CTD221 User Guide

Referenced Devices

CT220
CTD221

Introduction

The CT220 is current sensor based on Crocus Technology's patented XtremeSense™ TMR technology. It features a full-bridge configuration compromised of four (4) TMR elements monolithically integrated with active CMOS circuitry allowing it to perform contactless current measurements with high resolution and low noise.

The CTD221 demo board is used to showcase the ability of CT220 to detect currents from 5 mA to hundreds of Amps. The CTD221 is designed to perform contactless current measurements from PCB traces and busbars of varying widths and separations from the CT220.

This user guide describes how to connect and use the CTD221 demo board. It also provides a description of the circuit implemented and the expected test results.

General Description

The CTD221 demo board is shown below, and it features:

- 7x, male header connectors
- 6x, screw connectors
- 1x, CT220 device
- 1x, 1.0 µF 0603 SMD Capacitor
- 1x, 150 pF 0603 SMD Capacitor
- 1x, 105 kΩ 0603 SMD Resistor

The screw connectors are used to pass the current through the Printed Circuit Board (PCB) traces or busbar and the male headers on the PCB is used to bias the IC and measure the output from it. The PCB is powered by applying the bias voltage between the VCC and GND pins. The voltage at the OUT pin is proportional to the current flowing through the Evaluation Board (EVB). The output on the $\overline{\text{FLAG}}$ pin changes state when the current exceeds the factory programmed threshold.

The PCB has a Resistor-Capacitor (RC) filter connected to the output of CT220 to reject high frequency noise. The output noise spectrum of the CT220 for various RC filter values is illustrated later in this document.

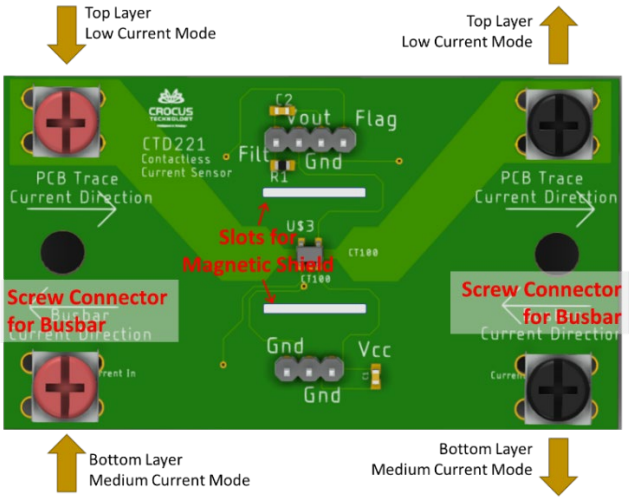

FIGURE 1: CTD221 EVALUATION BOARD

Operating Instructions

The evaluation board is powered by connecting a DC bias voltage between the VCC and GND pins on the PCB. The OUT pin of the PCB should be connected to a

Digital Voltmeter (DVM) or an Oscilloscope to monitor the output of the CT220 current sensor.

The data presented in this section will be for a 5.0 V bias voltage.

Low Current Mode

In this mode, the current is passed through a trace on the top layer of the PCB, which is 0.90 mm wide. This mode can be used to measure currents in the range of ±3.85 A.

Clearance between the trace and IC pads is 0.35 mm which provides isolation of 1 kV between the current trace and the SOT23 pins.

Figure 2 illustrates the linear behavior of the current sensor in this mode.

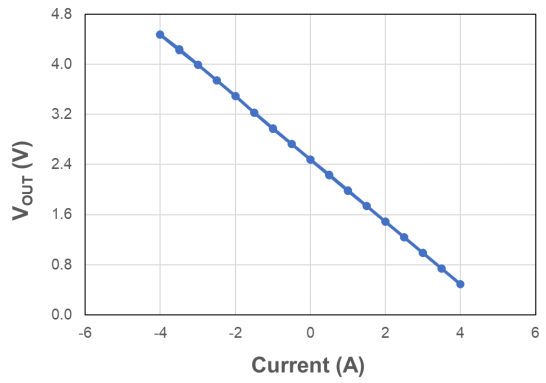

FIGURE 2: LINEAR PERFORMANCE FOR CONTACTLESS CURRENT SENSING

In addition to the excellent linearity across temperature, the high Signal-to-Noise Ratio (SNR) of the CT220 enables it to measure extremely low currents. Figure 3 illustrates the ability of CTD221 to detect currents as low as 5 mA.

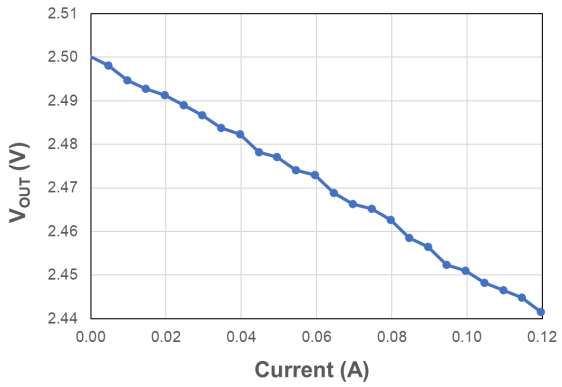

FIGURE 3: EXCELLENT RESOLUTION OF CTD221

Medium Current Mode

The CTD221 can be used in this medium current sensing mode by passing current through a trace on the bottom layer of the PCB. The wider trace (2.00 mm wide) allows for a larger current to be detected and this mode can be used to measure currents of ±10 A with the ability to resolve to 10 mA steps. Measurement data for this mode is shown in Figure 5.

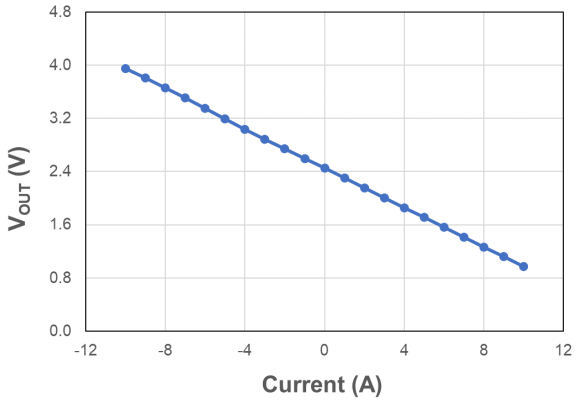

FIGURE 4: CT220 MEASURING ±10 A RANGE

The isolation of CT220 for this configuration of the CTD221 is 5.1 kV_{RMS} due to the distance between the bottom trace and the SOT23 pins is 1.6 mm.

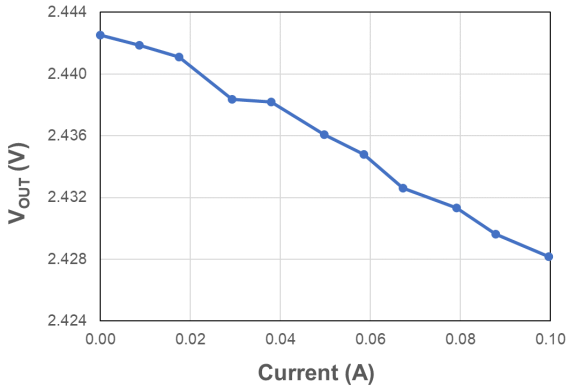

FIGURE 5: CT220 FOR ±10 A RANGE WITH 10 MA RESOLUTION

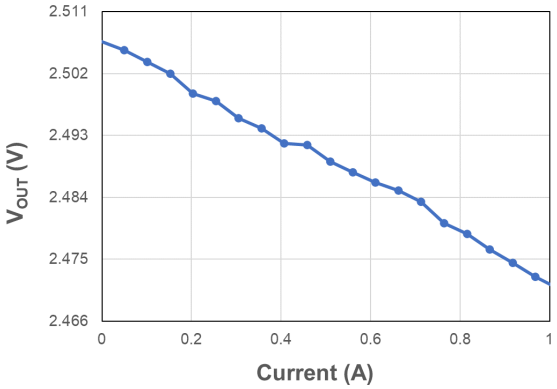

FIGURE 6: CT220 FOR ±50 A RANGE WITH 50 MA RESOLUTION

Medium Current Mode with Shield

The CTD221 PCB is designed to accommodate a U-shaped magnetic shield to mitigate the impact of common mode field as well as prevent cross-talk interference. More details on using a magnetic shield are detailed in Crocus' Application Note AN122.

High Current Mode

The high current mode is used for applications involving currents too large to pass through PCB traces. In this mode, the current is passed through a copper busbar. The CTD221 is shipped with a copper busbar that is 1/2" wide and 1/16" thick. The user has the flexibility of adjusting the distance of the busbar from the top surface of the PCB using spacers. The CTD221 demo board is shipped with spacers to maintain a 4.00 mm gap between PCB and the busbar. With this configuration, the CTD221 can be used to measure currents in the range of ±50 A with a 50 mA resolution as shown in Figure 6 while Figure 7 shows the CT220 measuring the full range of 50 A.

With a spacing distance of 4.00 mm between the CT220 and the busbar, the isolation voltage is over 5.1 kV_{RMS} in this high current mode.

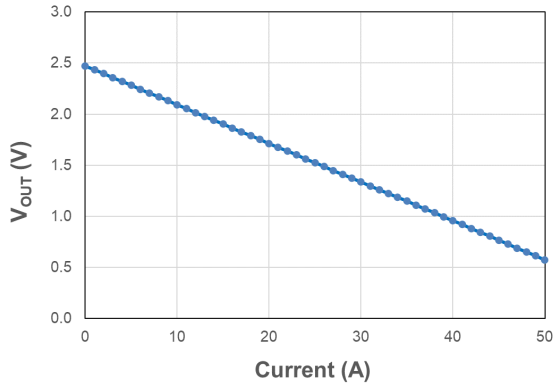

FIGURE 7. CTD221 PERFORMANCE IN HIGH CURRENT MODE

Output Noise

The SNR and resolution of the sensor can be further improved for low frequency applications by adding an RC low pass filter at the output of CT220. This is illustrated in Figure 8 and Table 1. By default, the CTD221 is shipped with a 10 kHz filter.

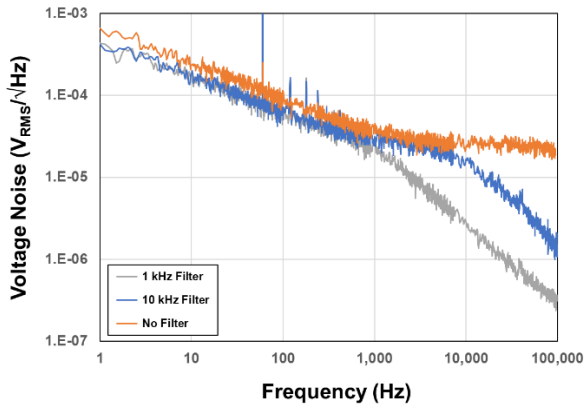

FIGURE 8: CT220 OUTPUT VOLTAGE NOISE SPECTRUM

Filter Cut-off Frequency	R (kΩ)	C (pF)	Integrated Noise, DC to 30 kHz (μTRMS)
1 kHz	105	1,500	1.19
10 kHz	105	150	2.20
No Filter	-	-	3.40

TABLE 1: REDUCTION OF NOISE WITH OUTPUT FILTERS

Board Schematic & Layout

The CT220 is a standalone device and it does not need any additional circuitry or components. The small form factor of the CTD221 is illustrated in Figure 9 and Figure 10.

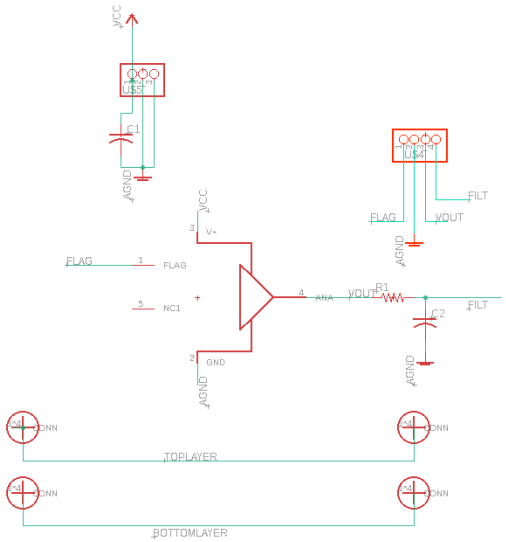

FIGURE 9: CTD221 PCB SCHEMATIC

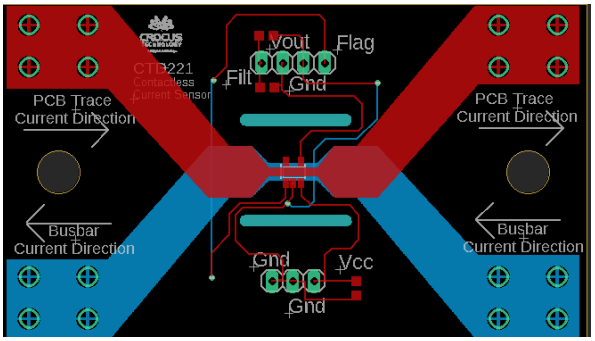

FIGURE 10: CTD221 PCB LAYOUT

Conclusion

The CTD221 demonstrates the capabilities of the CT220 Crocus Technology TMR linear sensor. This document provides a description of the demo board circuit and gives representative measurements of gain and linearity error.

Contacts

For samples or questions:
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