CTD110 User Guide

Referenced Devices

CT100
CTD110

Introduction

The CTD110 demo board is designed to demonstrate the current sensing capabilities of the CT100 linear magnetic sensor from Crocus Technology.

The CT100 is based on Crocus Technology's TMR technology. It features a full-bridge configuration compromised of four (4) TMR elements. The CT100 does not include any active CMOS circuitry allowing it to be a versatile and low power with a small package footprint.

This user guide describes how to connect and use the CTD110 demo board. It also provides a description of the circuit implemented and expected test results.

Features

- ±0.5% accuracy
- ±20 A_{RMS} range
- 70 mV/A Gain
- Non-intrusive current sensing
- Galvanic isolation
- 1.0 V to 5.0 V power supply

General Description

The CTD110 demo board is shown below and it features:

- 9x, male header connectors
- 2x, large connectors
- 1x, quad-opamp
- 1x, 3.3 V linear regulator
- 1x, CT100 device in SOT23-6 package

The two (2) large connectors (with screws) are used to connect and drive the external current to be measured. Please do not exceed 20 A_{RMS}.

The 3-pin male header on the left of the board labeled, from top to bottom: OUT, VSS (GND) and VDD are used to connect the power supply, ranging from 1.0 V to 5.0 V and the output pin to a metering device (e.g. oscilloscope, multimeter, etc.).

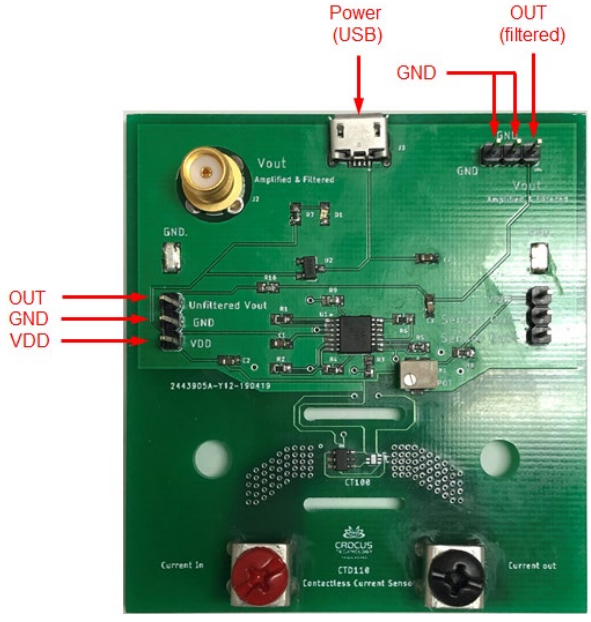

FIGURE 1 CTD110 DEMO BOARD QUICK START

The 3-pin male header on the right of the board labeled, from top to bottom: VREF, OUT+ and OUT- are used for further evaluation of the CT100 or external custom circuitry. OUT+ and OUT- are the direct outputs of the CT100 full bridge structure. VREF is the onboard reference voltage generated for offset compensation.

Additionally, the 3-pin male header to the top of the board labelled as GND, GND and RCOUT. The two (2) GND connectors are additional ground pins that can be used to connect to external power supplies or meters. The RCOUT pin is connected to the filtered output of the current sensor. The single-pole RC filter is designed for a 3-dB frequency of 1 kHz.

Magnetic Simulation

Simple magnetic simulations can be done to estimate the magnetic field that the CT100 sensor will see. Using FEMM software, the simulated Gain of the current trace is ~95 µT/A

The demo board uses standard copper layers and process:

- PCB copper layer thickness: 35 µm
- Current trace width: 1.60 mm
- PCB total thickness: 1.62 mm

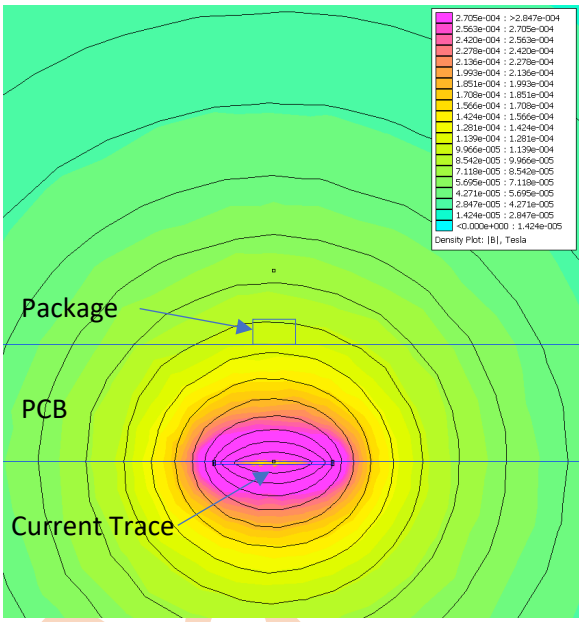

FIGURE 2 FEMM SIMULATION FLUX DENSITY PLOT

The distance between the sensor and the current trace includes the total thicknesses of: PCB, top layer, soldering paste and the vertical position of the die inside the package.

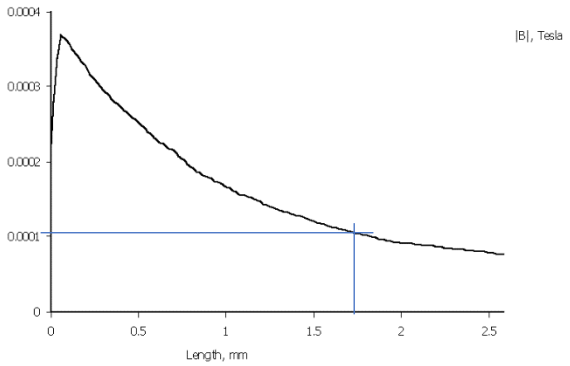

FIGURE 3 MAGNETIC FIELD (T) VS. DISTANCE FROM CURRENT TRACE

Board Measurements

This section summarizes the results of several practical measurements. The power supply is fixed to 3.0 V.

- Gain from PCB Trace to TMR: ~95 µT/A

- Sensor Gain (at 3.0 V bias): 12.9 mV/mT
- InAmp Gain: 54
- Board Gain (at 3.0 V bias): 70 mV/A

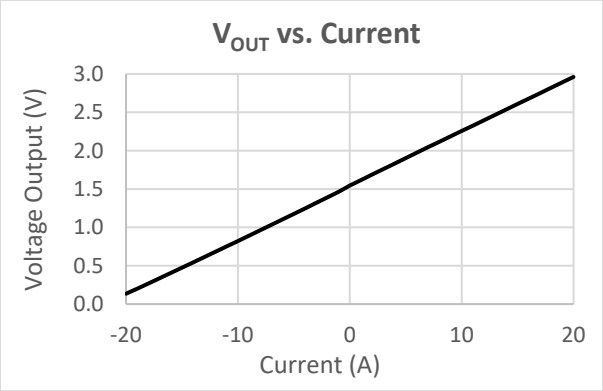

FIGURE 4 LINEARITY CURVE: VOUT VS. CURRENT

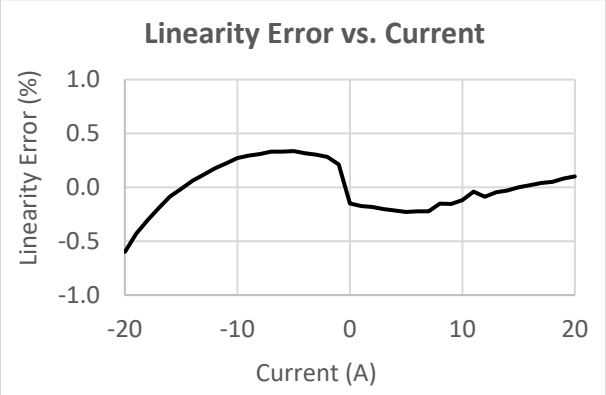

FIGURE 5 LINEARITY ERROR VS. CURRENT

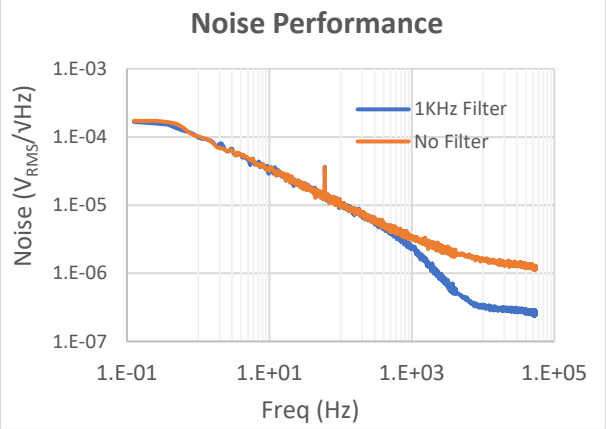

FIGURE 6 OUTPUT NOISE VS. FREQUENCY

Board Schematic

While the CT100 can be used as a standalone device without an external circuit, it is recommended, in a current sensing application, to amplify the output voltage CT100.

Figure 7 and Figure 8 show how the quad-operational amplifier IC is implemented to adjust the Gain and eliminate any offset. An RC filter is connected to the output of the Instrumentation Amplifier for low bandwidth applications.

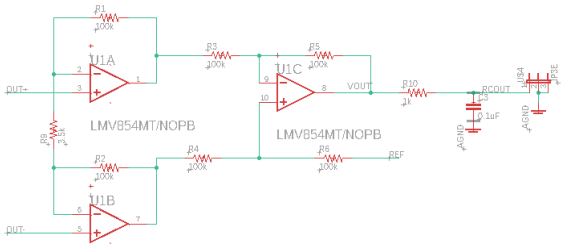

FIGURE 7 INSTRUMENTATION AMPLIFIER

Ideally, the offset, or quiescent voltage, of the demo board would be $V_{DD}/2$. However, due to the high amplification gain implemented on this board, offset can deviate from the ideal value.

There are two possible solutions to eliminate this offset, a hardware (circuit based) solution and a software solution. The hardware solution was implemented on the demo board seen on Figure 8. A software solution would record the voltage value at 0 A and subtract it from further measurements.

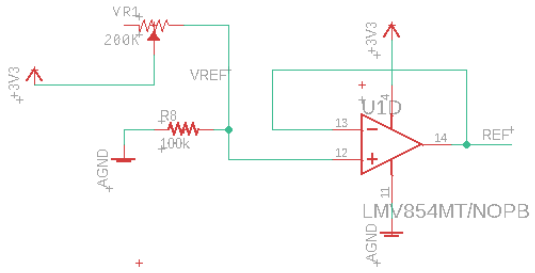

FIGURE 8 REFERENCE VOLTAGE GENERATOR

Board Layout

The board layout features a current carrying trace on the bottom layer (dotted in blue). It also features two cut-out areas around the sensor's footprint. These cut-out areas can be used to place a U-shaped flux guide (concentrator) to concentrator the magnetic field generated by the current trace, allowing the sensor to pick up small currents.

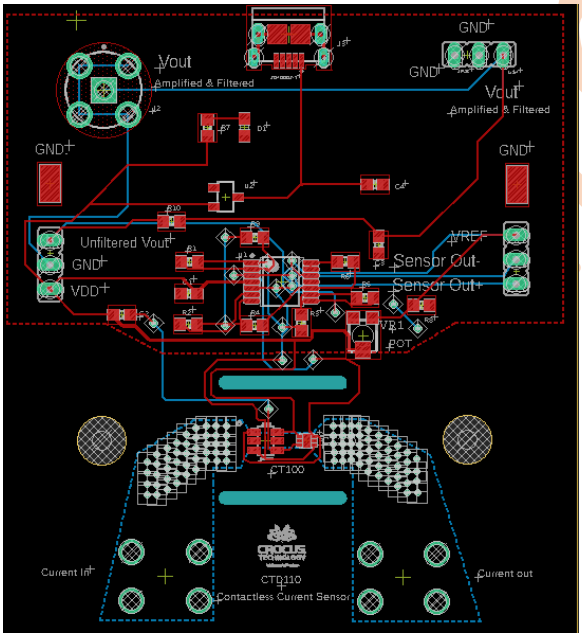

FIGURE 9 BOARD LAYOUT

Bill of Materials

Part	Description	Value	Qty
R1-8	0603 resistors	100 kΩ	9
R9	0603 resistors	3.5 kΩ	1
R10	0603 resistors	1 kΩ	1
VR1	TC33x-POT	200 kΩ	1
C1-2, C4	0603 capacitors	1.0 µF	2
C3	0603 capacitors	0.1 µF	1
D1	Green LED	TST-C191	1
U1	Quad opamp	LMV854	1
U2	3.3 V Regulator	AP221	1
U3	Crocus Technology TMR sensor	CT100	1

TABLE 1 BILL OF MATERIALS

Conclusion

The CTD110 demonstrates the capabilities of the CT100 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:
support@crocus-technology.com

Appendix: Full Schematics

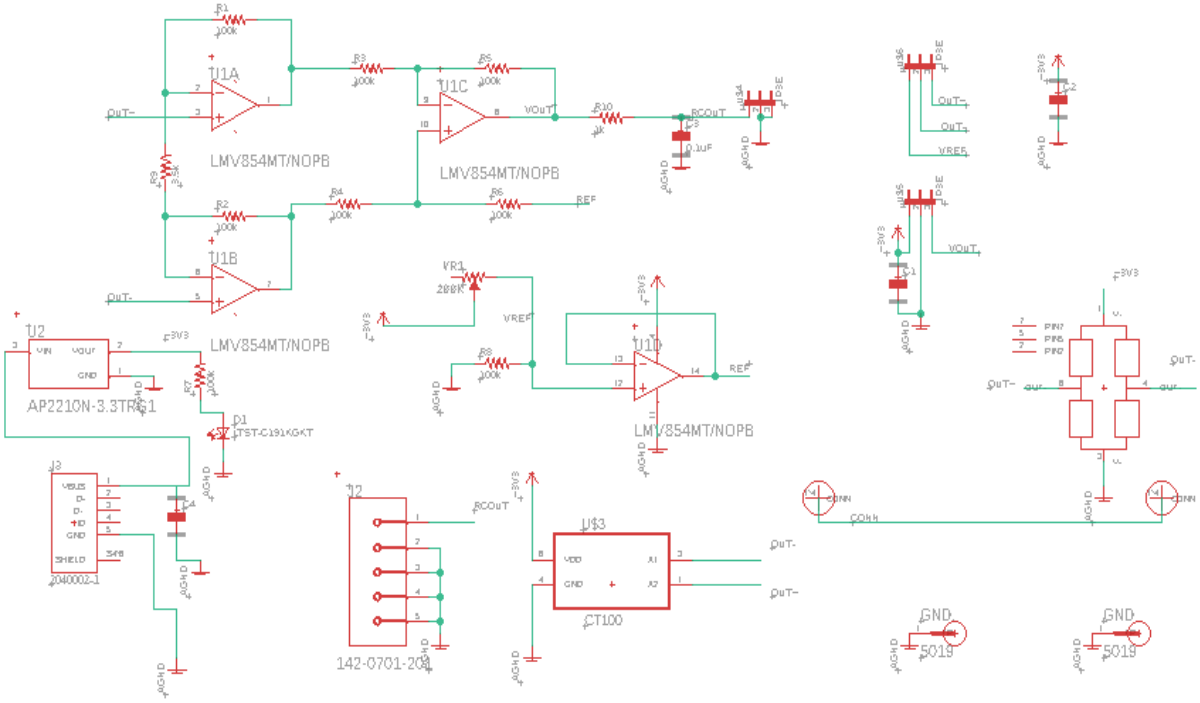

FIGURE 10 SCHEMATIC DIAGRAM OF CTD110 DEMO BOARD

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