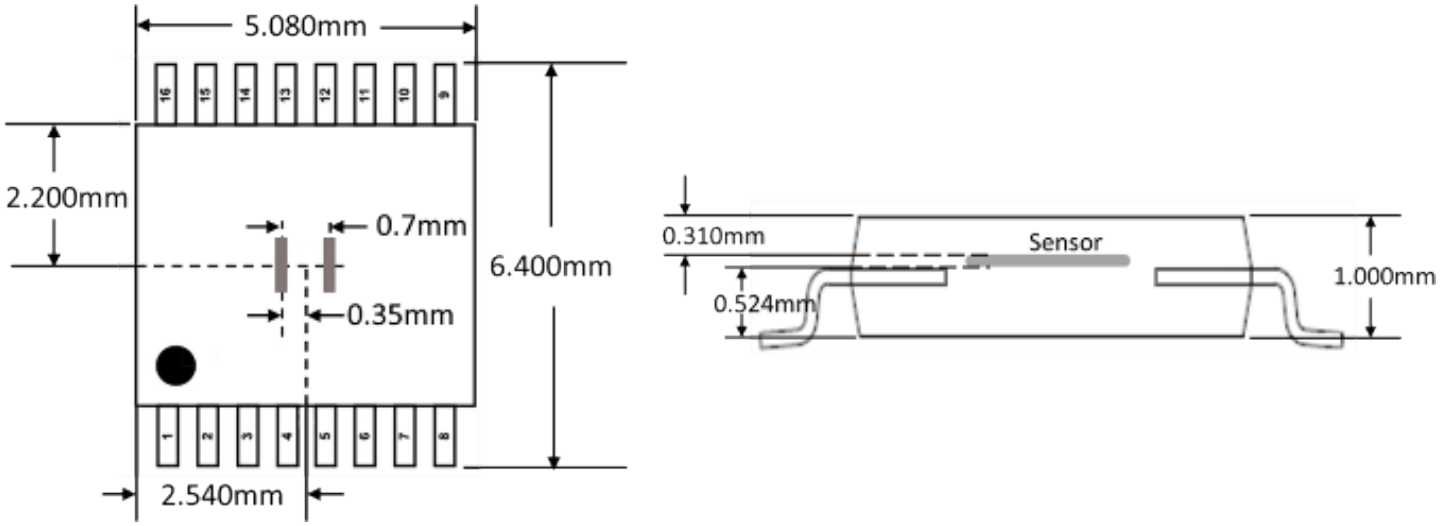

Figure 5: Dual TMR Sensor Position

PCB and Busbar Slit Design

For custom three-slit design guidance, contact Allegro.

Conversion of Field mT to mV/A

For guidance regarding busbar design and placement, contact Allegro because this affects the magnetic field (mT) generation and how the CT452 converts this to a sensitivity (mV/A) for current-level detection.

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MATERIALS

The CTD452 evaluation board includes:

- 1× CT452 current sense IC
- 1× 4-layer 3 oz copper PCB
- 1× 100 pF SMD capacitor (optional)
- 1× 1 µF SMD capacitor
- 1× 5 pF SMD capacitor
- 1× Six-pin male header for biasing and measurements
- 2× Metal screw connectors
- 2× Sets of nylon screws and nuts
- 1× Custom slitted busbar

APPLICATION SUPPORT

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

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Revision History

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

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